On the Brink of Politicisation: Reflections on Ethical Dilemma's in Public Policy Impact Assessment Practice

Kwadwo Adusei-Asante
School of Arts & Humanities, Edith Cowan University, Western Australia
K.adusei@ecu.edu.au

Abstract

Like any other profession, impact assessment (IA) practice has its problematic aspects. Some of the pitfalls associated with IA practice relate to uncomfortable ethical issues with political undercurrents. This paper discusses an ethical dilemma encountered while carrying out an IA of the Australian federal government's proposed university fees deregulation policy on regional West Australians in 2015–16. The article describes the political undertones around the research topic vis-à-vis the need to publish the findings during the politically charged atmosphere of the time. The manner in which these sensitivities were managed is also presented briefly, to serve as a guide for early career public policy IA practitioners who may find themselves in similar ethical quagmires.

Background

The higher education sector in Australia is a lucrative industry. In 2016 alone, the sector contributed 45% of the $21.8 billion the government collected from international students on visas, making the industry Australia's third largest export, after iron ore and coal, and the largest export industry for the state of Victoria (Tyler, 2014; Wells, 2017). However, concerns over Australian universities being excessively regulated and having limited prospects of competing with international universities and the fact that some local institutions were believed to be missing out on current funding led the Australian federal government to propose in 2014 to deregulate university fees (Australian Government, 2014c; Quiggin, 2014). Under the policy, formulated under the auspices of economic rationality, registered higher education institutions (including public and private universities and non-university higher education institutions) would 'set their own tuition fees for Commonwealth-supported students, and the Australian Government would reduce its contribution towards tuition fees by an average of 20% for new students' (Australian Government, 2014a, p. 1, 2014b).

Stakeholders, including opposition parties, students, academics and some sections of the public, resisted the proposed policy. While groups resisted the policy for varying reasons, the most trumpeted and common reason was the notion that it would make higher education inaccessible to people from regional areas and low socioeconomic status backgrounds (see Adusei-Asante, Hancock, & Awidi, 2016). This resistance played a significant role in the blocking of the Bill that would have led to the introduction of the policy in the Australian

Senate twice, in 2014 and 2015. After monitoring the debate, we formed the view that the basis for assessing the manner in which the proposed policy would categorically have an impact (positive or negative) on regional students seemed anecdotal rather than empirical. As a result, we commenced research in 2015 aimed at contributing to the debate on how the policy to deregulate university fees would affect regional West Australians' access to and participation in tertiary education. The literature indicated that students from regional areas had high attrition rates nationally (Brett et al., 2015; Lim et al., 2014; Scevak et al., 2015).

Our study was conducted in three regional locations in Western Australia, using a qualitative research approach involving 50 respondents (Year 12 students, parents and teachers). We found that if the policy were implemented, the lack of opportunity that currently exists in regional Western Australia would increase. Further, the majority of students and parents were uninformed of the details of the policy. However, after being educated on the implications of the policy, most student respondents indicated that they would postpone their university education to save money to pay their fees and avoid being heavily indebted. We concluded that the majority of the respondents feared that if university fee deregulation came into effect in Australia, it would worsen rural and regional isolation and the already low level of interest in higher education in regional communities. We recommended that the federal government provide residents in regional and remote Western Australia with further information on the proposed university fee deregulation policy (see Adusei-Asante, Hancock, & Awidi, 2016).

The Dilemma

Our study confirmed the fears of opponents of the proposed university fees policy; however, the release of the report coincided with the 2016 Australian federal elections. Although our study was scientific, we were concerned that the media and the opposition political parties would latch onto our study for political gains. While such a move might have brought attention to our research, we had concerns that the research team might also become targets of political rebuttals, and that this might damage our careers. In fact, although the government announced within a few months to the election that it had suspended its decision to deregulate university fees until the following election, the opposition political party maintained its attacks on the government, repeating that the policy was not good for Australia (Anderson, 2015; Conifer, 2016).

After considering the potential repercussions, we resolved not to release the report until after the federal elections. As the election drew near, the pressure and anxiety associated with the question of whether to release the research findings during the political campaign grew. Some close acquaintances accused us of being cowards, and doing Australians a disservice by withholding the report. Some argued that as scientists, we had a duty to report our findings regardless of the circumstances and should be prepared to be martyred, if necessary.

Resolution

The first strategy for resolving the dilemma was to seek counsel from senior colleagues and IA professionals, many of whom advised that releasing the report after the election would be ideal. When pressure to release the report increased, we spoke to a media consultant, who also confirmed that the timing and atmosphere were not conducive to release our findings, and that we could play into hands of the opposition political parties and the media.

The other strategy was introspective reflection. As the lead researcher on the team, I gave careful thought to the potential consequences, including risk to careers that might follow the release of the report. Clearly, the report could become a tool in the hands of the media and opposition political parties. While this was an opportunity to gain fame, I considered the fact that I was only starting my research career, and could not risk being 'shot down by political arrows'. I felt I needed more weight in the field before exposing myself to such political vagaries.

We also considered the sensitivities around university fee increases and how associated issues had led to chaotic situations in South Africa, for example. We examined our motives for conducting the research, and found that they related more to knowledge production than to wading into a political frenzy.

The next strategy was to test the waters by sharing excerpts of the findings with some key institutions and at conferences. Most of the feedback we received indicated that the findings were very insightful and that the government needed to rethink the policy. We shared portions of the findings at the 2016 International Association for Impact Assessment conference in Nagoya, Japan, after which we became even more resolute that the topic was 'too hot' to be released at the time, as the presentation generated passionate discussion.

Lessons Learned

We released the report after the elections. A media release was circulated, and within hours, we received calls from several media outlets in Western Australia expressing interest in the findings. We granted interviews to media outlets, some of whom featured the story as their headline. We also sent a copy of the report to the Federal Minister of Education, whose office thanked us for the study and implied that they would consider it when the policy was revisited.

Although the research was released after the election, it had a great impact. While all researchers want their research to find recognition, timing is important. We were presented with a window of opportunity, during which we could have ridden the political tide, but realised that with quick fame comes quick failure. Introspective reflection and sharing excerpts of the findings at conferences informed our decision to release our findings after the political climate had quietened. The lesson we learned is that being strategic about timing is important in IA practice.

Seniority is key in public policy IA practice. While it has no bearing on the policies a person can research or study, practitioners' professional standing may affect their confidence in reporting the outcomes or findings. As an early career academic, researching and reporting on such a highly politically sensitive policy brought me much self-inflicted worry. I overcame these concerns by seeking the guidance and mentorship of senior colleagues who validated my findings.

References

Adusei-Asante, K., Hancock, P., Awidi, I. (2016). Impact Assessment of University Fees Deregulation on Prospective Regional University Students in Western Australia. *IAIA16 Conference Proceedings: Resilience and Sustainability*, 1-7, Nagoya, Japan.

Anderson, S. (2015). Turnbull Government shelves university fee deregulation plan, Education Minister Simon Birmingham confirms. http://www.abc.net.au/news/2015-10-01/turnbull-government-shelves-university-fee-deregulation-plan/6818916.

Australian Government (2014a). Higher Education Reforms – Regulation Impact Statement – Department of Education. http://ris.dpmc.gov.au/2014/10/01/higher-education-reforms-regulation-impact-statement-department-of-education.

Australian Government (2014b). 2014/15 Budget Statement on Higher Education. http://budget.gov.au/2014-15/content/glossy/education/html/index.htm

Australian Government (2014c). Regulation Impact Statement 2014-15 Budget Higher Education Reforms. http://www.comlaw.gov.au/Details/C2014B00180/Other/Text.

Brett, M., Sheridan, A., Harvey, A. & Cardak, B. (2015). Four barriers to higher education regional students face – and how to overcome them. The Conversation.

Conifer, D. (2016). Budget 2016: University fee deregulation scrapped but universities still facing big cuts. http://www.abc.net.au/news/2016-05-03/morrison-abandons-uni-fee-deregulation/7380564

Lim, P. (2014). Do individual background characteristics influence tertiary completion rates? NCSEHE, Curtin University.

Quiggin, J. (2014). Three misguided beliefs of the Group of Eight universities. The Conversation. http://theconversation.com/three-misguided-beliefs-of-the-group-of-eight-universities-31334.

Scevak, J., Southgate, E., Rubin, M., Macqueen, S., Douglas, H. & Williams, P. (2015). Equity Groups and Predictors of Academic Success in Higher Education. A 2014 Student Equity in Higher Education Research Grants Project. Report submitted to the National Centre for Student Equity in Higher Education, Perth: Curtin University.

Tyler, M.C. (2014). Africa, Australia and international education. http://www.internationalaffairs.org.au/australian_outlook/africa-australia-and-international-education/.

Wells, J. (2017). International education worth $21.8 billion to Australia. https://www.campusreview.com.au/2017/02/international-education-worth-21-8-billion-to-australia/

Towards Developing Policy Impact Assessment Framework: An Introduction

Kwadwo Adusei-Asante
School of Arts & Humanities, Edith Cowan University, Western Australia
K.adusei@ecu.edu.au

Abstract

Policy impact assessment has received little attention in current discussion on impact assessment frameworks within the International Association for Impact Assessment (IAIA), the leading global organisation on impact assessment for informed decision-making. While there are accepted guidelines for strategic environmental assessments, social impact assessments (SIAs) and health impact assessments, there appear to be various siloed policy impact assessment (PIA) guidelines, mainly drawing on programme evaluation models. The lack of a PIA framework means that SIA professionals working on public policies and programmes have to adapt existing impact assessment frameworks or look elsewhere, however discrepant the field. This can create validation problems when comparing studies from different jurisdictions. This paper is an introduction to discussions on the need to develop a PIA framework within the IAIA, and argues that relevant policy analysis models could be drawn on and developed into one coherent but adaptable IAIA-led PIA framework.

Introduction

> So the goal of social impact assessment is to help individuals and communities, as well as government and private-sector organizations, understand and better anticipate the possible social consequences for human populations and communities of planned and unplanned social change resulting from proposed policies, plans, programs and projects. (as cited in Burdge, 2003, pp. 85–86; emphasis mine)

We started a discussion at the 2016 International Association of Impact Assessment (IAIA) Conference in Japan on adapting the current social impact assessment (SIA) framework to render it applicable to policy-type impact assessment. It was noted that the current SIA framework was ostensibly developed to measure the social impacts of resource-type projects, and that the growing interest in SIA by policy professionals necessitates the development of a policy-relevant SIA framework. In our view, this would enhance further development of SIA as a standalone practice, while discouraging policy SIA practitioners' reliance on programme evaluation models (Adusei-Asante & Hancock, 2016). This paper seeks to continue the discussion on embedding a 'policy focus' in the current SIA framework.

Why Do We Need a Policy Focus in SIA?

This section discusses arguments on the need for a policy focus in SIA. First, assessing the impact of 'policies' is part of the process and requirements for environmental and natural resource decision-making in the United States, where environmental impact assessment (EIA) started (IAIA, 2003; Vanclay, Esteves, Aucamp, & Franks, 2015). EIA has been a key part of environmental planning and decision-making in the United States since the passage of the National Environmental Policy Act (NEPA) in 1970. NEPA requires agency planners and decision-makers to identify and address social consequences of policies, plans, programmes and projects (IAIA, 2003). SIA was launched in 1992, when a group of social scientists created the Interorganizational Committee on Guidelines and Principles for Social Impact Assessment to delineate a set of guidelines and principles to support public and private-sector agencies and organisations to meet their obligations under NEPA and other related mandates (IAIA, 2003). In 1994, the Interorganizational Committee on Guidelines and Principles for SIA defined SIA as including:

> All social and cultural consequences to human populations of any public or private actions [including policies] that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of society. (as cited in Burdge, 2003, p. 85; emphasis mine)

In 1999, Burdge argued further that:

> In a research context, social impact assessment is a sub-field of the integrated social sciences that is developing a knowledge base to allow a systematic appraisal of impacts on the day-to-day quality of life of persons and communities whose environment is affected by a proposed policy, plan, program or project. (as cited in Burdge, 1999, p. 4; emphasis mine)

The definition of SIA presented in a 2003 IAIA monograph is similar:

> In the 2003 version, we continue to define social impact assessment in terms of efforts to assess, appraise or estimate, in advance, the social consequences that are likely to follow from proposed actions. These include: specific government or private projects, such as construction of buildings, siting power generation facilities, large transportation projects, managing natural resources, fish and wildlife; and preserving or leasing large tracts of land and the adoption of new policies and resulting plans. (as cited in IAIA, 2003, p. 231; emphasis mine)

Vanclay (2003) defined SIA to include:

> The processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment. (p. 5)

What is clear from the definitions above is that policy impact assessment (PIA) is not new, and is an established component of procedures for understanding the social impacts of activities.

Second, the definition of what constitutes 'social' in impact assessment processes is relevant for policy-type SIA. According to Vanclay et al. (2015):

> Almost anything can potentially be a social impact so long as it is valued by or important to a specific group of people … [and also] that social impact may be experienced cognitively, bodily, physically and at different relationship levels including the individual or corporate dimensions (family/household, workplace or community). (p. 2)

Descriptors of social impacts as provided by Vanclay et al. (2015, p. 8) include variables that are relevant to policies and not only resource projects, which were the focus of the authors. Typically, SIA professionals assess changes pertaining to:

1. way of life—how people live, work, play and interact with one another
2. culture—shared beliefs, customs, values and language or dialect
3. community—cohesion, stability, character, services and facilities
4. system—the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place and the resources provided for this purpose
5. environment—the quality of the air and water, the availability and quality of food, the level of hazard or risk, dust and noise, the adequacy of sanitation, physical safety and access to and control over resources
6. health and wellbeing—where health is a state of complete physical, mental, social and spiritual wellbeing, and not merely the absence of disease or infirmity
7. personal and property rights—particularly, whether people are economically affected or experience personal disadvantage, which may include a violation of their civil liberties
8. fears and aspirations—perceptions about safety, fears about the future of the community and aspirations for their future and the future of their children.

When examined critically, each of these eight variables are also applicable to policies. The findings from our study of the Australian federal government's proposed policy to deregulate university fees in 2014 is a case in point. The proposed policy, which generated impassioned debates in Australia, aimed to ensure that:

> Registered higher education institutions (including public and private universities, and non-university higher education institutions) would … set their own tuition fees for Commonwealth-supported students, and the Australian Government would reduce its contribution towards tuition fees by an average of 20% for new students. (Australian Government, 2014a, p. 1)

An SIA of the proposed university fees deregulation policy in 2015 revealed that regional Western Australians had concerns that the policy would lead to fee increases. The respondents also noted that, without adequate social-support policies, they (1) feared being left with unusually high student debt, (2) might reconsider accessing higher educational altogether, and/or (3) would access higher education as mature-age students, because of the necessity of taking gap years to work and save (see Adusei-Asante et al., 2016). The issues raised in the study reflected what Vanclay et al. (2015) would regard as social impacts, a clear indication that policies, whether proposed or implemented, generate social concerns.

Third, although project-type SIA and policy-type SIA share similarities, they are different in many respects, and therefore, an SIA framework developed for resource-type projects cannot be used to assess social impacts of policies without adaptation. In terms of their areas of commonality, both project-type SIA and policy-type SIA seek to unearth outcomes ultimately meant to benefit people (Budge, 2003). Further, policies create the environment for projects, while project outcomes may feed back into policy development processes (World Bank, 2003). However, the Interorganizational Committee on Principles and Guidelines for SIA distinguishes between project SIA and policy-type SIA, describing policy-type SIA as the 'general approach to such issues as immigration, hazard and contaminated waste disposal, the relocation of households, global warming and the maintenance of food stocks' and project-type SIA as including examples such as the 'building of irrigation facilities to enhance agricultural development or the expansion of an airport' (IAIA, 2003, p. 231). According to Vanclay et al. (2015), SIA activities related to 'dams, mines, oil and gas drilling, factories, ports, airports, pipelines, electricity transmission corridors, roads, railway lines, and other infrastructure including large-scale agriculture, forestry and aquaculture projects' comprise project-type SIA (p. i).

Further, project-type SIA appears to operate reactively, as a 'fire service' approach, while policy-type SIA tends to be proactive. Project-type SIA is a mandatory statutory requirement for resource extraction industries and those working with the environment in many jurisdictions (State of Queensland, 2013; Suopajavi, 2013; Vanclay, 2003; World Bank, 2003). In contrast, policy-type SIA is not driven by codification and statutory obligations; rather, it operates as a fact-finding tool, providing insights to decision-makers on best practices, potential outcomes and worst-case scenario analysis.

Another important reason that a policy focus is needed in SIA is that the SIA framework provides 'advice to various stakeholders about what is expected in good practice social impact assessment (SIA) and social impact management processes, especially in relation to project development' (Vanclay et al., 2015, p. i; emphasis mine). While the work done by Vanclay et al. (2015) is commendable, in the sense that it provides extensive guidelines for SIA practice, the focus on project-type SIA means that the framework cannot be regarded as the standard guide for all SIA practitioners, particularly those working on SIA of public policies. For example, while the Vanclay framework does not provide any variable that measures (qualitatively or quantitatively) people's knowledge of a given policy/project they may be affected by, our study of the proposed university fee deregulation policy in Australia showed that this is critical in PIA:

> Most of the research participants (students, teachers and parents) had limited knowledge of the proposed policy. Specifically it was found that 92% of students, 40% of teachers and 70% of parents interviewed had never heard about the policy … when they learned through this research that the policy would give universities the autonomy to set their own fees, the general concern was that it would lead to fee increases. (Adusei-Asante et al., 2016, p. 3)

Thus, while the need to measure community knowledge of a given policy or project may not be important in project-type SIA, it is crucial for policy-type SIA.

Lastly, developing a policy-type SIA will lead to the professionalisation of the field and enhance integration of the impact assessment family. As the current SIA guidelines offer little or no guidance to policy SIA professionals working on public policies and programmes, the latter have to adapt or look elsewhere for various siloed impact assessment frameworks, however discrepant (see Centre for Disease Control and Prevention, 2013; Morestin, 2012; Mingat, Tan, & Sosale, 2003). This tends to create validation problems when comparing studies from different jurisdictions. Developing a policy-type SIA framework will result in the standardisation of practice guidelines, opening avenues for knowledge sharing and training in the field, and ultimately, strengthening SIA as a standalone discipline within the broader EIA fraternity.

Discussion

This paper introduced a proposition to develop a policy-type SIA for measuring public policy outcomes. It sought to generate discussions on insights into developing a coherent but adaptable international PIA framework. Several arguments were put forward to support this proposition: (1) PIA is not new, and has always been part of the procedures for understanding the impacts of environmental and natural resource activities; (2) public policies have social implications that need to be studied and addressed; (3) the current SIA framework is project biased despite the fact that SIA is not only about projects; and 4) there is a need to standardise PIA practice and professionalisation within the IAIA.

The audience of this presentation at the 2017 IAIA conference in Montreal, Canada, welcomed the proposition to develop an IAIA-led PIA. There was a general consensus that PIA is an important component of SIA and that uniform PIA guidelines approved by the IAIA were long overdue. It is within this context that we recommend that the IAIA establishes or supports a taskforce to discuss and develop a draft PIA, for presentation either at the 2018 Durban (South Africa) IAIA conference or the conference earmarked for Brisbane (Australia) in 2019.

References

Adusei-Asante, K. Hancock, P. & Awidi, I. (2016). Social Impact Assessment of University Deregulation on Prospective Regional University Students in Western Australia. In IAIA 2016 conference proceedings, Nagoya, Japan.

___Hancock, P. (2016). Measuring Policies with the Social Impact Assessment Framework: Opportunities and Challenges. In IAIA 2016 conference proceedings, Nagoya, Japan.

Australian Government (2014a). Higher Education Reforms – Regulation Impact Statement – Department of Education. Accessed February18, 2016 from http://ris.dpmc.gov.au/2014/10/01/higher-education-reforms-regulation-impact-statement-department-of-education.

Burdge, R. J. (1999). *A Community Guide to Social Impact Assessment: Revised Edition*. Middleton, Wisconsin: Social Ecology Press.

____ (2003). The practice of social impact assessment background, *Impact Assessment and Project Appraisal*, *21*(2), 84-88.

Centres for Disease Control and Prevention (2013). *CDC's Policy Analytical Framework.* Atlanta, GA: Centres for Disease Control and Prevention, US Department of Health and Human Services.

IAIA (2003). Principles and guidelines for social impact assessment in the USA: The Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, *Impact Assessment and Project Appraisal, 21*(3), 231-250,

McCallum, A. & Walton, K.G. (2016). How to maximize the value and effect of social impact assessment. IAIAI Training Workshop Notes, Nagoya, Japan.

Mingat, A., Tan, J-P & Sosale, S. (2003). *Tools for Education Policy Analysis. World Bank,* Washington DC.

Morestin, F. (2012). A Framework for Analyzing Public Policies: Practical Guide September 2012. National Collaborating Centre for Healthy Public Policy, Quebec, Canada.

State of Queensland. (2013). *Social impact assessment guideline.* Department of State Development, Infrastructure and Planning. Brisbane, Qld. Retrieved from: http://www.statedevelopment.qld.gov.au/resources/guideline/social-impact-assessment-guideline.pdf

Suopajavi, L. (2013). Social impact assessment in mining projects in Northern Finland: comparing practice to theory. *Environ Impact Assess Review* (4), 25–30.

Vanclay, F. (2003). International Principles for Social Impact Assessment. *Impact Assessment & Project Appraisal 21*(1), 5-11.

Vanclay, F. Esteves, A.M., Aucamp, L., Franks, D. (2015). *Social Impact Assessment: Guidance for assessing and managing the social impacts of projects*. International Association for Impact Assessment, USA.

World Bank. (2003). *A User's Guide to Poverty and Social Impact Analysis*. Poverty Reduction Group and Social Development Department. World Bank, Washington DC.

Abstract ID#: 665

Title: Social Dynamics Prevent 400 MW Hydropower-Porce IV

•Presenting author first and last name, e-mail address, company, and country.

Andres Amaya

andresamaya@ingetec.com.co

INGETEC

Colombia

•co-author(1)

Yaddy H. Ruiz

yaddyruiz@ingetec.com.co

INGETEC

Colombia

- Co-author (2)

Fabio Sanchez

fsanchez@ingetec.com.co

INGETEC

Colombia

•Summary statement (30-word limit) This text will be included in the final program to summarize your presentation for attendees.

High expectations create special social dynamics, migration and settlement at projects sites, in some cases preventing its development. The emblematic case of the Porce IV 400 MW hydropower project.

•Presenting author bio (30-word limit) Your session chair will use this information to introduce you to attendees.

Civil Engineer with Master Degree studies in environmental and Project management, currently director of Environmental and Social Team of Colombia´s INGETEC´s consultancy, Project manager and director of EIAs in all infrastructure arenas.

Social Dynamics Prevent 400 MW Hydropower-Porce IV

Paper Abstract (as submitted and approved):

Over the Porce River (rural region of Amalfi-Anorí in Colombia), a 400 MW hydropower project was to be constructed. During the EIA development, 2007, 110 families in the direct influence area were to be participants of the proposed resettlement and compensation program. Prior to construction, thousands of families migrated to the Project area, rented few square meters and built huts in order to receive compensation. An uncontrollable regional speculation chain developed, resulting in a wide range of social and public problems, detriment of living conditions for locals and ultimately in the decision by the Project developer to halt the construction phase of the Project. Social dynamics and movement indirectly prevented the project´s development.

General Discussion

The mere expectation caused by the initial phases of the environmental and social impact evaluation can lead to unforeseen and uncontrollable impacts at local and regional levels. Expectation, coupled with uninformed stakeholders lead to speculation and uncertainty, which can hinder the normal development of an infrastructure or capital investment Project. In some cases, it can even prevent the project from developing while generating impacts that can trespass the regional level and affect national development and expansion projects.

Managing expectations generated during the Project definition and preconstruction stages is highly important in order to successfully develop study, construction and operation´s phases. Good understanding of the project´s regional dynamics and socio-environmental aspects is key to anticipating rapid changes at local and regional levels generated by uncontrolled expectations and actions. Stakeholder identification, mapping and understanding as well as designing and implementing communication strategy at various levels has proven to be the best strategy to strengthen relationships, understand social forces and control expectations.

The impacts generated during the study and preconstruction phase normally lack consideration nor have a specific action plan for prevention, mitigation or management. This is because the study, Project definition, engineering and preconstruction phases do not require environmental licensing (Ministry of Environment and Sustainable Development, 2015). However, the impacts generated during this phase of the Project can be harmful to the baseline social dynamics, livelihood costs, land costs, migration, public services capacity, not to mention changes in cultural aspects as well as planning for individuals and authorities.

The most critical situations have been observed in rural or undeveloped areas where the sole idea of a major Project and investment generates speculation while for some creates the possibility of a brighter future. Unfortunately, not all projects reach the construction phase, by either Project developer decisions, environmental licensing not reached or changing environmental or social conditions the make the Project unviable.

Study, Project definition and engineering phases need to be handled responsibly by consultants, Project developers, authorities and leaders, aiming at managing expectations, strengthening relationships and credibility and understanding social and environmental dynamics in order to predict and prepare to manage these impacts.

In Colombia expectations develop highly around major infrastructure and investment projects, both for public and private sectors (probably not different from any other country or region).

In rural areas where historically government presence is poor, social and public services are lacking, basic needs are not satisfied and where armed forces, illegal groups and individual and political interests influence strong social dynamics, higher expectation levels can be expected. Generally, and understandably given baseline conditions, at pre-licensing and pre-construction phases local stakeholders position themselves in order to obtain benefits (directly or indirectly) at a later construction phase; most foresee an opportunity for direct or indirect negotiation with project developers.

INGETEC´s (Colombian engineering, environmental and social consultant company with over 1800 employees) environmental and social specialist's team has participated in environmental studies and Project development for over 40 years. Over time, the Company and team have participated directly and indirectly in a wide range of development and Project areas and different Project stages (conceptual development stages all the way to construction and operation).

Case Studies

Various territories in Colombia have experienced interesting social dynamics during the preconstruction phase of the project (exploration, studies and environmental impact assessment stages). As an example, La Guajira Department, known for its wealth of natural oil, gas and coal resources has catapulted as one of the biggest coal reserves in the world. Unfortunately, the region has high poverty levels, unsatisfied basic needs, and poor health and education programs, among others. During the last decade, and promoted by the higher coal, oil and gas market prices, various project developers implemented vast exploration campaigns and large engineering and geological research activities. Lower market values and environmental licensing issues, among other conditions, led project developers to stop investment, companies closed activities and the "dream" of considerable capital investment scenario vanished. Authorities, leaders and locals hopped on the prospect, made life changing plans and committed investments (hotels, office and commerce space, fleet vehicles, public infrastructure, land and even tourist attractions). Today, locals keep waiting for private investment, while return of their own investments is null, there are no projects at near site.

The Porce IV hydroelectric Project case is worth highlighting. Over the Porce River (rural region of Amalfi-Anorí in Antioquia, Colombia), a 190 m dam was to be constructed in order to generate more than 400 MW of hydropower (EPM 2010). With over 230 km in length, the Porce River basin has one of Colombia´s highest hydropower potential (studies determining its potential started in the year 1990). Upstream of the Porce IV Hydropower project site the other hydropower projects, Porce II and Porce III, have more than 1.000 MW installed capacity; Porce III started operating in the year 2011m.

Although the hydropower projects are relatively close to Medellín, less than 200 km, access to the Porce IV site is not easy, the river canyon offers a hostile environment, where a complex mix of natural and socio-political conditions have historically prevented colonization and social development. The river at the project site has intense rapids and steep slopes, water levels vary rapidly and currents limit navigation. Prior to the start of the Porce IV engineering and environmental studies, few adventurers had been able to conquer these lands risking their lives and that of their families.

Picture 1. Access through river rapids to the Porce River

In the early 2000´s most migration to the area was promoted by a sense of opportunity however at a high stake. The possibility of quick improvement of economic conditions through illegal plantations as well as illegal gold mining was the only way to improve substandard conditions for several migrants and locals.

The area has been historically known for being a drug trafficking corridor, managed by illegal armed groups who controlled not only access but all movement within the area, at least two different armed groups controlled the territory. On the other hand the production from illegal gold mining generated other type of stakeholders and other type of control. Gold miners, in precarious conditions risked their lives in a gold rush frenzy while the gold commercial chain was controlled by armed groups. Even though risky for some, the profit could often be substantial.

In rural remote areas in Colombia, the institutional capacity is limited and often influenced by political maneuvers as well as individual interest. Governance and institutional presence is lacking in many areas while control of such areas is handled by armed groups and local leaders responding to larger influential groups. The Porce River basin was not an exception during the first decade of the century, even to date.

Yet another important condition for the Porce River basin was the construction and operation of other hydropower projects (Porce II under operation since the year 1999 and Porce III which entered operation in late 2011). Reality, stories and myths around compensations offered by these project developers to affected peasants, miners and land owners generated speculation. For some the construction of a new project represented yet another attractive reason to migrate to the Porce IV project.

In the year 2007 the engineering and environmental studies were developed for the Porce IV hydropower project. By 2010, environmental license was granted to build the project (Colombian Ministry of Environment, Housing and Territory Development, 2010). For more than 2 years detailed environmental and social studies were developed and numerous activities were carefully designed and undertaken to carry out the study. One of the first activities was the socio-economic census to determine the social and economic characteristics of the population that lived in the projects area of influence. Families and communities were identified, as well as their conditions, economic activities, land ownership status, social dynamics among others. Initially, it was determined that 110 affected families by the Project and reservoir were to be part of an ambitious resettlement and compensation program (economic activities, housing, livelihood, etc.). During the next months, a massive migration towards the area was observed.

Over the next few years, while the environmental, social and engineering studies were finished and the environmental licensing process carried on the territory lived on uncertainty and speculation. Thousands of families migrated to the Project area, in some cases rented few square meters and built huts for which they though would be compensated. In the Chispero area, where initially a single family lived and managed a local goods shop, thousands established some sort of residence. Along with the migration, side businesses also arrived, these provided all sorts of goods and services, thus a town was developed on the cliffs of the river canyon. There was a mix of interests for migrating, some had migrated due to the gold rush, some migrated attracted by activities connected with illegal plantations and trafficking while most were attracted by the expectation of being included in the census and ultimately receiving some type of compensation.

Picture 2. Migration to the Chispero territory

Individuals and leaders also saw an opportunity. In some cases, mobilized people were grouped by local leaders who promised compensation in exchange for a monthly fee; leaders intended negotiations with the project developer increasing speculation to higher rates. Some leaders provided information, speculating that up to fourteen thousand people were to be affected by the project and should eventually receive some type of compensation (El Colombiano, 2011).

Hundreds of miners had migrated as well; dredges and excavators were a more common site on the river. Miners risked their lives constantly in a competition for a spot on the river. Miners also claimed compensation for the loss of mining activities or even mining rights over the resources that would be impounded by the reservoir.

An uncontrollable regional speculation chain developed, over ten thousand people migrated and invaded Project areas, resulting in a wide range of social and public problems along with detriment of living conditions for locals. Despite these conditions a clear opposition to the project was not perceived, most likely due to the fact that most stakeholders were expecting a high compensation when the project started construction.

Picture 2. Pontoons and dredges mining alluvial gold

In late 2010, the Project developer decided to halt the construction phase of the Project mainly because the costs related to the compensation of over 14.000 people were not manageable (EPM, 2010); neither costs related to land acquisition of mining rights.

Conclusions

While conditions vary along the development phases of a Project, there is an implicit responsibility of understanding the territory, social dynamics, and cultural, economic and environmental conditions in order to manage expectations.

Among other several projects where INGETEC has provided environmental and social consultancy in Colombian territory, most in complex contexts, lessons learned have been accumulated and documented.

Actions plans have been and implemented specifically focused on managing expectations of local forces and stakeholder at early project phases prefeasibility and feasibility studies). It has been proven that those projects that have implemented assertive communications program, interinstitutional collaboration, community engagement and a continuous reality check have been more successful in managing stakeholders than those that don´t.

It has been recognized that a first and important effort is needed in order to understand local social, political, economic and environmental characteristics, as well as an effort to establish stakeholder mapping and strategic relationships which will eventually help monitor social dynamics. This effort will provide the basis for the design of a strategic “project entry plan” which should involve stakeholder engagement as well a robust communications and relationship strengthening strategy. Another long term and sustained effort is needed to implement such plan. A considerable effort is needed at the preconstruction phase in order to manage expectations at a local and regional level aiming at both preventing preconstruction phase impacts as well as preparing the road for the project´s construction phase. An equilibrium needs to be reached where expectations are kept low, however enough to motivate stakeholders and groups of interest.

Expectations are result of human nature and will happen, it is a matter of how well a project can anticipate the unforeseen and quantify the unknown to better control the outcome its own promotion and actions.

REFERENCES

1. Colombian Ministry of Environment, Housing and Territory Development, February 2010. Resolución Número 0357.
2. Colombian Ministry of Environment and Sustainable Development, 2015. Decree 1076.
3. El Colombiano, January 10, 20111. “AZA Reconoce que le Cañó a EPM con los 14.500 Afectados”,
4. EPM, 2010. “Boletín Informativo Diciembre 14, 2010”.
5. EPM, 2010. “Proyecto Hidroeléctrico Porce IV - Actualización del Estudio de Impacto Ambiental”.

Title: Reasons to approve hydropower projects in Brazil

André de Lima Andrade
Environmental analyst - IBAMA and Doctor in Energy Planning
e-mail: andreandrade02@hotmail.com

Marco Aurélio dos Santos
Associated professor Energy Planning Program COPPE/UFRJ and Research Fellow of CNPq ,
e-mail: aurelio@ppe.ufrj.br

1. Introduction:

Brazil has an electricity generation matrix of predominantly renewable origin, with hydroelectric generation responding in 2015 for 64% of the electricity supply (EPE, 2016)

However, building hydroelectric power plants can have significant environmental impacts, which are very often irreversible (WCD, 2000). The environmental impacts could be even more relevant if the hydropower plant projected is to be developed in an environmentally relevant or sensitive areas (Kumar et al., 2011 and Winemiller et al., 2016).

It is therefore important to point out that hydroelectric generation expansion in Brazil will be highly concentrated (86% in terms of installed capacity) in the Amazon region, where the water resources are quite abundant and available, however this region that represents the planet's largest biodiversity reserve (IBAMA, 2002).

Thus, it is fundamental that the planning, construction and operation of hydroelectric plants be carried out within a broad and robust process of environmental impact assessment (EIA)

In Brazil, EIA is carried out in order to provide elements for the environmental licensing instrument, provided by Law no. 6.938/1981.

Brazil's EIA procedure has 3 (three) stages, and in each of which it is necessary to obtain specific licenses: (i) prior license, when the project environmental viability is discussed, as detailed below; (ii) installation license, when the work is authorized to start; and (iii) operating license, when the enterprise is authorized to operate, which, in the case of hydroelectric plants, includes filling the reservoir and power generation start-up (Law no. 6.938/1981);

In the 1st stage, or prior licensing stage, the project is assessed in terms of location and concept, based on EIR (Environmental Impact Assessment Report) analysis. If the environmental body certifies the project environmental viability, the Prior License is issued and requirements to be fulfilled in the process next phases are established (CONAMA Resolution no. 237/97);

This paper aims to discuss how the concept of environmental viability or sustainability has been applied by The Brazilian Environmental Institute (IBAMA) to support the issuing of environmental permits of hydropower plants.

2. Material and Methods

Data was collected by reviewing 24 (twenty-four) out of all the 29 (twenty-nine) federal environmental licensing processes for hydroelectric plants that had been through the prior licensing phase. The complete research was published in Andrade and Dos Santos (2015). This paper will highlight the most important findings.

A list of all process analyses was included at Annex 1. When reviewing hydroelectric plants federal environmental licensing processes, this study looked for the most important criteria adopted in the EIA when discussing viability and the reasons to declare a project environmentally unsustainable.

3. Results

In diagnosing hydroelectric plants licensing processes where environmental viability was discussed, it was found, in practice, that there pattern both in the EIA and in the licensing body technical opinion to determine an enterprise environmental viability and to evaluate EIA quality.

In the analyzed EIRs, the main reasons to justify the environmental viability were the possibility of minimizing negative impacts forecast by adopting environmental programs and mitigating measures, followed by the possibility of generating income and boosting the region's economy (Figure 1). The reasons to justify the environmental viability at EIRs for each process analyzed is presented at Annex1.

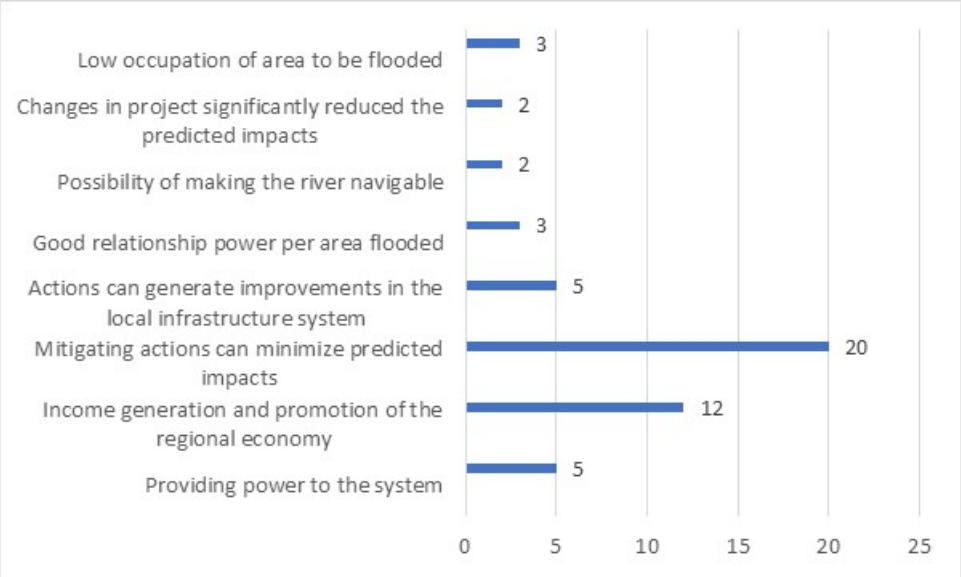


Figure 1 - Reasons to justify the environmental viability at EIRs

It was observed that diagnosis and prognosis presented are very often non-conclusive, so the licensing institution frequently resorts to the precautionary principle as a justification for an environmental license request rejection, or the need for additional information to complement the study.

In 79% of the cases (19 out of 24 projects), complementary information was requested, what contributes to the delay in the entity's final position announcement regarding the enterprise's prior license issuing. According to this research, it takes, on average, 5 years and 4 months to the federal agency to give the final answer to the prior license request.

In the processes in which environmental viability was discussed, it was found that certain information types are very often requested. Subjects that are usually requested is depicted in figure 2.

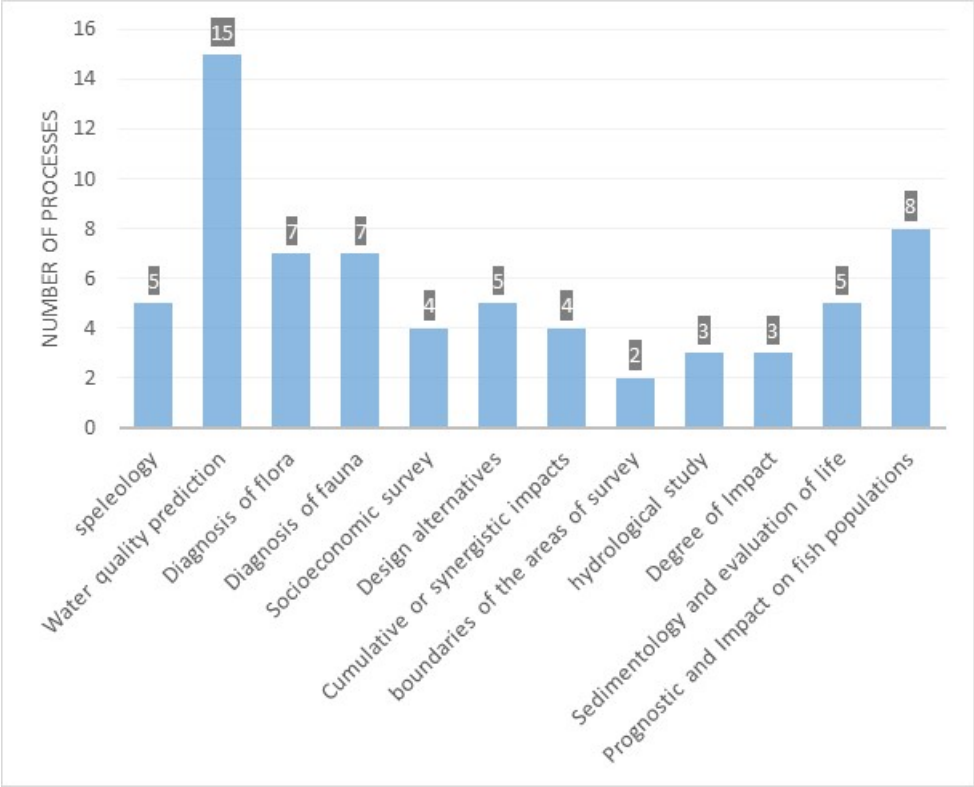


Figure 2 – Usually requested complementation

It was verified that IBAMA´s final decision if often qualitative, subjective and discretionary even though based on environmental studies. Some criterias were used to check if the hydropower project was environmental viable or sustainable:

- verification if the installation or operation of the project would result in the violation of any law or legal rule;
- evaluation if is being proposed the better locational and technological alternative for the project;
- assessment if the most significant environmental impacts are mitigated, reversible or temporary;
- review if the environment can withstand the impact of the installation and operation of an enterprise and maintain a minimum environmental quality;
- assessment if there is a positive balance between gains and environmental costs;
- assessment if the scenario that considers the installation and operation of the project is more promising than the scenario in which the project is not built.

It was also identified the reasons by IBAMA to reject or suspend Prior Licenses (Annex2).

When analyzing the processes that were evaluated for environmental sustainability by the federal licensing body, it was found that in 85% of hydroelectric plant processes in which the prior license was granted, significant environmental improvements were identified due to environmental sustainability discussion. Such improvements resulted in project alterations or in the inclusion of mitigating programs or measures that were not initially present. The most frequently identified environmental improvements are shown in Figure 3.

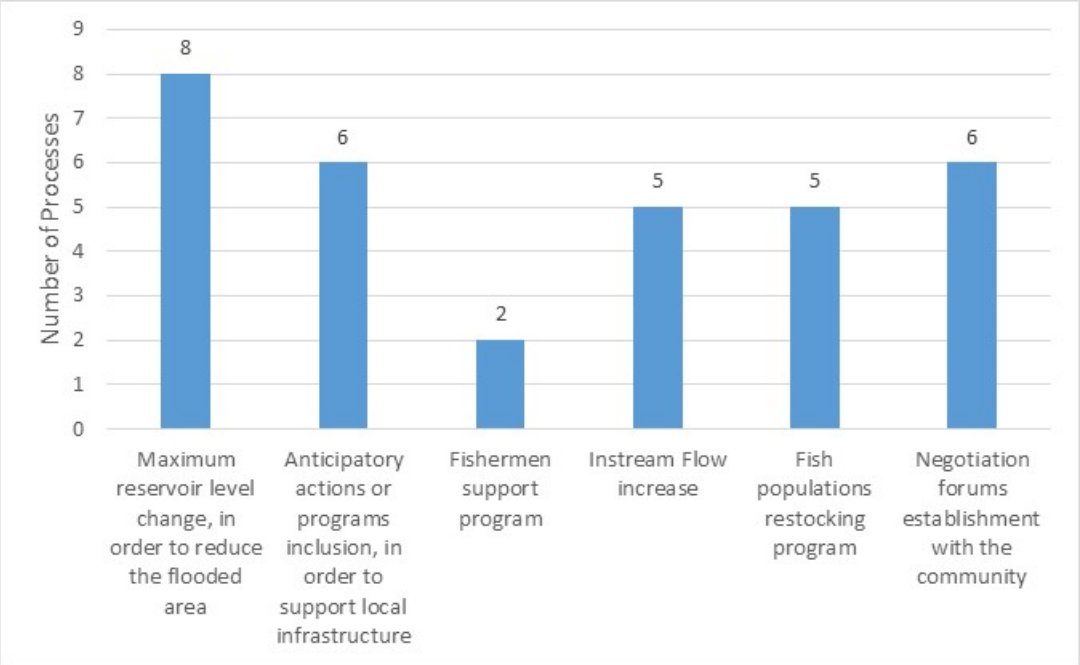


Figure 3 - Environmental improvements identified in hydroelectric plants licensing processes

4. References

- ANDRADE, André; DOS SANTOS, Marco Aurélio. Hydroelectric plants environmental viability: Strategic environmental assessment application in Brazil. Renewable and Sustainable Energy Reviews, v. 52, p. 1413-1423, 2015.
- IBAMA, 2002. GEO Brasil 2002. Perspectivas do Meio Ambiente no Brasil / Organizaed by Thereza Christina Carvalho Santos e João Batista Drummond Câmara.
- Kumar, A., T. Schei, A. Ahenkorah, R. Caceres Rodriguez, J.-M. Devernay, M. Freitas, D. Hall, Å. Killingtveit, Z. Liu, 2011: Hydropower. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Manyary, Waleska e Carvalho, Osmar. Environmental considerations in energy planning for the amazon region: downstream effects of dams. Energy Policy 35, 2007
- EPE, 2016. Balanço Energético Nacional – BEN relativo ao ano de 2015. Empresa de Pesquisa Energética. Disponível em: <http://<www.epe.gov.br>
- WCD, 2000. The World Commission on Dams. Dams and Development – A new framework for decision-making. The report of the Word Commission of Dams. Earthscan Publications.
- WINEMILLER, K. O. et al. Balancing hydropower and biodiversity in the Amazon, Congo, and Mekong. Science, v. 351, n. 6269, p. 128-129, 2016.

5. Annex 1 - Reasons to justify environmental viability at EIAR

Nº	Hydropower	Reasons to justify environmental viability at EIAR
1	Aimorés	Entrepreneurship will generate positive ecological and economic impacts in order to motivate the preservation and creation of other planned options of use and exploration in the area, which minimizes the negative impacts caused.
2	Batalha	Implementation of the enterprise can accelerate the dynamics of the region's economy; Negative effects should be minimized by the implementation of the environmental programs proposed in the EIA

3	Belo Monte	Pressure for deforestation of the region will continue to occur in the event of non-installation of the development; (PDRS - Xingu, contributing to the sustainable development of the region, anticipatory actions in support of local infrastructure can minimize the effects of expected migration, environmental compensation actions may contribute to the protection of areas Changes in design and proposed mitigating measures are able to reduce most of the predicted impacts and the energy to be generated will be quite significant.
4	Cachoeira	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population
5	Castelhanos	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population
6	Couto Magalhães	Change in project considerably reduced the environmental impacts of the project, positive impacts arising from the generation of energy and dynamism of the local economy, possibility of reducing the environmental impacts predicted through the adoption of proposed mitigating measures
7	Davinópolis	Region where the enterprise will be inserted is a fairly anthropized area, impacts may be minimized, possibility of the enterprise boosting the region's economy, construction of the enterprise will increase the water availability for the Davinópolis AHE region and will provide multiple use of river
8	Estreito (Parnaíba)	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population
9	Estreito (Tocantins)	Possibility of improvements for the region's population, in the areas of health, education, resettlement infrastructure, increase of revenue for municipalities, possibility of mitigation and compensation of the foreseen impacts
10	Foz do Chapecó	EIAR not available
11	Ipueiras	EIAR not available
12	Itaocara	With the adoption of mitigation programs and measures, it was not envisaged the occurrence of impacts of great relevance
13	Jirau	Good relation reservoir / power area, possibility of building locks to make river navigable in the stretch, possibility of mitigation of the most significant adverse impacts, positive impacts considered relevant
14	Pai Querê	Mitigating measures and environmental programs are able to mitigate predicted environmental impacts
15	Ribeiro Gonçalves	Not specified
16	Santo Antônio (Jari)	Alteration of the project resulted in a significant decrease in the magnitude of the impacts, vegetation to be suppressed and the reduction of habitat imposed will not be limiting for the preservation of the local fauna, especially if it is considered the continuous widths of similar vegetation in the area of influence, waterfall to be affected already Represents a natural obstacle to the migration of fish, few families to be relocated.
17	Santo Antônio (Madeira)	Good relation reservoir / power area, possibility of building locks to make river navigable in the stretch, possibility of mitigation of the most significant adverse impacts, positive impacts considered relevant
18	São Manoel	Sparsely populated region; Possibility of local development and generation of jobs, possibility of minimizing environmental impacts through the adoption of mitigating measures and environmental programs
19	São Salvador	Possibility of minimizing the negative impacts and relevant positive impacts from the socioeconomic increase of dynamism of the region
20	Serra do Facão	Possibility of minimizing negative impacts, suggested environmental programs can improve the region's environmental quality, relevant positive impacts resulting from the availability of energy and construction of two bridges over the reservoir to facilitate access

21	Simplício	Positive impacts resulting from the availability of energy and socioeconomic dynamism of the region, most of the adverse impacts are temporary and can be mitigated through the execution of mitigation actions.
22	Teles Pires	Positive balance between negative and positive impacts resulting from the project, low human occupation of the area directly affected, excellent power / flood ratio, possibility of minimizing negative effects arising from the installation of the project.
23	Tijuco Alto	Changes in the project have reduced the negative impacts and can generate positive impacts (control of floods in the river valley, possibility of navigation in the reservoir and use of the lake for tourism purposes), an enterprise can induce regional economic development, predicted impacts can be mitigated through implementation of environmental programs
24	Uruçui	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population

6. Annex 2

Nº	Hydropower	Reasons of IBAMA to justify the suspension or rejection of Prior License
1	Couto Magalhães (150 MW)	Reduced flow instream flow passage does not allow aquatic ecosystems maintenance.
2	Ipueiras (460 MW)	Flooding of large areas of cerrado with significant importance, flooding of marginal lagoons, unfavorable power / flooded area ratio, intention of establishing a protected area in the area to be flooded.
3	Itumirim (60 MW)	Direct interference in Emas National Park.
4	Marabá (2160 MW)	Flooding of indigenous land.
5	Pai Querê (292 MW)	Possibility of endemic species extinction, interference in the priority area for biodiversity. conservation, intention of establishing a protected area in the area to be flooded, interference in archaeological heritage area (Passo de Santa Vitória).
6	São Luiz do Tapajós (8000 MW)	Flooding of indigenous land.and lack of presentation of requested information
7	Santa Isabel (1087 MW)	Potential impact in a Conservation Área (Serra dos Martirios State Park, interference in caves, areas of endemism and scenery of the Araguaia guerrilla.
8	Serra Quebrada (1328 MW)	Flooding of indigenous land.
9	Tijuco Alto (144 MW)	Reason for the initial rejection: Interference in caves, quilombola communities, Atlantic Forest remnants, risk of species extinction, poor diagnosis of vegetation to be removed, fish populations to be affected. Possibility of lead contamination. Lack of integrated impacts assessment.
10	Tupiratins (620 MW)	Affects indigenous land.
11	Uruçui (134 MW)	Unfavorable installed capacity/flooded area ratio. Need for removal of riparian populations and flooding of large cerrado fragments with importance to local wildlife. Interference area of great importance for Ichthyofauna breeding (flooding of marginal lagoons).

ECE: Sound Foundation for Sustainable Development

Gunnar Baldwin, Jr.

I. INTRODUCTION

In Latin America and other parts of the developing world that are striving to realize the goals of sustainable development, environmental compliance and enforcement (ECE) institutions provide a critical nexus between policies designed to channel economic growth in more sustainable directions and the regulatory oversight of licensed activities (GGKP 2015, Koźluk 2014). Such policies aim to achieve win-win, "green growth" synergies, where positive economic and environmental (broadly defined) outcomes are simultaneously achieved. A growing body of literature suggests that green growth synergies can be successful if ECE capacities are sufficiently robust to support them. (GGKP 2015).[1] Since sustainable development goals frequently compete with opportunities to exploit natural resources in ways that cause lasting harm, ECE capabilities are critical to ensuring a level playing field and maximizing the economic value of pursuing green growth pathways (Delreux 2016, OECD 2009). This paper proposes that fostering sustainable development in Latin America will require not only strengthening capacity for enforcement against the worst environmental offenders, but also enhancing the effectiveness of compliance promotion and assistance programs implemented by ECE authorities to support environmentally proactive industries.

Existing studies suggest that universal indicators for the economic success of ECE interventions remain elusive. (GGKP 2015). In addition, compliance and enforcement mechanisms in Latin America vary widely across countries, sectors, and environmental issues. ECE institutions in this region must often enforce regulatory requirements that are interwoven with private sector requirements in many green growth industries. However, some Latin American ECE institutions have also developed programs to proactively promote and support the adoption of environmentally sustainable business processes. These efforts represent important capacity building focal points, since industries at the forefront of green growth (e.g., cleaner production, renewable energy, and sustainable infrastructure) help set the agenda for broader environmental compliance goals.

II. BACKGROUND

Role for environmental compliance and enforcement authorities in supporting green growth

Although the capacity to police environmental crimes remains as critically important as ever, ECE institutions in Latin America increasingly help reinforce political and private sector commitment to proactive, rather than reactive, approaches to environmental compliance and sustainability (OECD 2015). Government ECE institutions can provide an enabling environment for green growth in a number of ways. These include verifying and recognizing sustainable performance (avoided pollution and waste, healthy conditions), compliance promotion and assistance, creating certainty that compliance is the least expensive pathway, ensuring the

[1] This document is a pilot for an elaborated mapping of ECE components of environmental governance in Latin America and those needed to provide foundational support for green growth.

integrity of environmental auditors and certification schemes, and backstopping compliance programs with the rule of law (OECD 2013).

III. CONVERGING ENVIRONMENTAL AND ECONOMIC SUCCESS: CASE EXAMPLES

This section highlights four examples of national environmental policy implementations that aim to harmonize environmental objectives and economic competitiveness. These examples operate within regulatory environments that may involve complex interrelationships between public and private sector governance and which require distinctive government ECE mechanisms. "Economic competitiveness" is defined to encompass not only market advantage and profits, but also cost savings and increased GDP.

1. Cleaner production

Under this approach, a commercial enterprise provides goods or services that can be distinguished from similar goods and services based on the sustainable manner in which they are produced (USAID 2010). These products have an intrinsic "environmentally friendly" pedigree for which the enterprise can receive a price premium, enjoy a competitive market advantage, and realize cost savings. Compliance requirements include both generalized and sector-specific legislation, as well as industry standards for maintaining green credentials (Ashton 2015). Noncompliance results in regulatory enforcement actions (administrative sanctions, fines, warnings, facility closure) and industry actions (suspension of green credentials, reduced market access) (CNP+LH 2009). In Honduras, "incentives and other voluntary and flexible mechanisms" are a pillar of the National Strategy for Compliance with Environmental Legislation. Honduras also has a National Strategy for Cleaner Production.

Case example: Green textile industry in Honduras

In Honduras, cleaner production (*Producción Más Limpia* (P+L)) methodologies have been refined by the National Center for Cleaner Production (CNP+LH) in collaboration with the national environmental ministry, SERNA. The owners of textile companies that commit to the cleaner production practices enjoy a competitive advantage in two ways: (1) increased market visibility and access, and (2) cost savings through reduced waste (OAS 2014). Although participation in P+L is voluntary, companies commit to the program by obtaining an environmental license through SERNA, transforming the P+L procedures into mandatory legal requirements. Participating companies must submit to monitoring by both private sector and government auditors and inspectors. SERNA has played a significant role in developing P+L standards and methodologies for over twenty sectors and has created a national reference laboratory (CESSCO) to assist in monitoring environmental performance.

2. Market-based instruments

This category of green growth synergies exists primarily to meet the demands of regulatory instruments, such as emission taxes and tradeable allowances (cap-and-trade), which governments establish to achieve specific objectives (e.g., decreased fuel emissions) through market signals (Koźluk 2014).

Case example: Green certification of biofuels in Brazil

The production of biofuels in Brazil (ethanol and biodiesel) is based primarily on the use of sugarcane as a feedstock (EC 2016). Originally promoted under Brazil's Proalcool program to achieve national energy independence, Brazilian ethanol production now helping meet the demand driven by renewable fuel mandates in Europe and North America. Domestically, ethanol production is subject to environmental laws on sugarcane production, runoff, forestry, and land use, and biofuels play a key role in Brazil's National Climate Change Policy (IETA 2015). Where stringent indicators of sustainability are required, ethanol production is audited and certified under the international *Bonsucro* voluntary standard. Although the certification process is undertaken by accredited private sector certifiers, government authorities must ensure certification integrity and enforce compliance with national and state laws (Zessa 2013).

3. Sustainable infrastructure projects

This category involves infrastructure projects that are designed to remedy the costly environmental impacts that result from the collective actions of a large population. The economic value to the public sector partner can be measured, in part, by a co-benefit of the project: increased gross domestic product (GDP) resulting from the decreased government costs of responding to respiratory illnesses, diseases borne by poor sanitation, and other public health and safety issues (WRI 2015).

Data gathered by the World Health Organization (WHO) and Pan American Health Organization (PAHO) are compelling. More than 100 million people in Latin America are exposed to pollution levels that exceed the organization's recommended limits (CAI 2013). Similarly, PAHO has estimated that urban air pollution is the cause of at least 35,000 premature deaths annually in the region (UNEP 2015). It has been estimated that reduced public health costs could achieve savings of between 2 and 6 billion dollars a year (CAI 2013).

During all phases of infrastructure development, government monitoring and enforcement mechanisms are needed to assure compliance with legislation, as well as licensing requirements derived from the ESIA (e.g., in São Paulo, some new emissions sources must offset existing ones by 110%).[2] The distribution of air, water, and soil contaminants requires the need for numerous sampling instruments deployed over a broad geographic area.

Case Example: Bus rapid transit (BRT) networks in Brazil and Colombia

Almost three fifths of Brazil's transport emissions occur in cities and are expected to grow by 60 percent per year in the near future (World Bank 2012). In some urban localities, these emissions may even account for 70-90 percent of air pollution (WRI 2015). Since the 1970s, Brazil has been addressing this transport pollution problem by developing a variety of commuter transit systems (EIU 2014). For example, Brazil has been the leader in the use of Bus Rapid Transit (BRT) systems. A BRT system in the city of Curitiba has led, in part, to the municipality having the cleanest air of all Brazilian cities. (Cervero 2013). A similarly BRT system, the TransMilenio, has been used in Bogotá, Colombia.

[2] Decreto Nº 52.469 (2007).

4. Climate change: Carbon sequestration through REDD+

The fourth example derives from national policies and commitments for action on climate change through reduced emissions from deforestation and forest degradation (REDD+), a forest-based approach for sequestering greenhouse gases (GHGs) designed for implementation in developing countries under the United Nations Framework Convention on Climate Change (UNFCCC) (FCPF 2015). Implementation of REDD+ activities may yield carbon credits, payments for ecosystems services (PES), or sustainable, commercial forest products. Since the environmental and social integrity of these outputs is critical to maintaining market confidence, robust monitoring of REDD+ activities as well as is the enforcement of legislation and project-specific requirements is paramount (Seppänen 2013).

Case example: REDD+ in the Chaco region of Argentina

Argentina's REDD+ strategy is designed to discourage the conversion of forest to pasture for grazing and other agricultural uses. In Argentina's Chaco region, the market value of avoided carbon emissions from deforestation must be sufficiently high to compete with cattle ranching, a profitable enterprise and the largest driver of deforestation in the region (UN-REDD 2016).

REDD+ arguably represents the extreme case for robust monitoring and verification, since near-perfect performance by the project developer must be assured (Streck et al. 2012). Part of the high standard for REDD+ is the requirement that sequestration of GHGs within the protected area be permanent. (UN-REDD 2017). In the Chaco region, provincial authorities are responsible for assuring that REDD+ projects in their jurisdictions comply with national and provincial laws related to these activities (UN-REDD 2016). These authorities are assisted by a National Environmental Monitoring Network that provides increased capacity to perform sophisticated monitoring, including satellite surveillance of remote areas. The network also supports other ECE targets (e.g., illegal logging), spreading the cost of these capacities more broadly.

IV. DISCUSSION

A commonality of the four examples is that compliance is driven as much by incentive-based ECE mechanisms as by deterrents for noncompliance, although the presence of the latter is critical for maintaining integrity and public confidence. Nevertheless, there is considerable variation among Latin American countries in implementation of environmental and climate-related policies, at all levels, through the authorities tasked with carrying out ECE functions. Deriving generalized lessons from the varied organization of Latin American ECE systems will require further study.

The cleaner development model used by Honduras involves a high level of public and private sector collaboration, whereas the regulation of the biofuel industry in Brazil involves public and private sector actors who execute parallel but separate oversight functions. In contrast, government institutions for monitoring and enforcing the environmental compliance of sustainable transport projects and REDD+ forest projects involve highly differentiated structures and capacity needs. A central question for ongoing study is how ECE capacities can be strengthened to best support the growing variety of sustainable industry models that exist.

V. CONCLUSION

In order to maintain confidence in the integrity of green industries, government authorities will need to maintain a backstop of stringent enforcement, even where private sector innovation in environmental performance provides desirable environmental outcomes. Ceding ECE functions entirely to private verifiers would invite corruption, undermining a country's exports and reputational advantage.

It is possible that the economic success of green growth models may, over time, result in environmental performance may be seen as a driver of return on investment, justifying cost concerns. In the optimal case, the economic success of green growth will lead to higher political priority and larger budget allocations. For micro, small, and medium-sized enterprises, this will mean deploying many ECE efforts at the local level.

Finally, obtaining sufficient resources for ECE ministries and other authorities may require that ECE mechanisms prove their worth in economic terms. It will be critical to maintain capacities on multiple fronts to address the heterogeneous nature of green growth synergies. Heightened efforts should be applied at critical points where isolated failures could undermine broader confidence in a country's output, such as confirming the validity of green credentials for exported goods. Protecting the integrity of a nation's sustainable pedigree is worth the investment.

The methodological study (underway) that follows this paper aims to provide in-depth, comparable findings.

gunnar.baldwin@roadrunner.com

Bibliography

Ashton, W.S. et. al. (2015) *Stimulating the Market: Incentives for Cleaner Production and Energy Efficiency in Latin America*, 5th International Workshop, Advances in Cleaner Production, São Paulo.

Centro Nacional de Producción Más Limpia de Honduras and SERNA (CNP+LH 2009) *Guía de Buenas Prácticas Ambientales para la industria textil*.

Cervero, Robert (October 2013), *Transport Infrastructure and the Environment: Sustainable Mobility and Urbanism*, Institute of Urban and Regional Development.

Clean Air Institute (CAI 2013), *Air Quality in Latin America: An Overview*.

Delreux, Tom and Happaerts, Sander (2016) *Environmental Policy and Politics in the European Union*, 135 Palgrave-MacMillan.

European Commission (EC 2016), *Alternative fuels and infrastructure in seven non-EU markets - Final report*.

EIU (Economist Intelligence Unit) (2014). Evaluating the environment for public-private partnerships in Latin America and the Caribbean: The 2014 Infrascope. EIU, New York, NY.

Forest Carbon Partnership Facility (FCPF 2015), *What is REDD+?*, https://www.forestcarbonpartnership.org/what-redd.

Green Growth Knowledge Platform (GGKP 2015) *Measuring Environmental Action and Economic Performance in Developing Countries, Working Paper*, GGKP Research Committee on Trade and Competitiveness, UNEP 01|2015.

IETA (2015) Brazil: An Emissions Trading Case Study.

Inter-American Development Bank (IDB 2015), Ending the Tradeoff: Harmonizing Efficiency and Effectiveness in Environmental Licensing and Enforcement, Discussion paper by Gunnar Baldwin, Jr. for the IDB Environmental Safeguards Unit.

LeFevre, Benoit and Leipziger, David (WRI 2015) Private Investment in Public Transport: Success Stories for Brazilian Cities, World Resources Institute, Available at http://www.wri.org/publication/private-investment-public-transport-brazil.

Organization of American States (OAS) (2014), Monitoring Progress of the Environmental Cooperation Agenda in the CAFTA-DR Countries, Fourth Evaluation Report, 3 http://www.oas.org/en/sedi/dsd/elpg/aboutELPG/4_CAFTA-DR_Report-_ENG.pdf.

Quintero, Juan David (Nov 2012) Principles, Practices, and Challenges for Green Infrastructure Projects in Latin America, Inter-American Development Bank, VPS/ESG Discussion Paper No. IDB - DP - 250.

Seppänen, Sampo (2013) Demand in a Fragmented Global Carbon Market: Outlook and Policy Options, ordisk Ministerråd, 80.

Streck, Charlotte and Costenbader, John (2012) *Standards for Results-Based REDD+ Finance: Overview and Design Parameters*, ClimateFocus.

UN-ECLAC (ECLAC 2014), Preliminary Reflections on Latin America and the Caribbean in the Post-2015 Development Agenda Based on the Trilogy of Equality.

UNEP (2015) Latin America and the Caribbean reaffirms its commitment to improve air quality, http://web.unep.org/latin-america-and-caribbean-reaffirms-its-commitment-improve-air-quality.

UNIDO (2015) *National Cleaner Production Centres: 20 years of achievement: Towards decoupling resource use and environmental impact from manufacturing growth*.

UNEP (2016), *Regional Cooperation for Environmental Sustainability in the Latin American and Caribbean Region A revision of current regional and subregional strategies within the framework of the 2030 Agenda for Sustainable Development*.

UN-REDD Programme (2017), *Towards a Common Understanding of REDD+ under the UNFCCC*.

UN-REDD Programme (2016) The innovative character of REDD+ payments and their potential for change: trends from Latin America, Gabriel Labbat.

USAID (2010), *Cleaner Production in Latin America and the Caribbean: USAID's Role*.

Vandenbergh, Michael P., Private Environmental Governance (May 13, 2013). Cornell Law Review, Vol. 99, 2013, Forthcoming; Vanderbilt Public Law Research Paper No. 13-11.

World Bank (2012) *Implementation Completion and Results Report: São Paulo Metro Line 4 Project*. Report No. ICR00001735.

Zezza, Annalisa (2013) Sustainability Certification in the Biofuel Sector: A Case Study of Brazilian Ethanol. Belfer Center for Science and International Affairs, Harvard University.

Title of Paper: Eel River Dam Removal Project EA and Follow-up Program: A Benefit to those affected by the Project.

Authors: Province of New Brunswick (Mike Pauley), Eel River Bar First Nation (Keshia Moffat, Sacha Labillois), Stantec Consulting (Darek Moreau, Jenny Reid, Chris Blair)

This Project consisted of the removal of an earthen dam constructed in 1963 that was no longer serving the purpose for which it was designed and was demonstrably hurting the ecology of the River within which it was installed. The purpose of this paper is to provide a lesson's learned perspective on the follow-up program that was developed from the EA for the removal of the dam. As originally scoped, most of the Follow-up Programs were to be completed by technical specialists, but as the program evolved it became apparent that the right thing to do was to have as many programs as possible be implemented by members of the community immediately adjacent to and most affected by the Project – Eel River Bar First Nation (ERBFN). Further, the proponent and their consultant worked with the Chief and Council of ERBFN to seek opportunities for training and professional mentorship for members of the Community.

Background

The Eel River dam is located in eastern Canada, on the northeastern coast of the Province of New Brunswick, near the town of Dalhousie, adjacent to the ERBFN community. The dam and gateway were in the lower tidal estuary of the river about 600 m from its mouth in the Eel Bay. The Eel River watershed is approximately 220 km^2 and 24 km long. Mean annual stream flow is 5 m^3/s. The dam was built in 1963 to provide an industrial water source (non-potable) to attract industry to the region. Following construction, there was no longer upstream tidal exchange and all but the lower 600 m of the estuary was lost. Fish passage was incorporated into the dam's construction, however it never functioned properly. Changes in flow, increased water elevation above the dam, and lack of tidal influences caused the impoundment to be more "lake-like" than a river. This had detrimental environmental and social impacts on the river, particularly the traditional uses of the river by the ERBFN.

Members of the ERBFN, Fisheries and Oceans Canada (DFO), and local anglers, reported that Atlantic salmon were once relatively plentiful in Eel River. Monitoring conducted by DFO and the Province of New Brunswick documented few adult salmon above the dam even though upstream spawning habitat is still suitable.

Reports from DFO and observations by members of ERBFN, indicate that clam populations declined in the remaining estuary below the dam partially due to sedimentation associated with the reduced tidal flushing and destruction of clam beds, and there were no clams upstream of the dam due to the change to a freshwater environment. Adding injury to insult, the presence of sewage-related bacteria, made worse by the reduced tidal exchange, resulted in closures of the remaining clam fishery in the Eel River estuary and Eel Bay.

Environmental Assessment

In 2002, the Government of Canada, Province of New Brunswick and ERBFN entered into an agreement to conduct an environmental assessment for the removal of the dam with the following Project Objectives to address the challenges related to fish passage, loss of salt marsh, and loss of habitat for soft-shelled clams.

The proponent was the Province of New Brunswick, the owner of the dam, and the EA was completed and the project, the removal of the dam, was approved by 2007.

Project Implementation

Prior to the implementation of the 3-stage removal, a Steering Committee was formed to oversee the work being undertaken and provide overall direction in relation to the decommissioning. Decisions of the Steering Committee are based on consensus. The Steering Committee is made up of various Departments of the Province of New Brunswick (and their consultant, Stantec), ERBFN, and Indian and Northern Affairs Canada, among others.

The dam was removed in three stages: 1 – project planning (2009); 2 - create 150 m opening in the dam to reestablish the pre-dam flow patterns in the river (2010); and 3 - remove the remainder of the Eel River dam (2011).

Several ceremonies in the ERBFN Community were initiated around the opening of the gates and removal of the dam. The project implementation was interesting for many in the community (those under 50 years of age) as they had only ever known the river to have a dam.

Follow-up Program

The EA recommended Follow-up Programs to verify the predictions of the environmental assessment of a Project and determine the effectiveness of mitigation. The following components of the environment were subject to Follow-up Plans:

- Clams
- Finfish
- Public Health and Safety
- Vegetation and Wetlands
- Migratory Birds, and
- Archaeological Resources.

Soft shell clam (*Mya arenaria*) habitat quality was assessed through monitoring of sediment quality (grain size) upstream and downstream of the dam as well as clam population density. Surveys and monitoring programs for finfish were undertaken to monitor TSS, freshwater fish species and their distribution (electrofishing and redd surveys), and fish passage (adult Atlantic salmon counts). Training was provided for both of these components which are being conducted by trained teams from ERBFN.

Of the remaining Follow-up Plans, for the purposes of this paper, only those elements that were found to be "problematic" are discussed further. Those not discussed were carried out as described in the EA.

The Problem of Positive Impacts

As the removal of the dam resulted in largely positive impacts for the majority of the Value Components assessed in the EA, the follow-up program was based on verifying those positive effects. But to what end?

The changes observed in the first two years of the follow-up program for terrestrial and wetlands, and migratory birds, called into question whether further years of observations would be of value to the Project. In addition, what would be done if the anticipated rate of change was slower or faster than predicted--Implement further mitigation? Plant salt marsh species? Import estuarine birds? The environmental and ecology was going to change, it was just a matter of when, so the purpose of these elements of the follow-up program was questioned retrospectively. The program surveys were done by consulting professionals with only little participation by the Indigenous Community members living on the river – yes, the removal of the dam would hopefully be a benefit, but what other more tangible benefit opportunities could be realized?

In some cases, such as those predicted from the wetland and bird VCs, one year of follow-up was considered by those professional undertaking the surveys to be sufficient for the requirements of the EA. So what could we learn from a situation such as this? As an example, the wording surrounding the follow-up program could have read, "The follow-up program was meant to document the shift in bird species using the estuary through breeding bird and migratory surveys (Years 1 and 3)," however if the shift from freshwater to estuarine species is observed after one year, the follow-up program is considered complete."

In Projects where there is a change to pre-Project conditions (e.g., decommissioning) mitigation should focus on impacts from construction, and follow-up programs should focus on recommendations that may require further mitigation and adaptive management (i.e., things we can do something about), not simply to document whether something worked or not.

Further, and perhaps more importantly particularly in the case of this Project where all funding from the Project was coming from government sources, additional consideration could have been given to the human factor – are there additional tangible benefit opportunities that could be made available to the Indigenous partners in this Project? As you will see this was eventually what was done.

Indigenous Involvement

For the members of the ERBFN Community, the restoration of Atlantic salmon was a top priority as this species is an integral part of their culture and diet. Monitoring indicated that juvenile Atlantic salmon were present within three years of the dam removal, however there were no salmon populations in the upper reaches of Eel River because of numerous stream blockages (some natural (beaver dams), others anthropogenic (wood debris from clear cutting, etc., hung

culverts) that were noted during the salmon redd counts. During the 2014 Steering Committee meeting, it was decided to divert funds from the scheduled wetland and migratory bird surveys to the development of an obstruction removal plan for fish passage and to continue with the redd surveys to monitor the effects of the fish obstruction removal. Further, this Obstruction Removal program would be staffed entirely from individuals from ERBFN.

The removal of the dam signified a huge victory for the small Migmaq community of Eel River Bar. Historically, the river had been a vital to the survival of the community through salmon fishing and clam harvesting – the dam dramatically and adversely affected those sources of food and revenue for individuals within the Community.

After the dam was removed, the Project Follow-up activities which included clam surveys, water quality analysis, river surveys, fish counts, and the obstruction removal brought an exciting transformation to how the river is viewed by members of the Community; although still no longer a source of food, it was now a source of income for some.

As the project grew over the years and the team became more educated on why they were doing the work, they understood what their work would accomplish. The crew was able see the results in their obstruction removals and the other studies and were knowledgeable and aware of its importance to the successful return of fin fish to the river. A Community information session on the Project was held in 2012 and it instilled a sense of pride and accomplishment in the crew members. The team understood the importance of how the Follow-up Plan for the river could eventually lead to the revitalization of the river and the return of its natural state – maybe not to its former natural state, but certainly much better than it was when the dam was in place. Those participating in the various studies on the River could relate to the importance of this end goal with community and cultural values in mind.

Today the crew has come to realize that their work is valuable and meaningful. As Aboriginal people, traditionally and in modern day, the members of the ERBFN have a strong bond with Mother-Earth. To be a steward to the environment is an important role for ERBFN and they always look forward for the next seven generations. The follow up to the dam removal has allowed for the people to act as stewards of the Eel River by embracing adaptive management and community involvement in a manner that respected the true purpose of the project.

Leadership was exemplified in this project and was the key component for the hard work completed on the river. The authors believe that after the Follow-up plan has been completed, ERBFN will continue to have a presence on the river and will identify and implement activities that reflect their careful stewardship of traditional values. ERBFN now clearly see themselves as a capable organization that could take the lead on managing this watershed.

Closure

The work on Eel River continues – some arising from commitments made in the environmental assessment process, others as a result of the strong relationships and collaborative efforts that have developed between the Province of New Brunswick and the ERBFN Community through this project. EA practitioners should look for opportunities to have the Follow-up programs

developed with a purpose that is not simply to data gathering to fulfill process requirements. Importantly, they should seek additional value for those most affected by Projects – the people of the local community.

References.

Jacques Whitford. 2006 Final Report. Environmental Impact Assessment for the Removal of the Eel River Dam. Report prepared for New Brunswick Department of Supply and Services.

[i] * Stantec Consulting Ltd
** New Brunswick Department of Transportation and Infrastructure
*** Eel River Bar Firs Nation

SOCIO-ECONOMIC EFFECTS MANAGEMENT PLANNING IN BRITISH COLUMBIA, CANADA – A NEW ERA

Frank Bohlken, Stephen Roberts, Kelly Sims (Stantec Consulting Ltd.)

Daria Hasselmann (LNG Canada Development Inc.)

Presented at IAIA Montreal 2017

Introduction

A common issue of socio-economic impact assessments (SEIAs) as conducted in Canada is the lack of required follow-up. Unlike for many environmental valued components, for which environmental protection plans and follow-up monitoring are often legally prescribed, there are few regulatory requirements or policies guiding proponents in the implementation of socio-economic mitigations and management measure. The lack of regulatory framework for socio-economic effects management became evident to environmental policy makers in British Columbia (BC), Canada, facing the possibility of multiple large liquefied natural gas (LNG) and related pipeline infrastructure projects being built along the province's lightly populated north coast. This paper overviews the international and Canadian requirements for socio-economic effects management planning, discusses the regulatory rationale behind BC's requirement that some projects prepare a socio-economic effects management plan (SEEMP), and reviews the Community Level Infrastructure and Services Management Plan (CLISMP) prepared for the LNG Canada project, the first such plan to be approved under BC's new requirement that socio-economic effects management plans be prepared for certain projects.

International and Canadian Requirements

Social management plans, in various guises, have been features of international development bank (IDB) projects since at least the 1990s (IFC 1998, IFC 2015, Nobel 2014). Proponents of development projects financed through the International Finance Corporation (IFC) are required to establish an environmental and social assessment and management system comprising several elements: policy; risk and impact identification; management programs; organizational capacity and competency; emergency preparedness; stakeholder engagement; and monitoring and review (IFC 2012). Social management plans may also be required by jurisdictions not seeking IDB funding. Recent examples include those prepared for the Australia Pacific LNG and Arrow LNG projects in Australia (APLNG 2012, SKM 2013).

Canada does not have a universal approach to socio-economic effects management planning. Any such requirements vary depending on the federal, provincial, or territorial environmental review regulations applicable to a project. At the federal level, the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) requires that proponents include follow-up program(s) to verify the accuracy of the environmental assessment, and to determine the

effectiveness of mitigation measures. However, such requirements do not generally extend to socio-economic effects. Projects reviewable under the *National Energy Board Act* must file inspection plans to ensure compliance with biophysical and socio-economic commitments identified in the Environmental Impact Statement, including methods for tracking and monitoring the effectiveness of mitigations (NEB 2016).

Most Western Canadian provinces do not require that social management plans be developed as part of the environmental review process. Environmental assessments undertaken under Alberta's Environmental *Protection and Enhancement Act (EPEA)* do not require the preparation of social management plans, though in theory under the EPEA legally binding conditions could be set out requiring such a plan (AESRD 2013, Dowse et al. 2016). The environmental review processes of Saskatchewan and Manitoba also do not require social management plans.

In Nunavut, the Nunavut Impact Review Board (NIRB) may require that socio-economic effects be included within a project's monitoring program. In 2007, three Socio-Economic Monitoring Committees (SEMCs) were established to address project-specific monitoring programs of NIRB certified projects. The SMCs create a forum for information sharing, and discussion between proponents, affected communities and other stakeholders (NIRB 2017). In the Northwest Territories, guidelines issued by the McKenzie Valley Impact Review Board identify the importance of monitoring programs as follow-up to socio-economic impact assessment of development projects (MVEIRB, Consilium, Gartner Lee 2007).

Discussed in greater detail in the following section, socio-economic effects management in BC is an evolving practice. While not a legislative requirement under the BC *Environmental Assessment Act (BCEAA)*, the BC Environmental Assessment Office's (BCEAO) has recently required that certain projects prepare a SEEMP as a condition of environmental certification.

Socio-Economic Management Planning in British Columbia

BC's bid to develop an LNG industry, which picked up steam in 2012, resulted in an unprecedented number of large LNG projects and associated pipelines being proposed along BC's North Coast. The prospect of multiple large projects being constructed near relatively lightly populated communities raised concerns by Aboriginal Groups, local governments, community groups, and stakeholders over potential adverse socio-economic effects resulting from a sudden large population influx. Common concerns included potential effects on community infrastructure and services, housing affordability, and additional demands on health care. There were also concerns that large construction workforces lodged near relatively small communities could affect safety, security, and community wellbeing.

Most LNG and pipeline projects have triggered mandatory environmental assessments under the *BCEAA* and/or CEAA *2012*. Those projects that have submitted provincial environmental assessment certificate (EAC) applications have undertaken comprehensive assessment of potential socio-economic effects, and have proposed mitigation measures designed to address potential adverse socio-economic effects (e.g. LNGC 2013, PRGT 2013, PNW LNG 2012). However, despite the assurances of proposed mitigation measures, government regulators, local communities, and stakeholders remained concerned over the potential for adverse socio-economic effects befalling the region. Four general concerns emerged:

- Large projects may adversely affect community infrastructure and services
- Potential for multiple LNG-related projects to be constructed concurrently, which could result in cumulative adverse socio-economic effects due to rapid population growth
- Risks and uncertainties related to the implementation and effectiveness of mitigation measures proposed by project proponents
- Inadequacy of existing regulatory frameworks and planning processes in meeting the expectations of local and regional governments in regard to addressing project-specific and cumulative socio-economic effects (MCSCD 2015a; MCSCD 2015b; BC EAO 2015d).

To address these concerns, the Ministry of Community Sport and Cultural Development (MCSCD), in coordination with the BCEAO, developed the SEEMP framework as an EAC condition for some projects (MCSCD 2015a; MCSCD 2015b). The intent of the SEEMP is "*to ensure a clear and defined role for an EA certificate holder in identifying, quantifying and mitigating (or contributing to the mitigation of) socio-economic effects on community-level services and infrastructure arising from construction of the certificate holders project*" (MCSCD 2015b). BC EAO and MCSCD has provided guidance that condition holders are expected to follow when preparing their plans. The guidance describes the primary purpose of the SEEMP, outlines recommended engagement during SEEMP development and implementation, identifies SEEMP roles and responsibilities, and suggests key plan content (MCSCD 2015a).

LNG Canada CLISMP

LNG Canada is a joint venture company comprised of four global energy companies with substantial experience in LNG – Shell, PetroChina, KOGAS (Brion) and Mitsubishi Corporation. LNG Canada is proposing to design, build and operate a 26 million tonnes per year LNG export terminal in Kitimat, BC, within the traditional territory of the Haisla Nation. Construction of the project would require a workforce of up to 7500 persons be housed in an accommodation village located within Kitimat. The estimated operational workforce, at full build out, would be 400 – 800 persons (LNGC 2014).

LNG Canada's EAC application focused on effects that could result from the construction and operation of the LNG facility, marine terminal, and shipping activities. The following socio-economic valued components (VCs) were addressed in the application: Economic Effects, Infrastructure and Services, Visual Quality, Marine Transportation and Use, and Community Health and Wellbeing.

LNG Canada was issued an EAC on June 17, 2014. The certificate includes 24 conditions that must be fulfilled prior to or during construction and operations. Condition 14 requires that the certificate holder "develop a plan to adaptively manage potential socio-economic effects on services and infrastructure delivered by provincial agencies and local governments" (BCEAO 2015). Condition 14 requires that the plan[1]:

[1] The full text of Condition 14 can be found at: https://projects.eao.gov.bc.ca/p/lng-canada-export-terminal/docs

- Include engagement and communication with Aboriginal Groups, local governments, and service agencies in both its development and implementation
- Include mitigation measures identified within the Infrastructure and Services and Community Health and Wellbeing VC chapters
- Be based on MCSCD guidance with respect to plan contents
- Provide an approach for monitoring and reporting on the effectiveness of mitigation measures
- Include adaptive management for addressing unexpected effects.

LNG Canada's CLISMP was structured to fulfill EAO requirements of Condition 14, and in accordance with MCSCD's 2015 guidance. The CLISMP includes a core plan that describes roles and responsibilities, implementation strategies, monitoring and reporting processes, and an adaptive management framework (Table 1). Sub-plans were prepared for socio-economic aspects of concern: community amenities, community health, education, emergency response, housing and accommodations, municipal utilities, and traffic. These sub-plans detail how the mitigations identified in the EAC application would be implemented, monitored, and measured for effectiveness. The sub-plans also identify parties responsible for information sharing, implementation timelines and interested stakeholders. The CLISMP also provides information on the engagement undertaken during its development, and details the community feedback process during plan implementation (LNGC 2016).

<table>
<tr><th colspan="5">LNG Canada CLISMP</th></tr>
<tr><td colspan="3">Introduction
Project Description
Engagement during Plan Development
Organization Roles and Responsibilities</td><td colspan="2">Plan Implementation, Engagement, and Information Sharing
Potential Socioeconomic Effects
Monitoring and Reporting
Adaptive Management</td></tr>
<tr><td>Appendix 1
EAC Conditions and Mitigations</td><td>Appendix 2
Parties Engaged during Plan Development</td><td>Appendix 3
Record of Engagement</td><td>Appendix 4
Social Management Plans</td><td>Appendix 5
Community Feedback Process</td></tr>
</table>

Table 1 – LNG Canada CLISMP Framework

The adaptive management framework described in the CLSIMP outlines the steps that would be taken to address uncertainty related to the effectiveness of mitigation measures (Figure 1). A core element of this process will be regular engagement with local governments, service providers, Aboriginal Groups, and interested stakeholders. In its CLSIMP LNG Canada proposes to form a Social Management Roundtable, comprised of groups that contributed to the plan, as a forum to share information, review the effectiveness of mitigations, and identify adaptive management measures.

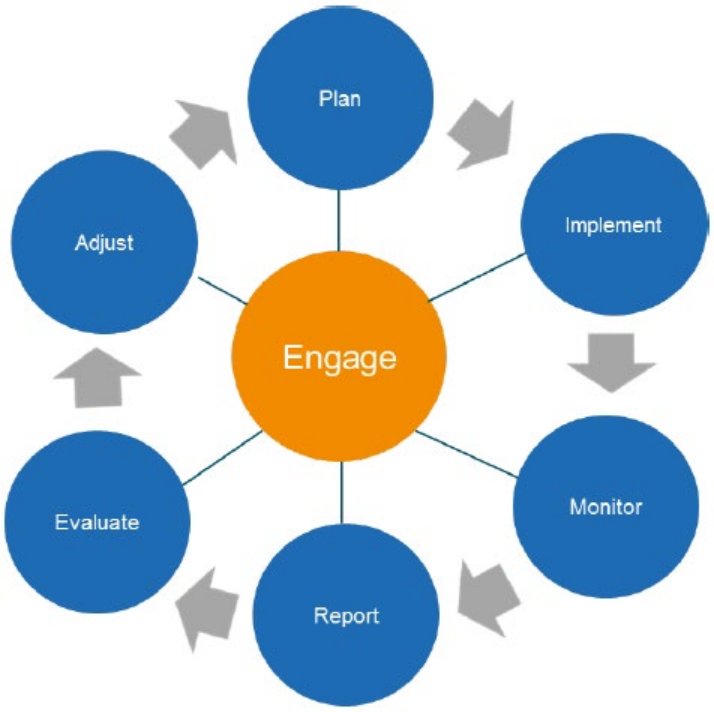


Figure 1 – LNG Canada CLISMP Adaptive Management Process

The CLISMP was developed in collaboration with input from technical experts, seven Aboriginal Groups, three local and regional governments, and over 27 service providers and provincial government agencies. It took over a year and involved 300 separate engagements. It was submitted in the spring of 2016 and approved June 14, 2016.

Lessons Learned

Because the development of LNG Canada's CLSIMP was in response to a new regulatory requirement, with limited precedent in Canada, the LNG Canada project team were, to an extent, involved in a "learning by doing" situation. Lessons learned from the CLSIMP development process included:

- Scoping – limiting the focus to community level infrastructure and services may facilitate practical implementation, but there may also be stakeholder interest in broadening the scope to include other considerations (e.g. economic benefits)
- Collaboration – early and ongoing collaboration with local communities, Aboriginal Groups, and service providers is important for plan credibility and buy-in
- Share responsibility - the proponent can best collect project-specific monitoring data, but information on many socio-economic aspects (e.g. housing, health, community infrastructure) can best be collected by government agencies
- Engagement fatigue –local governments, Aboriginal Groups, and service providers may have limited capacity to engage.

When implemented, LNG Canada's CLISMP would provide a robust platform for ensuring that potential adverse socio-economic effects of the LNG Canada project are addressed. However, it does not address all issues of concern, notably cumulative effects. A government-led initiative, such as a Nunavut-style Socio-economic Monitoring Committee, might usefully complement the initiatives outlined in LNG Canada's CLISMP by more comprehensively addressing such broader concerns.

Conclusions

Social management plans are a mandatory component of environmental and socio-economic effects management for projects funded by international development banks. In Canada, however, such plans are uncommon. British Columbia's recent requirement that certain industrial/infrastructure projects develop and implement a comprehensive SEEMP establishes it as a social management planning leader in Canada. With few projects having prepared such documents as a regulatory condition, and none having yet implemented them, the efficacy of this requirement in reducing and avoiding adverse social effects has yet to be tested. As demonstrated with the development of LNG Canada's CLISMP, comprehensive community engagement is an important element in the development of such plans, because through such discussions, expectations can be established regarding the scope, shared responsibilities, communications and reporting, and collaborative processes that will set the stage for successful plan implementation going forward.

References

Alberta Environment and Sustainable Resource Development [AESRD]. 2013. Standardized Terms of Reference - Updated January 2013.

Australia Pacific LNG [APLNG]. July 2012. Environmental and Social Management Plan.

British Columbia Environmental Assessment Office [BC EAO].2015. Environmental Assessment Certificate #E15-01 for the LNG Canada Export Terminal, Schedule B – Table of Conditions.

Canadian Environmental Assessment Act, 2012 (SC 2012, c. 19).

CEAA. 2016b. Projects on Federal Lands: Making a determination under section 67 of the Canadian Environmental Assessment Act, 2012.

Dowse, S., Hoyle, M., Card, K., & the International Pipeline Conference, I. P. C. 2016. Socio-economic effects monitoring and pipelines: Moving towards a practical and project-specific framework. Proc. Bienn. Int. Pipeline Conf. IPC Proceedings of the Biennial International Pipeline Conference, IPC, 2.

International Finance Corporation [IFC]. 2015. Environmental and Social Management System Implementation Handbook: General.

International Finance Corporation [IFC]. 2012. Performance Standards on Environmental and Social Sustainability: January 1, 2012.

International Finance Corporation [IFC]. 1998. Performance Standards on Environmental and Social Sustainability: 1998.

LNG Canada Development Inc.[LNGC]. May 2014. Application for Environmental Assessment Certificate.

LNG Canada Development Inc. [LNGC]. June 2016. LNG Canada Community Level Infrastructure and Services Management Plan

MCSCD.2015a. Ministry of Community Sport and Cultural Development. October 2015. Guidelines for Preparing a Socio-Economic Effects Management Plan (SEEMP) for Community-Level Infrastructure and Services Related to Liquefied Natural Gas (LNG) Projects.

MCSCD.2015b. Ministry of Community Sport and Cultural Development. Provincial Response to the Resolution of the 2014 Union of British Columbia Municipalities Convention.

Mackenzie Valley Environmental Impact Review Board [MVEIRB], Consilium, Gartner Lee Limited. 2007. Issues and Recommendations for Social and Economic Impact Assessment in the Mackenzie Valley.

National Energy Board [NEB]. (2016). Filing Manual - Release 2016-02.

Nobel, B. F. (2014). Introduction to Environmental Impact Assessment: A Guide to Principles and Practice (3 edition ed.): Oxford University Press.

Nunavut Impact Review Board. 2017. Socio-Economic Monitoring Committees.

Pacific Northwest LNG LP. February 2014. Environmental Impact Statement and Environmental Assessment Certificate Application

Prince Rupert Gas Transmission Ltd. [PRGT]. May 2014. Application for Environmental Assessment Certificate.

Sinclair Knight Merz [SKM]. January 2013. Arrow LNG Plant Social Impact Management Plan Update. Prepared for Arrow Energy.

Offsets: guiding practice in Russia's energy sector

By Susie Brownlie[1], Mark Botha, Hugo van Zyl, Alexey Vladimirov and Svetlana Sheynfeld

Introduction

Russia has ratified the Convention on Biological Diversity; its objectives and targets in the 2014 National Strategy and Executive Plan for the Conservation of Biodiversity within the Russian Federation or 'NSEP' (Ministry of Natural Resources and Environment: MNRE 2014a) are intended to correspond with Aichi targets, including halving rates of loss of natural habitats, significantly reducing degradation and fragmentation, and safeguarding essential ecosystem services.

Russia's economy is heavily dependent on natural resource extraction. Regions of globally significant biodiversity are increasingly targeted for energy development, leading to destruction and increasing fragmentation of intact habitat in areas of oil and gas exploitation (MNRE 2014b). Warner *et al* (2002) noted that the resource base is being consumed at unsustainable rates, with "…little value being recovered and distributed to the public".

Projects in the energy sector require EIA and measures to mitigate harm. Provision is made in law for both State and in some cases Public environmental expert review of project documentation. Compensation is required for ecological damage (including for loss of commercially important or Red Listed species), taking the form of payments to government according to rates and damage calculations in line with the federal law on Environmental Protection. 'In kind' compensation is limited to the release of fish fry into rivers, but not necessarily into the same river system as affected by a project.

According to Plyusnin and Müller (2014, p12), the main deficiency of the Russian system of compensation is "the absence of precisely stated requirements for mandatory natural compensation adequate to these impacts".

There is growing interest in addressing ecosystem services in Russia (MNRE 2014b). The assessment of impacts of industrial activities and spatial planning has begun to consider ecosystem services, but there has been insignificant overall progress in this field to date. The development of ecosystem services concepts and economic assessments in EIA of large industrial projects is of particular interest to Regional and Federal Authorities.

Both the NSEP and the 5th National report on Conservation of Biodiversity in the Russian Federation (MNRE 2014b) emphasize the need to increase the ecological and social responsibilities of businesses, and involve the business community in the activities aimed at biodiversity conservation and sustainable use, and the development of partnerships between the state, business and scientific communities and the public.

To promote good practice and support the objectives of the NSEP, the UNDP/ Global Environmental Facility (GEF) and Russia's MNRE initiated the 'Mainstreaming biodiversity conservation into Russia's energy sector policies and operations' project. This project included the preparation of guidance for companies operating in the energy sector, focusing on biodiversity offsets (UNDP 2015).

[1] susie.brownlie@dbass.co.za, deVilliers Brownlie Associates, South Africa

Approach

Offset approaches and requirements of different countries, companies, organizations and institutions (including the International Finance Corporation Performance Standard 6) were synthesized, as well as 24 case studies from around the world. The views of a range of Russian stakeholders (regional and federal authorities, Public Chamber representatives, companies, research organisations, and non-government organisations) in regions of Russia where the UNDP project was being piloted were gathered. Two pilot studies on 'in kind' compensation in Russia were evaluated: a coal mine in Kemerovo Oblast and a hydropower plant in Amur Oblast (Figure 1). General guidance was then prepared for use by companies, responding to the needs expressed.

Figure 1: Coal mine, Kemerovo Oblast (left); hydropower project, Amur Oblast (right)

Findings

Stakeholders identified the lack of guidance on when and how to address biodiversity in project planning and EIA as problematic. One interviewee stated that '*The best intervention for biodiversity conservation would be 'to get EIA working correctly*'. In some cases, decisions on land use (e.g. allocation of land for coal mining) were taken before an EIA had been conducted, undermining its effectiveness.

The standard of EIA practice is variable and to some extent depends on the veracity of review: State environmental expert review is only required for a minority of development projects (e.g. not required for most coal mining projects), but it does appear to act as a check on the ecological adequacy of project documentation. Deficiencies in current practice include insufficient gathering of baseline information on biodiversity in the early phases of a project (on which impact assessment is based), poorly developed mitigation measures, and engagement with key stakeholder groups too late in the process to have any positive influence.

Mitigation of biodiversity impacts in Russia focuses on Red List and commercial species. Mechanisms such as *ex situ* conservation and 'search, rescue and relocate' are encouraged as a remedy for dealing with impacts on these species. Rehabilitation of impacted areas is often undertaken with commercial timber rather than reinstating natural communities. There is strong emphasis on monitoring as a way of managing ecological damage, but it is often unclear how the results of monitoring would be used to evaluate and adapt mitigation actions to improve management and biodiversity outcomes. Stakeholders criticised the current form of compensation as reacting to damage, rather than proactively mitigating and managing it. Moreover, the system of paying for loss

of individuals of a species fails to address impacts on the long-term viability of that population or species.

The need to provide 'in kind' compensation for damage – framed as 'compensation in nature' - was repeatedly raised as a core issue. Stakeholders felt that compensation should benefit those parties and ecosystems negatively affected by a project. In the current system of payments, compensation fails to benefit affected communities and ecosystems. There was '*sincere indignation*' amongst affected people at the ongoing loss of, and damage to, biodiversity. It was felt that local communities affected by damage to 'their' nature do not receive adequate compensation, and that the current level of investment by companies in conserving nature – largely rehabilitating surface damage - is not enough.

Companies interviewed recognised that providing offsets could benefit their reputation and give them a competitive edge. They felt uncomfortable to be seen as 'the problem' by affected communities, since compensation paid to government for environmental damage did not materially benefit these communities. However, there was reluctance to 'pay twice': legally required compensation payments for damage in addition to the costs of delivering 'in-kind' compensation to affected places and people. (Interestingly, a recent constitutional court judgement seems to pave the way for reduced payments provided that mitigation measures implemented by the project developer were effective[2]). Companies felt that project documentation could be improved by including efficient offsets and budgeting for them early on in the project cycle.

The Guideline

For offsets to work in Russia, the whole way that biodiversity was addressed in EIA would need to be improved, particularly focusing on application of the mitigation hierarchy. The mitigation hierarchy ('ARRO': Avoid, Reduce, Restore, Offset) is incorporated in Russian environmental law, encompassing prevention of harm to the environment, reduction of unfavourable consequences, and compensation for damage *over prescribed, legally permissible norms of admissible effects*. These norms are stipulated for particular environmental components e.g. water, forestry and specific animals, using 'best available technologies' as a mechanism for introducing or defining these norms. Despite this framework, it seems that the mitigation hierarchy is not sufficiently clearly articulated, understood or applied in EIA practice in Russia.

The Guideline comprises eight parts on particular themes responding to the concerns and needs expressed by stakeholders. Part A looks at the importance of biodiversity and ecosystem services in Russia, and describes the institutional and regulatory context for addressing them in project planning and EIA, and provisions for compensation. Part B explains what is meant by 'biodiversity' and 'ecosystem services', and sets out the business case for companies to exercise 'good practice' impact assessment and apply the full mitigation hierarchy – including offsets. Part C of the Guideline covers compensation and offsets; where they fit into the mitigation hierarchy, and when they would be required.

The Guideline then sets out the core principles of biodiversity offsets in Parts D and elements of 'good practice' stakeholder engagement in Part E before covering application of the mitigation

[2] http://www.jus.uio.no/pluricourts/english/blog/maksim-usynin/russian-constitutional-court-refers-to-the-polluter-pays-principle-and-reduces-liability-b.html

hierarchy in project planning and EIA. Part F of the Guideline goes into some detail on addressing biodiversity and ecosystem services, emphasizing the need to identify important biodiversity and priority ecosystem services early on in project siting and design, preferably avoiding significant impacts. It incorporates the concepts of keeping risk 'as low as reasonably practicable' (the ALARP principle) and using best available technology to this end. It also gives guidance on ecosystem services assessment and economic valuation. Parts G and H guide companies in setting explicit goals for biodiversity and offsets, respecting core offset principles, and in designing and implementing offsets in the Russian context. Part G includes guidance on respecting limits to biodiversity loss, selecting the most appropriate form of offset, satisfying equivalence in the exchange, where and when to offset, ensuring additionality, avoiding leakage, dealing with uncertainty, and checking the technical and social acceptability of a proposed offset. It sets out the possible role for ecosystem services assessment and valuation in offset design. Part H, planning for offset implementation, comprises sections on long-term protection, financial provision, preparing a biodiversity action or offset management plan (as appropriate), monitoring and adaptive management, and incorporating this plan within a company's Environmental Management System. It includes a section on choosing an implementing agent, verification and auditing, as well as data management, reporting and disclosure.

Annexures support the main body of the Guideline, including a template for companies to track, evaluate and report on their own performance in designing and implementing offsets. Summaries of 24 case studies from around the world on offsets - mainly in the energy sector - are included, as are numerous useful sources of information on 'good practice' in biodiversity-inclusive EIA and offsets in the coal mining, hydropower, and oil and gas sectors. One annexure deals explicitly with ecosystem services assessment, consideration in impact assessment and economic valuation. Another covers typical key biodiversity and ecosystem services issues encountered in energy projects.

Conclusions

The Guideline synthesizes available information and guidance on 'good practice' consideration of biodiversity and ecosystem services in the energy sector for use by Russian companies in their project planning and EIA. It responds to a need for improved approaches to applying the mitigation hierarchy and providing appropriate 'in kind' compensation or offsets, both for biodiversity and important ecosystem services. The content of the Guideline responds to the shortcomings expressed by stakeholders, and their expectations of such a guidance document.

The focus of the Guideline was initially intended to be on offsets. However, it became clear that without strengthening the broader field of biodiversity-inclusive project planning and EIA, that focus would be ineffective and inappropriate. In addition, while the Guideline's emphasis is on projects, the need to locate biodiversity impacts in a broader landscape highlighted the lack of strategic conservation planning, Strategic Environmental Assessments and spatial prioritization of areas for protection. The latter would provide a valuable 'higher-level' framework into which projects and offsets should slot, both to enable better 'avoidance/ prevention' of unique or irreplaceable areas, but also to guide offsets to sites where they could make the best contribution to wider landscape-scale conservation targets.

The Guideline was prepared for use by companies in the energy sector. It aims to support the stated objectives of the NSEP, by striving to increase the ecological and social responsibilities of businesses,

and involve the business community in activities aimed at conservation and sustainable use of biodiversity. It makes the case for 'compensation in nature' for ecological damage rather than payments to the state. While legislative reform to incorporate 'in kind' compensation could take time, other business and 'good practice' drivers exist to encourage this approach. These Guidelines are intended to help companies that need or wish to comply with good practice operate responsibly and contribute to sustainable development. It is hoped that the Guideline will also be used by government authorities and non-government organizations: helping to introduce consistency and rigour in approaches to biodiversity-inclusive EIA in general, and compensation/ offsetting in particular; and to achieving Aichi targets, Sustainable Development Goals and meeting international obligations.

References

Ministry of Natural Resources and Environment of the Russian Federation (MNRE). 2014a. Strategy and Executive Plan for the Conservation of Biodiversity within the Russian Federation. Moscow.

Ministry of Natural Resources and Environment of the Russian Federation (MNRE). 2014b. 5th National report: Conservation of biodiversity in the Russian Federation. Moscow.

Plyusnin V. and Müller B. 2014. Assessment, Compensation and Biodiversity Offsets of Environmental Impacts. The German-Russian Compendium.

UNDP. 2015. Mainstreaming biodiversity conservation into Russia's energy sector policies and operations.

Warner R, Simonov E and Gibson D. 2002. Biodiversity Assessment for Russia. Chemonics International, Washington DC. USA.

Scenarios-based risk model for shale gas scientific assessment

G. Schreiner[1], L. Snyman-Van der Walt[1], D. Fischer[2] and L. Cape[1]
[1]Council for Scientific and Industrial Research, Stellenbosch, South Africa.
[2]National Department of Environmental Affairs, Pretoria, South Africa.
Corresponding author: Lydia Cape, Tel.: +27 21 888 2429, Email: lcape@csir.co.za

Abstract

The shale gas Strategic Environmental Assessment (SEA), compiled by over 200 authors and peer reviewers from around the world, was the largest assessment of its kind undertaken in South Africa. Seventeen topics were assessed across four scenarios providing temporal and spatial scales following a rigorous risk assessment approach. The sensitivity of spatially explicit receiving environments in the Central Karoo region of South Africa were classified and mapped to enable the assessment of risks per sensitivity class, with- and without mitigation, across the four scenarios. The risk profiles were determined by taking into account the consequence and the likelihood of an impact, with topic consequence terms calibrated to ensure consistency through the risk classifications. Finally, a composite spatial overlay was generated to demonstrate the evolution of the risk profile across the four scenarios for the full life-cycle of proposed shale gas development activities.

Introduction

Exploration and production of shale gas (collectively called "development") in the Central Karoo region of South Africa remains a contested issue, due in part, to uncertainty regarding the distribution and magnitude of the gas reserves (Burns et al., 2016) coupled with the potential social, economic and ecological consequences associated with a domestic gas industry (de Wit, 2011). The Strategic Environmental Assessment (SEA) for Shale Gas Development in South Africa was commissioned by the Republic of South Africa in February 2015 under the leadership of the Department of Environmental Affairs. The purpose of the SEA is to provide an integrated assessment and decision-making framework to enable the establishment of effective policy, legislation and sustainability conditions under which shale gas development could occur. During the SEA, a 'scientific assessment' was conducted by 146 experts covering seventeen topics including: geophysics, water resources, terrestrial biodiversity, air quality, social fabric, visual and noise, heritage resources, agriculture, tourism, waste management, infrastructure planning, energy planning and economics[1] within a 171 811 km^2 study area (Figure 1). A scenario-based risk assessment combined with spatial modelling was followed during the assessment to provide an integrated 'picture' of cumulative risk over the extent of the study area and temporal range of the scenarios. The assessment was peer reviewed by 25 local and 46 international independent review experts and by a large number of stakeholders involved in the process.

[1] see http://seasgd.csir.co.za/scientific-assessment-chapters/

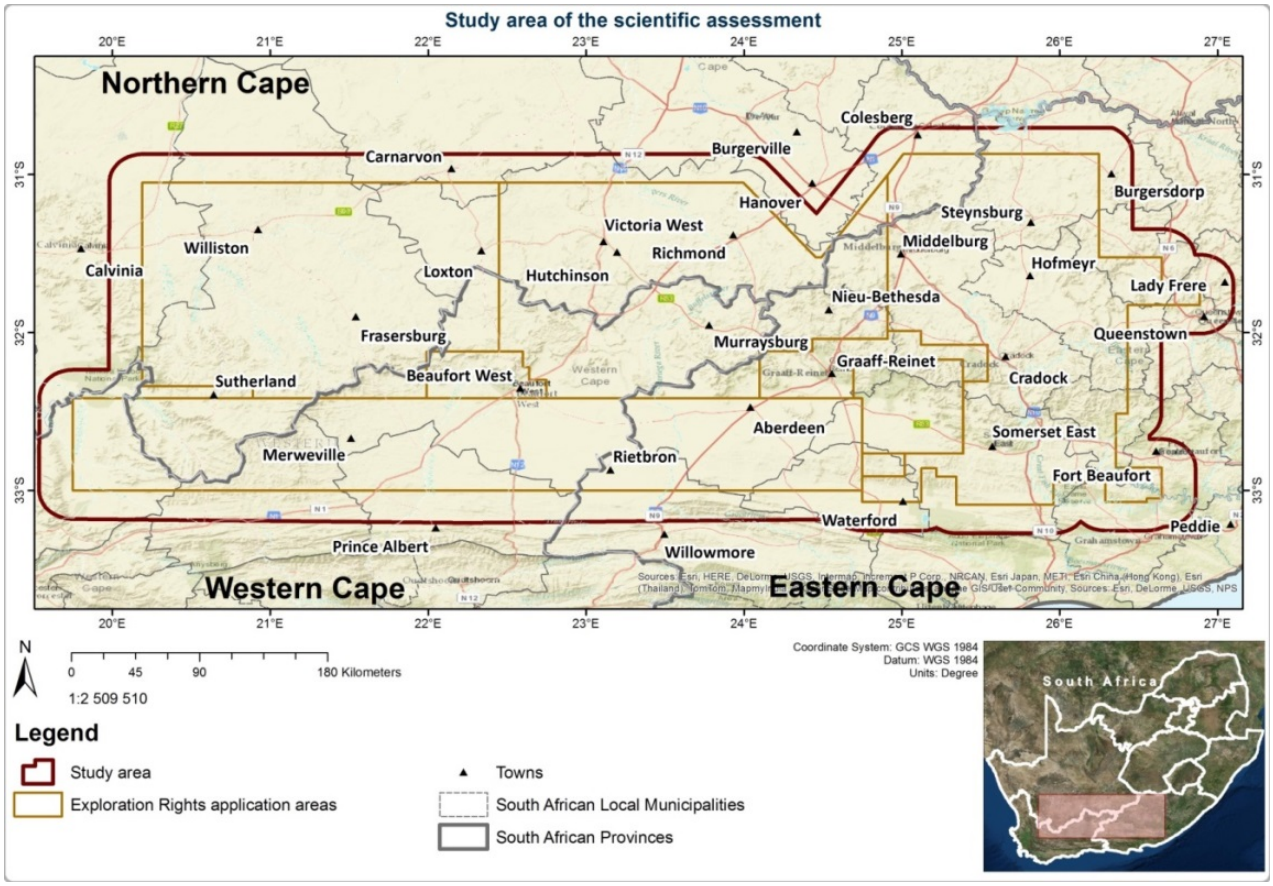


Figure 1: Scientific assessment study area delimited by current applications for shale gas exploration rights plus a 20 km buffer (Source: Scholes et al., 2016).

Methodology

1. Scenario development

Scenarios originate on the assumption that the future is fundamentally unpredictable (van der Heijen, 2000) but acknowledge that complexity and uncertainty can be reduced to within logical parameters (Ash et al., 2010). As such, scenarios provide the qualitative and quantitative information from which an assessment of future activities can be made across a range of spatial and temporal scales. The scenarios were developed in an iterative manner based on the identification of major concerns (nominal risk associated with increasing shale gas development activities in the sensitive receiving environment of the Central Karoo) and the determination of major uncertainties (volumes of economically recoverable gas reserves). Through a collaborative process of expert engagement workshops consisting of more than 60 experts from the oil- and gas industry, petroleum geologists, engineers, energy planners; and natural- and social scientists, three cumulative scenarios were generated in relation to a dynamic Reference Case[2] where no shale gas development occurs but regional trends continue on observed trajectories (Table 1).

[2] A reference scenario is usually a plausible and relatively nonthreatening scenario, featuring no surprising changes to the current environment and continued stable growth (Ash et al., 2010).

Table 1: Summary of the scenarios

Reference Case scenario (S0)	No shale gas development.
Exploration Only scenario (S1)	Results from exploration indicate that production is not economically viable. All sites are rehabilitated, drilled wells permanently plugged and monitoring of the abandoned wells implemented. National energy supply in South Africa is supported by imported natural gas either via pipeline or from Liquefied Natural Gas importation.
Small Gas scenario (S2)	Results from exploration indicate relatively small, but economically viable, shale gas resource. Approximately 5 trillion cubic feet (tcf) of gas is produced from 550 wells on about 55 wellpads in one 30 x 30 km production block. Downstream development results in a 1 000 megawatt (MW) combined cycle gas turbine power station located less than 100 km from the production block.
Big Gas scenario (S3)	A relatively large shale gas discovery of 20 tcf is made, produced from 4100 wells on about 410 wellpads distributed across four production blocks. Downstream development results in the construction of two CCGT power stations (each with a generation capacity of 2 000 MW) and a gas-to-liquid plant located at the coast with a refining capacity of 65 000 barrels per day.

2. Risk assessment

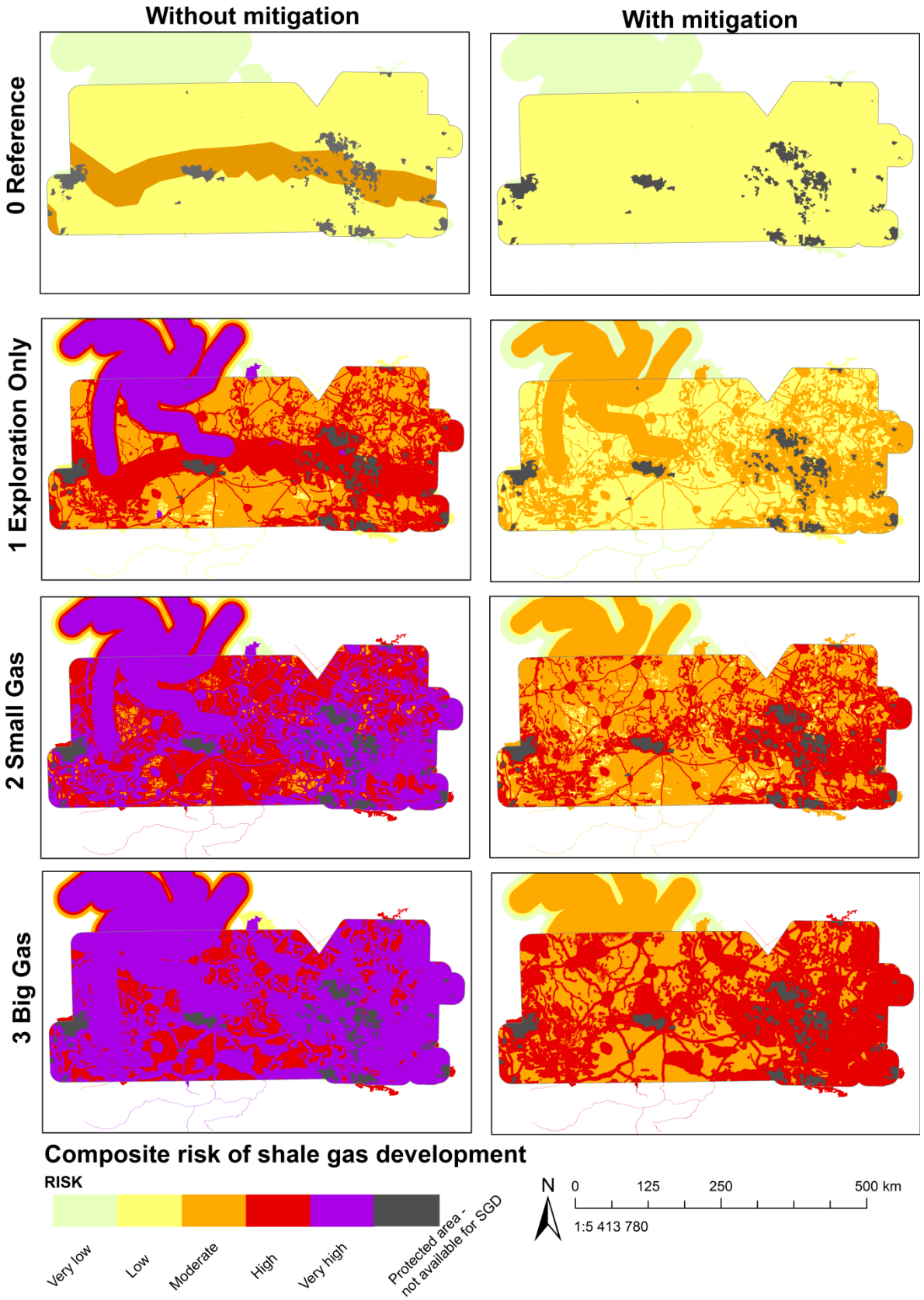
The risk assessment approach was developed based on the Fifth Assessment Report (AR5) of the United Nations Intergovernmental Panel on Climate Change (IPCC) which defines risk as "the probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur" (IPCC, 2014). Risk was determined by estimating the likelihood of events or trends occurring, in relation to their consequences (Risk= likelihood x consequence, ranging from very low to very high risk). Consequences were calibrated for each topic based on quantitative and qualitative descriptions of the consequence terms ranging from slight to extreme, which ensured consistency in the manner risks were measured, enabling integration across different topics, and providing a common conceptual and spatial understanding of risks (Table 2). Risks were assessed with- and without mitigation, across the four scenarios (S0, S1, S2 and S3). 'Without mitigation' assumed inadequate governance capacity, weak decision-making and non-compliance with regulatory requirements. 'With mitigation' assumed effective implementation of best practice principles, adequate governance and responsible decision-making. The assessment of the four scenarios, both with- and without mitigation led to increased scenario variance and provides decision-makers with practical estimation of the importance of strong governance and institutional functionality.

Table 2: Risk assessment classes (Source: Scholes et al., 2016).

Risk category	Definition
Very low risk	Extremely unlikely (<1 chance in 10 000 of having a consequence of any discernible magnitude); or if more likely than this, then the negative impact is noticeable but slight, i.e. although discernibly beyond the mean experienced in the absence of the impact, it is well within the tolerance or adaptive capacity of the receiving environment (for instance, within the range experienced naturally, or less than 10%); or is transient (< 1 year for near-full recovery).
Low risk	Very unlikely (<1 chance in 100 of having a more than moderate consequence); or if more likely than this, then the impact is of moderate consequence because of one or more of the following considerations: it is highly limited in extent (<1% of the area exposed to the hazard is affected); or short in duration (<3 years), or with low effect on resources or attributes (<25% reduction in species population, resource or attribute utility).
Moderate risk	Not unlikely (1:100 to 1:20 of having a moderate or greater consequence); or if more likely than this, then the consequences are substantial but less than severe, because although an important resource or attribute is impacted, the effect is well below the limit of acceptable change, or lasts for a duration of less than 3 years, or the affected resource or attribute has an equally acceptable and un-impacted substitute.
High risk	Greater than 1 in 20 chance of having a severe consequence (approaching the limit of acceptable change) that persists for >3 years, for a resource or attribute where there may be an affordable and accessible substitute, but which is less acceptable.
Very high risk	Greater than even (1:1) chance of having an extremely negative and very persistent consequence (lasting more than 30 years); greater than the limit of acceptable change, for an important resource or attribute for which there is no acceptable alternative.

3. Risk modelling

An integrated risk model was developed, per scenario with- and without mitigation, based on the allocation of sensitivity ratings to geographically distinguishable receiving environments and the determination of risk profiles for these sensitive areas of the receiving environment. Spatially explicit risk profiles were then overlayed and depicted using the 'maximum rule' to prioritise the highest risk areas over those of lower risk (Figure 2). The risk model aims to demonstrate the evolution of the risk profile across the four scenarios for the full life-cycle of shale gas development activities and to test the efficacy of proposed mitigation actions in reducing risks.



<u>Figure 2:</u> Composite map of spatially explicit risk profiles within the study area, depicting the risk of shale gas development across four scenarios without-and with mitigation (Scholes et al.,).

Results and Discussion

The risk model presents a mosaic of cumulative risk, evolving across the scenarios. Risks range from low to very high in the study area, with higher risk areas prevalent towards the eastern portion of the study area. This may be attributed to more variable landscape features which are characterised by a denser distribution of towns, more diverse habitats and a greater concentration of protected and sensitive areas, higher agricultural production potential and an increased concentration of scenic resources and landscapes. Through effective project planning, many of sensitive features of the Central Karoo can be avoided. This includes high sensitivity water resources, biodiversity resources, high sensitivity agricultural land, heritage features, important tourism areas or routes, vulnerable people living in towns or rural communities, high sensitivity visual resources and the footprint of the South African mid-frequency array of the Square Kilometre Array Phase 1 project[3]. Without mitigation, the risks associated with shale gas development from S1 to S3 increase incrementally from moderate-very high to high-very high. Effective implementation of mitigation and best practice principles may reduce the risk profile to low-moderate for S1, and overall moderate-high for S2 and S3 scenarios. At the strategic-level of assessment, the risks associated with S1 could be mitigated to low-moderate. Best practice mitigation is reliant on the veracity of the future decision-making processes which should be guided by evidence-based policies, robust regulatory frameworks and capacitated institutions in a manner that is ethical, responsible and transparent. Most of the features mapped at the scale of this assessment would require additional project-level assessment processes for specific development applications, where the exact nature, location and extent of shale gas development activities are clearly defined, in order to ground-truth features on-site. South Africa is in the advantageous position of being able to accumulate a broad baseline dataset and start building or supporting the institutions capable of collecting, managing and analysing that data in a responsible manner. Decisions regarding shale gas development should be considered in a 'step-wise' manner with baseline and on-going monitoring data repeatedly collected and fed back into the evidentiary base to critically test decisions, the efficacy of management actions and scientific assumptions.

Acknowledgments

The authors would like to acknowledge the experts and peer reviewers responsible for the development of scientific material leading to the finalisation of the South African SEA. Funding was provided by the national Department of Environmental Affairs who led the process from within government. The project leaders, Professor Bob Scholes from the University of the Witwatersrand and Paul Lochner from CSIR were instrumental in designing and executing the scope of work described here.

References

Alcamo, J., and T. Henrichs. 2008. Towards guidelines for environmental scenario analysis. In Environmental futures: The practice of environmental scenario analysis, ed. J. Alcamo. Oxford: Elsevier.

Ash, N., Blanco, H., Brown, C., Garcia, K., Henrichs, T., Lucas, N., Ruadsepp-Heane, C., Simpson, R.D., Scholes, R., Tomich, T., Vira, B. and Zurek, M. (*Eds*.). 2010. Ecosystem and human well-being: A Manual for Assessment Practitioners. Island Press, United States of America.

Börjeson, L., M. Höjer, K. Dreborg, T. Ekvall, and G. Finnveden. 2006. Scenario types and techniques: Towards a user's guide. Futures 38 (7): 723–39.

[3] The final phase of the SKA project is currently a high level concept and a detailed description is not available in the public domain. Conservative buffers were provided in order to map potential sensitivities resulting of the future phase of the SKA development in the Karoo region of South Africa.

Burns, M., Atkinson, D., Barker, O., Davis, C., Day, L., Dunlop, A., Esterhuyse, S., Hobbs, P., McLachlan, I., Neethling, H., Rossouw, N., Todd, S., Snyman-Van der Walt, L., Van Huyssteen, E., Adams, S., de Jager, M., Mowzer, Z. and Scholes, B. 2016. Scenarios and Activities. In Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR. Available at http://seasgd.csir.co.za/scientific-assessment-chapters/

Department of Energy (DoE), 2016. Gas To Power Programme. *Gas Utilisation Master Plan (GUMP)*. Available at: https://www.ipp-gas.co.za/ [Accessed April 5, 2016].

De Wit, M.J. (2011). The great shale debate in the Karoo. South African Journal of Science 107(7/8). Commentary.

IPBES (2016): Summary for policymakers of the methodological assessment of scenarios and models of biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. S. Ferrier, K. N. Ninan, P. Leadley, R. Alkemade, L.A. Acosta, H. R. Akçakaya, L. Brotons, W. Cheung, V. Christensen, K. A. Harhash, J. Kabubo-Mariara, C. Lundquist, M. Obersteiner, H. Pereira, G. Peterson, R. Pichs-Madruga, N. H. Ravindranath, C. Rondinini, B. Wintle (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 32 pages.

IPCC, 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.

Ramasar, V and Patrick, M. (2007). Scenarios – Alternate Futures. In CSIR.2007. Enhancing the effectiveness of SEA. CSIR Report CSIR/NRE/RBSD/EXP/2007/0068, pp 21-27

Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR. Available at http://seasgd.csir.co.za/scientific-assessment-chapters/

Title: Using resilience to offset cumulative impacts

Abstract ID#617 Session #93

Author: *Ruari Carthew, Senior Environmental Assessment Officer*
Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT, Canada.

Introduction

Four major diamond mines operate in Canada's Northwest Territories. Since diamond mining began in 1998, the region has seen a significant drop in caribou populations and corresponding impacts on Indigenous communities. The Mackenzie Valley Environmental Impact Review Board (Review Board) commenced an environmental assessment (EA) of a diamond mine expansion project in November 2013 and issued its reasons for decision in February 2016.

A key issue in the environmental assessment was the cumulative impacts on caribou and indigenous communities arising from nearly two decades of mining. The Review Board found these impacts to be significant. As per their mandate, the Review Board had three options: to reject the project; to impose binding mitigation measures ensuring the impacts are no longer significant; or to refer the project for further environmental impact review. The Review Board decided that the project's likely significant impacts could be mitigated through appropriate measures, including those intended to build resilience for both caribou and local Indigenous communities. The measures were designed to improve the well-being of the herd and that of affected communities, and to offset any project-specific impacts that could occur.

This article discusses how resilience theory contributed to the understanding of adverse effects and influenced the design of mitigation measures to protect and preserve the well-being of caribou and affected Indigenous communities.

Description of the proposed mine expansion

The Jay Project (the Project) is an expansion of the existing Ekati diamond mine, located 300 km northeast of Yellowknife, in the Northwest Territories, Canada. The Ekati mine has been in operation since 1998 and consists of multiple open pits, waste rock piles and roads. In 2013, the mine owners proposed a new open pit mine 30 km away from the main Ekati mine site in order to continue supplying the mill with diamond-bearing ore. The Project includes the construction of a new road to the Jay open pit and continued use of an existing access road to transport ore to the main Ekati site. The Project will extend the life of the Ekati mine by ten years or more.

Summary of the Board's findings

The Review Board assesses impacts on the environment based on both written evidence on the public record and from testimony presented during public hearings

in affected communities. The Review Board is guided by the *Mackenzie Valley Resource Management Act* (MVRMA), which defines **'impact on the environment'** as "any effect on land, water, air or any other component of the environment, as well as on wildlife harvesting, and **includes any effect on the social and cultural environment or on heritage resources**" (Canada 2017). In its February 2016 *Report of Environmental Assessment and Reasons for Decision (REA),* the Review Board determined that the Project is likely to cause significant adverse project-specific and cumulative impacts to the environment. Regarding the latter, the Board concluded that several valued components (VCs) were already significantly adversely affected, and could not tolerate additional stress or cumulative effects without substantial risk. In resilience theory, these VCs could be thought of as having surpassed an acceptable level of change and existing on the cusp of a threshold shift; any additional project-related effect had the potential of causing an irreversible change to these VCs.

The valued components in question were: the habitat and health of the Bathurst caribou herd (*Rangifer tarandus groenlandicus*); the well-being and traditional way of life of affected Indigenous groups; and the health and well-being of communities, families and individuals in diamond mining communities.

The diamond mines are located within one of the Bathurst caribou herd's key migration corridors. Since the discovery of diamonds in the region, the herd population has declined over 95%, from a census high of 460,000 animals in the 1980s to a low of 16,000 -22,000 animals in 2015. Numerous factors likely contribute to this decline, such as climate change, harvesting pressure, successive difficult winters and habitat disturbance from forest fires and industrial development. However, the scientific and traditional knowledge remained uncertain over the main driver(s) behind the herd's decline. In an attempt to estimate its contribution to the overall decline, the proponent estimated a 15km zone of influence around the diamond mine, within which caribou are considered disturbed by mining-related activities. While the proponent had proposed mitigations, it was not likely that all impacts to caribou could be avoided. Meanwhile, the expansion of the mine would extend the area and duration of habitat disturbance on the Bathurst caribou.

Regarding the well-being and traditional way of life of Indigenous groups, the Project is both situated in the traditional territory of several Indigenous groups and has the potential to affect environmental components that multiple Indigenous groups depend on. The following Indigenous groups were considered affected by the Project: the Deninu Kue First Nation, the Kitikmeot Inuit Association, Lutsel K'e Dene First Nation, North Slave Métis Alliance, Tłı̨chǫ Government, and Yellowknives Dene First Nation. The well-being and cultural identity of the affected Indigenous groups are inextricably linked to caribou. As a migratory animal, numerous Indigenous groups and communities rely on the Bathurst caribou herd for physical, economical, cultural, and spiritual sustenance. The declining health of the herd has had a profound impact on these groups. The Review Board heard from Aboriginal groups that their cultural well-being and way of life are threatened by: the transition

to a wage economy, reduced time on the land, less practice of a traditional way of life, reduced use of their native language, and reduced transmission of culture between generations. Moreover, Indigenous groups stated that the diamond mining industry has contributed significantly to those challenges since it began in 1998. They argued that the Project would extend the life of the Ekati mine by an additional decade, likely adding to and prolonging these impacts on cultural well-being.

Similarly, the health and well-being of communities, families and individuals in communities directly affected by diamond mining was also seen to have declined in several areas (e.g. number of single parent families, violent crimes, potential years of lost life, number of sexually transmitted diseases, number of houses in core need, etc.). Annual reporting on the health and well-being suggested that these indicators had all worsened during the time of diamond mining and were continuing to decline. The existing impacts to health and well-being were acknowledged as significant by communities and the proponent, particularly to the most vulnerable members in the communities, which included women, elders, youth and those unable to benefit from employment opportunities. Concern was expressed over how much additional stress these communities could take before a large social change occurred. The Project would likely add to these impacts and continue the worsening trends.

Mitigating cumulative impacts

The Review Board was faced with determining whether the Project could proceed without adding to existing significant impacts; could the Project go ahead without making the cumulative impacts worse? The proponent had made numerous commitments during the EA to reduce impacts to VCs and had included industry best practices within their project design. Despite these mitigations, the Review Board concluded they were not adequate to reduce the impacts to an acceptable level. Moreover, the Review Board did not consider the Project's economic benefits sufficient to offset the significant adverse impacts to the Bathurst caribou or affected Indigenous communities.

The Review Board assessed how diamond mining had already impacted VCs and affected cumulative impacts. They then considered how this understanding was reflected in management decisions – both by the mining sector and by responsible government agencies. The Review Board found much uncertainty around the link and magnitude of impacts from diamond mining to VCs. Past efforts to improve those understandings did not appear proportionate or effective; the feedback mechanisms to measure effects on these VCs and improve upon mitigation measures were not operating as intended.

In reviewing the evidence, the Review Board determined that significant cumulative impacts could be addressed through the imposition of appropriate mitigation measures. The mitigation measures address the perceived knowledge gaps and superimpose a strict adaptive management approach for both the proponent and responsible regulatory authorities to follow. These measures serve to improve the underlying mechanisms to understand and reduce the social and environmental

impacts of diamond mining in general and the Project specifically. Additional offsets were recommended to counter project-specific impacts that might occur to each affected VC. Table 1 outlines and summarizes the mitigation themes used to address significant baseline cumulative impacts. The themes are grouped around the following resilience strategies: addressing uncertainty, promoting adaptive management, and strengthening (offsetting) external system components.

The Review Board believes that the mitigation measures recommended in their REA report will allow for the Project to proceed in a responsible manner that respects the environment and local communities. The measures the Board developed had a specific focus on building the resilience of the valued components at a regional scale. The measures looked beyond the immediate impacts of the Project to see if improvements to health or well-being could be achieved in novel or creative ways. In some cases this resulted in efforts to reduce known stressors. In other cases it meant expanding the knowledge base in decision-making through local expert involvement or building on existing strengths to offset project-related losses.

Collectively, these measures serve to:

- reduce adverse social impacts of diamond mining on affected communities
- reduce barriers to employment for women
- identify causal links between diamond mining and social concerns
- improve accountability on the use of Traditional Knowledge in decision-making
- identify and reduce cultural impacts through improved engagement and reporting
- lessen the cumulative challenges faced by diamond mining communities and affected Aboriginal groups through an improved adaptive management process

Through these measures, the Review Board was able to address significant baseline cumulative impacts by recognizing and addressing underlying issues of uncertainty, promoting adaptive management, and offsetting local impacts by reducing vulnerabilities elsewhere.

Considering Project and cumulative impacts from a resilience perspective enabled the development of measures to reduce overall significance and contribute to a more acceptable project. The Review Board looks forward to following the effectiveness of these measures as they are implemented and learning from them for future EA consideration.

Table 1. Mitigation measures to address baseline significant cumulative impacts, organized by resilience building strategy, mostly directed to the proponent.

Resilience strategy	Mitigation measures
Reducing uncertainty by increasing knowledge and modes of knowing	Incorporating a traditional knowledge (TK) based caribou monitoring and mitigation in project design and operations, including the formation of an Elders advisory group.
	Development of a TK management framework to improve management and implementation of TK, to ensure appropriate consideration and improve transparency over TK use in decision-making.
	Engagement with Indigenous groups on cultural impacts to ensure they are identified before an issue arises and that appropriate management actions/mitigations are put in place.
Strengthening system components by offsetting mitigation measures	Enhanced caribou mitigation at other locations (Ekati mine) to ensure no new impacts to the herd.
	Formation of a culture camp to reduce the risk that Indigenous use of the land, connection to the land and knowledge of the land will not fade over the course of the Project and diamond mining.
	Reducing vulnerability in affected communities by actively reducing barriers to employment for women.
Improving and building robust adaptive management	Requirement of the Government of the Northwest Territories (GNWT) for the timely completion of caribou management plans to mitigate cumulative impacts of development and human activities.
	GNWT will actively investigate and address the linkages between diamond mining and community health and well-being, including annual engagements, discussions and reporting on initiatives and problem solving.
	GNWT will actively investigate and address the linkages between diamond mining and community health and well-being, including annual engagements, discussions and reporting with communities.
	Establishing objectives for monitoring and adaptive management that must be fulfilled by the proponent.
	Annual reporting from both the proponent and GNWT on the implementation of the full suite of EA measures.

References

Dominion Diamond Ekati Corporation (DDEC). 2015. Jay Project Developer's Assessment Report Information Request Responses – Appendix D. April 2015, p. 1. Available online at: http://reviewboard.ca/upload/project_document/EA1314-01_App_D_Post_Closure_Caribou_Habitat_IR_responses_Dominion_7_April_2015.PDF

Government of Canada (Canada). 2017. Mackenzie Valley Resource Management Act. Justice Laws Website. Available online at: http://laws-lois.justice.gc.ca/eng/acts/m-0.2/index.html

Government of the Northwest Territories (GNWT). 2015. Communities and Diamonds: 2014 Annual Report of the Government of the Northwest Territories under the Ekati, Diavik and Snap Lake Socio-Economic Agreements. Available online at: http://reviewboard.ca/upload/project_document/EA1314-01_Communities_and_diamonds_2014_annual_report.PDF

Mackenzie Valley Review Board (MVEIRB). 2016. Report of Environmental Assessment and Reasons for Decision, Jay Project. February 1, 2016, pi-iii

Water quality and Health Risk Assessment on Arsenic and Manganese Exposure of Community Located in the Border Adjoining Phichit, Phetchabun and Phitsanulok Provinces, Thailand

Sukanda Pudpadee, Panita Charoensuk*, Chanajit Panou,Lamai Chaingam
Health Impact Assessment Division, Department of Health, Thailand
*n_atom90@hotmail.com

Abstract

This cross-sectional study research aimed to determine water consumption sources and assess the risk of manganese and arsenic exposure due to consumption of well water and village water supply in a community located in the border adjoining Phichit, Phetchabun and Phitsanulok Provinces in Thailand. Interviews of 314 households on their water consumption behavior were conducted. Additionally, the water from 18 wells and 49 village water supplies were analyzed for a suite of water quality parameters.

The studied found that there were approximately 5% and 6% of households using well water for cooking and water supply for drinking purpose respectively. The concentration of heavy metals, namely Cr, Cd, As and Hg in well water were not found while As was found below the drinking water standard in village tap water samples. The concentrations of manganese in well water and village water supplies varied from 0.002 to 2.64 mg/l and from 0.002 to 1.12 mg/l respectively.

Health risk assessments of manganese and arsenic exposure were performed at an intake rate dictated by water sampling (i.e., at 97.5 percentile). Health risk associated with manganese exposure was determined to be at acceptable levels. In addition, the average skin cancer risk attributable to tap water consumption for drinking purpose in the age group 3 years did not exceed the acceptable level of 1 in 1,000,000. However the maintenance of village water supply system is recommended.

1. Introduction

Trace metals in a water supply, such as arsenic, cadmium, chromium, manganese, and mercury, may occur naturally (e.g., from weathering of rocks, soils) or may be the result of contamination attributable to human activities. Inorganic arsenic is known to be highly toxic to humans while organic compound are less toxic to human health (ATSDR, 2007). Long-term inorganic arsenic exposure via drinking water is known to cause skin cancer. In addition, longer oral exposure has also been associated with adverse reproductive outcomes and increased risk of cancer in the liver, bladder, and lungs (ATSDR, 2007; Kim Yoon-J; Smith et.al., 1992).

Manganese is a naturally occurring element and is known as an essential nutrient. Several enzyme catalytic system and cell functions depend on manganese availability (ATSDR, 2012), as does the formation cartilage and bone. In addition, manganese is required for the maintenance of mitochondria and the production of glucose. Epidemiological studies both in children and the elderly have found that extremely high levels of manganese exposure may lead to neurological and brain development effects (ATSDR, 2012; U.S.EPA, 2004).

According to the Department of Health drinking water surveillance report which the water supply and well water quality in 8 villages for an area of Tambon Tabklor, Phitjit province has been sampling and analyzed annually between 2011 and 2014 (Department of Health,2014), it was found that manganese levels in the village water supply and well water, exceeded the drinking water standard. In addition, at an adjoined area of Phichit,Phetchaboon and Phitsanuloke provinces, a 16-year gold mining located 0.6 kilometers from a village where manganese and arsenic levels in surface water monitoring wells exceeded the standards at some stations.The objective of this study are to determine water consumption sources and to determine health risk from arsenic and manganese exposure in well water and tap water in a community located on the border adjoining Phichit, Phetchabun and Phitsanulok Provinces,Thailand.

2. Material and methods

The present study focused on the potential area of gold mineralization, 24 villages, at the adjoined area of three provinces. It's approximately 5- 10 km from an open-pit mine where the ground and surface water move through. In addition, manganese and arsenic exposure were found in the villager were found.

2.1 Source of drinking water determination

An interview was conducted to identify community sources of drinking water among the villager. Ten percent of all households in the 24 villages were randomly selected (400 out of 3,981 households).The structure of the questionnaire included detailed questions on drinking and cooking water sources.

2.2 Sampling and analytical of heavy metals in drinking water

With respect to water quality sampling, all village water supplies and water wells used for drinking purpose across the 24 villages were assessed. Samples were collected on two occasions (summer and raining season) – once in March and September 2016. In total,water samples from 49 tap water stations and 67 wells were collected. Samples were analyzed for arsenic, , following the Standard Method for the examination of water and wastewater (APHA,AWWA,WEF, 2012).

2.3 Health risk assessment

In this step of the study, information was analyzed to determine whether heavy metal results may cause adverse effects following exposure to a risk source. Manganese and arsenic exposure assessment and risk characterization were assessed by following the United States Environmental Protection Agency guidance (U.S.EPA.1989a, 2001). The most common measureis are the chronic daily intake (CDI). Risk characterization of noncancer effects due to manganese and arsenic exposure were then evaluated by comparing an exposure level (CDI) with toxicity value (RfC) which were expressed in term of hazard quotient (HQ). If the calculated HQ is equal or less than 1, noncancer adverse effects due to drinking water pathway is assumed to be negligible. For the risk estimated of an individual developing cancer over a life time due to inorganic arsenic exposure is expressed as cancer risk (CR) which accepted in the range of $1x10^{-4}$ to $1x10^{-6}$.

Drinking water exposure and risk equations used in this study, were calculated as follows:

Exposure assessment: $$CDI = \frac{C \times IR \times EF \times ED}{BW \times AT} \quad (1)$$

Cancer risk assessment: $$Risk = CDI \times CSF \quad (2)$$

Noncancer risk assessment: $$HQ = \frac{CDI}{RfC} \quad (3)$$

Where: CDI is the chronic daily intake of arsenic and manganese (mg/kg-day); C is the concentration of inorganic arsenic and manganese in tap water or well water (mg/L).; IR is the ingestion rate (L/day); EF is the exposure frequency (days/year); ED is the exposure duration (years); BW is the body weight (Kg); AT is the averaging time, (equal to ED x 365 days/year for noncarcinogen and 70 years x 365 day/years for carcinogen); CSF is the cancer slope factor for inorganic arsenic $(mg/kg\text{-}day)^{-1}$; RfC is the reference concentration for the manganese and inorganic arsenic for assessing noncancer health effects (mg/kg-

day). Total arsenic concentration in water samples was assumed to be inorganic arsenic and 100% absorption. In the same manner, manganese concentration in water samples was assumed 100% absorption.

Arsenic and manganese exposure and risk characterization for eight different age groups were calculated in the study, and included0 to 3 year, 3 to 6 year, 6 to 9 year, 9 to16 year, 16 to 19 year, 19 to 35 year, 35 to 65 year and >65 year categories. Exposure parameters were obtained from a national study of food consumption data which was conducted by the National Bureau of Agricultural Commodity and Food Standards (ACFS, 2006), Thailand.

Health risk was determined under a worst case scenario of exposure where 97.5th percentile of drinking water consumption in different age groups and 97.5 th percentile of manganese and arsenic concentration were used.

3. Results

3.1 The community source of drinking water

Of the households randomly targeted with surveys, 314 were successfully interviewed (7.8 percent of total household). Table 1 confirms that most of the households in the community used bottled water, rain water and tap water for drinking purpose at percentages of the total approximately 65%, 14% and 6 % respectively. These data also indicate that bottled water, tap water, rain water and well water are the dominant sources of cooking water with reported percentages of use roughly 39%, 29%, 11%,and 5.1% respectively.

Table 1 Source of drinking water in the community

Source of Drinking Water		Number (Percentage)							
		Bottled Water	Rain Water	Bottled and Rain Water	Tap water	Tap and Bottled Water	Well	Tap and Rain Water	Others
Drinking	n	205	43	26	19	0	0	0	21
	%	(65.3)	(13.7)	(8.3)	(6.1)				(6.7)
Cooking	n	123	35	6	90	23	16	15	6
	%	(39)	(11)	(1.9)	(29)	(7.3)	(5.1)	(4.8)	(1.9)

3.2 Heavy metal concentrations

Water samples from 49 tap water stations and 67 water wells were collected and analyzed for manganese, chromium, cadmium, arsenic, and mercury concentrations in March and September 2016. The concentrations of chromium, cadmium, and mercury were not found in both tap and well water. The mean, minimum, maximum, and 97.5th percentile of manganese and arsenic were evaluated and showed in table 2.

Table 2 Metals concentration in drinking water

Metals	Tap Water (n=49)			Well Water (n = 67)		
	Mean (mg/L)	Min-Max (mg/L)	97.5th percentile	Mean (mg/L)	Min-Max (mg/L)	97.5th percentile
Manganese	0.16	0.0015-1.124	0.973	0.43	0.002-2.64	2.30
Chromium	ND	ND	-	ND	ND	-
Cadmium	ND	ND	-	ND	ND	-
Arsenic	0.006	0.005-0.007	0.007	ND	ND	-
Mercury	ND	ND	-	ND	ND	-

ND= not detected

3.3 Exposure and Health Risk Evaluation

Exposure parameters used in this study are shown in Table 3.The 97.5th percentile manganese and arsenic concentration measured in tap water and well water were used to estimate risk. The study assumed total arsenic concentrations returned by water samples occurred as inorganic arsenic. Intake rates (IR) for the risk evaluation were 97.5th percentile values per national intake rate and ranged from 0.78 to 2.1 L/dayfor the eight age groups considered. In addition, exposure duration and body weight were range from 3 to 31 years and 10-60 kilograms respectively.

Table 3 Exposure parameter used in risk analysis

Variables	Values	Units	References
Concentration of Mn in tap water	0.973	mg/L	This study
Concentration of Mn in well water	2.3	mg/L	This study
Concentration of Inorganic As in tap water	0.007	mg/L	This study
IR	0 to 3 year =0.781 3to6year =1.1 6to9year =1.2 9to16year =1.6 16to19year =1.8 19to35year =2.05 35to65year =2.1 >65 year =1.9	L/day	ACFS,2006
EF	365	day/year	(U.S.EPA.1989a, 2001)
ED	0to3year = 3 3 to 6year =3 6to9year = 3 9 to16year =7 16to19year = 3 19 to35year =16 35to60year = 31 >65 year =5	year	Constance
BW	0to3year =10 3to6year =17.1 6to9year =22.8 9to16year =39.73 16to19 year =53.23 19to35year =58.28 35 to 65 year =60.37 >65 year =54.53	Kg	(ACFS, 2006)
AT	EDx365	Year	(U.S.EPA.1989a, 2001)
RfC (Mn)	0.14	mg/kg-day	(U.S.EPA.IRIS, 1988)
RfC (Inorganic As)	0.0003	mg/kg-day	(U.S.EPA.IRIS, 1988)
CSF (Inorganic As)	$5x10^{-8}$	unitless	(U.S.EPA.IRIS, 1988)

3.3.1) Noncancer risk effects - Manganese

The CDI and risk characterizations for manganese via drinking water are reported per age group in Table 4 (manganese). Outputs reported in this table show risk characterization of noncancer effects from exposure to manganese in tap water and well water returned HQ values that were less than 1, a result indicative that adverse effects due to manganese exposure may be assumed acceptable.

Table 4 The outputs of manganese exposure assessment and risk characterization

Results	Non-cancer effects			
	Tap water		Well water	
Age group	CDI (mg/kg-day)	HQ	CDI (mg/kg-day)	HQ
0-3	0.0032	0.02	0.0076	0.05
3-6	0.0027	0.02	0.0063	0.05
6-9	0.0022	0.02	0.0052	0.04
9-16	0.0039	0.03	0.0093	0.07
16-19	0.0014	0.01	0.0033	0.02
19-35	0.0078	0.06	0.0185	0.13
35-65	0.0145	0.10	0.0343	0.24
>65	0.0024	0.02	0.0057	0.04

3.3.2) Non-cancer and Cancer risk effects - Arsenic

The CDI and risk characterizations for arsenic via drinking water are reported per age group in Table 5. Outputs in Table 5 include Non-cancer effects and Cancer effect for this species. Similar to results for manganese (Table 4), risk characterization of noncancer effects from exposure to arsenic in tap water and well water returned HQ values that were less than 1, a result indicative that adverse effects due to arsenic exposure may be assumed acceptable. Also summarized in Table 5, the increased cancer risk (CR) of being exposed to inorganic arsenic by water consumption in different age groups ranged from 5.1 $x10^{-13}$ (16 to 19 yr Age group) to 5.2 10^{-12} (35 to 65 Age group). . The cancer risk computed did not exceed the acceptable of 1 in 1,000,000. In conclusion, risk estimates of both noncancer and cancer effects for arsenic do not exceed the risk level.

Table 5 The outputs of arsenic in tap water exposure assessment and risk characterization

	Non-cancer effects		Cancer effects	
Age group	CDI (mg/kg/day)	HQ	CDI (mg/kg/day)	CR
19-35	0.000056	0.19	0.000056	2.8 $x10^{-12}$
35-65	0.000104	0.35	0.000104	5.2 $x10^{-12}$
>65	0.000017	0.06	0.000017	8.7 $x10^{-13}$

4. Discussion

Among the fourth classified sources, bottled water, rain, and tap constitute a major proportion of main source of drinking water in this area which relatively same as Thailand's source of drinking water (Thaihealth, 2015). Manganese and arsenic concentration may differ between raw water and treated water as well as the depth of water well. The possible health effects associated with a consumption of drinking water containing 2 mg/L of manganese for a life time is concerned (US.EPA 2004).The adverse effects of manganese exposure from drinking water, possibly in concentration of 28 mg/l (WHO,2011). The effective village bottled water production as well as water supply treatment should be maintained for sustain drinking water quality. Water and foods are major potential sources of arsenic exposure. In addition, the greatest exposure to manganese is usually from food (US.EPA2004). Hence ,more research is needed to assess the variation of inorganic arsenic and manganese in different types of food in this area.

6. References

ACFS. (2006). *Food consumption data of Thailand.* Thailand: The national bureau of agricultural commodity and food standards(ACFS).

APHA,AWWA,WEF. (2012). *Standard methods for the examination of water and wastewater* (22nd edition). Washington: American Public Health Association.

ATSDR. (2007). *Toxicological profile for arsenic.* Department of Health and Human Serveices.United States of America.Retrieved 12,2016,from http://www.atsdr.cdc.gov/toxprofiles/tp2.html.

ATSDR. (2012). *Toxicological profile for manganese.* Department of Health and Human Serveices.United States of America.Retrieved 12,2016,from http://www.atsdr.cdc.gov/toxprofiles/tp2.html.

Department of Health. (201). *Drinking water monitoring report.* Thailand.

Kim Yoon-Jae, K. J.-M. (2015). Arsenic toxicity in maale reproduction and development. *Dev.Reprod.*, 19:167-180.

Monisha Jaishankar, T. T. (2014). Toxicity, mechanism and health effects of some heavy metals. *Interdiscip Toxical.*, 60-72.

P.D. Howe, H. M. (2004). *Manganese and its compounds:Enivronmental aspects.* Geneva: World Health Organization.

Smith et.al., A. H. (1992). Cancer risks from aresnic in drinking water. *Environmental Health Perspectives*, 97:259-267.

Thaihealth. (2015). *Health news:Thailand' patients drinking water per year over one million people*. Retrieved February 11, 2017, from Thai Health Promotion Foundation: www.thaihealth.or.th

U.S.EPA. (2004). *Drinking water health advisory for manganese.* Washington,DC.

U.S.EPA.1989a. (2001). *Risk assessment guidance for superfund:Volume III-PartA,Process for conducting probabilistic risk assessment.* Washington.

U.S.EPA.IRIS. (1988, 10 2). *IRIS summary of inorganaic arsenic.* Retrieved November 2016, from Integrate Risk Information System: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0278_summary.pdf

U.S.EPA.IRIS. (1988, 9 26). *Summary document of manganese.* Retrieved 11 2016, from Integrate Risk Information System: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0373_summary.pdf

WHO (2011).Manganese in Drinking-water:Background document for development of WHO Guidelines for Drinking-water Quality

Ecological Mitigation for Drainage Improvement Works in Hong Kong

Mr Wellem Cheng (Environmental Assessment Professional, Environmental Protection Department)
Ms Clara U (Senior Environmental Protection Officer, Environmental Protection Department)
Mr Tony Cheung (Principal Environmental Protection Officer, Environmental Protection Department)

Introduction

The effects of climate change are already being felt in Hong Kong with more frequent extreme rainfall and rising sea-level, making people vulnerable to the related risks. In the past 60 years, the mean sea level in Victoria Harbour rose at a rate of 30 mm per decade. Moreover, the annual total rainfall at Hong Kong Observatory rose at a rate of 31 mm per year and the annual number of heavy rain days (with hourly rainfall >30mm) increased at a rate of 0.3 days per decade. Extreme rainfall events have also become more frequent. The hourly rainfall record at the Hong Kong Observatory was broken several times in the last few decades (e.g. 145.5mm in 2008, 115.1mm in 2006, 109.9mm in 1992), whereas it used to take several decades to break the record in the past (e.g. 108.2mm in 1966, 100.7mm in 1926) (HKO, 2016).

Heavy downpours arising from the extreme rainfall may overload the capacity of drainage systems and cause flooding in the low-lying areas which may threaten citizen's lives and properties. Therefore, the Government identified flood prone black spots in rural areas of the territory and progressively upgrades the drainage system to adapt to looming climate change (DSD, 2016). Nevertheless, the drainage improvement works may involve modification of natural streams, which may have adverse effects on the ecological value and the natural habitats of these streams, if these projects are not governed by the Environmental Impact Assessment (EIA) process.

The Statutory EIA process in Hong Kong

In Hong Kong, drainage works, referring to channel/river training or diversion works with certain width or which discharge near the ecologically sensitive areas (e.g. <300m from conservation area or site of special scientific interest), are required to undergo the statutory EIA process and obtain an environmental permit (EP) before construction and operation, as mandated by the Environmental Impact Assessment Ordinance (EIAO). Through the EIA process, the potential ecological impacts and natural habitats that may be affected by the drainage projects shall be addressed with feasible mitigation measures, according to criteria as stipulated in the Technical Memorandum on the EIA Process.

In Table 1 below, twenty-two drainage improvement projects which have gone through the statutory EIA process are reviewed and the recommended ecological mitigation and enhancement measures are summarized, following the principles of avoidance, minimization, and compensation.

Table 1 Ecological mitigation measures for drainage improvement projects reviewed

Projects	Year obtained EP	Ecological mitigation measures								
		Avoidance		Minimization					Compensation	
		Alternative alignment	Alternative construction method	Divide works in segments	Schedule works in dry season	Standard good site practice	Transplanting rare/ protected flora	Translocating rare/ protected fauna	Compensatory planting	Wetland creation
1. Drainage Works at Mai Po	2014	×	✓	✓	×	✓	×	×	×	×
2. Drainage Improvement Works at Ngong Ping	2013	✓	✓	×	✓	✓	✓	✓	✓	×
3. Drainage Improvements in Southern Lantau	2012	✓	×	✓	✓	✓	×	✓	✓	✓
4. Regulation of Shenzhen River Stage IV	2011	✓	×	×	✓	✓	×	×	✓	×
5. Drainage Diversion Works for the Comprehensive Residential Development at Tai Po Tsai, Sai Kung	2011	×	×	×	✓	✓	×	×	✓	×
6. Drainage Improvement in Big Wave Bay	2010	✓	×	×	✓	✓	×	×	×	×
7. Hang Hau Tsuen Channel at Lau Fau Shan	2009	✓	×	✓	✓	✓	×	×	✓	×
8. Drainage Improvement in Sha Tin and Tai Po	2008	✓	✓	×	✓	✓	✓	×	✓	✓
9. Drainage Improvement in Tsuen Wan and Kwai Chung	2007	✓	×	×	✓	✓	×	×	✓	✓
10. San Tin Eastern Main Drainage Channel	2007	×	×	×	✓	✓	×	×	✓	✓
11. Kam Tin Secondary Drainage Channel KT13	2007	✓	×	✓	✓	✓	×	×	✓	×
12. Drainage Improvement in Northern New Territories - Package C	2006	×	×	✓	✓	✓	×	×	✓	×
13. Drainage Improvement Works in Upper Tai Po River	2005	✓	×	✓	✓	✓	×	✓	✓	×
14. Drainage Improvement in Sai Kung	2005	✓	×	×	✓	✓	✓	×	✓	×
15. Ngong Ping Stream Diversion	2003	✓	×	✓	✓	✓	×	✓	✓	×
16. Pok Wai Drainage Channel	2001	×	×	×	×	✓	×	×	×	×
17. Village Flood Protection for Mai Po Lo Wai and Mai Po San Tsuen	2001	×	×	×	✓	✓	×	×	×	×

18. Shenzhen River Regulation Project Stage III	2000	✓	×	×	×	✓	×	×	✓	✓
19. Yuen Long Bypass Floodway	2000	✓	×	×	×	×	×	×	✓	✓
20. Main Drainage Channels for Yuen Long and Kam Tin, Remainder Phase I	1998	×	×	×	×	✓	×	×	×	×
21. Improvement to Stream Course at Pui O	1998	✓	×	×	✓	×	×	×	×	×
22. Main Drainage Channels for Ngau Tam Mei, Phase 1	1998	×	×	×	×	✓	×	×	×	×
Total no. of respective ecological mitigation/ enhancement measures adopted	**n/a**	**14**	**3**	**7**	**16**	**20**	**3**	**4**	**15**	**6**

Findings and Discussions

The potential ecological impacts and ecological mitigation/enhancement measures for these twenty-two drainage projects are addressed in the EIA process. If not properly mitigated, most of the drainage projects would likely result in loss of stream, wetland or associated riparian habitats (from 0.1 ha to >30 ha) due to channel construction or straightening/widening of existing channels. In addition, some proposed construction works may affect wildlife relying on these habitats, particularly fishes and amphibians of conservation interest such as the globally endangered Romer's Treefrog (*Liuixalus romeri*) and the endemic Hong Kong Newt (*Paramesotriton hongkongensis*) .

During the EIA process, avoidance of impacts is preferred to minimization and then compensation, in line with the mitigation hierarchy. All of these twenty-two projects have considered mitigation in the form of avoidance and minimization first; for example, adjusting channel alignment to avoid loss of wetland habitat or habitat with species of conservation importance. In the drainage improvement works at Ngong Ping, the proposed alignment has been adjusted to avoid two orchid species *Bulbophyllum ambrosia* and *Coelogyne fimbriata*. Alternative construction methods are also considered in some drainage projects. Trenchless method pipe jacking was adopted in the drainage works at Mai Po and Ngong Ping for drainage installation to avoid aboveground works within wetland area and wooded area in Country Park respectively.

Most of the projects also minimize potential water quality and ecological impacts through scheduling works in the dry season with less stream flow and adopting standard good site practices such as enclosure of works areas from the existing stream, and collection of construction runoff. Some projects further divide the works into segments of a certain length and width to minimize the potential water quality impacts to the stream arising from the construction works and to keep the clear flow in the existing streams. For the species of conservation importance that would be affected by the works, these species will be transplanted or

translocated to the suitable receptor site with similar habitat characteristics (for 7 projects involving protected plants and amphibians). For instance, in the drainage works in Tai Po, the locally protected plants Hong Kong Pavetta (*Pavetta hongkongensis*) in the works site were transplanted to the newly created wetland and woodland compensation area. In the drainage improvement works of Lam Tsuen River, pre-construction capture surveys were conducted and endemic Hong Kong Newt and other fauna species in the affected channel section were relocated to upstream prior to work commencement.

Compensation measures for these projects include habitats creation (woodland and wetland for 15 and 6 projects respectively). The size of compensation area is comparable or greater than the respective habitat size lost in the works. Compensatory planting of native species in the number ratio from 1:1 to 1:3 is often adopted to compensate for the mature trees lost in the works, no matter whether the lost trees are exotic; while native species will bring more ecological benefit and its flowers/fruits are more attractive to wildlife. For wetland creation, using the Shenzhen River as example, >30 ha of marshy area and abandoned fish ponds along the river were reinstated and revegetated to compensate for the wetland loss of around 20 ha and provide the same ecological function for wildlife.

In Hong Kong, the construction and operation of these drainage projects approved under the EIAO are required to implement the Environmental Monitoring and Audit (EM&A) Program to check the implementation of the mitigation measures, evaluate their effectiveness and ensure that ecological impacts are tallied with those predicted in the EIA. The monitoring data have helped to evaluate whether the above mitigation measure are effective to mitigate ecological impacts and/or enhance the ecological values of these affected streams.

Based on the monitoring data, it is found that the species transplantation and translocation are feasible and effective in conserving rare and protected species. In drainage works in Tai Po, the transplanted individuals of Hong Kong Pavetta were monitored and their health status remains fair after the transplantation (AUES, 2016). In drainage improvement works of Lam Tsuen River, endemic Hong Kong Newt in the affected channel section were relocated upstream before works commenced. The monitoring data demonstrated that habitat quality was enhanced after the works and the number of Hong Kong Newt was nearly doubled in the improved channel section compared to the number before the works (AEC, 2015).

Besides the data from EM&A, another previous study has also demonstrated that the wetland compensation is effective and could enhance the ecological value of the site. Lam et al. (2004) demonstrated that bird species richness and density are higher in the reinstated fishponds for the Shenzhen River project and in the improved drainage channel in Yuen Long with mangrove planting along the stream embankment. These wetland habitats also support a large number of wetland dependent birds including the globally endangered Black-faced Spoonbill (*Platalea minor*).

In this review, we found evidence that biodiversity-friendly designs are incorporated into channel design for better ecological linkage after the EIAO came into the operation. Prior to the enactment of the EIAO, drainage design was mainly focused on the drainage capacity; thus the trapezoidal, concrete lined box channel with the straightforward way of drainage was usually adopted. With the EIAO, and through the EIA process, all the drainage channels purposely included natural substratum (e.g. boulders of different sizes), bends, shallow ponds and aquatic vegetation to attenuate flow and attract wildlife as to revitalize the concrete channel. Stream embankments comprising rock gabions also allow revegetation of stream banks and provide suitable habitats for wildlife. Moreover, fish ladders were constructed for drainages in Southern Lantau and Sai Kung with rich fish biodiversity, to facilitate fish movement along the drainage channel and the estuaries. Implementation of the above mitigation measures is ensured through enforcement of the EIAO while no non-compliance was detected.

Figure 2. Concrete lined drainage channel (left) Biodiversity-friendly drainage channel (right)

The Way Forward

Compared to the developing countries, Hong Kong has relatively robust infrastructure and is not particularly vulnerable to the risks of climate change, including flooding and rising sea level. With the continuous effort on drainage improvement, the number of flooding "blackspots" in rural areas has been reduced from about 80 in 1998 to only 8 in 2016 (DSD, 2016). Nevertheless, being a major climate change adaptation measure, it is anticipated that more drainage improvement projects will be carried out in the future. Taking biodiversity-friendly design and ecological mitigation measures into consideration, the potential adverse ecological impact from these drainage projects will be avoided, minimized and compensated through the EIA process, so as to conserve biodiversity while not compromising our ability to adapt to climate change.

Meanwhile, the Hong Kong Government will implement the city's first Biodiversity Strategy and Action Plan and strengthen biodiversity conservation, with EIA as one of the essential tools (Environmental Bureau, 2016). Conservation of biodiversity will in turn play an important role in mitigating the challenges climate change poses to our society as well as natural environment e.g. the eco-friendly drainage system and water bodies could moderate urban temperature, regulate water flow, provide natural habitats for wildlife and maintain habitat connectivity; vegetation in drainage channels could also absorb and store carbon from the atmosphere.

Hence, there are climate adaptation benefits to be gain from biodiversity conservation.

Through the review of twenty-two drainage projects which have gone through the EIA process, it is found that the Government has been creating attractive "Blue-Green" Infrastructure" in managing drainage and flooding, where landscape, biodiversity, connectivity and multifunctional benefits are optimized. To a certain extent, the statutory EIA process in Hong Kong has started contributing to the global efforts in addressing climate change and considering the biodiversity aspects in drainage projects. There is also a developing trend in Europe and North America in integrating climate change into the EIA process. It is expected that more practices will be in place in different countries and places (e.g. Canada, the UK, EU, the US, etc.) to use EIA to look into the climate change mitigation and adaptation requirements relating to development plans and projects.

References

AEC (Allied Environmental Consultant). 2015. Post-construction Ecological Monitoring Annual Report 2014. Report for Drainage Services Department, Hong Kong Special Administrative Region (SAR) Government, Hong Kong.

AUES. 2016. Final Environmental Monitoring and Audit Summary Report. Report for Drainage Services Department, Hong Kong SAR Government, Hong Kong.

DSD (Drainage Services Department). 2016. DSD Sustainability Report 2015-2016. Drainage Services Department, Hong Kong SAR Government, Hong Kong.

HKO (Hong Kong Observatory). 2016. Climate Change in Hong Kong. http://www.hko.gov.hk/climate_change/climate_change_hk_e.htm

Environmental Bureau. 2016. Hong Kong Biodiversity Strategy and Action Plan 2016-2021. http://www.afcd.gov.hk/tc_chi/conservation/Con_hkbsap/files/HKBSAP_ENG_2.pdf

Lam, S.K.S., Lee, W.H., Wong, B.S.F.. 2004. Some Ecological Mitigation Measures for the Main Drainage Channel Projects in Hong Kong. Proceedings of the 3rd European Conference on River Restoration. Zagreb, Croatia.

Erosion and Climate Change Challenges: Anambra State, Nigeria Case Study

Chizoba Chinweze[1]

Abstract

The study area; Anambra State is located in the south-eastern part of Nigeria. Soil erosion due to climate-induced flooding constitutes the major ecological challenge of the state.

The topography of the area, in addition to the soil type and the incidence of flooding, is a consequence of heavy rainfall and surface water runoff occasioned by climate change according to the Intergovernmental Panel on Climate Change (IPCC, 4AR, 2007)[1] which results in soil transport and severe gully erosion of this area. The state constitutes about 65% of gully erosion incidence in Nigeria.

Anthropological factors also accelerate the development and expansion of these gullies, with the attendant human vulnerability. Over 40% of the total land area in the state is currently severely eroded.

This paper classified the gully erosion in the area according to their severity and socioeconomic impact; it further analyses their consequence in the face of climate change challenges.

Keywords— **gully erosion, human vulnerability, climate change**.

Summary statement:
Soil erosion in the study area arising from increases in precipitation levels and heavy runoff due to climatic variability has led to ecological disasters with its attendant human vulnerability

1.0 INTRODUCTION

Soil erosion is an ecological process in which soil is displaced faster than it can be replenished. In Anambra State and the southeastern zone of Nigeria, the agents of this soil displacement is basically flooding exacerbated by climatic variability. However human activities also accelerate the process of erosion in this area.

Basically, three (3) types of erosion occurs; sheet, rill and gully erosion. Gully erosion is the most prominent in this region. The topography and the soil characteristics enhance the accelerated spread of gullies in this area. The incidence of gully expansion is heightened during the rainy season, with the resultant effect of loss of agricultural land, residential areas and even human lives.

1.1 The Study Area

With a population of 4,182,032 million people, spread over a land mass of 44,116 km^2; Anambra State in the Federal Republic of Nigeria is the most densely populated state in the southeastern part of the country. The state lies between latitude 5˚ 42´ N and 6˚ 47´N and longitude 6˚ 37´ E and 7˚ 23´ E, being made up of 127 communities divided into 22 Local Government Areas.

[1] Chemtek Associates, Lagos Nigeria. Correspondences: ud2001ng@yahoo.com

The study area lies within the tropical region. The area is influenced by two climatic seasons, the dry and wet seasons. The wet season starts around May and ends in November, with a break in August, and an average annual rainfall is about 1800mm. The dry season lasts for about 4-5 months spanning the period from December to April.

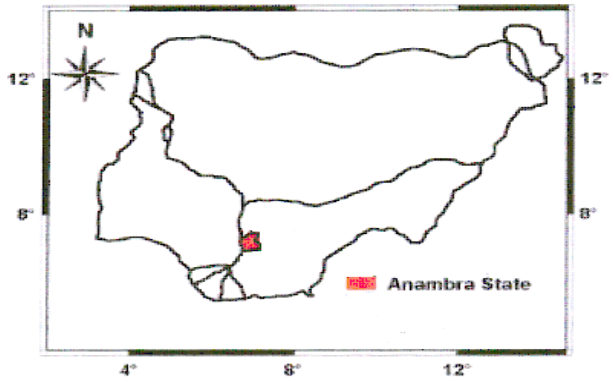


Figure 1: Map of Nigeria Showing the Study Area; Anambra State.

The prevailing winds are the southwesterlies which bring rains during the wet months and the northeasterlies or northwesterlies which occur during the dry months and are known for the hazy harmattan conditions. The wind speeds are low, less than 2 m/s (4 knots or 7.2km/h) throughout the year.

The relative humidity is high all the year round; 80% at night and between 65%-75% during the day. The ambient air temperature varies between 25^0C and 32^0C. The mean daily temperature is 28^0C, while the average annual temperature is 27^0C. However the temperature can go up to 32^0C during the hot periods of the year.

The main drainage system for the state is the Anambra River which empties into River Niger. The natural flow patterns of the river and streams in the area form a kind of drainage pattern in the area. The area is well drained. In general, two types of structures can be identified in the state; namely the uplifts and the basins of sedimentation.

The soil type is deep red, porous and unconsolidated. The land surface is covered with vegetation. The area used to be the rainforest part of Nigeria that has been deforested due to civilization and urbanization. There are various tree species of commercial value found within the area.

Farming (subsistence agriculture), trading and small scale industries are the main source of economy of the state.

1.2 The Issue of Climate Change and Gully Erosion Problem in Anambra State.

By the Intergovernmental Panel on Climate Change (IPCC) usage, climate change means any change in climate overtime, whether due to natural variability or as a result of intense human activities. Climate change refers to a change in climate that is attributable directly or indirectly to human activities, that alters the atmospheric composition of the earth which leads to global warming. Global warming produces increase in global temperature which brings about rising sea levels, changes in climate patterns, change in the amount and pattern of precipitation, and more severe weather including stronger tropical storms, droughts, and heat waves, likely including an expanse of

the subtropical desert regions. Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity[2]. Nigeria have experienced major climate-change-induced natural disasters, evidenced through high precipitations leading to flooding and soil erosion in Anambra State, in the south-eastern region.

The issue of gully erosion is a common phenomenon in the southeastern part of the country. Anambra State has the highest concentration of gully sites in this zone and the country at large. Every community in the state has their own story of woes to tell of the ever-expanding gully erosion and the attendant consequences.

1.2.1 Gully Erosion Trigger Factors.

The causative agents of gully erosion in Anambra State are both geologic and anthropogenic. Natural erosion occurs primarily due to geologic timescale[3]. Anthropogenic forces (human activities) include; deforestation, unsustainable farming practice, laterite mining, poorly constructed drainage systems, and path and road construction as well as economic and population growth. Soil erodibility depends to an extent on; soil texture, soil structure, soil permeability and the amount of organic matter. The geologic and anthropogenic factors contributing to erosion are discussed below;

Soil Type

The soil type of the study area is porous, with the soil particles being loose and are not compacted, thus making them easily detachable. The nature of the soil accelerates the process of erosion when exposed to external forces such as flooding and human disturbances.

Topography

The topographic features of the area distinctly influence erosion potential. The region has most areas with pronounced rolling highly terrain as shown in Figure 2. These areas have long steep slopes that enhance runoff velocity which gather momentum to produce force that speedily detach and transport soil particles, which results in gullies. This ~~(~~once~~)~~ lush, green land is now turning into an arid badland that's ~~[~~unsuitable~~]~~ for cultivation, dangerous for human habitation and well on the way of becoming a parcel of useless land.

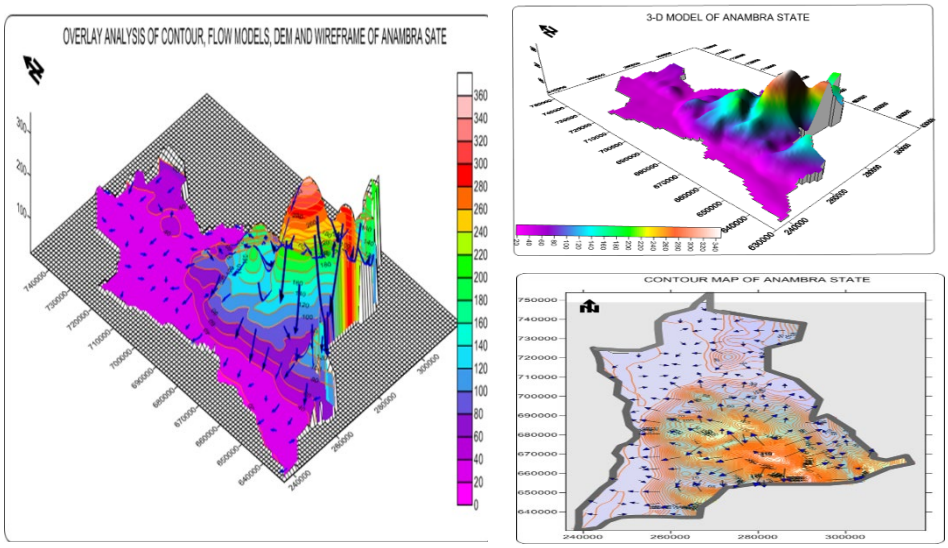


Figure 2: Topography of Anambra State

Agricultural Practices

The farming methodology practiced in the area is unsustainable. During farming, large portions of the land is cleared or burned exposing the fragile topsoil to erosion. Removal of groundcover increases the susceptibility of the soil to erosion. Disturbed land may have an erosion rate 1,000 times greater than normal[3].

Settlement Pattern, Urban and Infrastructural Development

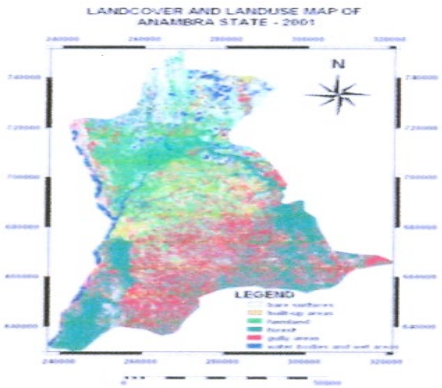
The state is densely populated, with a lot of developmental activities, a critical factor in erosion potential. Population density, is high for the state, about 798 persons/km$^{2(4)}$. Anambra State has probably the highest population density in the whole of sub-Saharan Africa[5]. It then follows that the issue of erosion will result in pressure on the human development potential of the state; such as water supply, housing, education, and waste management etc.

LateriteMining

In this area laterite mining is a booming business due to the level of infrastructure development that requires the use of laterite. The issue of concern here is that the excavation is carried out for commercial purposes indiscriminately without any regards to the environmental consequences. The government of the day seems not to have done enough to check the ugly situation, thereby giving the culprits a field day.

1.2.2 Landuse & and Landcover Mapping Scenarios of the State.

The available landuse and landcover imagery data of the state as captured with Landsat EMT+ (2001), is shown in Figure 3 below.



(a) Anambra State Landuse and Landcover from Landsat EMT+

Figure 3: Landuse and Landcover Maps of Anambra State- (Landsat EMT+)

The data obtained are summarized in Table 1 below.

Table 1: Result of Landuse and Landcover of Anambra State as depicted by Landsat EMT+.

S/N	Landuse & Landcover Type	Area (Km^2)
		Landsat ETM+
1.	Bare and Exposed Surfaces	822.94
2.	Built-up Areas	243.74

3.	Farmlands	782.72
4.	Forest/Vegetation	1814.06
5.	Gully Areas	906.16
6.	Water Bodies/Wet Areas	166.16

2.0 GULLY EROSION SURVEY.

The imagery classification of gully erosion in the state shows that 1769.52 km^2 of the total land area of the state is severely gullied. The map of the classification is as shown in Figure 4 below.

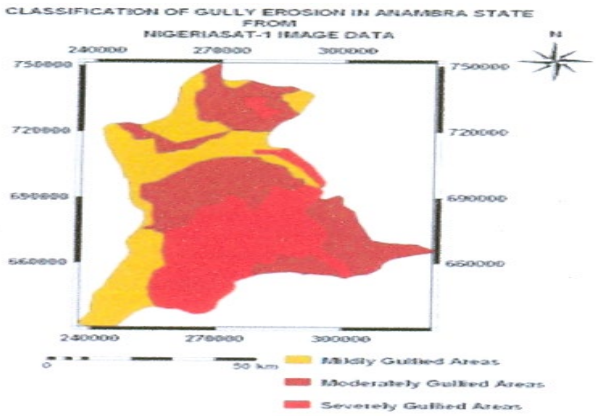


Figure 4: Image Classification of Gully erosion severity in Anambra State.

There are over 750 gully erosion sites in Anambra State. The state accounts for 65% of all gully erosion incidence of the whole nation. Available data showed that 1769.52 km^2 of the land area of the state or 40.1% are severely gullied, 1316.58 km^2 or 27.8% are moderately gullied and 1416.12 km^2 or 32.1% are mildly gullied. Figure 5 shows the picture of some of the gully sites in the state.

(a) A section of Agulu gully site (b) Umuchiana-Ekwuluobia gully site. (c) Gully site at Obosi

Figure 5: Some of the gully erosion sites in the state.

3.0 HUMAN VULNERABILITY OF GULLY EROSION IN ANAMBRA STATE.

The consequences of gully erosion in Anambra State are enormous and include;

- Displacement of communities

- Loss of lives
- Loss of farmland
- Destruction of Houses
- Destruction of Highways, link roads and infrastructural development

4.0 CONCLUSION.

Our survey showed that the people are using local wisdom to combat gully erosion havoc they have to face and live with. They use sandbags, erect barriers, dig shallow containment wells, divert floods to control the gully problem but all these efforts are not enough to check the gully erosion in the state.

We therefore recommend that a scientific and well-articulated measure; "sensitivity index mapping" be put in place to provide a solution to the problem. These measures shall not only serve as an early warning signal but help to check the menace.

We also call for capacity building through the establishment of a "Geomatics Information Station" that will provide data on the area gullied or prone to gully erosion. A special fund either by the Federal or International Funding Agency shall be made available to assist the state and the citizenry as gully erosion control is an expensive venture. The local people that are victims of this problem shall be properly educated on their practices and lifestyle that enhance gully erosion havoc and shall be better equipped with methodologies of handling.

We also recommend advocacy on the mitigation and amelioration of the effects of gully erosion in Anambra State in particular, other southeastern states (that face similar gully erosion problem) and Nigeria in general.

Reference:

[1] IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp IPCC 2007: Climate Change 2007 – The Physical Science Basis Contribution of Working Group I to the Fourth Assessment Report of the IPCC (ISBN 978 0521 88009-1 Hardback; 978 0521 70596-7 Paperback)
[2] IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22
[3] Erosion Processes (2008) "Chapter 2".
[4] NPC (2007). 2006 Population Census of the Federal Republic of Nigeria. National Population Commission, Abuja.
[5] Igbokwe J.I (2007) Gully Erosion Mapping/Monitoring in parts of South-Eastern Nigeria. Proceedings of Awareness Workshop on Gully Erosion Studies, Nnamdi Azikiwe University, Awka.

Mapping Climate Risks in an Interconnected System

Christopher Davidson and Kevin MacKenzie
Golder Associates Ltd, 6925 Century Avenue, Suite 100, Mississauga, Ontario, L5N 7K2

Abstract

Infrastructure spending for climate change adaptation in complex water management systems is an ongoing challenge. While some approaches allow for risk assessment of individual components, they struggle to address risks for interconnected systems with feedback effects. Water budget models can be used to assess designs, but forecasting of future climate using adjusted historical records is limitative when considering rare extreme events. In order to model an integrated water management system at a smelter in Sudbury, Ontario, Golder Associated Ltd. developed a coupled water balance model and climate generator tool. The tool used statistics for historic weather (rather than simply shifting historic records) and a range of potential climate change scenarios to generate thousands of 'potential' climate records and system response, defining risk based on occurrence across multiple realizations. The tool was provided to the client (with options to modify the system) so that they could assess best direct future infrastructure spending.

1. Introduction

In 2004, Golder developed a water management model for a smelter site near Sudbury, Ontario. This tool was created so that site operators could simulate effects of weather events (such as larger rainfalls, significant spring melts, or dry summers) on operations at the site. The model was created using the GoldSim modelling environment, and included natural runoff and pumping flows to and from a smelter site, and between the various tailings and treatment ponds at the site. The user entered basic design parameters for the system, and the model was run with historic 1956-2011 daily climate data from the Sudbury Airport meteorological station (#6068153). The strength of this approach was that once it had been calibrated to measured data it could be used to accurately model the range of historic events in what is a large interconnected system (where modelling single elements in isolation would not be adequate).

One acknowledged limitation of the original model however was that it only used historic data; potential events not captured in the historic data could not be simulated. This led to the development of the Golder Climate Generator; a code within the GoldSim model that could generate synthetic climate records based on historic climate statistics (Davidson and MacKenzie, 2011). The code was used to generate synthetic climate records at two test locations. Results generally compared well with the seed data, with longer synthetic records showing a proportional increase in the number of extreme events generated.

Discussions with the client following the development of the Golder Climate Generator resulted in additional features for the tool, designed to allow operators to assess impacts of proposed changes to the system (including capital expenditures and changes to processes). One of the most significant of these was the addition of Climate Change to the generator, allowing the operators to assess not just the potential range of climate events based on historical climate statistics, but to create multiple simulated scenarios, or realizations of multi-year synthetic climate records based on high level Global Climate Model (GCM) results. This final step allowed for modelling of the complex system under changing climate conditions.

2. Program Description

2.1 Original Code

The original Golder Climate Generator used the Monte Carlo simulation capabilities of the GoldSim software to generate synthetic climate records given historic climate statistics (Davidson and Mackenzie, 2011). This synthetic record included daily mean temperature and daily mean precipitation, with corresponding calculations for snowfall, snowmelt, and evaporation. Climate statistics entered into the generator included annual, monthly, and daily means and standard deviations for average temperatures and precipitations, as well as likelihood of daily precipitation. Tests showed the resulting synthetic records generally matched the averages for the historical records, while at the same time including additional 'extreme' events that were not present in the limited historical records.

2.2 Accounting for Climate Change

In order to add climate change accounting to the synthetic output from the generator, additional parameters were added that would gradually shift the governing climate statistics. The shift was assumed to be linear over the 40 year period. The total change over the duration of the synthetic record would depend on the start and end points of the climate data.

Based on discussions with climate specialists at Golder, the annual and monthly average precipitation and temperature results from the GCMs were used to estimate the annual change, using the 2011 baseline as the starting position and the GCM results for 2050 as the final statistics and dividing the difference over the 40-year period. The use of these GCM results was based in part on the availability of monthly temperature and precipitation results from the multi-model GCMs, and in part the desire to avoid costly downscaling given the desired level of analysis. Based on the range selected, the generator was set to produce 40-year realizations of synthetic daily precipitation and mean temperature data.

While the shift over time based on the GCM results modifies the annual and monthly mean statistics for temperature and precipitation, there remains several statistical parameters in the model for which the GCMs do not provide guidance. Generating the future climate realizations therefore included the following assumptions:

- Standard deviations for most values were assumed not to change from levels in the 50-year historic record, with only the means for those values shifting based on the GCM results; and,
- Future changes in daily precipitation distribution (mean and standard deviation) were assumed from extrapolating trends from the historic data. The mean and standard deviation for daily precipitation for each month was taken from the historic record, and plotted by year. A linear regression line through the resulting points was used to estimate the annual rate of change (i.e. the slope of the regression line).

2.3 Uncertainties and Scenarios

In addition to the assumptions, uncertainties around the daily chance of precipitation (information which is not provided in the GCMs) and the results from the GCMs themselves (which produce a range of results for both temperature and precipitation) led to a total of five (5) scenarios being used to generate synthetic records. The scenarios are outlined below, and summarized in Table 1.

- **Average Conditions**: Using the average 2050 monthly temperature and precipitation distributions across all selected GCMs with no change to daily chance of precipitation;
- **+30% Conditions**: Average Conditions (as above) with a 30% increase in daily chance of precipitation by 2050 (resulting in increasingly frequent but smaller precipitation events);
- **-30% Conditions**: Average Conditions (as above) with a 30% decrease in daily chance of precipitation by 2050 (resulting in decreasingly frequent but larger precipitation events);

- **High GCM Conditions**: the 2050 monthly precipitation distribution which produced the highest annual precipitation of all examined GCM results coupled with 2050 monthly temperature distribution which produced the coldest annual temperature of all examined GCMs;
- **Low GCM Conditions**: the 2050 monthly precipitation distribution which produced the lowest annual precipitation of all examined GCM results coupled with 2050 monthly temperature distribution which produced the warmest annual temperature of all examined GCMs.

Table 1: Scenario Descriptions

Scenario	Mean Annual Temperature (ºC)	Mean Annual Precipitation (mm/yr)	12-Month Average Daily Chance of Precipitation
Historic Climate (2011)	*3.7*	*889.7*	*0.56*
Average Conditions (2050)	6.2	954.4	0.59
+30% Conditions (2050)	6.2	954.4	0.89
-30% Conditions (2050)	6.2	954.4	0.26
High GCM Conditions (2050)	4.6	985.7	0.59
Low GCM Conditions (2050)	6.1	955.0	0.59

Note:
°C – degrees Celsius
mm/yr – millimetre per year

A total of 1,000 realizations (each with a 40-year synthetic record of daily data) were created for each of the above scenarios, which in turn were used in the water management model. The use of 1,000 realizations was intended to limit the bias from single events and to map out as fully as possible the 'expected' risks associated with certain events occurring (assumed as 5th and 95th percentile results for each year). The results were evaluated at key points in the model.

3. Results Evaluation and Discussion

Tables 2 through 4 provide selected results for water levels at three site ponds. Statistics for each scenario were estimated for the first and last years (2011 and 2050, respectively) from the 1,000 realizations run for each scenario.

The results generally show that, based on the water management at this particular site, both the expected low (5th Percentile) and high (95th Percentile) water level results are expected to decrease between 2011 and 2050. This included the scenario with the largest expected increase in precipitation and smallest increase in temperature ('High GCM'); this scenario had been expected to produce higher water levels due to increased precipitation and decreased evaporation. Likewise, the "-30%" scenario had been expected to produce higher expected water levels resulting from relatively larger single rainfall events (given similar monthly precipitation and less frequent rainfall), but in fact it was the more frequent rainfalls produced in the "+30%" scenario that tended to produce the higher expected water levels. Low water results are generally similar as they are tied to outflow invert levels.

Table 2: 5th and 95th Percentile Results – Tailings Pond A

	Tailings Pond A Water Level (masl)				
Scenario	**Average Conditions**	**+30% Conditions**	**-30% Conditions**	**High GCM Conditions**	**Low GCM Conditions**
2011 5th Percentile	308.28	308.27	308.28	308.28	308.28
2011 95th Percentile	310.55	310.54	310.57	310.52	310.51
2050 5th Percentile	308.27	308.27	308.27	308.27	308.27
2050 95th Percentile	309.94	309.96	309.84	310.27	309.52

Note:
masl – metres above sea level

Table 3: 5th and 95th Percentile Results – Tailings Pond B

	Tailings Pond B Water Level (masl)				
Scenario	**Average Conditions**	**+30% Conditions**	**-30% Conditions**	**High GCM Conditions**	**Low GCM Conditions**
2011 5th Percentile	292.95	292.96	292.96	292.96	292.96
2011 95th Percentile	294.11	294.11	294.10	294.09	294.10
2050 5th Percentile	292.85	292.83	292.85	292.95	292.82
2050 95th Percentile	293.81	293.83	293.77	293.93	293.65

Note:
masl – metres above sea level

Table 4: 5th and 95th Percentile Results – Quality Pond C

	Quality Pond C Water Level (masl)				
Scenario	**Average Conditions**	**+30% Conditions**	**-30% Conditions**	**High GCM Conditions**	**Low GCM Conditions**
2011 5th Percentile	290.72	290.72	290.72	290.72	290.72
2011 95th Percentile	292.02	292.03	292.02	292.02	292.02
2050 5th Percentile	290.69	290.69	290.69	290.73	290.69
2050 95th Percentile	291.79	291.82	291.74	291.92	291.66

Note:
masl – metres above sea level

Table 5 shows the change in total flow at the final discharge from the site. The results generally show a decrease in flows leaving the site for most scenarios between 2011 and 2050, with the exception of the 'High GCM' scenario. This suggest that, given reasonable assumptions for the site (an average of GCM results) that there will be somewhat less outflow from the site in the 2050 future.

Table 5: 5th and 95th Percentile Results - Final Discharge Point

	Final Discharge Annual Flow (m^3/yr)				
Scenario	**Average Conditions**	**+30% Conditions**	**-30% Conditions**	**High GCM Conditions**	**Low GCM Conditions**
2011 5th Percentile	4,620,000	4,790,000	4,800,000	4,680,000	4,700,000
2011 95th Percentile	8,150,000	8,100,000	8,170,000	8,210,000	8,290,000
2050 5th Percentile	4,020,000	4,230,000	4,180,000	4,910,000	3,840,000
2050 95th Percentile	7,650,000	7,680,000	7,760,000	8,640,000	7,500,000
	Final Effluent Point Daily Flow (m^3/day)				
Scenario	**Average Conditions**	**+30% Conditions**	**-30% Conditions**	**High GCM Conditions**	**Low GCM Conditions**
Overall Maximum	130,000	130,000	150,000	150,000	140,000
Overall Minimum	300	300	300	1,800	200

Note:
m^3/yr – cubic metres per year
m^3/day – cubic metres per day

4. Conclusions

Based on the previous sections, the following conclusions can be drawn:

- The Golder Climate Generator may be modified to include basic assumptions of climate change shifts from readily available GCM results.
- The resulting synthetic climate records can be used as input to complex water management models.
- Multiple scenarios may be required to assess the potential effects of variables for which GCM results do not provide guidance.
- Analysis of a large number of results may be used to estimate the probable effects of climate change on modeled systems.
- It is possible to evaluate the effects of a range of proposed site changes to water management into the future using this approach.

5. References

Davidson, Christopher and Mackenzie, Kevin, "*Golder Daily Climate Generator*", Canadian Society of Civil Engineering, 20th Canadian Hydrotechnical Conference, June 2011.

Biodiversity information in sugarcane industry CEA

Ana Paula Alves Dibo, Luis Enrique Sánchez

Escola Politécnica, University of São Paulo

anapauladibo@gmail.com

Abstract

Deficiencies related to CEA were found in the EIA process of sugarcane industry projects in São Paulo State (Brazil). Among the causes of poor practice, this paper analyzes biodiversity information availability and adequacy regarding the cumulative effects related to the change in the species diversity in forest fragments. Review of 27 ToR and EIS using content analysis found that this effect is overlooked and insufficiently considered. For supporting the assessment of cumulative effects on biodiversity, we point out the need to (i) ToR focus on specific questions and key information to assess change in species diversity; (ii) provide guidelines with general procedure, tools and techniques to drive CEA; (iii) adoption of initiatives – by the environmental agency - to manage biodiversity data and information generated in the EIA process, in order to facilitate their use in the future EIA; and (iv) reinstatement of landscape ecology studies in EIS.

Keywords: cumulative effects; biodiversity; sugarcane industry; licensing process.

1 Introduction

Cumulative effects assessment (CEA) is an internationally recommended good practice of environmental impact assessment (EIA) that identifies and analyzes the cumulative environmental changes of a combination of past, present and reasonably foreseeable future activities (Harriman & Noble 2008; Canter 2015), with focus on the effects on valued components (VCs) - environmental and social attributes considered important in a region. The CEA enables a better understanding and monitoring of the environmental consequences of development projects, especially those related to biodiversity (IFC 2013). Biodiversity is a key factor for the CEA in regions where there is a marked loss and continuing threats to biodiversity and ecosystem services (CBD 2006).

In Brazil, there are regulatory requirements to consider cumulative and synergistic properties during the preparation of an environmental impact statement (EIS). Specifically for sugarcane industry projects, the EIA regulations in São Paulo call for the "adequate assessment" of cumulative impacts (São Paulo 2008), due to the spatial concentration of monocultures and industrial plants in the state (Walter et al. 2014). However, previous research suggests that EIA of these projects insufficiently address their potential cumulative effects (Gallardo & Bond 2011). Neri et al. 2016 pointed out that practical difficulties to conduct CEA in Brazil include the lack of technical and methodological guidelines and availability of reliable information about other projects.

Internationally, it is acknowledged that availability of guidance is critical to improve practitioners' understanding of cumulative effects and how they should be addressed at project-level (IFC 2013; Olagunju & Gunn 2015). Further, difficulties to access information and/or its insufficiency limits the CEA application, due to the non-establishment of a relevant database for the baseline of VCs and understanding of other projects and activities in study area (Canter & Atkinson 2011; Noble et al. 2011).

Considering the need of baseline information to be available and transferred over time to properly support project-based CEA (Noble et al. 2016), this paper analyzes biodiversity information availability and adequacy to assess potentially significant cumulative effects on biodiversity in the EIA of sugarcane industry projects in São Paulo.

2 Methodology

The research was conducted in three steps (Figure 1). The study period was limited to 2009 to 2014 because the explicit requirement to "… adequately assess the associated environmental impacts, including cumulative impacts…", during the licensing process of sugarcane industry which was gazetted in 2008 (Resolution 88/2008).

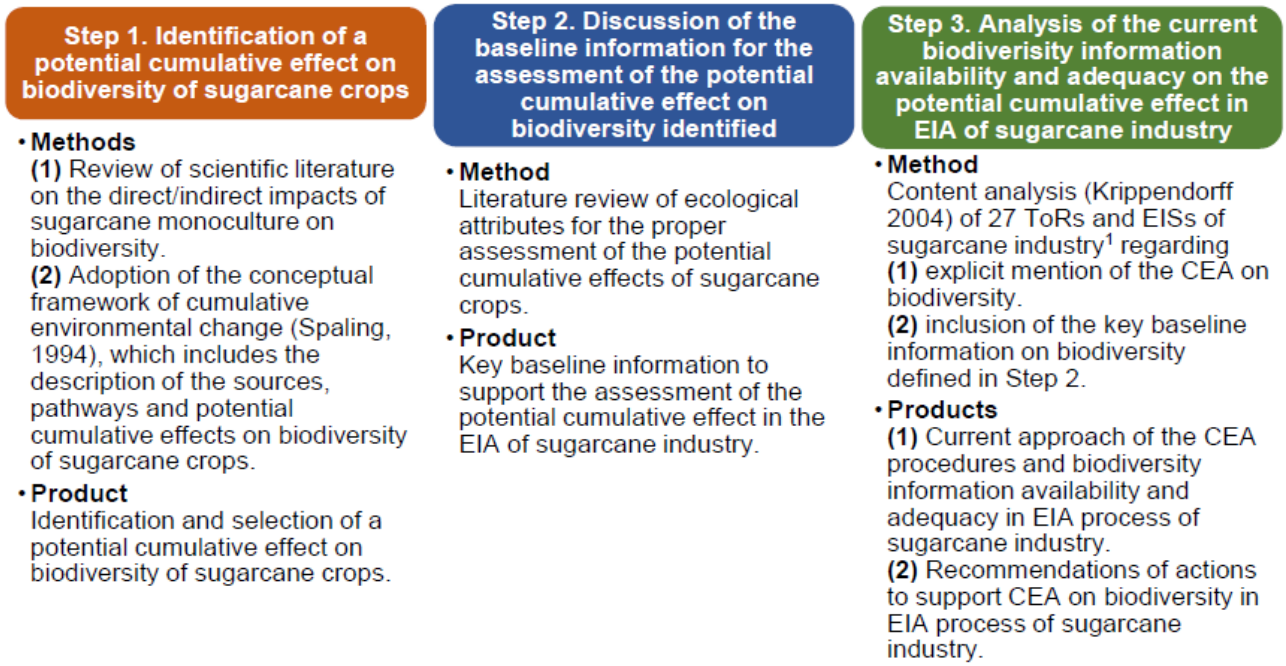


Figure 1. Main steps for the discussion of biodiversity information availability and adequacy to support CEA of sugarcane industry projects. Source: Elaborated by the authors.

3 Results

3.1 Potentially significant cumulative effect on biodiversity of sugarcane crops

Along the application of the conceptual framework (Step 1), we considered as *source* the implementation of sugarcane crops and corresponding land use change. The expansion of sugarcane in São Paulo state has not been occurring at the expense of deforestation, but as a result of replacing former pastures and agricultural lands (Filoso et al. 2015), in areas where the remaining forest is highly fragmented (Macedo 2005). To describe the *pathways*, we considered the several accumulated impacts that result in a more significant impact (Rajvanshi 2016), induced by a single sugarcane industry project. In this way, it was considered as direct impact 'change in the permeability of the landscape matrix'[1]. The ability of the landscape matrix is to support species (Franklin et al. 2002), and also it has critical role in controlling the connectivity in the landscape through allowing the movement of organisms in patches of native vegetation (Franklin & Lindenmayer 2009). In this scenario, we pointed out as accumulated impacts the alteration of habitat species and resources availability, changes in movement of individuals between populations, and changes in the abundance of species in sugarcane areas. These several impacts contribute to the larger effect of sugarcane crops (*cumulative effect)* 'change in the species diversity'[2] in native forest fragments over time.

3.2 Key baseline information to assess change in species diversity in forest fragments

As result of the literature review regarding the ecological attributes related to the cumulate effect discussed, we summarize some key baseline information that could be addressed in EIA of sugarcane projects in the light of CEA principles.

Landscape change is a dynamic process, whose description involves the understanding of compositional gradients, diversity of land uses, number of fragments, and structure connectivity of the landscape elements. Species occurrence is influenced by the sizes, shapes and composition of fragments, as well as the land use adjacent to the fragment (Bennet & Saunders 2010). Also, it is relevant to consider both temporal and spatial functional connectivity. Spatial functional connectivity is related to the connectivity of landscape structure,

[1] Landscape matrix is defined as a unit of landscape that controls its dynamics. In general, the matrix covers most of a landscape (Hobbs 2002).
[2] Species diversity is a measure of diversity that incorporates both number of species and their relative abundance (Gotelli & Chao 2013).

making possible the movement of fauna in space. Temporal functional connectivity is linked to persistence of organisms in time, in a same place (Auffret et al. 2015).

Considering the potential of change in species diversity in forest fragments, it is relevant to recognize (i) the isolation of a population by the distance between habitats; and (ii) the human land use on the ability of organisms to move through the landscape, take in the past influence in landscape structure, by land use history (Bennet & Saunders 2010). In doing so, landscape structure should be inventoried and monitored through: (i) aerial photography and satellite imagery; (ii) use of Geographic Information System (GIS); (iii) time series analysis of remote sensing data and indices of landscape pattern (Noss 1990).

Walz (2011) also notes the relevant relationship among landscape structure and species diversity, considering (i) the benefit of using habitat modelling of individual species or species groups; (ii) indicators of landscape diversity in monitoring agricultural landscapes, and (iii) GIS for evaluation of spatial information as land use information, habitat type, and others, which depend on availability of data, in order to better understand the effects of different landscape patterns on composition and diversity of species.

In summary, the key baseline information that should be addressed in EIA is: (1) past and current land cover characterization and mapping; (2) analysis of landscape structure (number of remaining fragments, shape, size, composition, types; permeability of landscape matrix); (3) temporal analysis (data from past activities and habitat conditions). Collection and analysis of such information should be supported by tools such as GIS, satellite images, indices, indicators, and modelling.

3.3 Analysis of biodiversity information in sugarcane EIA

In the analysis of the 27 ToR, no explicit requirement for assessing the cumulative effects on biodiversity was found. Only the need to consider the cumulative effects of water consumption in the region of the projects, taking into account other projects, is made explicit. However, 14 ToR call for considering the impacts on fauna communities due to the land use change, in which can be discussed the potential cumulative effects.

Reviewing the EIS, brief mention to cumulative effects on biodiversity was found in 9 studies (Figure 2), with no structured approach to assess them. Regarding the change on species diversity in forest fragments, 1 EIS pointed out the indication of cumulative effects due to the reduction of local richness of reptiles and amphibian.

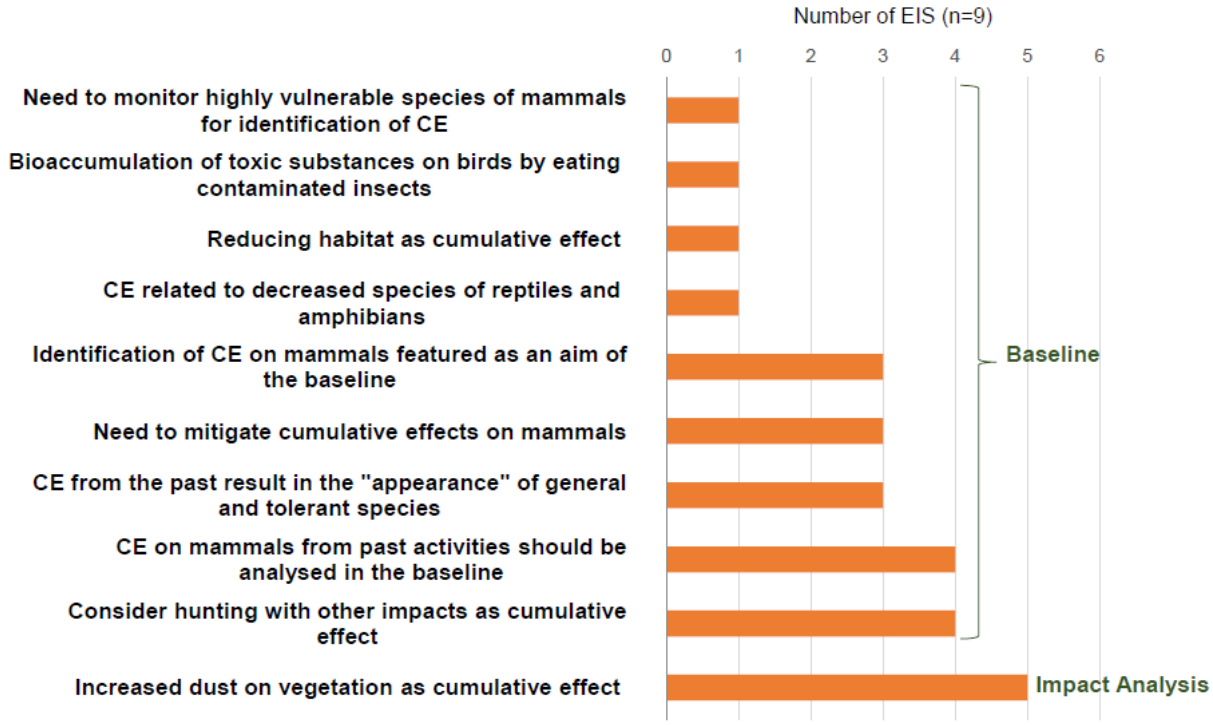


Figure 2. Synthesis of explicit mention to cumulative effects in EIS of sugarcane industry. Source: elaborated by the authors.

The analysis of key baseline information that could support the assessment of change in species diversity in forest fragments in EIS, resulted in the findings:

- 9 EIS consider the decrease or change in the permeability of the landscape matrix permeability due to the land use change. They recommend maintaining the scattered trees for allowing gene flow in fragments. In 1 EIS, the potential of increasing rodents abundancy is described, while 4 EIS mention the potential of reducing abundance and richness bird species.
- All EIS present flora and fauna species list; describe the current composition of forest fragments by richness and abundance species, and habitat conditions compared with secondary data. Regarding landscape analysis, we found the identification in maps or satellite image and quantification of the remaining fragments, description of past vegetation, brief description of historical dynamics of land use and past influences in the study area, use of GIS for mapping current land use and sugarcane areas, and 7 EIS refer to maps of areas of biological importance and connectivity.
- There is no use of indices of landscape pattern or indicators of landscape diversity. In 7 EIS, there is the application of an index of sensibility to human alterations to classify fauna species with high, medium and low sensibility.
- Time series analysis is not used for the baseline and impact analysis. There is no specific temporal boundary to identify and analyze the influences of past and/or future actions on VC selected. There is a description of past changes in the studies areas due to the land use, considering in some studies the potential contribution to cumulative effects, without ponder future actions.

4 Discussion

As stated above, sugarcane industry can cause highly significant cumulative effects on biodiversity that should be integrated in the EIA process for promoting biodiversity conservation, as the change in species diversity in forest fragments.

Some studies approach the species richness and abundance of species in sugarcane areas that could assist this understanding. Dotta and Verdade (2011) determined composition and frequency of occurrence of medium to large-sized mammals on an agricultural landscape in south-eastern Brazil and concluded that cane fields shelter a greater abundance of species as compared with pastures. Further, Dotta and Verdade (2009) consider the potential increasing in abundance of felines in forest fragments due to the increase of small rodents found in cane fields.

In this scenario, we also reinforce the crucial role in adopting a landscape or broader regional scale for support the CEA on biodiversity of sugarcane industry in the licensing process, that could be held by integrating Landscape Ecology in EIS to manage agricultural crops as sugarcane (Von Glehn, 2008). The application of tools or techniques such as landscape indicators, indices of biological integrity and habitat evaluation systems could also be used to improve CEA, supported by GIS to integrate spatial and temporal data.

Likewise, based on a recommendation of Noble et al. (2016), ToR should direct the types of cumulative effects questions and key information to assess the change in richness and abundance of specific species in forest fragments, to be considered in the EIS.

Finally, to allow a detailed identification of past, existing or planned activities that can contribute to significant impact is valuable for assessing cumulative effects (IFC 2013), better access to about other projects, possibly through the creation of a public database (Neri et al. 2016), is needed. Availability of baseline information of VC conditions from other studies to the usage by proponents is equally important to properly conduct CEA, likewise “a legal requirement on project proponents to share EA data/information” (Noble et al. 2016).

5 Conclusion

The notable spatial concentration of sugarcane industry projects in São Paulo State summon up the need to integrate a broader spatial and temporal scales in EIS, for an appropriate analysis of the combination of multiple influences in VCs, especially those related to biodiversity. The main practical difficulties of the CEA on biodiversity of sugarcane industry include: the vague definition in ToR and provision of directions to conduct CEA; lack of guidelines with specific terminology, procedures and tools to CEA; availability and standardization of past and current biodiversity data that could be addressed in the assessment and integrated adoption of landscape analysis. For supporting CEA on biodiversity in EIA, we point out the need to (i) ToR focus on specific question regarding cumulative effects on biodiversity, as the definition of key information to assess the change in species diversity; (ii) provide a guideline with general procedure and potential tools and techniques to drive the CEA; (iii) the environmental agency adopt initiatives to manage biodiversity data and information generated in the EIA process, in order to facilitate their use in future EIA; and (iv) reinstatement of landscape ecology studies in the environmental licensing process of São Paulo sugarcane industry as a requirement.

7 References

Auffret AG, Plue J, Cousins SAO. 2015. The spatial and temporal components of functional connectivity in fragmented landscapes. Ambio. 44:51–59.

Bennet AF, Saunders, DA. 2010. Habitat fragmentation and landscape change. In: Sodhi NS, Ehrlich PH. (Eds). Conservation Biology for All. Oxford University Press.

Canter LW, Atkinson SF. 2011. Multiple uses of indicators and indices in cumulative effects assessment and management. Environ Impact Assess Rev. 31:491–501.

Canter LW. 2015. Cumulative Effects Assessment and Management: Principles, Process and Practices. EIA Press.

CBD - Convention of Biological Diversity. COP 6 Decision VIII/28 Impact Assessment: Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment. 2006. Available from: <http://www.cbd.int/decision/cop/?id=11042>. Access in: 10 mar. 2014.

Dotta G, Verdade LM. 2009. Felids in an agricultural landscape in São Paulo, Brazil. CATnews. 51:22-25.

Dotta G, Verdade LM. 2011. Medium to large-sized mammals in agricultural landscapes of south-eastern Brazil. Mammalia. 75:345–352.

Filoso S, Braga J, Fernanda S, Rafaela S, Lins M, Figueiredo T, Antonio L. 2015. Reassessing the environmental impacts of sugarcane ethanol production in Brazil to help meet sustainability goals. Renew Sustain Energy Rev. 52:1847–1856.

Franklin AB, Noon BR, George TL. 2002. What is habitat fragmentation? Stud Avian Biol. 25:20–29.

Franklin JF, Lindenmayer DB. 2009. Importance of matrix habitats in maintaining biological diversity. Proc Natl Acad Sci USA. 106:349–350.

Gallardo ALCF, Bond A. 2011. Capturing the implications of land use change in Brazil through environmental assessment: Time for a strategic approach? Environ Impact Assess Rev. 31:261–270.

Gotelli NJ, Chao A. 2013. Measuring and estimating species richness, species diversity and biotic similarity from sampling data. In: Levin AS. (Ed.). Encycl Biodiversity. Vol. 5. Waltham, MA: Academic Press.

Harriman JAE, Noble BF. 2008. Characterizing Project and Strategic Approaches To Regional Cumulative Effects Assessment in Canada. J Environ Assess Policy Manag. 10:25–50.

Hobbs RJ. 2002. The ecological context: a landscape perspective. In: Perrow MR, Davy AJ. Handbook of Ecological Restoration. Cambridge University Press.

IFC - International Finance Corporation. 2013. Good Practice Handbook: Cumulative Impact Assessment and Management, Guidance for the Private Sector in Emerging Markets. World Bank Group, Washington, DC.

Krippendorff K. 2004. Content Analysis: An Introduction to its Methodology. Los Angeles: SAGE Publications.

Macedo IC. Síntese. In: Macedo IC (Org.). Doze estudos sobre a agroindústria da cana-de-açúcar no Brasil e a sua sustentabilidade. 2005. São Paulo: ÚNICA – União da Agroindústria Canavieira do Estado de São Paulo.

Neri AC, Dupin P, Sánchez LE. 2016. A pressure–state–response approach to cumulative impact assessment. J Clean Prod. 126:288–298.

Noble B, Liu J, Hackett P. 2016. The Contribution of Project Environmental Assessment to Assessing and Managing Cumulative Effects: Individually and Collectively Insignificant? Environ Manag. 10:25 pages.

Noble BF, Sheelanere P, Patrick R. 2011. Advancing Watershed Cumulative Effects Assessment and Management: Lessons From the South Saskatchewan River Watershed, Canada. J Environ Assess Policy Manag. 13:567–590.

Noss RF. 1990. Indicators for Monitoring Biodiversity: A Hierarchical Approach. Conserv Biol. 4:355–364.

Olagunju AO, Gunn J a. E. 2015. Selection of valued ecosystem components in cumulative effects assessment: lessons from Canadian road construction projects. Impact Assess Proj Apprais. 15:1–13.

Rajvanshi A. 2016. Cumulative effects of dams on biodiversity. In: Geneletti, D. (Ed.). Handbook on Biodiversity and Ecosystem Services in Impact Assessment. Northhampton, MA: Edward Elgar Publishing Limited.

São Paulo. 2008. Resolução Conjunta SMA-SAA n° 004, de 18 de setembro de 2008. Dispõe sobre o Zoneamento Agroambiental para o setor sucroalcooleiro no Estado de São Paulo.

Spaling H. 1994. Cumulative Effects Assessment: Concepts and Principles.Impact Assess. 12:231–251.

Von Glehn HC. 2008. Uso do Solo e Biodiversidade. In: Workshop Aspectos Ambientais da cadeia do etanol de cana-de-açúcar. São Paulo.

Walter A, Galdos MV, Scarpare FV, Leal MRLV, Seabra JEA, Da Cunha MP, Picoli MCA, De Oliveira COF. 2014. Brazilian Sugarcane Ethanol: Developments so far and Challenges for the Future. Adv Bioenergy Sustain Chall. 3:70–92.

Walz U. 2011. Landscape Structure, Landscape Metrics and Biodiversity. Living Rev Landsc Res. 5:1–35.

Following-up Cree Health Determinants in James Bay

Carine Durocher
Hydro-Québec, 75 Boulevard René-Lévesque, Montréal, Québec, Canada H2Z 1A4
Contact : durocher.carine@hydro.qc.ca

Background

The construction of the Eastmain-1-A/Sarcelle/Rupert hydroelectric project began in 2007. This project carried out by Hydro-Québec includes the diversion of the Rupert river in 2009 and the construction of the Eastmain-1-A and Sarcelle powerhouses which were commissioned between 2011 and 2013. This project is located in James Bay which is homeland for Cree native people and Hydro-Québec signed the Boumhounan Agreement in 2002 which stipulates that construction and the environmental follow-up program associated with the project must be carried out in concert with the Crees. An important environmental follow-up program was planned for this project and included the monitoring of Cree health determinants. The project's conditions of authorization, issued by Québec's environmental department required that Hydro-Québec work in collaboration with the Cree Board of Health and Social Services of James Bay (CBHSSJB) in carrying out this study.

This follow-up was a first for Hydro-Québec in two aspects, first in its topic, native health determinants, and secondly in the important level of participation of a health agency that was called for. It should be noted that when this study was started in 2008, no references could be found about a monitoring of health determinants in a native population, in the context of a natural resource development in Canada. This paper presents the process followed to carry out this study and its conclusions. We hope this information may be useful for other organisations engaged in a similar follow-up.

Objectives

The objective of this follow-up study was to evaluate changes in health determinants and the project's possible impacts on these determinants. The study also aim at evaluating the effectiveness of the mitigation measures implemented and suggest measures to factor in changes that had not been anticipated in the Environmental Impact Assessment.

The study was carried out in three times over the construction period which spanned from 2007 to 2014. Because the Eastmain-1 hydroelectric project had been carried out just before in the same area, the study tried to follow the evolution of the determinants since the early 2000's.

Methodology

Selection of indicators

The certificate of authorisation asked the determinant to be selected jointly with the CBHSSJB. In order to do so a Joint Committee was established in 2008 to facilitate cooperation between the CBHSSJB and Hydro-Québec. A lot of discussion in this committee was about what would be a Cree health determinants, which determinant of health would be relevant followed in the context of this project and how they should be tracked over time. The approach taken was to identify broader determinant and then to define more precise indicators. As some health determinants were covered in other follow-up studies such as methylmercury level in fish, the focus was more on identifying social determinants which were important for Crees. A review of literature done in 2008 found only few study aimed at identifying native determinant with a lot of theoric discussion but no reference to precise indicators. This review showed that self-determination was a non-negligeable determinant of health for native people. As the focus was on monitoring changes since the project beginning, the Committee focuses on which indicators were available over the 12 years covered by the study. A list of 9 determinants and 50 indicators to be monitored was set-up based on the data already gathered during the impact assessment, other data available at CBHSSSJB or in other institutions such as Statistics Canada and data collected through other social impacts follow-up done by Hydro-Québec. Some indicators had to be abandoned subsequently due to the fact that they were not updated consistently or that they were no longer available. Other indicators were added after finding new sources of information.

Data analysis

As it is often difficult to identify the multiple causes of a variation in a social indicator, it was assume that it would be hard to distinguish if the project would be in cause or not in a context where the Cree had already undergone rapid social changes. To make as much of a distinction as possible between the effects of the project and other factors likely to affect this population, the study distinguished:

- Subgroups of the Cree directly affected by the project, namely the Cree workers and contractors and the tallymen[1] and their families.
- The total population of the nine Cree communities of the James Bay area.

Data were collected and compiled for the 50 indicators selected for the period of 2000 to 2012 but due to lack of data, only 48 indicators could be analysed[2]. Analysis was done first in a quantitative way. Where possible, statistical cross-tabulation was done based on the year and a second variable to determine whether or not the observed changes were statistically significant.

Secondly, to facilitate the interpretation of the changes observed, two workshops were held with CBHSSJB and other Cree representatives. In these workshops, the result of the quantitative analyses were presented and hypothesis were made about the reasons for the changes and as to

[1] Tallymen are traditional leaders in animal harvesting, care-taker of their hunting territory (trapline).

[2] The two remaining indicators did not cover at least two years of data, making comparisons impossible

whether or not these changes were related to the project and to what extent. Lastly, it must be mentioned that the CBHSSJB had the opportunity to review and comments the reports done.

Results

Income and social status

Data show that although the income generated by the project were significant and has undoubtedly had a positive effect, other sources of income or revenues have contributed more significantly to the general increase observed in the Cree communities during the study period. Data available did not lead to any indication regarding a change in social status for Cree project workers or tallymen. It is noteworthy that between 2000 and 2010, a progression towards a greater equality in the distribution of revenu within the Cree communities was observed.

Employment, working conditions and occupation

As was the case for income, Cree employment has benefited from the positive effect of the jobs created by the project but the main factor affecting employment during the study period has been the public service jobs created mostly following agreements signed with federal and provincial governments. Although the positions occupied by Cree project workers were generally temporary and unskilled in nature, they were generally satisfied with their employment experience and working conditions.

Training and education

Data available showed that only a very small percentage of Cree interrupted their studies to work on the project, while a greater proportion of workers chose to return to school course after. The project contributed positively to training in the construction field although some workshop participants stressed that the short timeframe of the project had pose a challenge to organizing training. Overall, graduation rates in the Cree communities did not raised or decreased significantly.

Cultural continuity, language and identity

Nine indicators were selected to describe the cultural continuity, language and identity which are aspects that are closely related to the social fabric of a community. Despite the fears over the project related to the continuance of traditional activities on the land, only a very small number of tallymen were forced to temporarily move their activities to another trapline because of the project. Among the Cree population, an increase was even observed from 2005 to 2012 in how often traditional activities were practiced. This could be attributed in part to the various funds available to support these activities. Most of the Cree workers spoke Cree during their free time, but the use of Cree decreased slightly towards the end of the project. A slight decrease was also observed in the Cree communities. Despite encouraging numbers in the practice of traditional activities, data also showed that the population remained concerned about losing Cree culture. The main factors cited to explain this is the decreased time spent on the land, the threat posed by development project to the territory, the prevalence of Western lifestyles and new technologies.

Social environment

Five indicators were selected to evaluate changes in the social environment within the Cree communities. Despite the economic vitality that exist in the Cree communities and in which the project has somehow contributed, certain social problems (overcrowded housing, increase in single-parent families) persisted although a direct link, either positive or negative, could not be established with the project. No significant changes occurred in the perception of social issues during the period. Workshop participants appreciated that special measures had been taken to avoid that the project had an adverse effect on drugs and alcohol abuse in the communities.

Individual health habits and psychosocial issues

Using data available, it was possible to characterize three of the five indicators related to individual health habits. Self-reporting data about the frequency of alcohol consumption or drug use show globally few effects on the health habits of Cree workers. During workshops, it was argued that working on the project could have had positive effects on some individuals and negative effects on others. No data covering the project period were available about alcohol or drugs consumption in the community. As for the possible changes in weight of the Cree workers, it seems that here also the project had negative effects on some individuals and positive ones on others.

Health services

According to a study conducted by the CBHSSJB prior to the project, the project was likely to put more pressure on social and health services. Despite an increase observed in the number of hospitalizations due to injury, it is difficult to see, by the nature of injury, if there is a link with the project. Services offered by the Native social worker at the jobsite limited the demand on social services during the project.

Satisfaction and well-being

Data available showed that Cree project workers' level of satisfaction with life in general, predominantly positive and uniform throughout the study period, was similar to that observed in the Cree population as a whole. Socio-economic prosperity and the well-being of Cree were stable or increased within most of the communities. It was difficult to identify elements that explain the Crees' satisfaction with life in general, particularly concerning the project's effects on this determinant.

Self-determination

Two indicators were selected to evaluate self-determination. They indicate that the Crees' perception of the strength and future of their Nation has been predominantly positive throughout the period. Possible explanations for this include the agreements signed by the Cree Nation with various governments or even the greater coverage of the role of Cree leaders throughout the media.

Conclusion

In the light of these findings, different hypothesis were drawn on the links between the project and determinants of Cree health. For some determinants, the project seems to have had positive contributions (direct or indirect) such as for income and social status, employment and working condition and education and training. In other cases were negative effects were feared, such as cultural continuity, language and identity, social environment, individual health habits and health services, it seems like the project did not have any effects or only limited negative effects. Finally, owing to the wide range of factors that could explain changes, it was difficult to draw hypothesis about the project's effects on self-determination and satisfaction and well-being.

Regarding the process, doing this study was challenging in the fact that it was hard to find regularly compiled data covering the whole Cree population over a decade, beside the ones provided by public institutions such as Statistics Canada. Using data collected during the project on specific groups directly affected by the project and comparing them with the whole population gives interesting insights. Interpretation of data was improved by the participation of a health agency and Cree stakeholders.

References:

CENTRE DE COLLABORATION NATIONALE DE LA SANTÉ AUTOCHTONE (CCNSA). 2008. *A Background Report: Forum with Aboriginal Organizations on Indigenous Social Determinants of Health.* 33 pages.

CONSEIL CRI DE LA SANTÉ ET DES SERVICES SOCIAUX DE LA BAIE JAMES (CCSSSBJ). 2005. *The Evolution of Health Status and Health Determinants in the Cree Region (Eeyou Istchee): Eastmain 1-A Powerhouse and Rupert Diversion Sectoral Report.* Volumes 1 et 2. Serial 4 Number 3 Report on the health status of the population.

GROUPE DE RÉFÉRENCE CANADIEN (GRC). 2006. *Dialogue autochtone.* Commission de l'OMS –Déterminants sociaux de la santé. Centre de collaboration nationale de la santé autochtone.

HYDRO-QUÉBEC. 2005. *Centrale de l'Eastmain-1-A et dérivation Rupert - Complément de l'étude d'impact sur l'environnement.* Réponses aux demandes de renseignements additionnels de l'administrateur provincial de la Convention de la Baie James et du Nord québécois et de la Commission fédérale d'examen. Réponses 314 à 384.Volume 4. 261 pages.

HYDRO-QUÉBEC. 2004. *Centrale de l'Eastmain-1-A et dérivation Rupert – Étude d'impact sur l'environnement.* Volume 4. Pagination par section.

HYDRO-QUÉBEC ET SOCIÉTÉ D'ÉNERGIE DE LA BAIE JAMES (HYDRO-QUÉBEC ET SEBJ). 2012a. Centrales de l'Eastmain 1 A et de la Sarcelle et dérivation Rupert : Suivi 2010 des déterminants de santé des Cris. Rapport présenté par GENIVAR à Hydro-Québec et la SEBJ. Pagination multiple et annexes.NATIONAL ABORIGINAL HEALTH ORGANISATION (NAHO). 2007. *Broader Determinants of Health in an Aboriginal Context.* 17 pages. En ligne : http://www.naho.ca/publications/determinants.pdf

HYDRO-QUÉBEC ET SOCIÉTÉ D'ÉNERGIE DE LA BAIE JAMES (HYDRO-QUÉBEC ET SEBJ). 2011e. *Centrales de l'Eastmain-1-A et de la Sarcelle et dérivation Rupert : Bilan des enquêtes de perception de 2005, 2008 et 2010.* Rapport présenté par GENIVAR à Hydro-Québec et la SEBJ. Pagination multiple et annexes.

HYDRO-QUÉBEC ET SOCIÉTÉ D'ÉNERGIE DE LA BAIE JAMES (HYDRO-QUÉBEC ET SEBJ). 2011f. *Centrales de l'Eastmain-1-A et de la Sarcelle et dérivation Rupert : Suivi de l'intégration des travailleurs cris 2007-2010.* Rapport présenté par GENIVAR à Hydro-Québec et la SEBJ. Pagination multiple et annexes.

HYDRO-QUÉBEC ET SOCIÉTÉ D'ÉNERGIE DE LA BAIE JAMES (HYDRO-QUÉBEC ET SEBJ). 2010e. *Centrales de l'Eastmain-1-A et de la Sarcelle et dérivation Rupert : Suivi 2008 des déterminants de santé des Cris.* Rapport présenté par GENIVAR à Hydro-Québec et la SEBJ. Pagination multiple et annexes.

LE RÉSEAU QUÉBÉCOIS D'ÉCHANGE SUR LES QUESTIONS AUTOCHTONES/RÉSEAU DE RECHERCHE ET DE CONNAISSANCES RELATIVES AUX PEUPLES AUTOCHTONES (DIALOG). 2010. *Atlas socioéconomique des communautés autochtones au Québec*.

ORGANISATION MONDIALE DE LA SANTÉ (OMS). 2009a. *The determinants of health.* En ligne : http://www.who.int/hia/evidence/doh/en/index.html

ORGANISATION MONDIALE DE LA SANTÉ (OMS). 2009b. *La Commission des Déterminants Sociaux de la Santé.* En ligne : http://www.who.int/social_determinants/fr

ORGANISATION MONDIALE DE LA SANTÉ (OMS). 2007. *Social determinants and Indigenous Health : The international Experience and Its Policy Implications.* Presentations and Discussion At The International Symposium on the Social Determinants of Indigenous Health Adelaide, Commission On Social Determinants of Health. 2006.

ORGANISATION MONDIALE DE LA SANTÉ (OMS). 1999. *Report on the International Consultation on the Health of Indigenous People. Geneva, November 23rd to 26th. 1999.* 56 pages.

NATIONAL ABORIGINAL HEALTH ORGANISATION (NAHO). 2007. *Broader Determinants of Health in an Aboriginal Context.* 17 pages.

Environmental contestation in China: motives and impact

Bert Enserink, Dimosthenis Michalakeas and Dang Wenqi

Abstract

Environmental legislation in China prescribes Public Participation in Environmental Impact Assessment to be arranged by the initiator of a project. Nevertheless concerns of effected citizens are often neglected and not addressed in the impact studies. The rising public environmental awareness and realization of health risks related to the proposed activity can lead to outbreaks of public protests and mass events, which may result in cancellation of such projects. In this paper some recent cases of contestation in China are presented and their impact on environmental decision-making analysed. It shows that the Chinese public does have an impact on policy making and stimulates the government to sharpen environmental regulation and procedures.

Poor implementation of public participation provisions in environmental impact assessment in China gives rise to public contestation. Outbreaks of public protests may result in cancellation of projects and sharpening procedures.

Introduction

Since approximately the beginning 1980's China has been one of the fastest growing economies in the world. As a corollary, the unprecedented increase in the number of cars, industries, and coal-based power plants had major environmental consequences (Chunmei & Zhaolan, 2010; Du & Lin, 2015; Wang & Hao, 2012). Major urban areas such as the capital, Beijing, and other cities like Harbin face suffocating conditions, stemming from the toxic haze sprawl due to untamed urbanization (Han, Zhou, Li, & Li, 2014). Since approximately the mid-2000's pollution in China has caused several large social unrests. In particular, environmental mass incidents are on the rise in urban areas since large scale pollution cannot be tolerated anymore by the public (Wu, 2016).

Environmental legislation in China is implemented to curb the trend and prescribes PP in EIA to be arranged by the initiator of a project. Despite the regulation in place often the concerns of effected citizens are neglected and not addressed in the impact studies. Consequently, citizens protest against large scale developments that affect their living environment, especially waste-treatment facilities and paraxylene (PX) plants.

The present paper is a study regarding the possible factors that influence the willingness of the Chinese citizens to engage in health-related environmental action. Furthermore, based on the six cases studied, two of which presented in this paper, we show that the Chinese public does have an impact on policy making and thus, it can stimulate the government eventually to sharpen environmental regulation and procedures.

A variety of research methods are used: desk research, case analysis and interviews with experts. The desk research was based on existing data and official documents published by bureaus and governmental bodies (when available). We studied six cases that caused major social unrest in China, namely the Xiamen anti-PX case (2007), the Kunming anti-PX case (2013), the Maoming anti-PX case (2014), the Liu Li Tun garbage incineration plant (2007), the Panyu incineration plant (2009) and the Pingwang incineration plant (2008). Two of these cases: Kunming and Maoming are presented here. For verification five interviews with China experts were carried out.

Participation in Environmental Decisions

The concept of PP is based on the belief that those who are affected by a decision have a right to be involved in the decision-making process. This interpretation of PP in Impact Assessment was formally, first used in China in October 2003 by the Chinese leadership in the Third Plenum of the

16th Communist Party Congress (Horsley, 2009). More recently in 2014 the amendment of the *Environmental Protection Law* (first adopted in 1979) included a chapter that totally pertained to PP, entitled "Information Disclosure and Public Participation". It demands companies and governmental bodies to disclose and publish information relevant to pollution that should be available to all interested people, since everyone should have the right to access environmental information (Enserink & Alberton, 2016). The problem rests not in the legislative part, rather it is a lack of effective implementation. Xie, Yang, Hu, & Chan, (2014) revealed (or re-confirmed) four major reasons for insufficient public participation in China: (1) lack of suitable forms for collecting public opinion (53.1%), (2) lack of statutory processes and requirements (26.9%), (3) lack of technical support to participate in such activities (12.7%) and (4) absence of a responsible government agency (4.8%).

Legal action is not frequently used since citizens have to cope mainly with a number of institutional obstacles (Moser & Yang, 2011; van Rooij, 2010). These are related to (1) plaintiffs having limited or no resources; (2) justice institutions such as high costs, slow decisions, lack of independence; (3) a weak legal framework and (4) absence of necessary intermediaries such as lawyers, witnesses, etc. Knowing that the judicial track is neither very accessible, nor very supportive, the Chinese citizen chooses other ways to express his concern.

The Chinese concept of PP isn't in line with the meaning of PP, as given by Rowe & Frewer (2005): a bi-directional flow of information, Chinese scholars have a much broader definition of public participation. Their definitions of public participation focus on bottom-up communication from citizens to government and not as much on a dialogue between citizens and government. Zhang(2011) and Yu's (2006) for instance argue that public participation includes all kinds of citizen participatory practices, including voting, referenda, association, petition, protest, dialogue, demonstration, mobilization, accusation, negotiation, lobbying, public hearing, public forum, and public complaints. Zhong & Hwang (2015) confirm this idea by claiming that urban citizens were willing to take some form of action as their first choice in response to a hypothetical pollution incident. The responses provided in their survey with their likelihood are the following:

1. No action (4.1%)
2. Personally contacting local people's congress representatives (4.9%)
3. Personally contacting local government officials (16.3%)
4. Mobilizing neighbours to contact local government officials (48.3%)
5. Participating directly in street protest to get the problem solved (19.8%)
6. Other options (6.6%)

Clearly almost 50% would try to mobilize neighbours in order to address their problem to local officials and 20% would engage in street protests. The latter is corroborated by other researches. For example, the number of mass mobilizations according to Albert & Xu, (2016) increased by 31% from 2012 to 2013. In general, since the 1990s China has been experiencing an annual increase of almost 30% in protests related to the environment (Zhong & Hwang, 2015).

Cases

Kunming PX project 2013 (based on Li, 2016; Steinhardt & Wu, 2016)

Kunming is the largest city in Yunnan province in southeast China with more than 6.5 million people. As a large province, Yunnan has developed environmental NGOs that function pretty well and with a large influence.

In March 2013 the local government announced the construction of a PX plant in an industrial park around 30 km away from the city centre after the NDRC approval. Soon after, local NGOs demanded an environmental impact assessment report from the provincial environmental protection department in order to ensure the appropriateness and suitability of the potential area. They did not get any response. The two NGOs vocalized serious worries with regard to the environment and the air pollution that the plant would cause, and of course with regard to the impact on people's health.

Their strategy utilized the internet (websites, blogs) and other social network media with which a call for "civilized collective outing" was planned to take place in order to protest against the PX project. In the meantime, renowned environmentalist began a petition which was disseminated rapidly though popular mobile social portals such as WeChat. There were also some individuals who posted in online forums, with their names on, requesting the demonstration to take place. Following these events, two major protest occurred one in 4th and the other in 16th of May. After a month, with the EIA report by the ministry at hand, the city mayor declared the suspension of the project.
It is important to note that according to Steinhardt & Wu, (2016) (through interviews with protesters, officials, NOGs, etc.) the Kunming case reveals also additional characteristics for the mobilization of people such as reproach for the growth-driven local government and lack of transparency regarding public policies.

Maoming PX Project 2014 (based on Lee & Ho, 2014)
Maoming city is located in Guangdong province in southwest part of China with a total population of around 7 million (610,000 living in urban area). It has accommodated petrochemical facilities and ethylene plants for a long time and the new project funded by both local government and the Maoming PX company. The PX facility was located less than 5 km from the city centre and as a result residents have experienced pollution for a long time. In order to reach a successful outcome the local government initiated a closed-doors press campaign to direct the media and attempting to demystify and manifest the benefits and non-hazardousness of the PX project. Moreover, local officials, in an attempt to prevent protest, coerced citizens to "sign an agreement", while PX company's officials and local schools circulated a document titled "Agreement to Support the Aromatics Project of the Maoming Petrochemical Company and Maoming Municipal Government" to make citizens support the project. They also threatened students by saying that they would not be able to graduate or expelled from school in case they participated in protests. Following the exposure (by a member of PX company who spoke out) and the denial (on behalf of the deputy secretary of the education department) of the propaganda and the massive refusal of Maoming health school students to sign the document, people's indignation escalated rapidly. As a result, few aggrieved citizens living close to the planned PX site (around 1,500) initiated a peaceful demonstration in front of government's buildings which the following two days turned to a massive (estimated around 7,000) and violent protest. According to Lee & Ho, (2014), their interviews with citizens suggest that: (1) all people interviewed knew about Xiamen PX, (2) people were aware of local government official's venality, scandals and lack of transparency, (3) they no longer tolerated the job-pollution exchange as additional pollution combined with limited benefits changed the landscape and (4) the lack of NGOs branches, which are mostly active in major metropolitan areas, lead to protest.

Discussion

It is evident that over the years the Chinese government has attempted to develop a framework that would enable Chinese citizens to have a more vital role in environmental issues that would eventually increase their environmental awareness as well. But environmental policy has not been a priority for the Chinese leadership and it has been ailing for a long time. Obviously PP in IA in China seems to be not well established. The cases presented indicate that the existing PP provisions are not implemented during the project design while signs of a possible participatory process are evident in the aftermath of intense public resistance. Consequently, it would be advisable to improve the PP engagement mechanism during the project design phase by prescribing strict PP regulations and precise documentation.

Regarding the public's side, the authors suggests the implementation of online participation as the extensive usage of ICTs in China serves as a significant motivating factor for health-related environmental action in four out of the six cases studied. Although ICTs are controlled by state agencies (Freedom House, 2016), the daily communication through the use of modern technologies

enables people to bypass censorship and exchange information that could eventually motivate people to environmental action. Liu, (2016b)

Even though the primary reason to engage in health-related environmental action is concerns about the negative effects of pollution on human health, it seems that institutional factors indirectly intensify mobilisation and especially political action. In order to explain the attitude of Chinese people against the authorities, Ho (2007) introduced the term "embedded activism" which corresponds to "boundary-spanning contention" as described by O'Brien (2002). Both concepts suggest that this kind of contention exists within the canals of legality although near the margin; even a violent ending of public resistance does not damage this relation since, in the end, authorities consented to dialogue. The six cases studied (including the two cases presented in this paper) suggest that environmental resistance leads to the suspension and frequently cancellation of the proposed project. Thus, it is sensible to assume that the authorities recognize the environmental problem, which is corroborated by the recent amendments of laws that prioritize and prescribe environmental information disclosure (probably as a way to further "urge" the public to exercise additional bottom-up pressure to disobedient entities such as local authorities, companies, etc.).

Conclusion

Public protests are probably the most effective way of exercising bottom-up influence since only after continuous public resistance the (local) government suspended the proposed projects and consented to dialogue. Other methods seem to be smothered in bureaucracy. Finally, by confirming that the gap between the Chinese state and the environmental mass incidents does not necessarily damage the relation between the one party leadership and the public (since environmental pollution afflicts people without discrimination so both sides face the same enemy, namely environmental degradation), it is worth the effort to study whether a more participatory approach in environmental decision making in China could eventually lead to the sustainable development that China so much needs.

References

Asici, A. A. (2011). Economic growth and its impact on environment: A panel data analysis, (30238). Retrieved from http://mpra.ub.uni-muenchen.de/30238/

Chunmei, W., & Zhaolan, L. (2010). Environmental policies in China over the past 10 years: Progress, problems and prospects. Procedia Environmental Sciences, 2(5), 1701–1712. http://doi.org/10.1016/j.proenv.2010.10.181

Du, K., & Lin, B. (2015). Understanding the rapid growth of China ' s energy consumption : A comprehensive decomposition framework. Energy, 90, 570–577. http://doi.org/10.1016/j.energy.2015.07.079

Enserink, B., & Alberton, M. (2016). Public Participation in China: Strengths, Weaknesses, and Lessons Learned. *Journal of Environmental Assessment Policy and Management*, *18*(1), 1650005. http://doi.org/10.1142/S1464333216500058

Felstiner, W., Abel, R., & Sarat, A. (1981). The Emergence and Transformation of Disputes: Naming, Blaming, Claiming . . . *Law & Society Review*, *15*(3), 631–654. http://doi.org/10.2307/3053505

Freedom House. (2016). *Anxious Dictators, Wavering Democracies: Global Freedom under Pressure*. Retrieved from https://freedomhouse.org/sites/default/files/FH_FITW_Report_2016.pdf

Han, L., Zhou, W., Li, W., & Li, L. (2014). Impact of urbanization level on urban air quality: a case of fine particles (PM(2.5)) in Chinese cities. *Environmental Pollution (Barking, Essex : 1987)*, *194*, 163–70. http://doi.org/10.1016/j.envpol.2014.07.022

Ho, P. (2007). Embedded Activism and Political Change in a Semiauthoritarian Context. China Information, XXI(2), 187–209. http://doi.org/10.1177/0920203X07079643

Horsley, J. P. (2009). Public participation in the people's republic: developing a more participatory governance model in China. Retrieved from http://www.law.yale.edu/documents/pdf/Intellectual_Life/CL-PPPP_in_the__PRC_FINAL_91609.pdf

Lee, K., & Ho, M. (2014). The Maoming Anti-PX Protest of 2014: An environmental movement in contemporary China. *China Perspective*, *3*, 33–39. Retrieved from http://chinaperspectives.revues.org/6537?file=1

Li, W., Liu, J., & Li, D. (2012). Getting their voices heard: Three cases of public participation in environmental protection in China. *Journal of Environmental Management*, *98*(1), 65–72. http://doi.org/10.1016/j.jenvman.2011.12.019

Li, Y. (2016). *Governing Environmental Conflicts in China: Government responses to protests against incinerators and paraxylene (PX) plants*. Erasmus University Rotterdam. Retrieved from http://hdl.handle.net/1765/93089

Liu, J. (2016b). From "moments of madness" to "the politics of mundanity" - researching digital media and contentious collective actions in China. *Social Movement Studies*, *2837*(June), 1–15. http://doi.org/10.1080/14742837.2016.1192027

Moser, A., & Yang, T. (2011). Environmental Tort Litigation in China. *Environmental Law Reporter*, *41*(2002), 10895–10901. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1821748

O'Brien, K. (2002). Neither Transgressive Nor Contained: Boundary-Spanning Contention In China. Mobilization: An International Quarterly, 8(1), 51–64. http://doi.org/10.17813/maiq.8.1.6543n6m111722u42

Rowe, G., & Frewer, L. J. (2005). A Typology of Public Engagement Mechanisms. Science, Technology & Human Values, 30(2), 251–290. http://doi.org/10.1177/0162243904271724

Steinhardt, H. C., & Wu, F. (2016). In the Name of the Public: Environmental Protest and the Changing Landscape of Popular Contention in China. *The China Journal*, *20*(75), 61–82. http://doi.org/10.1086/684010

Wang, S., & Hao, J. (2012). Air quality management in China: Issues, challenges, and options. Journal of Environmental Sciences, 24(1), 2–13. http://doi.org/10.1016/S1001-0742(11)60724-9

Wu, F. (2016). In the Name of the Public: New Environmental Protest in China. [Power Point Slides]. Retrieved from https://www.wilsoncenter.org/sites/default/files/wu_fengshi_in_the_name_of_the_public_-_new_environmental_protests_in_china_0.pdf

Xie, L.-L., Yang, Y., Hu, Y., & Chan, A. P. C. (2014). Understanding project stakeholders' perceptions of public participation in China's infrastructure and construction projects: Social effects, benefits, forms, and barriers. *Engineering, Construction and Architectural Management*, *21*(2), 224–240. http://doi.org/10.1108/ECAM-12-2012-0115

Yu, K. Theoretical issues regarding public participation. Available from: http://theory.people.com.cn/GB/49150/49152/5192300.html

Zhang, X., 2011. *Political opportunity structure: a key factor impacting public participation in governmental environmental decision making in P.R.China*. Shenyang: Northeastern University Press.

Zhong, Y., & Hwang, W. (2015). Pollution, Institutions and Street Protests in Urban China. *Journal of Contemporary China*, *564*(October), 1–17. http://doi.org/10.1080/10670564.2015.1075719

Nile Basin Scenario Construction

Bert Enserink and Abby Onencan
Delft University of Technology, The Netherlands
PO Box 5015, 2600 GA Delft, The Netherlands
Corresponding author: b.enserink@tudelft.nl

Abstract

The Nile river traverses eleven countries in Africa. It is the source of life for millions of people and its aquifers, tributaries, lakes, and surface waters provide valuable nature (wetlands), drinking water, hydropower and it provides large areas of arid soils with irrigation water. Rapid urbanization, overexploitation and the construction of dams are leading to changes in the water regime and affect the quality of the ecosystems services. A participatory scenario building exercise was held in Jinja Uganda in 2014. This approach resulted in four scenarios for the future of the basin presented to the Ministers at the Nile Basin Development Forum in 2015. In this paper the scenario method, the resulting four scenarios and their impacts are presented.

Summary Statement: Rapid changes in the water regime affect the quality of the ecosystems services in the Nile basin. A participatory scenario building exercise resulted in four scenarios for the basin's future.

1. Introduction

The Nile Basin is characterised by high levels of hydro-dependencies that transverses political boundaries, while fresh water availability is shrinking. The current Nile basin water uses are not allocated equitably and reasonably thereby threatening the sustainability of the water resources [1] Since the Nile River is shared by 11 riparian states, the interests and conflicting uses are amplified. How do you facilitate these nations to effectively deliberate on prioritizing equitable access and effective governance; while avoiding reaching a deadlock?

Historically, the Nile Basin discourse has adopted a zero-sum approach. The presumption has been that there is a fixed amount of water to be divided amongst the riparian states [3]. Therefore, gains to one riparian state have been equated to losses to other basin states. This discourse structure has lead to a deadlock because there is no middle ground on which the divergent arguments can interact. As noted by Van Eeten (1999) fruitful deliberation can only be reached if a new agenda is defined that addresses the structural properties of the deadlock [2].'

Scenarios can define a new agenda by inducing changes in issue domains and acting as a bridge that links different social worlds. Scenarios are defined by Saritas (2012) as "narratives of alternative futures." Scenario construction is an ancient skill, with earlier usage by Herman Kahn with his colleagues at the RAND and the Hudson Institute in the 1960s [4]. Scenarios describe plausible futures and is deemed to be a unique strategic foresight technique because it addresses uncertainty and not risk. Scenario construction was selected for the Nile basin context because the Nile basin water governance context is increasingly becoming complex. In addition, the factors being considered are numerous, the available knowledge to anticipate future events is low and the degree of uncertainty about the future of Nile water governance, is high [4, 5, 6]. In addition, scenarios were selected so as to be interwoven with the Nile Basin models and as a consequence increase the resilience of the scientific models [7] and their utility as negotiation tools [8].

Fig.1 Nile River basin Map. Source: Encyclopaedia Brittannica Online

Yaakov (2008)[9] illustrates three main uses of scenarios that were utilised in this particular scenario planning exercise. First, scenarios lead to changes in explicit knowledge and shape the cognitive landscape by broadening the mental model on effective water governance and equitable and reasonable water use. Second, scenarios have been used to build trust, strengthen social capital and facilitate dialogue. When there is a deadlock that is reinforced by short-term planning and thinking, long-term strategic foresight in the form of scenarios may been used to build consensus through shaping the shared understanding and re-framing the contested issues and available policy options [9]. Third, scenarios are useful as `boundary-spanning' artifacts [9, 10] and help bridge the gap between policy and science.

There is, however, limited, fragmented and conflicting empirical evidence on the impact of scenarios on water governance decision-making [6, 12, 13]. There exists a big divide between scenarios and decision-making [6, 14, 15]. A lot of effort has been invested in predicting futures rather than understanding how the current system may behave in the future so as to be better prepared to take robust long-term strategic decisions [6]. In addition, many people fall into the trap of enhancing the technical sophistication of the scenarios while leaving out the most important portion: the simple narrative that brings to bear the social scientific perspectives [7].

2. The Nile Basin

The Nile is the longest river in the world with a length of 6,695 km and a navigable length of 4,149 km. The basin area of 3,176,543 km^2 is shared amongst 11 countries[1]. This basin area is 10% of the African surface area and contributes 60% of the riparian states' GDP [16]. Due to its large expanse, the basin is sub-divided into nine (9) sub-basins.[2] In 2009, the basin bare soil, shrub-lands and woodlands comprised over 68% of the basin land use [16].There is immense basin potential in expanding the under-utilised land into forests and agricultural land. The main constraint is water availability. Water governance decisions have an immense impact on the basin land-use and determine whether the basin will move more towards desertification or towards greening. 54% of the 437 million riparian state population lives within the basin area. 72% of this population lives in the rural areas and relies on agriculture not only for food but for their livelihood[3]. The population in the basin is projected to increase by 52% in 2030 [16, 17]. A large percentage of this population is highly dependent on the Nile as its freshwater source [16]. This rising population continues to put extreme pressure on the quantity and quality of the Nile water resources. The declining water quality is resulting in declining numbers of fish and increased water borne diseases.

In addition, the basin is susceptible to climate change impacts including climate induced water scarcity [18] This has increased food insecurity in the basin [19]. The hydropower potential in the basin is 28GW, of which only 26% is currently tapped. However, less than 10% of basin residents have access to electricity. Paisley (2013) [18] added to the list: the negotiation of the CFA (Cooperative Framework Agreement) seems unsuccessful while the Grand Renaissance Dam has raised tensions on the ownership of the Nile waters, and

[1]Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda
[2]Main Nile, Atbara (Tekezze), Blue Nile (Abay), White Nile, Baro-Pibor-Sobat, Bahr el Ghazal, Sudd (Bahr el Jebel), Victoria-Albert Nile and Lake Victoria.
[3]78% of the Nile waters at Aswan High dam is utilized in the agricultural sector

Sudan, South Sudan and Egypt have been undergoing unusually strong political turmoil. These social – economic and governance challenges have led to high uncertainty of the future of the Nile Basin. Scenario planning was proposed to bridge the science policy gap and thereby inform decision-making.

3. Scenario methodology

The scenarios developed were contextual scenarios of the Nile Basin water system by 2050. The scenarios were developed by undertaking an analysis of the effects of driving forces This process is defined in detail in the subsequent sub-section.

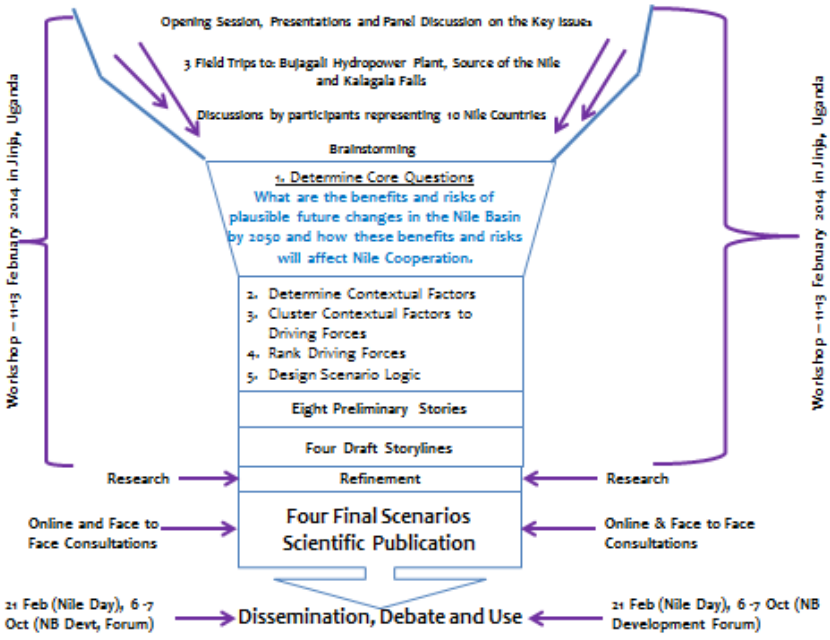


Fig.2. The Scenario Development Process

The scenario workshop "Futures planning for the restoration of ecosystem services through participatory Nile basin scenario construction" was held in Jinja Uganda, 11-13 February 2014. It was organized by Nile Basin Discourse and sponsored by Both Ends. The specific workshop objective was to develop storylines of plausible futures for the Nile Basin by 2050. The Workshop participants represented the ten riparian states and formed a multi-disciplinary group of experts and stakeholders from regional and national organizations with a spread of expertise around the various sectors and issues, local actors, as well as international partners. The scenario development process is illustrated in Figure 2. An important secondary objective of this four days workshop was to facilitate dialogue and to act as a bridge that links different social worlds.

Step 1: Determining the Core Questions

To determine the core question politicians and scientists elaborated their views to set the scene. These sessions were critical in engaging all the participants actively in determining the core question. The main question identified by the participants that the workshop was aimed at answering was: What are the benefits and risks of plausible future changes in the Nile Basin by 2050.

Step 2: Determining the Contextual Factors

In the short intensive afternoon session the participants worked in four groups on brainstorming individually and collectively on factors impacting the system (the Nile and its ecosystems services) and then organizing and naming factors, leading to a joint list of contextual factors influencing the governance of the Nile basin.

Fig. 3: The Contextual Factors

Step 3: Clustering the Contextual Factors into Driving Forces

The contextual factors influencing water governance in the Nile basin were the starting point of the next day of the workshop. Through different sequential steps, reaching consensus after each step, the list of contextual factors were scrutinized and reduced and then the groups discussed what would be the driving forces behind the changes in these factors. Causal relations were distinguished and sources of change identified. Six main driving forces were agreed upon as the main drivers for change: Governance; Population growth; Information/capacity/knowledge; Socio-economic development needs; Climate variability

and change and Energy. Figure 5 elaborates on the causal linkages identified between the contextual factors and the six main drivers of change.

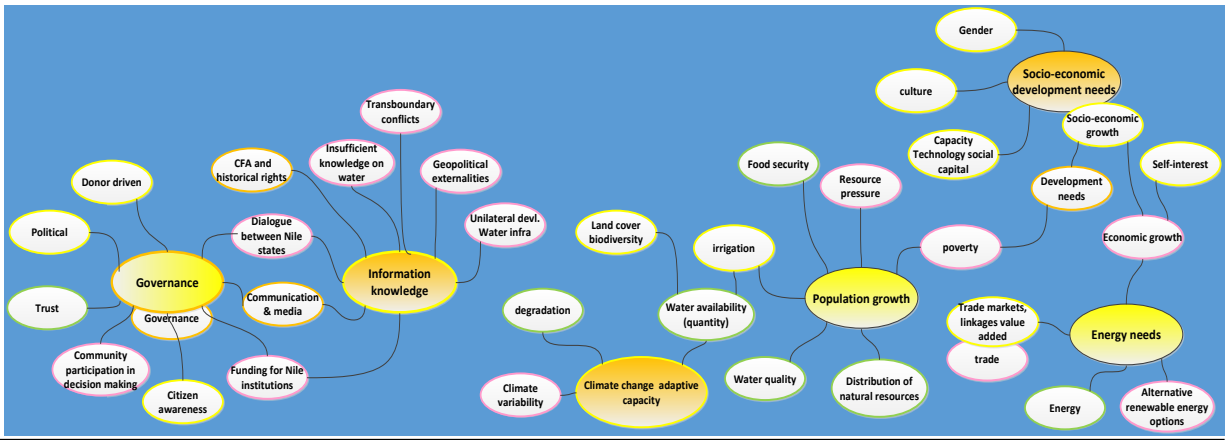


Fig. 4: Deconstruction of the scoping process: 89 factors >38 clusters of factors > 6 forces driving change

Step 4: Ranking of Driving Forces

The six main driving forces were then ranked according to their importance / relative impact on the Nile Basin system and also in terms of their uncertainty. Governance was found to be the most important, followed by socio-economic development needs and consequently by information, population growth and energy. Climate change was considered to be the least important driving force. However, in terms of uncertainty climate change was ranked the 2nd most uncertain driving force. The first most uncertain driving force was governance and the third information. The participants agreed to focus their scenario logic on these three key driving forces: governance, climate change and information.

Step 5: Designing the Scenario Logic

Two axes stood out from the rest: "Governance" (from non-responsive/non-adaptive to responsive and adaptive), and "Information sharing and knowledge" (from not shared/restricted to shared and applied). As a third axes the participants included "Climate change:" (from high variability to low variability). There was significant time spent on agreeing on the axes and the definition of terms and finally consensus was reached on the axes of the scenario logic and the definition of terms. Based on the above selection, the scenario logic was constructed as outlined in Figure 5.

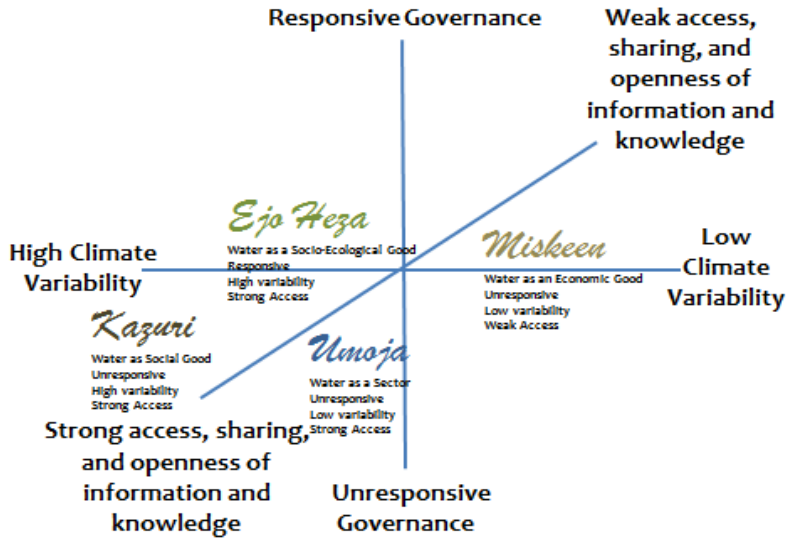


Fig. 5: The Scenario Logic

Step 6: Detailing the Scenarios

By having short pitches during the story writing the groups were able to come to a set of matching names and rudimentary storylines. The four scenarios were named: Kazuri, Miskeen, Umoja and EjoHeza. The four scenarios are not the best or the worst case scenarios but all represent some emerging potential opportunities, strengths, weaknesses and even threats that the Nile Basin may face in the near future.

Step 7: Evaluation and Dissemination

As indicated, the team of 24 active participants from the 10 Nile Basin countries were challenged to step out of their comfort zone, to be creative, critical, constructive and logical. In doing so, they learned a lot about each other's perceptions and biases. The initial storylines were edited and detailed by the workshop facilitators and further detailed in cooperation with the workshop participants. The participants were also regularly updated about the dissemination activities, like publications in the Nile Voices and future conferences. The outcomes were presented in the regional press and broadcasted in the national media in Uganda. At the opening session six members of the press including four camera teams were present.

The next big step in the dissemination of the results was the presentation to the Water Ministers at the Nile Basin Development Forum in October 2014 in Nairobi, where a special plenary session was dedicated to 'Exploring Possible Futures for the Nile'. The session set the scene for dialogue on possible and desirable futures of the Nile Basin, and on how to achieve the future we want/prevent unwanted futures. Out of the three presentations, the first focussed on the science of scenario construction as a means for stakeholder engagement and policy planning. This was followed by two presentations on results of recent scenario construction exercises for the Nile. The engaged discussion led to a political consensus that non-cooperation would be detrimental to the basin's future. The Conference Proceedings summarize as follows: "The political commitment to Nile Basin cooperation is TOTAL! Scenarios show that cooperation is a prerequisite for sustainable Nile Basin management and development."

4. References

1. Brunnée, J. and S.J. Toope, *The Nile basin regime: A role for law?*, in *Developments in Water Science*, S.A. Abdulrahman and W.W. Warren, Editors. 2003, Elsevier. p. 93-117.
2. van Eeten, M.J.G., *Dialogues of the Deaf: Defining New Agendas for Environmental Deadlocks*. 1999, Delft: Eburon Publishers
3. Godana, B.A., *Africa's shared water resources: Legal and institutional aspects of the Nile, Niger, and Senegal River systems* 1985, London and Boulder: F. Pinter. 370.
4. Saritas, O. and Y. Nugroho, *Mapping issues and envisaging futures: An evolutionary scenario approach.* Technological Forecasting and Social Change, 2012. **79**(3): p. 509-529.
5. Tapinos, E. and E. Tapinos, *Perceived environmental uncertainty in scenario planning.* Futures, 2012. **44**(4): p. 338-345.
6. Enserink, B., J.H. Kwakkel, and S. Veenman, *Coping with uncertainty in climate policy making: (Mis)understanding scenario studies.* Futures, 2013. **53**(0): p. 1-12.
7. Yaakov, G., P.a. Simone, and D.V.D. Stacy, *Scenarios in society, society in scenarios: toward a social scientific analysis of storyline-driven environmental modeling.* Environmental Research Letters 2008. **3**(4).
8. Peterson, G.D., G.S. Cumming, and S.R. Carpenter, *Scenario Planning: a Tool for Conservation in an Uncertain World.* Conservation Biology, 2003. **17**(2): p. 358-366.
9. Yaakov, G. e.a. Scenarios in society, society in scenarios: towards a social scientific analysis of story-line driven environmental modeling. Environemental Research Letters 2008. 3(4)
10. Gieryn, T., *Cultural Boundaries of Science: Credibility on the line* 1999, Chicago, IL: University of Chicago Press.
11. Shackley, S. and B. Wynne, *Representing uncertainty in global climate change science and policy: Boundary-ordering devices and authority.* Science, Technology & Human Values, 1996. **21**(3): p. 275-302.
12. Goodwin, P. and G. Wright, *The limits of forecasting methods in anticipating rare events.* Technological Forecasting and Social Change, 2010. **77**(3): p. 355-368.
13. Varum, C.A. and C. Melo, *Directions in scenario planning literature – A review of the past decades.* Futures, 2010. **42**(4): p. 355-369.
14. Hermans, L.M. and W.A.H. Thissen, *Actor analysis methods and their use for public policy analysts.* European Journal of Operational Research, 2009. **196**(2): p. 808-818.
15. Quist, J., W. Thissen, and P.J. Vergragt, *The impact and spin-off of participatory backcasting: From vision to niche.* Technological Forecasting and Social Change, 2011. **78**(5): p. 883-897.
16. Nile Basin Initiative, *State of the River Nile Basin Report 2012*. 2012, Entebbe, Uganda: Myriad Editions.
17. Salman, S.M.A., *The Nile Basin Cooperative Framework Agreement: a peacefully unfolding African spring?* Water International, 2012. **38**(1): p. 17-29.
18. K. Paisley, R. and T.W. Henshaw, *Transboundary governance of the Nile River Basin: Past, present and future.* Environmental Development, 2013. **7**(0): p. 59-71.
19. UNEP, N., *Adaptation to Climate Change Induced Water Stress in the Nile Basin: A Vulnerability Assessment Report*, ed. E. Kironde-Gowa. 2013, Nairobi, Kenya: UNEP.
20 NBDF Proceedings: http://www.nilebasin.org/index.php/media-center/documents-publications/26-proceedings-of-the-4th-nile-basin-development-forum/file

Promises and Pitfalls of Simplified EIA

Alberto Fonseca
Interdisciplinary Laboratory of Environmental Management (LiGA), Federal University of Ouro Preto (UFOP), albertof@em.ufop.br

Abstract

Pressures are mounting for the simplification of Environmental Impact Assessment (EIA). This phenomenon is drawing increasing scholarly attention, but studies have not gone far beyond the examination of recent regulatory changes. This paper takes a more longitudinal look at the simplification of EIA. The main objective is to analyze the outcomes of a number of simplified EIA process implemented in the past decade in Brazil's southeastern states. Data was collected through literature reviews and 18 face-to-face interviews. While simplification is often framed as regulatory and procedural changes that can reduce administrative burden, speed up the process and, at the same time, provide better environmental protection, the realization of the latter is contested. Some interviewees revealed concerns about the effects of simplification on the ground. One of the main concerns is that, without appropriate audits and inspections, simplified EIAs can further reduce environmental control.

Introduction

While the concept of simplicity has been studied in research fields such as cognitive sciences (Chater and Vitányi, 2003), it rests marginally explored in the field environmental impact assessment (EIA). However, recent regulatory changes in EIA policies are highlighting the importance of better comprehending the nature and effects of simplicity.

Much has evolved since 1969, when EIA was first regulated in the United States. EIA is now present in virtually every country on Earth (Morgan, 2012). Regulations have become more complicated; stakeholders and institutions, more diverse. And, despite decades of practical experiences and scholarly research, the benefits of EIA are not always clear (Morrison-Saunders et al. , 2015). Not surprisingly, the perceived shortcomings of EIA are being increasingly framed as a matter of excessive bureaucracy, cumbersome regulations, and unnecessary administrative burden. In reaction, policy-makers have begun to simplify EIA policies and procedures (e.g. Gibson, 2012; Middle et al, 2013, Sandham et al. 2013).

The revision of European Union EIA Directive (2014/52/EU) epitomizes this trend. During the review of the directive, the Commission concluded that it had the potential "for a future simplification exercise, the aim being to identify overlaps, gaps and potential for reducing regulatory and administrative burdens, in particular regarding transboundary projects" (CEC, 2009). As a result, the 2014 amended directive mandated Member States to simplify their various environmental assessment procedures, introduce shorter timeframes for

different stages of the EIA process, and much more (European Commission, 2014). Similar simplification-driven EIA review processes have taken place, for example, in Canada (Gibson, 2012), Australia (Middle et al. , 2013), South Africa (Sandham et al. , 2013) and Brazil (Oliveira et al. , 2016). In the latter, simplification has been underpinning changes in EIA regulations since at least the mid-1990s. The quest for simplification is likely to continue. Simplicity is a very attractive concept. As Gibson points out, “in a world that is complex, difficult, ambiguous and uncertain, simplicity offers a soothing never-never land of uncomplicated truth and easy fixes” (Gibson, 2010, p. 40).

The simplification phenomenon is drawing increasing scholarly attention, but studies have not gone far beyond the examination of recent regulatory changes. For example, Bond et al. (2014), in their review of recent EIA streamlining in Australia, acknowledged that “(…) no conclusion can be reached on whether such streamlining can be seen as cost effective or not”, and thus called researchers to revisit the effects of streamlining in the future. This paper takes a more longitudinal look at the nature and effects of EIA simplification using Brazil as the empirical context. The main objective was to analyze the perceived outcomes of a number simplified EIA process implemented in the past decade in Brazil’s southeastern states. Brazil has a unique EIA system that should be carefully compared to Australia’s, Canada’s or any other international system. In Brazil, as Oliveira *et al* (2016), the simplification of EIA can take various forms. However, by shedding some light on Brazil’s diversity, this study hopes to add more content to an increasingly relevant debate in the EIA research community.

The paper proceeds in four sections, besides this introduction. The following explains the methodology. The third section presents a conceptual review of simplified EIA, with a particular focus on the Brazilian context. The fourth section presents the results of the interviews with representatives of four Brazilian environmental agencies. Section five finally draws concluding remarks.

Methodology

This article has a geographical and temporal focus on southeastern Brazil in 2014-2015, and based its findings mostly on data collected through literature reviews and interviews. The interviews (all confidential, face-to-face and audio-recorded) were undertaken, between 2014 and 2016, in the premises of the four state environmental agencies of southeastern Brazil, as follows: CETESB (state of São Paulo); INEA (state of Rio de Janeiro); IEMA (state of Espírito Santo); SEMAD (state of Minas Gerais). Table 1 presents the codes and profiles of the 10 mains interviewees. The author also conducted 8 short, targeted interviews (through telephone calls) with analysts from those agencies to confirm specific information found on the academic and grey literatures.

Table 1- Main Interviewees` profiles and codes

Agency	Profile	Code
CETESB (SP)	High administration position with more than 20 years of experience in the agency	SP-1
	High administration position with more than 10 years of experience in the agency	SP-2
	Leading technical position with more than 10 years of experience in the agency	SP-3
INEA (RJ)	High administration position with more than 30-year experience in the agency	RJ-1
	Leading technical position with more than 10 years of experience in the agency	RJ-2
IEMA (ES)	High administration position with more than 10 years of experience in the agency	ES-1
	High administration position with more than 5 years of experience in the agency	ES-2
	Leading technical position with more than 10 years of experience in the agency	ES-3
SEMAD (MG)	High administration position with more than 30-year experience in the agency	MG-1
	Leading technical position with more than 10 years of experience in the agency	MG-2

It should be noted that this paper synthetized the main findings of a research project. The complete findings of the interviews are expected to be published later in a scientific journal.

Results

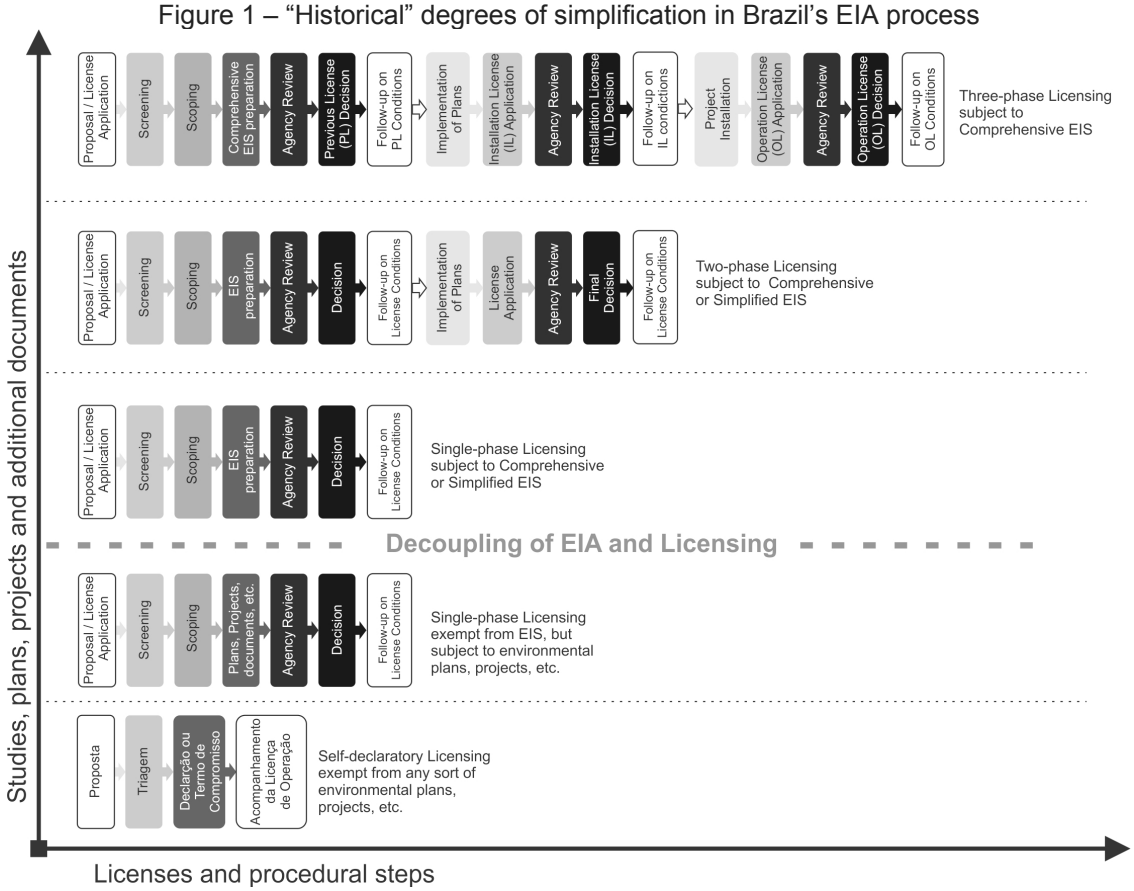
The Various Ways to Conceptualize and Implement Simplified EIAs

Policy makers are increasingly trying to simplify EIA, that is, trying to reduce its complexity, but this is often carried out without any direct mention to the concept of simplicity. Systematic searches conducted in November 2016 in Scopus and Science Direct revealed less than a couple dozen of articles that explicitly use the term “simplification”, “simple”, “simplify” to describe procedural and regulatory changes in EIA systems. The term “streamlining” (one of the potential effects of simplification) is arguably most often used to describe attempts to simplify EIA, particularly in countries like Canada and Australia. In Europe, grey literature suggests that the verbs “streamline” and “simplify” have been used interchangeably, as if they were synonymous. Arguably, the literature suggests that there is no consensus over what a simple EIA or a simplified EIA means - our should mean. The simplification of EIAs is, therefore, likely to reflect the various political and institutional contexts in which EIA is carried out.

In Brazil, the simplification of EIA has been explicitly addressed by policy makers. This is to a great extent a result of one of the country’s most important federal-level EIA regulations, CONAMA Resolution 237/97 (CONAMA, 1997), which states that those projects that are “potentially low impact” or that include some sort of “voluntary program of environmental management” can be subject to simplified procedures of environmental licensing and impact assessment. This resolution provided explicit incentives for the simplification of EIA procedures, but in specific situations. Between 2001 and 2010, the Brazilian government published at least 8 federal-level resolutions creating alternative, simplified EIA procedures for potentially low-impact projects. The simplification, during this period, was clearly reflecting an attempt to reduce the number of licensing phases as well as the volume of information in environmental studies and other documents required in the process.

At the state level in southeastern Brazil, numerous simplified EIA procedures were created between 2004 and 2015, also targeting potentially low-impact projects. The degree of simplification varies significantly. As shown in Figure 1, it ranges from the complete exemption of Environmental Impact Statements (EIS) through self-declaratory permits (as in the case of the AAF permit system in Minas Gerais), to narrower scopes in EISs. Various federal-level and state-level approaches to EIA simplification, in Brazil, suggest that simplification is most frequently implemented through the reduction of licensing and procedural steps, as well as through the reduction in the quantity of information required in the approval process, as illustrates Figure 1. Interestingly, in Brazil the simplification can reach degrees in which the EIA process is decoupled from the licensing process through the complete exemption of impact assessment studies.

Figure 1 – “Historical” degrees of simplification in Brazil’s EIA process



Source: Designed by the author. The white/grey/black was used to indicate progress on specific licensing phases.

The simplified approaches to the traditional three-phase licensing with comprehensive EIS are, increasingly, being applied to large projects with a clear potential for significant negative impacts. For example, mining projects and small, but potentially impactful hydropower plants, are being increasingly exempted from more complex licensing processes. In the year 2011, the Brazilian federal government issued a number of regulations targeting mainly large infrastructure projects (e.g. oil and gas, railroads, ports, etc.). In these

cases, simplicity is sought after not only through reduction of procedures and information in the process, but also through harmonization and institutional changes. In these cases, instead of reduction of something, simplification takes the form of process and institutional optimization and integration. Simplification, in any case, is often "sold" as a win-win situation, where administrative burden is reduced and process sped up while maintaining the quality of decision-making. Such claims, however, are rarely evaluated.

The Perceived Effects of Simplification on the Ground

The effects of EIA simplification are beginning to draw scholarly attention. In Brazil; however, very few studies addressed this problem. The interviews conducted here were fundamental to overcome this knowledge gap. All four southeastern states have been adopting some sort of simplification measures in their EIA processes, but the states of Minas Gerais, Espírito Santos and São Paulo seem to be more explicitly trying to simplify their procedures in the past decade. According to the interviewees, the main driver for simplifying EIAs has been the states' low institutional capacity, a fact corroborated recently by Fonseca et al (2017). The interviewees, in all four states, recognized that their analysts are not capable of reviewing all EIA processes that are filed in the agencies. As one of them pointed out: "piles of EISs are waiting for our review, but we simply do not have enough staff" (MG-2). In São Paulo, thousands of EIA processes were accumulating the agency's archives (SP-1). The interviews suggest that those who manage EIA in environmental agencies do not perceive simplification as an option, but as a necessity. Developers' pressure to streamline the process, according to a couple of interviewees (MG-2, ES-3), can also play a role in driving simplification, but not as great as the internal factors.

The state governments, unfortunately, have not yet developed geographical and environmental information systems to effectively monitor changes in their territories, let alone to monitor changes that resulted from their policy changes. While many interviewees (e.g. SP-1, MG-1, ES-3, RJ-1) highlighted their efforts in this area, their statements suggest that it would be extremely difficult to establish a cause-and-effect relationship between EIA policy change and environmental quality on the ground.

Several interviewees were hesitant to comment on the actual effects of EIA simplification on the ground, particularly in São Paulo and Rio de Janeiro. But in Minas Gerais, one of the interviewees stated that their 2004 self-declaratory permitting system had failed, as it had very questionable outcomes on the ground. As a result, the Minas Gerais agency decided to phase out that system, in favor of a "less simplified" one. In Espírito Santo, one of the interviewees (ES-1) acknowledged that their simplified permitting system, while having clear internal benefits, could be translating into worse environmental performance.

Concluding Remarks

EIA has been increasingly simplified worldwide, but few studies have analyzed its effects and conceptual aspects. This study addressed this problem in the context of Brazil's southeastern states. Through literature reviews and interviews, it was found the simplifying of EIAs, most often, takes the form of reduction of procedures and information in the process. It was also identified a more recent trend to simplify EIA through harmonization and institutional changes. While simplification is often framed as regulatory and procedural changes that can reduce administrative burden, speed up the process and, at the same time, provide better environmental protection, the realization of the latter is contested. The interviews, particularly in Minas Gerais State and Espírito Santo, revealed concerns about the effects of simplification on the ground.

References

Bond A, Pope J, Morrison-Saunders A, Retief F, Gunn JAE. Impact assessment: Eroding benefits through streamlining? Environmental Impact Assesment Review. 2014;45:46-53.

CEC. Report on the application and effectiveness of the EIA Directive (Directive 85/337/EEC, as amended by Directives 97/11/EC and 2003/35/EC) Brussels: Commission of the European Communities (CEC); 2009.

Chater N, Vitányi P. Simplicity: a unifying principle in cognitive science? TRENDS in Cognitive Sciences. 2003;7:19-22.

CONAMA. Resolução CONAMA Nº 237/1997 - Regulamenta os aspectos de licenciamento ambiental estabelecidos na Política Nacional do Meio Ambiente. Brasília: Conselho Nacional do Meio Ambiente (CONAMA); 1997.

European Commission. Press Release: Impact assessment of projects now simplified. Brussels: European Comission; 2014.

Fonseca A, Sánchez LE, Ribeiro JCJ. Reforming EIA systems: A critical review of proposals in Brazil. Environmental Impact Assesment Review, 2017;62, 90-97.

Gibson R. Simplicity. Sounds good, if you don't mind a dollop of ignorance with your bliss. Alternatives Journal. 2010;36:40-40.

Gibson RB. In full retreat: the Canadian government's new environmental assessment law undoes decades of progress. Impact Assessment and Project Appraisal. 2012;30:179-88.

Middle G, Clarke B, Franks D, Brown L, Kellett J, Lockie S, et al. Reducing Green Tape or Rolling back IA in Australia: What are four jurisdiction up to? 2013 Conference of the International Association for Impact Assessment. Calgary, Canada 2013.

Morgan RK. Environmental impact assessment: the state of the art. Impact Assessment and Project Appraisal. 2012;30:5-14.

Morrison-Saunders A, Bond A, Pope J, Retief F. Demonstrating the benefits of impact assessment for proponents. Impact Assessment and Project Appraisal. 2015;33:108-15.

Oliveira FSD, Prado Filho JFd, Rocha CPF, Fonseca A. Licenciamento ambiental simplificado na região sudeste Brasileira: conceitos, procedimentos e implicações. Desenvolvimento e Meio Ambiente. 2016;38:461-79.
Sandham LA, van Heerden AJ, Jones CE, Retief FP, Morrison-Saunders AN. Does enhanced regulation improve EIA report quality? Lessons from South Africa. Environmental Impact Assessment Review. 2013;38:155-62.

A Changing Climate: Environmental Assessment for a Proposed Mine in Yukon, Canada.

Presenting Author:

Colin Fraser, colin.fraser@lorax.ca
Lorax Environmental Services Ltd., 2289 Burrard Street, Vancouver, BC, Canada V6J 3H9

Co-authors (alphabetically by last name)*:

*Jennie Gjertsen, Jennie.Gjertsen@goldcorp.com
Goldcorp Inc., 666 Burrard St #3400, Vancouver, BC, Canada V6C 2X8

*Scott Jackson, scott.jackson@lorax.ca
Lorax Environmental Services Ltd., 2289 Burrard Street, Vancouver, BC, Canada V6J 3H9

*James Scott, James.Scott@goldcorp.com
Goldcorp Inc., 666 Burrard St #3400, Vancouver, BC, Canada V6C 2X8

1.0 Introduction: This paper pertains to the construction, operation, reclamation and closure of the Coffee Gold Mine (Coffee Project or Project), a proposed gold development project in west-central Yukon, approximately 130 km south of Dawson, Yukon, Canada. Major infrastructure related to mining and processing at the Project area includes: an upgraded road; a primary waste rock storage facility; several open pits; water diversion structures and storage ponds; haul roads; primary and secondary crushing facilities; heap leach facilities; a gold refinery; an accommodation complex; and an all-weather airstrip.

Local climate conditions for the site are typical for the region: average annual air temperature (T) is -2.6 °C and mean annual precipitation (P) is estimated to be 485 mm (65% rain, 35% snow) at elevation 1,300 m above sea level. Inspection of the instrumental records from nearest weather stations (e.g., Dawson, Mayo, Pelly Ranch) confirms T and P have been increasing on an annual basis since the 1960s. Further, climate change scenario data for the Project area indicate continued change for these key water balance variables (i.e., +5°C and +20% increases by 2100).

2.0 Objectives of the Poster: The sections below summarize steps taken to create a long-term (84-year), daily- climate record that accounts for a changing climate and then introduces a site-specific water balance model (WBM) that has been constructed and calibrated using GoldSim modelling software. To evaluate potential issues and risks associated with the Project and to fulfill requirements for an EA submission, the long-term climate record was used to drive the WBM with outputs being used to quantify residual streamflow changes attributable to the Project.

3.0 Baseline Monitoring: A baseline hydrology program was initiated at the Project site in the autumn of 2010, starting with installation of 3 automated hydrometric stations. Eight additional stations were established in 2014 to further characterize the streamflow regime of headwater basins containing Project infrastructure. A high-elevation climate station was installed in summer 2012 and measures: air temperature and relative humidity (2 m); wind speed and direction (10 m); incoming solar radiation (2 m); barometric pressure; and precipitation (tipping bucket rain gauge with solid phase adapter and Alter shield). Snow course measurements are also carried out

at several site stations (i.e., various elevations, aspects and cover types) following Yukon protocols.

4.0 Generation of a Long-term, Daily- Climate Record for the Project: The procedures below were followed to generate a long-term climate record for the mine site:

- Daily climate data from the mine site and a nearby regional station were assembled to create monthly predictive relationships (i.e., x-axis, regional station; y-axis, mine site climate station) based on 4-years of overlapping data.
- Next, the regional station (predictor) and the monthly predictive relationships derived for T and P were utilized to compute a long-term synthetic climate record representative of the mine site.
    - The McQuesten, YT, climate station was selected as the most desirable regional predictor station owing to proximity to the mine, overall duration (28 years) and active monitoring status through 2015.
- To span the full Project life (i.e., Construction (Today to 2021); Operations (2020 to 2029); Closure (2030 to 2040); and Post-closure (2041 to 2100), the 28-year climate record was looped three times to create an 84-year, daily climate record.
- To represent a plausible future condition, climate change scenario data were downloaded from the Scenario Network for Alaska and Arctic Planning (SNAP, 2016), a research collaborative that produces downscaled, historical and projected climate data for sub-Arctic and Arctic regions of Alaska and Canada.
- Monthly T an P predictions (2001 to 2100, CMIP3/AR4 – A2 Scenario, 2 km grid) for grid points covering the mine site extent were downloaded, averaged and then used to scale the 84-year, looped daily climate record.
- For water balance modelling, the resultant climate-scaled daily dataset was utilized to represent years 2018 to 2101 inclusive (shown in Figure 1 below).

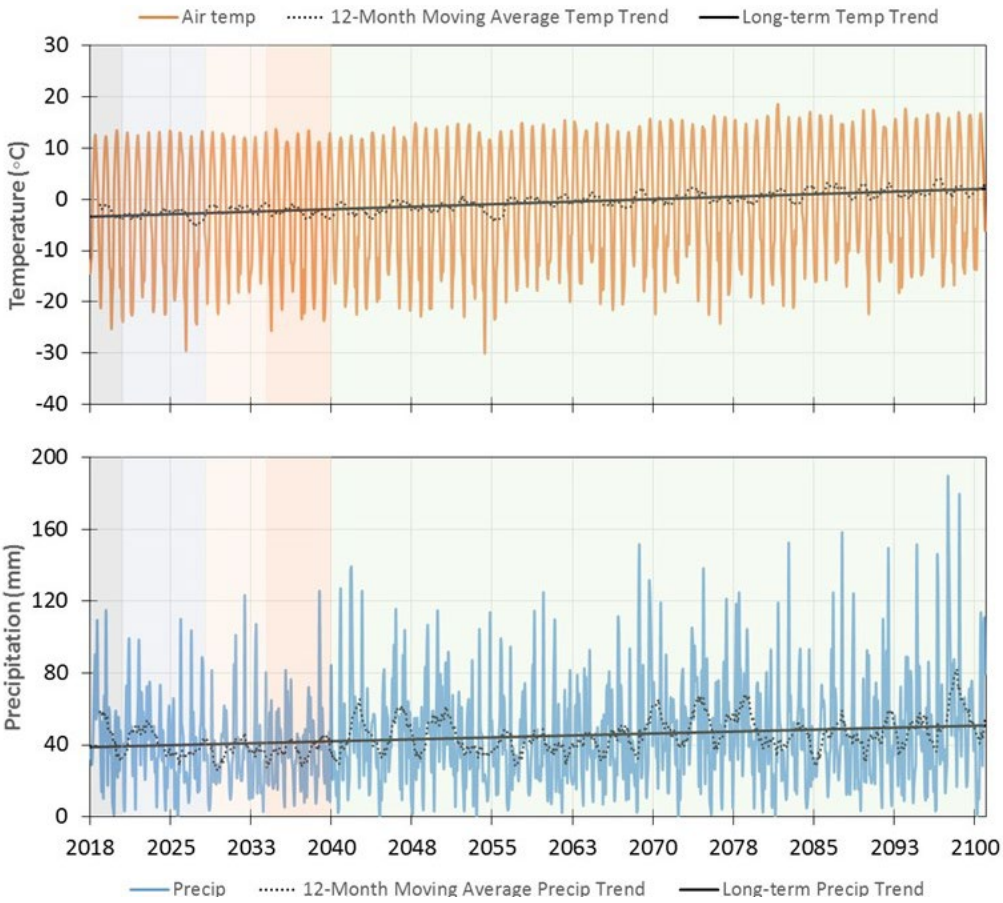


Figure 1: Climate inputs to the Project WBM for the period 2018 to 2101.

5.0 Construction of a Site-Wide Water Balance Model for Natural and Base Case Conditions:

The WBM for the Coffee Gold Mine was developed in GoldSim and considers ten receiving environment nodes, each situated downstream of mine drainages containing waste rock and/or open pits. The WBM was first constructed and calibrated to predict streamflow conditions in local watercourses for a Natural Flow condition (i.e., a baseline scenario that considers no Project). A detailed description of this model is presented in Table 1, which serves as a summary of how geospatial data and baseline/synthetic climate and hydrometric information were used to construct and calibrate the watershed model. Representative model output from the Natural Flow sub-model is shown in Figure 2 (i.e., the figure shows measured/baseline flows (red lines) versus modelled flows (blue)) and provides an overall indication of the reasonableness of the WBM calibration.

Table 1: Water Balance Model – Natural Flow Sub-model

Natural Flow (Baseline) Sub-model	
GIS Data	• Watershed boundaries and hypsometric outputs (*i.e.*, curves and representative bands of elevation data) for local catchments were generated from 1:50,000 mapping data. • To encode elevation dependent climate parameterizations into the WBM, drainages were separated into three elevation bands (400-800 m, 800-1200 m and >1200 m).
Climate	• The natural flow sub-model of the WBM was driven by a 28-year P, T and evaporation record that was looped three times. • P and T inputs were scaled by elevation using gradients ascertained from site- and regional climate data. • Monthly climate change scenario data (from the Scenario Network for Arctic Planning) for the A2 emission scenario (2-km resolution) were used to scale P and T inputs over the long term (Closure and Post-closure phases).
Hydrology	• Baseline hydrology data from autumn 2010 to December 2015 were combined with regional streamflow data to generate long-term synthetic streamflow records. • The sub-model was calibrated at daily time-step using long-term, daily- synthetic streamflow data as the target.
Outputs	• For this sub-model and Base Case, 84-year predicted streamflow records are generated for seven local tributaries and three large river nodes at a monthly time step. • The outputs per WBM node consist of 28 unique iterations (*i.e.*, 28-year climate record is time stepped) each extending the 84-year time-period.

The same catchment boundaries, climate and hydrology inputs described for the Natural Flow sub-model (Table 1) were used to populate undisturbed portions of local watersheds in the Base Case (With Project) sub-model. However, to represent the disturbed condition, year-by-year mine footprints for proposed open pits, a waste rock storage facility, the heap leach facility, soil and ore stockpiles and related Project infrastructure were encoded into the Base Case sub-model. Sediment control ponds and conveyance structures (e.g., drains, interception ditches) envisioned for the Project were also represented in the Base Case model.

A notable feature of the WBM was that it was configured in GoldSim using separate 'reservoirs' to track different types of flow, building upon applicable research and modelling of Christophersen and Seip, 1982 and Seip et al., 1985. Briefly, the architecture of the watershed model is predicated on the concept that natural streamflow, or any runoff generated from mine footprint areas, is comprised of three types of flow as described by Maidment (1993): 1) quickflow, generated by storm or snowmelt events and often resulting in peak flow events; 2) interflow, derived from near-surface, lateral movement of infiltrated meteoric water through the catchment; and 3) baseflow, the portion of surface discharge derived from groundwater discharge.

The WBM was accurately calibrated to replicate baseline flow conditions for undisturbed areas (e.g., Figure 2), or to conditions consistent with professional practices (e.g., targeting a desired

waste rock seepage runoff coefficient or pitwall runoff efficiency) in the case of the Base Case module, over a wide range of flow conditions and at high-resolution time-step. Accordingly, surface runoff, snowfall/melt processes and aufeis production from winter baseflow are all represented in the Natural Flow and Base Case modules of the WBM.

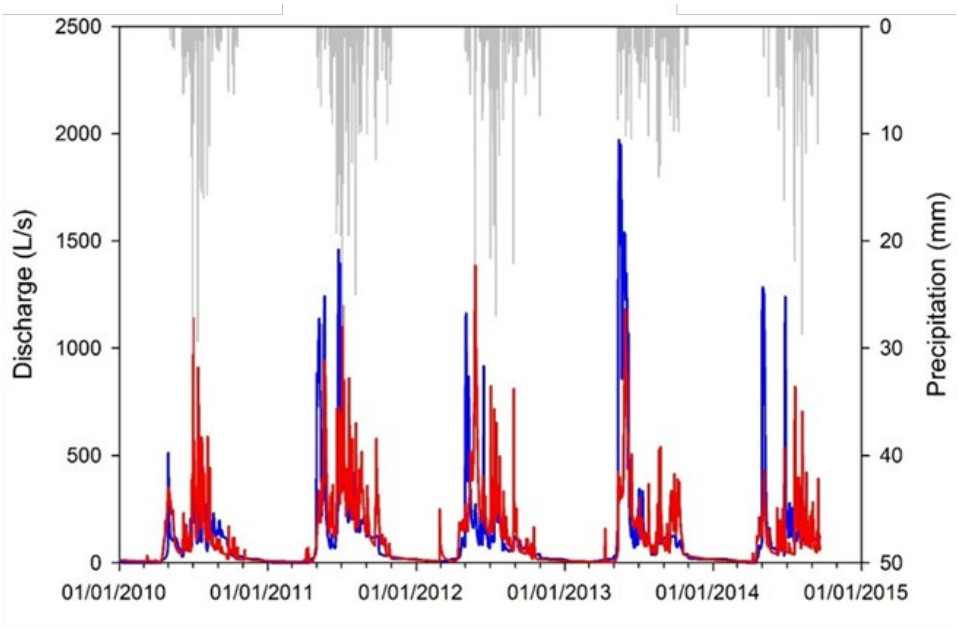


Figure 2: Measured (red) and modelled (blue) natural flow series for a sample WBM node. Growing season rainfall is shown in the figure using grey bars.

6.0 Data Analysis and Streamflow Assessment Results:

For each identified WBM node, resultant flow series from the Natural Flow and Base Case sub-models were compared to one another with Project-related flow changes being indexed against natural/baseline conditions. Daily WBM model outputs were averaged to monthly flow values and predicted streamflow changes were then represented by a percent change metric as follows:

Percent change (%) = ((Mine Altered Flow – Natural Flow)/Natural Flow) x 100 [Eqn 1]

A suite of streamflow change characteristics (i.e., direction, magnitude, frequency and reversibility of streamflow change) were selected to guide a detailed streamflow change assessment. These change characteristics were selected to best quantify and describe potential streamflow changes against key components of a natural flow regime as described by Poff et al. (1997).

Natural Flow and Base Case WBM outputs were screened using tabular and graphical formats (e.g., flow vs. percent change plots, comparative flow duration curve plots, time series plots). Figure 3 (upper panel) shows sample Natural Flow and Base Case time series results for three different flow conditions. These flow predictions are for a location currently predicted to experience minimal change to streamflow indicators owing to the Project. While predicted flow changes at this location are minor, it is important to note that the surface water quantity (streamflow) valued component is closely linked to other water-related studies (e.g., groundwater

quantity and quality, surface water quality, fish and aquatic habitat) and necessary that streamflow changes be assessed through the lenses of these related disciplines.

Decadal patterns and trends in streamflow were also assessed in this study by analyzing Natural Flow sub-model outputs (see Figure 3, lower panel) from the WBM. Consistent with recent findings for the Yukon (Streiker, 2016), these model results confirm the following streamflow changes for a warmer and wetter future climate regime: progressively earlier onset of freshet; later occurrence of autumn freeze up and longer ice-free season; changes to the relative proportions of P realized as rainfall vs. snowfall, especially in the spring and autumn seasons; increases in winter baseflow conditions and likelihood of mid-winter melt event; and, progressive increase in annual discharge over time.

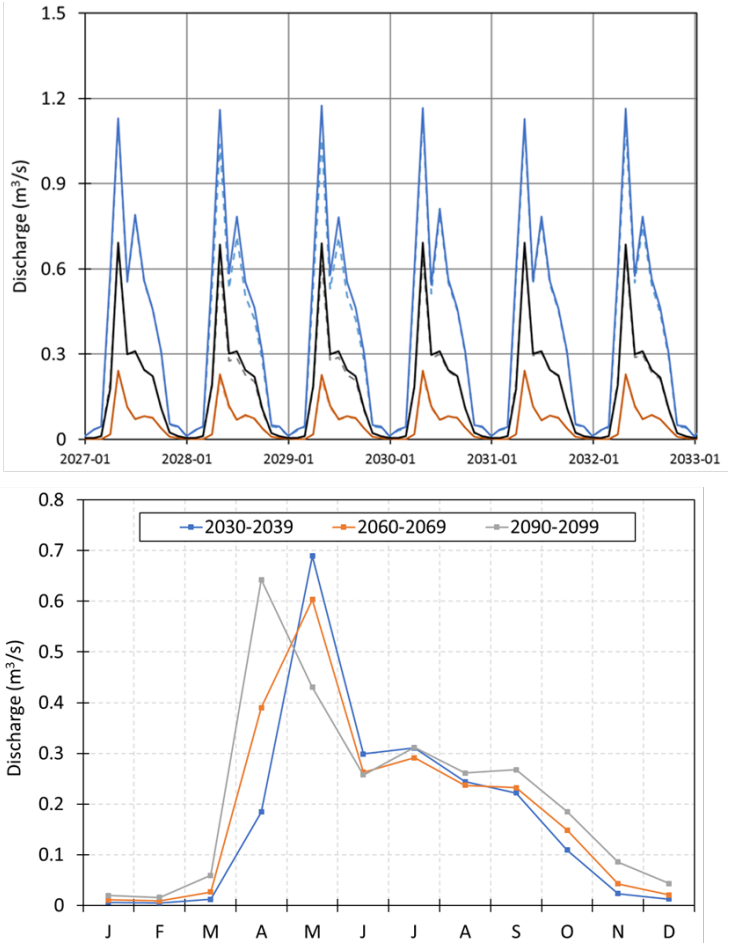


Figure 3: Example flow outputs for a WBM node. The upper panel compares Natural Flow and Base Case outputs for a 6-year period. The lower panel, which is based on output from the Natural Flow sub-model, shows predicted decadal shifts in monthly streamflow owing to future T and P changes.

7.0 References

Christophersen, N. and H.M. Seip. 1982. A model for streamwater chemistry at Birkenes, Norway. Water Resources Research. 18:4, 977-996.

Maidment, D.R. 1993. Handbook of hydrology. McGraw-Hill. 1424 pp.

Poff, N.L., J.D. Allan, M. B. Bain, J.R. Karr, K.L. Prestegaard, B. Richter, R. Sparks, and J. Stromberg. 1997. The natural flow regime: a new paradigm for riverine conservation and restoration. BioScience 47:769-784.

Seip, H.M., R. Seip, R., P.J. Dillon, and E. de Grosbois. 1985. Model of sulphate concentration in a small stream in the Harp Lake catchment, Ontario. Can. J. Fish Aquat. Sci. 42: 927-937.

SNAP, 2016. Scenario Network for Alaska and Arctic Planning. Data portal for climate change scenario data: https://www.snap.uaf.edu/tools/data-downloads

Streicker, J. 2016. Yukon Climate Change Indicators and Key Findings 2015. Northern Climate ExChange, Yukon Research Centre, Yukon College, 84 p.

Sustainability in EIS of sugarcane ethanol sector

Davi Wilkson Furtado Sozinho [1]
Amarilis L. C. Gallardo [2]
Roseli Frederigi Benassi [3]

Introduction

Brazilian sugarcane ethanol is expected to play an important role in achieving sustainability (Filoso et al. 2015) by providing a relevant source of renewable fuel in the global energy scenario. Brazil is the largest grower worldwide and since 2003 sugarcane ethanol has been mostly produced for attending internal market of biofuels for flex fuel vehicles fleet (Goldemberg et al. 2008). However, there is a still current prospect for growth and also for import to supply foreign market (de Mattos Fagundes et al. 2016).

Notwithstanding, some recognized benefits for diversifying energy grid by using renewable sources there is a controversial debate with regarding sustainability of sugarcane ethanol production not only in Brazil but in other parts of the world such Southern Africa, Thailand and Latin America (Janssen; Rutz, 2011). Significant negative impacts are inherent in all stages of the sugarcane ethanol production process from agricultural to industrial phase. Brazilian ethanol has been subject of considerable criticism from the international market that crediting serious problems to environment and social matters to its production (Triana, 2011).

As a response to this growing concern on sustainability of expanding production of biofuels some traditional impact assessment tools have been recommended such as Life Cycle Assessment (LCA), Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA). Of these instruments, EIA is broadly applied for assessing the planned expansion and expected impacts in sugarcane ethanol producer countries such Brazil (Gallardo and Bond, 2011a). To achieve sustainability the Brazilian sugarcane ethanol production has been using EIA guided by the Environmental Impact Statements (EIS).

In Brazil, since 1981, EIA is applied to projects that may cause significant effects to the environment (Montaño and Souza, 2015), when the Brazilian National Environmental Policy was introduced. According to Gallardo and Bond (2011a, b) the institutional framework for EIA in Brazil has some examples of good practice, especially in the State of São Paulo. For Sánchez and Silva-Sánchez (2008), in this state the EIA process is quite strong.

This research has as a problem the following question: is there a balance between the distribution pattern of the environmental, social and economic impacts of the EIS of sugarcane ethanol plants in the State of São Paulo?

The objective of this research is to explore how the Environmental Impact Assessment embraces the sustainability pillars in Brazilian sugarcane ethanol sector.

Methodology

This is an applied research based on exploratory-descriptive approach, performed through a multi-case study where data collection was accomplished by documental data. In Brazil there are currently 382 sugarcane plants capable to produce ethanol fuel, 357 in operation and 25 authorized, of these, 164 are located in the São Paulo State (ANP, 2016), the foremost Brazilian producer. Due to this reason we choose those sugarcane plants situated in the State of São Paulo - where there is evidence of good practice in EIA process (Sánchez and Silva-Sánchez, 2008; Montaño and Souza, 2015) Some ethanol plants have the Bonsucro environmental certification, specific to the sugarcane production chain, in search of greater sustainability (Jordão and Moretto, 2015). As a criterion of our research subject, we selected plants that have EIA and Bonsucro environmental certification. In

1. Universidade Federal do ABC, davi.sozinho@ufabc.edu.br
2. Universidade de São Paulo Escola Politécnica and Universidade Nove de Julho, amarilisgallardo@usp.br
3. Universidade Federal do ABC, roseli.benassi@ufabc.edu.br

order to meet these criteria, 12 plants were selected as subject of this research, with the selection of 12 Environmental Impact Statement (EIS) sector.

The theoretical framework from an extensive review of the literature regarding sugarcane expansion for ethanol production compiled by Gallardo and Bond (2011a and 2011b) was used for featuring sustainability – environmental, social and economic – issues in documental data. The documental analysis embraces the categorization of contents of 12 EIS, named EIS 1 to EIS 12. The categorization of each EIS of sugarcane ethanol enterprise mainly focuses on two of the main chapters of this report: impact analysis and Management plan that includes mitigation, offset measures and also monitoring plan.

Results and Discussion

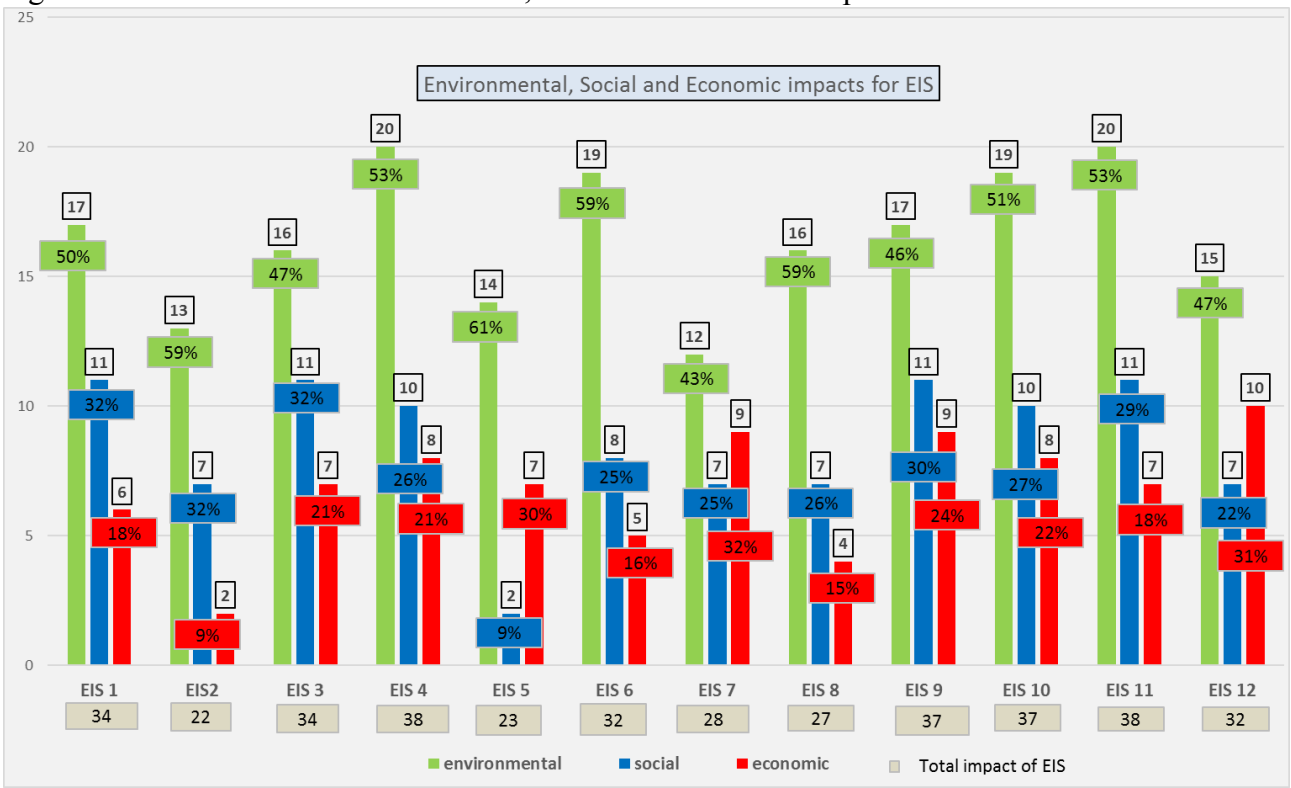
Table 1 presents the categorization of an EIS (EIS 3) that is a representative EIS in terms of impacts of the sugarcane sector, and Figure 1 consolidates the distribution of environmental, social and economic impacts for each EIS analyzed. In the first column are described the categorization of the impacts of the EIS 3. In the second column are described the management plans of such impacts. The third column is the classification of the category in environmental, social and economic.

Table 1 - Categorization of EIS 3.

Impacts	Managment Plan	Category
Affected protected areas	Environmental monitoring program; Communication and social participation plan	
People's expectations	Communication and social participation plan; Mobilization and staff demobilization program	
Pollution by construction site and construction works	Environmental management program; Soil conservation plan	
Urban facilities and services	Environmental monitoring program; Communication and social participation plan	
Vegetation removal	Integrated plan for permanent preservation area recovery; Wildlife conservation plan	
Earthwork	Environmental management program; Soil conservation plan	
Increased local noise level	Medical control of occupational health program; Hearing conservation program; Conservation program of environmental risks	
Tax revenues of municipalities	Communication and social participation plan; Mobilization and staff demobilization program	
Pressure of health infrastructure, housing and education	Inclusive policy of social welfare, health, housing and education;	
Pressure on public safety infrastructure of municipalities facing the arrival of workers from other regions	Communication and social participation plan; Mobilization and staff demobilization program	
Land use change for cropping sugarcane in areas occupied by pastures and other crops	Environmental monitoring program;	
Erosion process intensification	Soil conservation practices plan; Environmental management program	
Pressure on conservation areas	Agroenvironmental Protocol; Integrated plan for permanent preservation area recovery; Wildlife conservation plan; reforestation program	
Disturbance of wildlife	Monitoring wildlife program; Integrated plan for permanent preservation area recovery; Wildlife conservation plan	
Use of degraded areas by previous monocultures and pastures	Integrated plan for permanent preservation area recovery; Wildlife conservation plan; reforestation program	
Increase of jobs	Manpower qualification plan; communication and social participation plan; mobilization and manpower demobilization program	
Impacts on urban infrastructure that should meet the workers	communication and social participation plan; mobilization and manpower demobilization program	
Interference in archaeological sites	archaeological program; Heritage education program	
Pollution of surface water	Selection for use of pesticides; Handling and disposal of packaging control; Biological control; water resources plan conservation	
Groundwater pollution	Selection for use of pesticides; Handling and disposal of packaging control; Biological control; water resources plan conservation	
Changing the chemical soil	Selection for use of pesticides; Handling and disposal of packaging control; Biological control;	

quality	water resources plan conservation	
Risk to workers in the application of pesticides	Training of employees; Use of protective equipment; Safe storage of packaging and products; environmental monitoring program	
Pollution of surface water by fertirrigation	Fertirrigation practices control; water resources plan conservation	
Groundwater pollution by fertirrigation	Fertirrigation practices control; water resources plan conservation	
Job offer reduction in agriculture by mechanization	Manpower qualification plan; communication and social participation plan; mobilization and manpower demobilization program	
Impacts on traffic	monitoring and maintenance of roads program; Avoid transportation of heavy loads; Traffic control Program	
Increase road risks	Adequate cargo; safety conditions of vehicles; secure transport of agricultural machinery and implements.	
high consumption of water resources to meet the demands in the factory	water resources plan conservation; environmental monitoring program	
Pollution of surface water by industry operation	water resources plan conservation; environmental monitoring program	
Air pollution emission	environmental monitoring program	
Reducing pollution by ethanol use	environmental monitoring program	
Pressure on the road system	Traffic control Program	
Increasing of employment and income	communication and social participation plan; mobilization and manpower demobilization program	
Deactivation of industrial and agricultural activity	communication and social participation plan; mobilization and manpower demobilization program	
	Social impact – 11 Environmental impact - 17 Economic impact – 6	

Figure-1 – Distribution of environmental, social and economic impacts for the 12 EIS.



From Figure 1 the total of 382 impacts presented in the 12 EIS: 198 (52%) are environmental; 102 (27%) are social and 82 (21%) are economic. There is a strong predominance of environmental impacts (generally greater than 50% considering each EIS) then the social and economic impacts in all the EISs. Social impacts are the second category after environmental ones.

The number of economic impacts exceeded the social impact only in 3 EIS (EIS 4, EIS 11 e EIS 12).

The pattern of distribution of impacts between EISs is mostly similar showing that regardless of the particularities of each project the approach of EIA process mainly focuses on environmental matters. Morisson-Saunders and Pope (2013) highlighted that EIA represents a traditional way of assessment guided by a biophysical approach once project-based EIA is always not directed to strategic focus thus the scope of sustainability issues in EIA process is quite limited.

According to Bond and Morrison-Saunders (2011), EIA is considered an environmental advocacy tool rather than a more sustainability-related approach. In an EIA survey undertook in the UK, Chadwick (2002) reported that social impacts were rarely included and social and economic impacts were only limited to population data, potential employment opportunities and / or community infrastructure needs. Despite all the advances made in terms of EIA practice, in Brazil EIS has been developed with a purely environmental focus (GALLARDO; BOND, 2011) the data from this research corroborates this statement.

Socioeconomic impacts evaluation is historically relegated in EIS, doing by an imprecise and incomplete way according to Conde (2012). This analysis does not meet social demands and only serves to approve projects. Difficulties of quantifying some social impacts are also highlighted by Burdge (2012) who emphasized the need for considering social impacts within EIS, in order to provide a more sustainable perspective in EIA process. Greater participation of society is desired in all phases of the EIA process. For Thérivel et al. (1992) society's participation in the EIA process is quite limited however it is one of the challenges to be improved in this taking-decision process guided by EIS. For undertaking it is necessary provide a wider range of information.

According to Sheate (2012, p. 92) after review of 25 years EIA process in Europe some authors criticize a rationalist model of EIA supported by a weak view of sustainability. However some authors "argue that EA can support a strong view of sustainability, one that is rooted in its integrative concepts". Gallardo and Bond (2011a) reached the same results with a different sample of environmental studies in sugarcane sector in the São Paulo state. These authors demonstrated that the potential significance of social and economic impacts hasve been poorly considered.

The Social Impact Assessment (SIA) is proposed as an alternative to this constraint in the traditional approach of EIA (ESTEVES; FRANKS, VANCLAY, 2012). SIA can be used as an independent evaluation or within the context of EIA. In this sense a broader range of socioeconomic impacts would be an advance towards greater sustainability.

Conclusions

The research shows that there is a strong predominance of environmental issues on social and economic issues in all EIS analyzed in the ethanol sector of the state of São Paulo. It reinforces the expectation of literature where this imbalance is often encountered. To overcome this more environmental approach, some social and economic actors must become involved in EIA processes from the very beginning to the final decision-making phase, ensuring that more social and economic aspects are better addressed in the EIA of sector.

The involvement of society in the whole EIA process, from the beginning of the process to the final decision-making phase, would be a way of ensuring more social and economic would be better addressed.

In addition EIA process can be benefit of the development of social and economic indicators for assisting he assessment of social and economic impacts. As well as to bring professionals with experience in social matters for integrating the team responsible for EIS can be better enhance the balance of sustainability pillars.

Brazil has crucial social and environmental issues, such as large ecosystems, great biodiversity, great socio-cultural wealth, great social and educational challenges and a necessary economic growth and reduction of social inequalities. In this context sustainability is not mere requirement but an urgent necessity.

References

Art, J., Caldwell, P., Morrison-Saunders, A. (2001) Environmental impact assessment followup: good practice and future directions — findings from a workshop at the IAIA 2000 conference. **Impact Assessment and Project Appraisal**, 2001, v.19, n.3, p. 75-185.

Bond, A., Marrisson-Saunders, J.A. (2011). Re-evaluating sustainability assessment: aligning the vision and the practice. **Environ Impact Assess**, v.31, n.1, p. 1-7. Burdge, R. J. (2012). The practice of social impact assessment background. Impact Assessment and Project **Appraisal, v.21, n.2, p.84–88, Feb. 2012.**

Chadwick, A. (2002). Socio-economic Impacts: Are They Still the Poor Relations in UK Environmental Statements? Journal of Environmental Planning and Management, v.45, n.1, p. 3–24.

Conde, L. C. D. (2012). A análise dos Impactos Socioeconômicos na Estrutura do EIA/RIMA: A importância da abordagem humanista para a sustentabilidade. Rev. Adm., v. 5, Edição Especial, p. 799-804.

Esteves, A. M., Franks, D., Vanclay, F. (2012) Social impact assessment: the state of the art. Impact Assess Proj Apprais, v.30, n.1, p. 34-42.

de Mattos Fagundes, P., Padula, A. D., & Padilha, A. C. M. (2016). Interdependent International Relations and The Expansion of Ethanol Production and Consumption: The Brazilian Perspective. *Journal of Cleaner Production*.

Gallardo, A. L. C. F., & Bond, A. (2011) a. Capturing the implications of land use change in Brazil through environmental assessment: Time for a strategic approach? Environmental Impact Assessment Review, 31(3), 261-270.

Gallardo, A. L. C. F., & Bond, A. (2011) b. Investigating the effectiveness of environmental assessment of land use change: A comparative study of the approaches taken to perennial biomass crop planting in São Paulo and England. Biomass and bioenergy, 35(5), 2285-2297.

Goldemberg, J., Coelho, S. T., & Guardabassi, P. (2008). The sustainability of ethanol production from sugarcane. *Energy policy*, *36*(6), 2086-2097.

Janssen, R., & Rutz, D. D. (2011). Sustainability of biofuels in Latin America: risks and opportunities. Energy Policy, 39(10), 5717-5725.

Jordão, C. D. O., & Moretto, E. M. (2015). The environmental vulnerability and the territorial planning of the sugarcane cultivation. *Ambiente & Sociedade*, *18*(1), 75-92.

Montaño, M., & De Souza, M. P. (2015). Impact assessment research in Brazil: achievements, gaps and future directions. Journal of Environmental Assessment Policy and Management, 17(01), 1550009.

Morgan, R.K. (2012). Environmental impact assessment: the state of the art. Impact Assessment and Project Appraisal, v.30, n.1, p.5-14.

Morrison-Saunders, A., & Pope, J. (2013). Conceptualising and managing trade-offs in sustainability assessment. *Environmental Impact Assessment Review*, *38*, 54-63.

Sánchez, L. E., & Silva-Sánchez, S. S. (2008). Tiering strategic environmental assessment and project environmental impact assessment in highway planning in São Paulo, Brazil. Environmental Impact Assessment Review, 28(7), 515-522.

Sheate, W. R. (2012). Purposes, paradigms and pressure groups: Accountability and sustainability in EU environmental assessment, 1985–2010. *Environmental Impact Assessment Review*, *33*(1), 91-102.

Thérivel, R., Wilson, E., Thomson, S., Heaney, D., Pritchard, D. (1992) Strategic Environmental Assessment. London: Earthscan.

Triana, C. A. R. (2011). Energetics of Brazilian ethanol: Comparison between assessment approaches. *Energy Policy*, *39*(8), 4605-4613.

Unica 2016 http://www.unica.com.br/noticia/70519739203348049 93/brasil-ja-possui-43-usinas-certificadas-pelo-bonsucro/ acesso em 08/07/2016.

Canada/U.S. Transboundary Aquatic Electric Transmission Line Impact Assessment

Authors: Leigh Hagan, NEPA Project Manager, HDR, Inc., Plymouth Meeting, PA, USA
Patrick Solomon, Senior NEPA Project Manager, HDR, Inc., Vienna, VA, USA

Abstract

The Champlain Hudson Power Express (CHPE) transmission line proposes to bring renewable power from Canada to New York City via a primarily underwater and underground route. The project highlights international and U.S. coordination and interagency consultation, parallel federal and state compliance processes, and complex impact assessment. The project initiated federal and state permitting processes with the U.S. Department of Energy (DOE), and the New York State Public Service Commission (NYSPSC). Challenges included translating the interdependency of federal and state permitting to the Environmental Impact Statement (EIS) process; determining appropriate geographic and technical scopes based on DOE's limited regulatory authority; and addressing relevant issues such as endangered species, climate change, and mitigation within federal and state regulatory frameworks.

Introduction

The purpose of this paper is to provide an overview of the impact assessment process for the CHPE Project, an interjurisdictional project that would cross international and local boundaries requiring the approval of multiple federal and state agencies with differing geographic and subject matter jurisdictions, goals, and mandates.

Project Background

The CHPE Project is a 541-kilometer, 1,000 megawatt, high-voltage direct current (HVDC) transmission line that would provide power from the Canada/U.S. border to the New York City metropolitan area. In 2010, Champlain Hudson Power Express Incorporated (the Applicant), applied to the DOE for a Presidential permit to authorize construction, operation, maintenance, and connection of the U.S. portion of a transmission line that would cross the international border. The transmission line would traverse 162 kilometers through Lake Champlain; cross overland for 203 kilometers to the Hudson River via railroad and roadway rights-of-way (ROWs); traverse 171 kilometers through the Hudson, Harlem, and East rivers to Astoria, Queens, in New York City; and finally cross overland for 5 kilometers in Queens to a substation interconnection (Figure 1). DOE determined the issuance of a Presidential permit would constitute

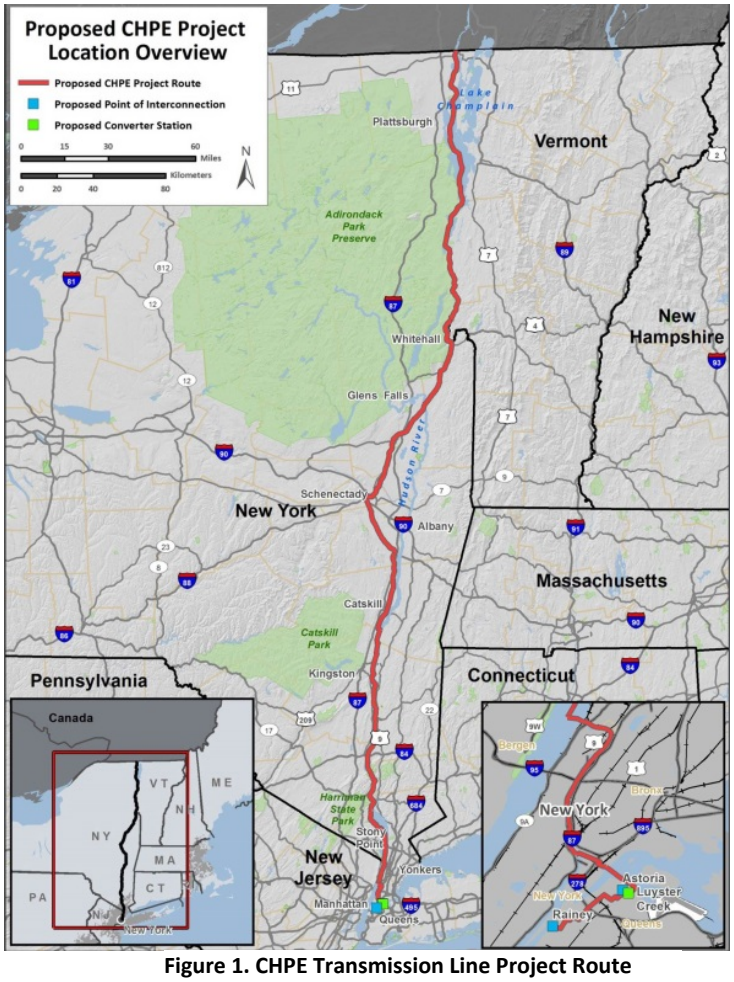


Figure 1. CHPE Transmission Line Project Route

a major federal action and an EIS was the appropriate level of impact assessment under the U.S. National Environmental Policy Act of 1969 (NEPA). An EIS is the most detailed of three distinct levels of impact assessment prepared under NEPA. All NEPA documents are prepared by (or under the guidance of) a U.S. federal government agency.

Canadian Review

The source of electric power supplied to the CHPE Project is expected to be from a generating station interconnected to the Hydro-Québec TransÉnergie electric transmission system. The electricity would be transmitted through a new HVDC converter station at Hydro-Québec TransÉnergie's Hertel Substation, south of Montréal, and carried by a new transmission line to the CHPE Project at the Canada/U.S. border (collectively referred to as the Hertel-New York Interconnection project).

Although development of the CHPE Project would require the associated construction of a new HVDC converter station and transmission line in Québec, NEPA does not require analysis of environmental impacts that occur outside of the United States when a foreign nation is participating with the United States or is otherwise involved in the action. This approach is consistent with Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*, which requires federal agencies to prepare analyses of potentially significant impacts from federal actions in certain defined circumstances and exempts agencies from preparing analyses in others. In the case of the Hertel-New York Interconnection project, the Québec Provincial Government and Canadian Government, through the National Energy Board, are responsible for conducting an environmental review for impacts in Canada, as applicable, as part of their authorization processes associated with the construction of facilities in Canada.

U.S. Federal/New York State Review

The CHPE Project was required to go through simultaneous U.S. federal and state permitting and review processes for agencies with different jurisdictional responsibilities. Both processes began in 2010 when the Applicant submitted a Presidential permit application to the DOE for the international border crossing, and a siting application under Article VII of the New York State Public Service Law to the NYSPSC for siting and construction of a major utility transmission facility. Although DOE only had jurisdiction over the CHPE Project's crossing of the international border, the EIS addressed potential impacts of the whole project. New York State has primary authority over the siting of transmission lines within the state, and through its Article VII environmental review and permitting process, the state helped refine the CHPE Project route and imposed other project conditions and measures to reduce impacts that were ultimately analyzed in the federal EIS.

In 2011, the federal EIS process was put on hold while the New York State process continued. During the state process, meetings and negotiations among 30 active stakeholders occurred to provide information and address route concerns, culminating in a "Joint Proposal" in 2012. This Joint Proposal, which included routing changes made to addresses stakeholder concerns, informed and became the basis for the Proposed Action analyzed in the EIS. The state Article VII Certificate was issued in early 2013, while the federal Final EIS, Record of Decision, and the Presidential permit were issued in mid to late 2014. The project is currently going through final review and permitting. Construction is expected to begin later in 2017 and operation in 2020 (Powers 2016).

Lessons Learned: Issues, Challenges, and Solutions

Several issues arose during preparation of the CHPE Project EIS that illustrate the complexity of an interjurisdictional impact assessment. Some aspects of the impact assessment that were affected by the involvement of multiple jurisdictions included the following:

- Development of alternatives within project scope
- Agency consultation for threatened and endangered species
- Climate change.

Alternatives Analysis. The action DOE analyzed in the EIS was the issuance of a Presidential permit that would authorize the CHPE Project's crossing of the Canada/U.S. border. However, analysis of the impacts of constructing and operating the transmission line was required to facilitate the decisionmaking process for the Presidential permit. This action presented challenges in identifying and analyzing project alternatives, and determining which alternatives were reasonable to be carried forth for full analysis in the EIS.

Project Alternatives. A range of reasonable alternatives for the CHPE Project were analyzed. Ultimately, only the Proposed Action and the No Action Alternative were carried forward for detailed impact analysis in the EIS. DOE determined that given the issuance of the state Article VII Certificate, other alternatives were no longer feasible because DOE did not have jurisdiction over siting of the project, which was determined through the state process.

Out of Scope Alternatives. Some stakeholders requested analysis of other alternatives that were determined to be outside the scope of the CHPE Project. Some of these alternatives included the following:

- Restarting mothballed coal-powered power plants in New York State.
- Development of alternative energy production, including wind farms and solar panels.
- Addressing impacts in Canada, including those from the Romaine hydroelectric complex and Hertel-New York Interconnection project.

DOE determined that the federal action evaluated in the EIS was not the construction of electric power generation facilities. As such, continued operation or development of other power sources or transmission lines were not the subject of the application for a Presidential permit and, therefore, were outside of the scope of the CHPE Project EIS. Additionally, based on Executive Order 12114, impacts in Canada were also determined to be outside the scope of the EIS. The Romaine hydroelectric complex is independent of and not connected to the CHPE Project, and would not be affected by the federal action of issuing a Presidential permit for the project. Although the Romaine hydroelectric complex is a possible source of power for the CHPE Project, Hydro-Québec has existing hydroelectric facilities with sufficient capacity to supply power to the CHPE Project.

Agency Consultation. Initial agency consultation efforts for the project were delayed by data requests from federal agencies that were not involved in the state process. Because federal agencies did not participate in the state process, they were also not involved in development of mitigation measures and establishment of exclusion zones for the CHPE Project, and consultation with these agencies did not get substantially underway until after the Draft EIS was released.

Threatened and Endangered Species Consultation. Listed and candidate species in the project area included the shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Karner blue butterfly (*Lycaeides melissa samuelis*), Indiana bat (*Myotis sodalis*), and Northern long-eared bat (*Myotis septentrionalis*). Federal agencies, such as the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), were concerned with impacts on these species from construction through aquatic and terrestrial habitats, including aquatic transmission line installation using water jetting, and use of concrete mats where the transmission line could not be buried.

Consultation with NMFS on aquatic species progressed slowly due to their request for additional information on potential impacts on aquatic species. Evaluation of the impacts from water jetting and installation of concrete mats demonstrated that increases in turbidity would be short-term during construction and pre-existing conditions would likely be re-established over time. To further minimize impacts on aquatic species, NMFS requested modifications to construction windows developed during the state Article VII process, which limit the time periods when aquatic installation activities can occur. The Applicant proposed mitigation measures to minimize turbidity and would conduct pre- and post-installation surveys to verify a return to original conditions.

Consultation with USFWS on terrestrial species was most concerned with the loss of potential fringe habitat for the Karner blue butterfly and Indiana bat. The agency originally requested a "likely to adversely affect" finding under the Endangered Species Act due to proposed vegetation maintenance (i.e., mowing) in the transmission line ROW. However, no existing wild blue lupine habitat, which the Karner blue butterfly uses for nectar, would be impacted because the Applicant would install the transmission line using horizontal directional drilling under existing lupine habitat. Vegetation maintenance could actually stimulate growth of lupine in other areas. Collaborative review of the data resulted in agreement that a "may affect, but not likely to adversely affect" finding was more appropriate. Analysis determined that while loss of Indiana bat roosting trees could occur, impacts would only occur in fringe habitat along already established road and railroad ROWs.

Climate Change. The Applicant expects most of the electricity transported through the CHPE Project would be from renewable resources, primarily hydropower. The CHPE Project is expected to introduce 7.65 terawatt hours per year of low-carbon renewable energy into New York's power markets (CHPEI 2012). It is anticipated that the electricity delivered by the CHPE Project would be of lower cost. Therefore, the Applicant has stated that the power would be purchased first and displace natural gas and oil-fueled sources of electricity supplying the region. This would result in the potential to reduce regional greenhouse gas emissions. NYSDPS predicted the CHPE Project would reduce annual emissions of carbon dioxide by approximately 1.5 million tons, sulfur dioxide by 751 tons, and nitrogen oxides by 641 tons (NYSDPS 2012).

Conclusion

The experience and lessons learned from the CHPE Project EIS can be applied to impact assessments for transmission lines, and other long-distance linear infrastructure projects that include multiple jurisdictions with varied statutory requirements. A common theme among the lessons learned is to engage all parties early and often. Early coordination should include alignment of all federal, state, and local processes to allow these processes to proceed in conjunction or consecutively to reduce the total required completion time. It is important to identify all agencies that have jurisdiction over resources in the project area and their responsibilities, and offer them a role in the project. The framework for the impact assessment should be clearly identified early to allow all reviewing parties an opportunity to provide comments.

Acknowledgements

The authors would like to acknowledge Brian Mills and Julie Smith of DOE for serving as co-authors for the CHPE Project EIS, and the Applicant for this project, Transmission Developers, Inc., which led to the preparation of this paper.

References

Champlain Hudson Power Express, Inc. (CHPEI). 2012. Champlain Hudson Power Express Project Joint Proposal Exhibit 27: Projected Energy Market, Capacity Market and Emissions Impact Analysis of the Champlain Hudson Power Express Transmission Project for New York.

New York State Department of Public Service (NYSDPS). 2012. Rebuttal Testimony of NYSDPS Staff Members Leka Gjonaj and David Wheat, Regarding the CHPE Project. Submitted on Behalf of NYSDPS to NYSPSC. Case 10-T-0139. 28 June 2012.

Powers, Mary B. 2016. "US Approves $2 Billion of Canada Cross-Border Transmission." *Engineering News Record*. Available online: <http://www.enr.com/articles/41091-us-approves-2-billion-of-canada-cross-border-transmission>. 13 December 2016.

Evolution of Compliance Oversight of Environmental Assessment Projects in BC

Kate Haines[a], Autumn Cousins[a], Celesa Horvath[b], Deborah Lacroix[c], Paul Craven[a]

1. Introduction:

Since 2011, the British Columbia (BC) Environmental Assessment Office (EAO) has undertaken several initiatives to strengthen the post-certificate[1] phase of the environmental assessment (EA) process, particularly the enforceability of EA certificates and the effectiveness of compliance and enforcement (C&E). This paper relates the story of the evolution of EAO C&E over the last six years, highlighting successes and challenges and describing approaches that may be of value for other jurisdictions.

2. Organizational and Legislative Framework:

EAO manages the review of major projects in BC, as required by the *Environmental Assessment Act* (EA Act). EA in BC under the EA Act provides an integrated process for identifying, assessing, and mitigating potential adverse environmental, economic, social, heritage, and health effects of major projects. Large industrial, mining, energy, water management, waste disposal, food processing, transportation, and resort developments typically require an EA in BC. If a project is approved under the EA Act, an EA certificate is issued that defines the project and specifies required mitigation through a legally binding Certified Project Description (CPD) and conditions.

The EA Act provides C&E mechanisms, including the authority to inspect and a suite of enforcement options, including orders to cease, orders to remedy, compliance agreements, fines, imprisonment, and suspending, amending, or cancelling a certificate.

3. Office of the Auditor General Report on the EAO's Oversight of Projects

In 2011, the Office of the Auditor General (OAG) published an audit concluding that EAO's post-certificate oversight of approved projects was insufficient. The OAG provided six recommendations relating to: clear certificate requirements; environmental mitigation policy; post-certificate monitoring responsibilities; development of a C&E program; effectiveness evaluations; and public accountability.

Concurrent with the audit, EAO began a multi-pronged approach to strengthening both its oversight and the EA certificate language and content[2].

4. Evolution of EAO Compliance Oversight

Prior to OAG's audit, EAO's approach to compliance verification was *ad hoc*. In 2011, EAO worked with the provincial Ministry of Forests, Lands and Natural Resource

---

[a] British Columbia Environmental Assessment Office
[b] Ventus Development Services Inc.
[c] Ecofish Research Ltd.

[1] Following an EA in BC, an EA certificate is issued if the project is approved.

[2] EAO's approach has proven to be successful. In a 2015 follow-up, the OAG confirmed that EAO had implemented four and partially implemented two of its recommendations.

Operations (FLNRO) to develop a pilot compliance program within EAO. Since then, EAO has developed a full C&E program that is coordinated with other compliance agencies. EAO's C&E Program is staffed by a Director of C&E, four C&E Officers, a Compliance Policy Officer, and shared support staff. In addition to EAO's Officers, over 350 individuals from other provincial agencies are authorized to inspect EA projects on EAO's behalf.

EAO C&E conducts a range of compliance oversight activities. While field inspections are the most valuable oversight mechanism, various desk-based activities are integral to EAO's oversight, such as administrative inspections and review of proponent's compliance self-reports and monitoring reports. The majority of EAO's inspections are determined through an annual planning process. EAO strives to inspect a range of projects each year based on criteria such as project phase, location, and industrial type.

In 2011, EAO C&E Officers were delegated the authority to inspect but not to conduct formal enforcement under the EA Act. Throughout the initial years of the program, Officers relied on warnings to compel proponents to comply, only seeking ministerial level enforcement in rare circumstances. In 2014, FLNRO designated EAO C&E Officers as Natural Resource Officers, enabling EAO to enforce a wide range of natural resource legislation. In 2015, the BC Minister of Environment delegated the authority to issue Orders to Cease and Remedy to EAO C&E Officers. As a result of these changes, EAO's capacity to enforce EA certificates has increased.

5. Key Initiatives to Increase Effectiveness of EA Certificates and EAO's Oversight:

The initiatives to increase effectiveness of EA certificates and EAO's oversight include measures both *during* the EA process and *after* the issuance of an EA Certificate.

<u>During the EA Process:</u>

In 2012, EAO overhauled its approach to EA certificates. Previously, each EA certificate included various documents from the EA and conditions based on commitments the proponent made during the EA process. This approach had proven problematic as there was considerable lack of clarity in some EA certificates, given that commitments and documents developed by the proponent for the EA process were not written with the intention of being enforced, rather to inform the EA process. Historic EA certificates also had considerable inter-project variability due to lack of EA certificate guidance.

In 2012, EAO became more deliberate in establishing the legal requirements for each project. EA certificates now include three components: the certificate itself, a table of conditions, and a CPD. The measures developed during the EA to avoid, mitigate and manage adverse effects are contained within the table of conditions and the CPD. The conditions specify how the project must be constructed, operated, and in some cases decommissioned. The CPD comprises a series of maps and text that describes where and what the project is.

EAO developed a comprehensive policy to guide the development of EA certificates. This policy provides detailed drafting guidance to ensure all conditions are clear, measurable, and enforceable with an appropriate relationship with post-EA permitting. It also includes minimum mapping standards for the CPD. EAO has developed

standardized language for topics frequently addressed in EA conditions.

Post EA Certificate:

In addition to establishing a dedicated C&E program, EAO has undertaken numerous post-EA initiatives to increase the effectiveness of oversight, informed by the extensive learning since the inception of EAO C&E.

Policy Framework:

A wide range of policies, procedures, and guidance documents have and are being developed to support C&E Officers, Aboriginal groups, the public and proponents. These include the development of policies/guidance on officer conduct in the field, the role of Aboriginal liaisons on inspections, complaint processes, compliance self-report requirements, and what to expect during compliance oversight. Many of these documents are (i.e. 2015 Compliance and Enforcement Policy and Procedures) or will soon be available at www.eao.gov.bc.ca.

Interagency C&E Coordination:
There are multiple C&E agencies that conduct oversight of approved projects under the EA Act. Significant efforts are being made to ensure coordination among agencies to improve oversight, enhance interagency learning, and facilitate strategic deployment of resources.

Working with Aboriginal Groups in Compliance Oversight:
To facilitate effective participation of Aboriginal groups in oversight of natural resource development, the Province of BC has developed the *Natural Resource Sector Aboriginal Liaison Program* (NRS ALP); EAO and other provincial agencies participate in this program in addition to their own initiatives with Aboriginal groups.

Through the NRS ALP, government funds liaisons to serve as a conduit between provincial agencies and the Aboriginal community. The liaisons gain employment, including training and field mentoring, catered to their community's interests, and also gain experience in a wide range of natural resource development oversight. Liaisons join agencies on inspections of major projects and other natural resource development.

In addition to contributing to the NRS ALP, EAO C&E has developed an *Aboriginal Liaison Framework* that provides various levels of engagement. Through the Framework, Aboriginal groups work with EAO C&E to develop information sharing protocols, provide input into compliance oversight, participate in inspections, and so on.

Increased Oversight of Management Plans:
EAO has increased its oversight of the development and implementation of management plans, a key form of mitigation required by EA certificates. EAO continues to improve practices and guidance relating to management plans, including internal procedures for review of management plans, external guidance for the development of management plans, and a focus during inspections on the mitigation measures defined within management plans.

Compliance Promotion with Industry:
EAO C&E conducts a wide range of compliance promotion activities with industry,

including participating in conferences and industry association meetings, assisting with interpreting EA certificates, and attending proponent meetings.

Public Accountability in Compliance Oversight:

EAO C&E continues to increase the types of compliance information available on-line. Currently, EAO C&E publically posts all inspection records, warnings, enforcement, proponents' compliance self reports, and various documents required by EA certificates. In addition to EAO's website that provides information on all certified projects, EAO with the provincial Ministry of Energy and Mines and Ministry of Environment are developing a joint website that provides authorizations and compliance information for mines.

6. Lessons Learned and Outcomes

EAO has learned that one must think of post-certificate oversight as an integral component of the EA process. This includes considering *during* the EA how compliance will be effectively conducted and incorporating lessons learned from previous compliance oversight into policy and future EAs. EAO also shares those learnings with proponents to promote compliance. Key learnings and outcomes of EAO's C&E efforts to date are summarized below.

Clear and Measurable Requirements:

Clearly written EA certificates and management plans are critical for effective implementation by proponents and compliance oversight by agencies. While ambiguous statements such as 'if applicable', 'as appropriate', and "where feasible" may appear to provide flexibility, in reality these vague terms increase risk for proponents when staff and contractors interpret these statements in a manner different than the proponent and/or regulators' expectations. EAO's efforts to strengthen certificates and management plans have contributed to both improved compliance and enforceability.

Common Non-Compliances:

The most common issues that cause non-compliance relate to general construction environmental management. EAO C&E and independent environmental monitors (IEMs) frequently observe non-compliances in erosion/sediment control, wildlife attractant management, hydrocarbon management, waste management, and invasive plant control, among other things. To improve compliance in these areas, EAO now requires a Construction Environmental Management Plan and IEM on all projects. EAO is developing guidance to support IEMs.

Relationship between EA and Permitting:

There continues to be confusion in industry and regulators about the relationship between EA certificates and permitting, including regarding overlap and/or conflict between certificate conditions and permit conditions. To address this, EAO continues to work closely with permitting agencies when developing EA conditions to avoid gaps, overlap and conflicts.

Culture of Compliance:

EAO C&E finds a wide range in compliance culture across proponents and contractors. C&E Officers have noted that clear accountability for compliance within proponents/contractors and the presence of senior proponent personnel on the ground increases the likelihood of compliance. EAO's compliance promotion efforts therefore focus on strengthening cultures of compliance.

Failure of proponents to actively monitor and maintain mitigation measures lead to frequent non-compliance, as well as increased time and costs for proponents. Proactive planning, implementation, monitoring, and maintenance are key to achieving compliance. EAO C&E has found it worthwhile to meet with proponents in advance of construction to assist them with understanding the requirements and to advise that requirements will be enforced. These sessions are most effective when attended by senior project personnel, contractors, environmental managers, environmental monitors, and other provincial agencies.

Officer Presence:

Visible C&E Officer presence increases compliance. When proponents receive regular C&E inspections, they and their contractors tend to make additional effort to maintain compliance. EAO coordinates inspections with other provincial agencies to increase oversight. EAO C&E Officers now wear a formal uniform with the provincial coat of arms; this has been found to increase both visibility and credibility, leading to more effective compliance.

7. Next Steps for EAO C&E:

While EAO C&E is now a fully developed program, there is still much to do to codify practices and continuously improve the program. Core activities planned for the next five years include:

- Continuing to strengthen relationships with permitting and C&E agencies;
- Expanding the involvement of Aboriginal groups in compliance oversight;
- Developing a more robust way to consider risk in compliance of EA projects;
- Improving the transition of learning and relationships with stakeholders from the EA process into C&E;
- Supporting the C&E team to address significantly high workload to enable more timely inspection and enforcement; and
- Providing support to other agencies and Aboriginal groups as they develop their C&E programs.

Clear, measurable EA certificates and effective C&E is contributing to achieving the purpose of the EA Act, which is to prevent significant adverse environmental, economic, social, heritage and health effects from major projects.

Substitution in Action – Case Studies from British Columbia

Kate Haines, Mary Rathbone, Kash Cheema, Paul Craven
British Columbia Environmental Assessment Office

Introduction

Due to the structure of Canada's constitution, there is significant overlap between federal and provincial jurisdictions with respect to the regulation of environmental matters. This means that environmental assessments (EAs) are often required at both the federal and provincial levels for a single project, which can result in duplication of efforts and process inefficiencies. As a means of addressing the challenges of multiple assessment processes, British Columbia (BC) has been a long standing advocate for the one- project-one-assessment principle, defined by the following characteristics: a single project description provided by the proponent; a single comprehensive terms of reference/information requirements for the EA; a single engagement process for the public and government experts; a fully integrated engagement process for Aboriginal groups; a single application by the proponent; a single comprehensive assessment report; and, a single set of timeline requirements. Rationale for the one-project-one-assessment principle is well documented, and its most compelling benefits are experienced by the public, Aboriginal groups and proponents. It ensures a single contact point for the public when obtaining information, participating in the process, and understanding how input has been considered by all jurisdictions. Similarly, a single process allows Aboriginal groups to focus their efforts and resources, and not be repeatedly required to engage multiple agencies at both federal and provincial levels for the same project.

Events of recent years have allowed BC to implement the one project-one assessment principle. In 2012, the federal government introduced the *Canadian Environmental Assessment Act* (CEAA 2012), granting the Federal Minister of Environment authority to approve, where both a federal and provincial EA is required and a province requests it, substitution of the provincial EA process for the federal one[1]. A 2013 Memorandum of Understanding (MOU) between Canada and BC sets out the administrative framework for BC to request a substituted EA process, and for facilitating the implementation of the CEAA 2012 substitution provisions in an efficient and timely fashion[2]. Building on earlier BC-Canada agreements that facilitated cooperation between the jurisdictions in conducting EAs, the MOU delegates certain procedural aspects of the federal government's duty to consult with First Nations[3] to BC, and outlines the contribution of relevant expertise by federal agencies to a substituted EA process.

[1] CEAA12 substitution provisions, Ss. 32-36: http://laws-lois.justice.gc.ca/eng/acts/C-15.21/page-5.html#h-18
[2] Link to 2013 Canada-BC Memorandum of Understanding: http://www.eao.gov.bc.ca/EAO_CEAA.html
[3] First Nations is a term used to describe Aboriginal groups that are not Metis or Inuit.

Each jurisdiction retains its EA decision making authorities at the completion of the provincial EA process.

BC's Environmental Assessment Office (the EAO) is the body responsible for the neutral administration of the *BC Environmental Assessment Act* (BCEAA)[4] and oversight of EA processes in the province. From the EAO's founding in 1995 until the end of 2016, 298 projects have entered BC's EA process, 59 of these after the introduction of the CEAA 2012. Since CEAA 2012, 58 percent of all BC projects have required both provincial and federal EAs, and 37 percent of all projects that trigger a federal review in Canada have been located in BC.[5] This paper reviews BC's experience with substitution to date, how the substitution process has developed, and what has been learned from early experience.

BC's Experience with Substitution

The Substitution Process

BC's history of cooperating with the federal government on EAs placed it in an ideal position to pilot the EA substitution process that was authorized under CEAA 2012. So far, the EAO has successfully sought permission for substitution from the federal Minister of Environment for 14 projects, three of which have completed the assessment process. This early experience with substitution has led to development of the following model for the process.

The 2013 MOU was successful in establishing an operational framework for substitution, and out of this three distinct phases have developed to guide the process. During the first phase, **pre-substitution,** which occurs before substitution is requested, the EAO and the Canadian Environmental Assessment Agency (the Agency) work together to determine whether a project is suitable for substitution[6]. This early dialogue helps the agencies reach agreement on a number of issues, including: the scope of project, the scope of assessment, and the extent and type of Aboriginal consultation required. Best practices have been established to ensure that a decision to substitute an EA coincides with the Agency's determination that a federal EA is required. The pre-substitution phase also allows the Agency and EAO to discuss whether there are potential transboundary effects, or if a project is more suitable for a panel process. (Under CEAA 2012, substitution is not an option when a federal panel is required[7]).

[4] Link to BCEAA: http://www.bclaws.ca/civix/document/id/consol14/consol14/00_02043_01
[5] Source: BC Environmental Assessment Office Project Information Centre (e-Pic)
[6] Under CEAA 2012, substitution is available only for designated projects where the responsible authority is the Agency. Designated projects where the National Energy Board or the Canadian Nuclear Safety Commission is the responsible authority are not eligible for substitution. In addition, CEAA 2012 specifically disallows substitution for projects undergoing a panel review. Substitution may also not be appropriate when: a proposed project is located primarily on federal lands, or considerable trans-boundary effects are anticipated. However, the fact that a proposed project is located on federal land or has potential transboundary effects does not mean substitution cannot be granted.
[7] The Minister of the Environment may refer an EA to a review panel (a group of independent experts appointed by the Minister to conduct the EA) if the Minister is of the opinion that it is in the public interest to do so. http://ceaa-acee.gc.ca/010/type5index-eng.cfm

Requests for substitution are made public by both the EAO and the Agency, and the Agency uses its initial public comment period to seek input on the substitution request[8].

The second phase is **conducting the substituted EA**. Once substitution has been approved by the federal minister, the EAO conducts the assessment following its standard process. A key feature of all EAs in BC is the use of a technical working group (WG). Representatives from Aboriginal groups and federal, provincial and local governments are invited to join the WG to provide technical advice to the EAO. The WG also comments on the information requirements for the EA, the proponent's application, the draft assessment report prepared by the EAO, and the Certificate conditions proposed by the Province. Once substitution is authorized, federal agencies remain actively involved in the assessment process and participate in the WG. While the Agency itself does not normally have representatives on the WG, it is kept well informed throughout the process and is well positioned to assume its role in the decision-making phase. The Agency also provides guidance, as needed, throughout the EA, a role that was particularly important during the early days of implementing the substitution process, coinciding as it did with CEAA 2012, the then new federal act.

The third and final phase of a substituted EA is the **referral and decision-making** phase. Following the EAO's completion of the assessment process, the Agency takes final steps to complete the referral for decision. As discussed, both organizations recognize the importance that coordination and information-sharing throughout the assessment play in the Agency's ability to successfully fulfill its role. A fundamental characteristic of the model is that, while the EA follows the provincial assessment process with the Agency's support, there is recognition throughout that the federal minister makes an independent decision when the EA is completed, and that the substituted process must meet all federal requirements. The broad scope of BC's assessment process enables the EAO to ensure that all matters of federal interest can be incorporated into a provincial assessment.

Under the current substitution model the federal government's consultation obligations are delegated to BC, with two important exceptions. The federal government, through the Agency, determines who should be consulted during the EA process and, at its conclusion, determines whether the consultation has been adequate. The EAO continually seeks to improve its methods and processes for engaging with First Nations and Aboriginal groups and, as indicated in the discussion below, substitution has so far played a positive role in achieving this goal.

Assessments Completed and Lessons Learned

The following are overviews for the first three projects to have successfully completed the substituted assessment process.

[8] During its initial public comment period, the Agency posts background information for the project on its website, and invites public to provide input on whether a federal EA should be conducted and, if substitution has been requested, whether substitution should be granted.

LNG Canada Export Terminal Project[9]: LNG Canada is a proposal to develop a Liquid Natural Gas (LNG) plant and associated marine terminal in Kitimat, BC, to export LNG to Asian markets. BC requested substitution for this project under CEAA 2012 in March 2013, and was granted this request in May 2013. Canada and BC both reached a decision on the project on June 17, 2015

LNG Canada represented a test case for the substitution process in Canada, with the EAO and the Agency navigating both the new CEAA 2012 and federal and the provincial substitution processes for the first time. While developing the substitution model, both governments were able to identify opportunities for improving their own EA processes. All federal and provincial legislated timelines were met during this assessment, and the EAO engaged directly with the appropriate federal departments to ensure that all requirements for the federal decision making process were met. BC consulted with First Nations and Métis [10] (the latter on behalf of Canada only), and assessed the impacts on current use of lands and resources by all Aboriginal groups.

Woodfibre LNG Project[11]: Woodfibre LNG is a proposal to construct a small-scale LNG processing and export facility near Squamish, BC. A request for substitution under CEAA 2012 was granted for the project in February 2014. BC issued a certificate for the project in October 2015, and Canada, in March 2016.

The proposed project site is located within Squamish First Nation's asserted traditional territory. Squamish First Nation and the proponent signed an agreement in 2014 allowing the First Nation to conduct its own review (also known as the Squamish Process). Upon completion of the Squamish Process, the company committed to the 25 conditions imposed by Squamish First Nation, and design changes were made to the project to satisfy these.

The Woodfibre EA process demonstrated that the substitution model is able to not only ensure that all federal and provincial obligations to engage and consult with Aboriginal groups are satisfied, but that it has the flexibility to adapt to alternative approaches to engaging with First Nations, as they arise. It also enabled the current federal government, for the first time since introducing its interim principles[12], to assess greenhouse gas emissions from a proposed project.

Kemess Underground Mine Project[13]: Kemess Underground Mine is a proposal to construct and operate an underground gold-copper mine, located approximately 250 kilometres (km) northeast of Smithers and 430 km northwest of Prince George, BC. The EAO's request for substitution for the project

[9] Link to EAO webpage for LNG Canada project: **https://projects.eao.gov.bc.ca/p/lng-canada-export-terminal/detail**
[10] The Métis are an Aboriginal group recognized in the *Constitution Act* of 1982. British Columbia currently does not recognize a legal obligation to consult with Métis people in BC.
[11] Link to EAO Webpage for Woodfibre LNG: **https://projects.eao.gov.bc.ca/p/woodfibre-lng/detail**
[12] "…The following principles are intended to provide greater certainty as to how the Government of Canada will be guided in the application of its discretionary decision-making authorities for projects being assessed during the review of environmental assessment processes: … 5. Direct and upstream greenhouse gas emissions linked to the projects under review will be assessed…" *Government of Canada Bulletin: "Government of Canada Moves to Restore Trust in Environmental Assessment", January 27, 202*
[13] Link to EAO Webpage for Kemess Underground Project: **https://projects.eao.gov.bc.ca/p/kemess-underground/detail**

was approved by the federal Minister of Environment in April 2014, and both Canada and BC reached a decision for the project in March 2017.

During the Kemess project EA, the EAO invited the public to comment on the draft assessment report and the draft conditions for the Certificate, making this the first ever public comment period to be held for a draft BC assessment report. Consulting on draft assessment reports is consistent with the CEAA approach to conducting EAs, and the introduction of the practice into the BC model is an example of how substitution is promoting innovation across government levels. The EAO also worked collaboratively with the Tse Keh Nay First Nations[14] throughout the EA, and Tse Keh Nay representatives participated in drafting sections of the project's assessment report that specifically discuss impacts on Aboriginal interests.

Conclusion

Since it was introduced with the CEAA 2012, substitution has proven to be an effective tool in BC. It achieves all the characteristics of the one-project-one-assessment principle identified above. Substitution strengthens the rigour of the EA process by integrating federal and provincial requirements, and addresses all issues in one process while retaining separate decisions. It creates a single conversation with the public, agencies at every level of government, and Aboriginal groups, while enhancing their consultation opportunities and reducing their process burden. It reduces duplication of process and the resulting administrative burden on all participants. It also increases the certainty of timelines by minimizing delay between federal and provincial decisions. An added benefit is that it supports innovation within both the federal and provincial processes and, as the substitution process matures, more opportunities for future innovation will likely be identified.

[14] Kemess Underground Mine project is located within the traditional territory of the Tse Keh Nay First Nation.

Incorporating climate change mitigation and adaptation into environmental impact assessment: a review of current practice within transport projects in England

Stephanie Hands, Graduate Environmental Coordinator, Mott MacDonald

This article is based on the paper within the journal of Impact Assessment and Project Appraisal, Available at: http://www.tandfonline.com/doi/full/10.1080/14615517.2016.1228340 by S.Hands and M.Hudson.

Climate change has emerged as a key environmental issue in the past decade, with growing attention focussed on mitigating and adapting to its potential effects. As Environmental Impact Assessment (EIA) is a well-established and legally required environmental decision-making tool for certain project types in most countries (Glasson et al 2012; Yi & Hacking 2012), it can potentially play a key role in assisting efforts to minimise greenhouse gas emissions and adapt to the changing climate (Institute of Environmental Management and Assessment (IEMA) 2015a).

Climate change is not explicitly included in the formal requirements of the European EIA Directive (2011/92/EU); 'climatic factors' are listed along with soil, water, air and landscape as a factor that should be assessed. For this reason, along with issues of availability of historical climate information and uncertainty in climate predictions, it is therefore not currently common practice to explore climate change in the EIA for the majority of project types (Chang & Wu 2013). Currently, the consideration of climate-related impacts is typically limited to assessments of flood risk, carbon dioxide and greenhouse gas emissions. Revisions to the EU Directive (2014/52/EU), to be transposed by 16 May 2017, state the need to explore '*the impact of the project on climate and the vulnerability of the project to climate change'* (annex IV 5. (f)), confirming the need to consider climate change at greater detail and specificity than current practice.

Various guidance documents exist on integrating climate change into EIA both in the UK and internationally however guidelines providing specific advice on accounting for climate change mitigation and adaptation are lacking. Despite this, climate change is beginning to be considered in a small number of EIAs.

As the consideration of climate change is a new inclusion in EIA and there is a requirement for guidelines for accounting for climate mitigation and adaption, this paper assesses the quality of current inclusion of climate mitigation and adaptation in UK Environmental Statements (ESs) in order to evaluate current practice and suggest recommendations moving forward. This has been achieved through the development of a specific climate change mitigation and adaptation review method, incorporating criteria-based review approaches adapted from existing methods and wider literature and involving input from environmental professionals. Review methods for EIA evaluation and quality assurance have been adopted by many studies (Jay et al 2007; Briggs & Hudson 2013) due to their effectiveness at assessing specific aims.

The review criteria (outlined in Table 1) was derived from an audit of 50 environmental statements, literature review and interviews with EIA professionals to identify the current knowledge gap of climate change mitigation and adaptation in EIA. Each question was graded from A-E against criteria specific to each question. For example, an A grade was awarded where the question was addressed in comprehensive detail; at the other end of the scale, a D grade was given for minimal consideration and an E grade for no consideration at all. The criteria was applied to a sample of ten UK transport ESs that considered climate change. As transport projects are highly vulnerable to the effects of

climate change (Eisenack et al 2012), such projects would benefit from effective consideration of climate change mitigation and adaptation.

Table 1. The review criteria questions

Question
3.1. Is a justification given for the need for mitigation in the policy (3.1.1), development (3.1.2) and climate change (3.1.3) contexts?
3.2. Is a justification given for the chosen mitigation?
3.3. How detailed is the description of the mitigation measure?
3.4. Is the effectiveness or benefits of the chosen mitigation stated?
3.5. Is there evidence of commitment to implementing the mitigation?
3.6. Is there evidence of measuring or monitoring the success of the mitigation measures?

The application of the review criteria (Table 2) found that justifications relating to climate policy, climate science, the effect of climate change on the development, and its vulnerability to climate risks were well explained in most projects. As outlined in Table 1, many projects lacked detail of climate change mitigation and adaptation measures and their benefits, whilst evidence of commitment to mitigation and adaptation or to post-decision monitoring was poor or non-existent.

Table 2. An overview of the grades allocated for each individual project and question. Green represents a good quality answer, yellow an average answer and red an unsatisfactory answer.

Project/Question	3.1.1 Justification: policy context	3.1.2 Justification: development context	3.1.3 Justification: climate change context	3.2 Justification for mitigation	3.3 Detail of mitigation	3.4 Effectiveness or benefits stated	3.5 Evidence of commitment	3.6 Measuring/ monitoring
Northern Line Extension	A	A	A	B	C	D	D	C
High Speed 2	A	A	B	A	C	C	D	E
Leeds NGT	A	A	A	B	C	B	C	D
North Doncaster Chord	A	A	B	B	C	D	B	D
Mersey Gateway	A	C	D	C	B	C	D	B
M1 Junction Improvement	A	A	A	B	B	C	C	D
London Luton Airport	B	A	E	C	C	C	B	D
Northern Distributor Road, Norwich	A	A	A	B	C	A	D	D
Birmingham International Airport	B	A	B	B	B	D	D	D
London Ashford Airport	B	B	B	C	C	D	D	E

From Table 2 it is evident that currently lacking in ESs is commitment to implementing climate mitigation and adaptation measures and to post-decision measuring or monitoring. Reasons for the neglect of post-auditing include the cost and time of monitoring, the absence of mandatory or

auditable requirements and a lack of appropriate legislation (Jones & Fischer 2016). Fundamental to EIA practice is incorporating explicit requirements into legislative frameworks (Jay et al 2007) however the requirement for post-decision auditing is not explicit in the current EIA regulations. Revisions to the Directive (2014/52/EU) move towards a clearer requirement for monitoring and commitment, by stipulating that Member States shall implement mitigation measures and subsequent monitoring procedures for significant adverse effects (Article 8a (4)).

When reviewing the case studies, many chapters contained inexplicit climate mitigation and adaptation. Following consultation with EIA professionals, it was explained that whilst mitigation or adaptation measures may relate to climate change, in order to keep ES chapters consistent and focused, it is not necessary to cross-reference them to other impacts. This highlights the need for a holistic consideration of climate change within EIA due to its interference with many environmental disciplines. The challenge, similar to that of post-auditing, is the nature of EIA as a methodological and process-based tool. Morrison and Retief (2012) suggest that rather than legislative reform or change in the EIA process, a bigger change can stem from the behaviour of individual professionals, recognising that climate change should be considered holistically and as an integrative part of the EIA.

Given the regulation amendments and increasing concern over how to consider climate change in EIA, it is important to address whether EIA is a good platform to evaluate climate change. Including climate concerns in EIA only accounts for climate change impacts from new developments required to undertake EIA. This excludes climate impacts from ongoing activities and from new developments not requiring an EIA. Small proportions of planning applications include an environmental impact assessment with only 0.1% of Environmental Statements submitted for over 450,000 planning applications between April 2014 and March 2015 (IEMA, 2015b). Therefore, the impacts mitigated or adapted to within new developments compared to those from existing developments will be very small. Additionally, as EIA primarily identifies the impact of a project on the environment rather than the impact of environmental change, EIA may not fully evaluate climate change (Agrawala et al., 2012).

It has been questioned if EIA is as effective as its originators expected (Cashmore et al., 2004) and if it offers more in theory than in practice (Lawrence, 1997). This concurs with the findings of this study, which demonstrate that climate change is only included in ESs following the requirements of the EIA Directive, with the absence of best practice commitment, post-auditing and explicit inclusion of climate change. It appears that currently, EIA is not a platform fit to address climate change for three main reasons (Jay et al., 2007; Morrison-Saunders & Retief, 2012; Chang & Wu, 2013):

(1) To date, climate change is yet to be required by EU legislation (but will be when the 2014 Directive is implemented);
(2) There is a lack of guidance and understanding of how climate change should be included in UK EIA assessments; and,
(3) Current practice in EIA is to achieve development consent with lesser focus on the post-EIA impacts and sustainability of the project.

As the 2014 Directive amendment comes into force, points (2) and (3) need to be addressed in symbiosis. On asking practitioners how they included climate change when producing an ES, P6 stated they "*used a variety of information and informal guides available as not one source was solely appropriate*". This statement, along with the low grades allocated to the last few questions in the criteria proves the current disjointed nature of including climate change and the need for guidelines.

IEMA and engineering consultancy Mott Macdonald have produced guidance on climate change adaptation and resilience in EIA (IEMA and Mott MacDonald 2015). This guidance outlines how to build climate resilience into project design and the aspects of climate change reporting that should be featured in the ES. It provides a seven step approach to considering climate change adaptation in EIA, beginning with scoping and defining the emerging baseline to identifying climate change vulnerability in combination with assessment and concluding with developing a climate change action plan and monitoring and adaptive management. Additionally, the EC have an extensive guide on integrating climate change and biodiversity into EIA. This shows there will no longer be an absence of guidance for including climate change however their application by professionals is uncertain. This suggests that the issue may not be the inclusion of climate change but how it is embraced by individual professionals. Other elements of EIA have gone through similar transitions, with, for example the UK's Chartered Institute for Ecological and Environmental Management Guidelines pushing forward better practice in ecological assessment (Briggs and Hudson 2013). Including climate change in EIA will be a new but necessary challenge for professionals.

With some caveats based on the examination of a sample of projects from one sector, this study has suggested that EIA is not currently a good platform to consider climate change; however for its successful integration, it is recommended that stronger links between the EIA process and continual environmental management are needed through a more holistic consideration of climate change and more explicit use of sustainability terms. The update of guidelines for integrating climate change mitigation and adaptation are required in the UK along with the enhancement of the competence of practitioners through a change in their behaviour and attitudes from viewing EIA less as a systematic process but rather as an integrative process. Finally, an additional challenge will be adapting the EIA framework to consider climate change successfully and sustainably given the conventional nature of EIA practice.

Including climate change in EIA should not be seen in isolation as a solution to mitigating or adapting to climate change as only small proportions of new developments require an EIA and the climate impacts from ongoing activities are excluded. In addition, including climate concerns in EIA only accounts for climate change impacts from new developments required to undertake EIA. This excludes climate impacts from ongoing activities and from new developments not requiring an EIA.

Future research should investigate how to consider climate change impacts from existing developments and activities and should evaluate the lessons learnt from integrating climate change into EIA. In addition, further review is recommended once the parameters of Brexit and its implications on EIA legislation are made clear.

References

Agrawala S, Kramer, AM. Prudent-Richard G, Sainsbury, M, Schreitter, V. 2012. Incorporating climate change impacts and adaptation in environmental impacts assessments: opportunities and challenges. Clim Dev. 4(1): 26-39.

Briggs S, Hudson MD. 2013. Determination of significance in ecological impact assessment: past change, current practice and future improvements. Environ Impact Assess Rev. 38: 16-25.

Cashmore M, Gwilliam R, Morgan R, Cobb D, Bond A. 2004. The interminable issue of effectiveness: substantive purposes, outcomes and research challenges in the advancement of environmental impact assessment theory. Impact Assess Proj Appraisal. 22(4): 295-310.

Chang IS, Wu J. 2013. Integration of climate change considerations into environmental impact assessment – implementation, problems and recommendations for China. Frontiers Environ Sci Eng. 7: 598-607.

Eisenack K, Stecker R, Reckien D, Hoffman E. 2012. Adaptation to climate change in the transport sector: a review of actions and actors. Mitig Adapt Strateg Glob Change. 17: 451-469.

Glasson J, Therivel R, Chadwick A. 2012. Introduction to Environmental Impact Assessment. 4th edition. London: Routledge.

IEMA. 2015a. EIA and Climate change. [online] Available at: http://www.iema.net/eia-climate-change [Accessed 22/03/2016].

IEMA. 2015b. Environmental Statements on the rise. [online]. Available at: http://www.environmentalistonline.com/article/environmental-statements-rise [Accessed 05/09/2016].

IEMA and Mott MacDonald. 2015. IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation. [online] Available at: http://www.iema.net/eia-climate-change [Accessed 02/02/2017].

Jay S, Jones C, Slinn P, Wood C. 2007. Environmental impact assessment: Retrospect and prospect. Environ Impact Assess Rev. 27: 287-300.

Jones, R. and Fischer, T.B. 2016. EIA Follow-Up in the UK - a 2015 update, Journal of Environmental Assessment Policy and Management; 1650006; DOI:10.1142/S146433321650006X.

Lawrence DP. 1997. Integrating Sustainability and Environmental Impact Assessment. Environ Manage, 21(1): 23-42.

Morrison-Saunders A, Retief F. 2012. Walking the sustainability assessment talk – progressing the practice of environmental impact assessment (EIA). Environ Impact Assess Rev. 36: 34-41.

Yi J, Hacking T. 2012. Gaps in EIA Incorporating climate change. 'IAIA12 Conference Proceedings'. [Online] Available at: http://www.iaia.org/conferences/iaia12/uploadpapers/Final%20papers%20review%20process/Yi,%20Jeonghwa.%20%20Gaps%20in%20EIA%20Incorporating%20Climate%20Change.pdf [Accessed 22/03/2015].

Assessment of Forest Ecosystem Services Using Unmanned Aerial Vehicles

－Case study of *Chamaecyparis obtusa* forest, in Takayama, Japan－

Yuya Katada[1], Kiichiro Hayashi [1], Satoru Sugita[2], Takashi Machimura[3], Ayana Fujimoto[3]

1: Nagoya University, 2: Chubu University, 3: Osaka University

Abstract: Creating 3D forest datasets has become relatively easy due to the development of the UAV (unmanned aerial vehicle) and SfM (structure from motion) techniques. These methods can cover a wider range of the forest utilizing a small number of people and for a low cost, with higher resolution compared to conventional methods such as satellite images and aircraft-based LiDAR (Light Detection and Ranging) surveys. Many studies have focused on ecosystem service assessment (ESA); however, the number of ESA studies using UAVs is limited. The objective of this study was to develop a method to assess forest ecosystem service (ES) supply potential by using the UAV and SfM techniques. A planted forest of *Chamaecyparis obtusa* in Takayama City, Gifu Prefecture, Japan was selected for this study. Through the development of 3D datasets supported by a field survey, an ESA was conducted, comprising four ESs from regulating and supporting services. This study showed usability of a UAV for ESA.

Keywords: ecosystem services, forest, Japan, SfM, UAV

INTRODUCTION

Forests provide many benefits to human society, termed ecosystem services (ESs), which are classified into four categories (Millennium Ecosystem Assessment (MA), 2005). Several methods can be used to assess ESs, e.g., field surveys, remote sensing techniques using aircraft and/or satellite data. The scale of analysis for each method is different, so an appropriate analysis method should be considered depending on the study objective. If forest area is relatively small or the study requires species-scale information, a field survey can be carried out, including tree height and DBH (diameter at breast height) measurements, species identification, and soil surveys. If the study area is large, aircraft and/or satellite images can be used. In addition, the resolution of data obtained by LiDAR (Light Detection and Ranging) is high, with several-centimeter-scale spatial resolution (Yone et al., 2002). However, aircraft-based LiDAR surveys are expensive. As a result, satellite remote sensing datasets are frequently used, for example, surface temperature estimation (Honjo and Takakura, 1986) and vegetation monitoring (Takahashi et al., 2011). However, the resolution of satellite data is relatively low, with several-meter-scale resolution. In recent years, the UAV (unmanned aerial vehicle) and SfM (structure from motion) method (UAV–SfM method) has been widely applied in many fields. Through the UAV–SfM method, 3D point cloud datasets can be obtained at relatively low costs. In addition, this method has seasonal flexibility (Albert et al., 2009; Dunford et al., 2009). The UAV–SfM method has a possibility to complement the above mentioned methods. Several studies have investigated the application of the UAV–SfM method to forest research (Tamura et al., 2015). However, the number of studies focusing on ESAs by the UAV–SfM method is limited. The objective of this study was to develop a method to assess forest ES supply potential by utilizing the UAV and SfM techniques.

MATERIALS & METHODS

The forest study site is located in Takayama City, Gifu Prefecture, Japan (36.012°N, 137.366°E) (Figure 1 (a)–(c)). The total area of the site is approximately 0.81 ha. A strength thinning was conducted in 2015. The

main tall tree species in the site was *Chamaecyparis obtusa* with *Cryptomeria japonica*. The other vegetation included low trees and shrubs with bamboo grass and fallen trees by the thinning activities.

Firstly, aerial photographs were taken during several UAV flights. Secondly, based on the photos, a 3D point cloud dataset, orthophoto (vertical view for every position), and DSM (Digital Surface Model) were developed. Thirdly, basic forest information, such as tree height, crown area, and DBH, were estimated supported by a forest field survey. Finally, four ES supply potentials were calculated.

Figure 2 shows the Phantom 3 Professional (DJI) UAV used in this study. The flights were conducted over two days (Table 1) using the autopilot mode in the Map Pilot for DJI software (DRONES MADE EASY). The first and second days represented the leafing and autumn leaves stages, respectively. Different flight conditions were tested on each flight day (Table 1). Principally, the camera direction was set to be vertical; however, in the November flight, oblique photographs were also added.

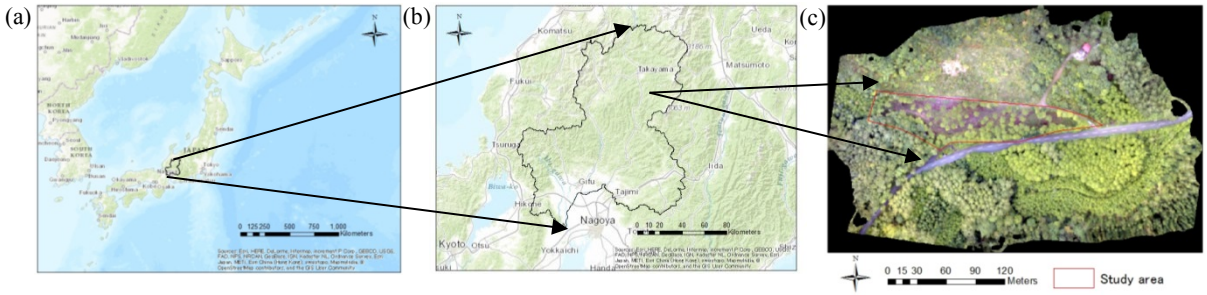


Figure 1. Maps of the study area: (a) Gifu Prefecture in Japan; (b) Gifu Prefecture outlined in black, with the study area; and (c) the study area outlined in red

Table 1. UAV flight conditions

Date	Photos (Number)	AGL(above ground level) (m)	Weather
September 21, 2016 4:00 PM - 5:00 PM	129	80	Cloudy
November 2, 2016 11:00 AM - 1:00 PM	1029	40, 50, 60	Sunny

Note: Camera direction in Sep.: Vertical,
in Nov.: Vertical (AGL 40m and 60m) ±30°(AGL 50m)

Figure 2. Phantom 3 Professional

A field survey was conducted. DBH measurement and species identification were conducted for 149 trees on November 2nd, 2016. Then, the heights of 25 trees selected were surveyed on December 2nd, 2016 by a Laser range finder (Nikon Laser 550A S). The average tree density in the site before thinning was approximately 1100 trees per hectare, based on a pre-survey conducted by the land manager in 2015.

The 3D forest dataset as well as DSM and orthophoto were created using the software PhotoScan Professional 1.2.6 (Agisoft), as well as the DSM and orthophoto. To create the 3D point cloud dataset for the November flight, the quality parameter in PhotoScan was set to be “high”. Based on these data, several forest datasets were estimated (Table 2).

A DTM (Digital Terrain Model) was made based on the visual identification of ground control points (GCPs) in the DSM and orthophotos from the November flight dataset. One or more GCPs were set in each 5 m × 5 m mesh and the points were interpolated using the Kriging tool in ArcGIS 10.4.1 (Esri). Next, a DCM (Digital Canopy Model) was calculated by extracting the DTM from the DSM (September flight dataset).

Table 2. Forest data obtained from UAV and field surveys

Data	Method	Data used	Software used	Assessed ES
DTM	Visual identification	DSM (Nov.flight) Orthophoto (Nov. flight)	ArcGIS 10.4.1 (ESRI)	Climate regulation Air purification
DCM	DSM－DTM	DSM (Sep. flight) DTM	ArcGIS 10.4.1	
Tree top and height	Moving windows method	DCM	R software (Free software)	
Tree crown area	Voronoi division method	DCM Tree top	rLiDAR of R software (Free software)	Water regulation
Stem volume	Inoue and Kurokawa (2001) formula	DBH Tree height	Excel 2010	Carbon stock

Note: DTM: Digital Terrain Model, DCM: Digital Canopy Model.

The tree top location and height were estimated by using the moving window method in rLiDAR ver. 0.1 on R ver.3.3.1 (Silva et al., 2015), which is a package of the statistical software R language (Free Software). For the tree top extraction, firstly, smoothing the DCM was conducted by utilizing a Gaussian filter by ArcGIS tool to avoid extracting too many tree crown tops. Secondly, to select the tree top, the moving window method in rLiDAR was employed. The highest point in each moving window was identified as a tree top in the tree crown, which could be used to estimate the height of each tree.

Regarding the estimation of the tree crown area, the tree top location and height datasets were used with the DCM to divide the tree crowns by using the voronoi division method in the rLiDAR of R software. In this method, Crown parts are divided by the sector of each tree top.

The DBH was calculated in Excel 2010 (Microsoft) by simple regression using the DBH measurements obtained in the field survey and the tree crown area based on Takahashi et al. (2015).

Finally, the stem volume was calculated by using the DBH and tree height datasets, based on a formula in Inoue and Kurokawa (2001). Ishida et al. (2012) showed that the formula produced good accuracy when applied to *Chamaecyparis obtusa* and *Cryptomeria japonica* in Gero City, Gifu Prefecture, which was close to the study site. In addition, forest volume and crown surface area were used for the estimation of ESs.

RESULTS & DISCUSSION

Figure 3 (a)–(c) shows the 3D point cloud, orthophoto, and DCM results. Tree crown extraction accuracy was approximately 76%. Table 3 shows the results of the ES estimation. In this study, the DBH of each tree was estimated by using the tree crown area data. Four ESs were assessed (Table 3). Each indicator was selected by referring to previous studies (Kobayashi et al., 2016). The carbon stock service (tC/ha) was estimated from stem volumes that were taller than 5 m in height and the estimated formula had expansion factor for roots, branch and leaves (National Institute for Environmental Studies, 2014). The forest volume (m^3/ha), which was obtained from the DCM using the Surface Volume tool in ArcGIS, was set to be the indicator of the climate regulation service, in this case the heat-reduction effect, based on Hiruta and Ishikawa (2012). The tree crown surface area (m^2/ha) was used as the air purification service indicator based on Tadaki (1990). These were related to the leaf area of trees. The tree crown surface area shows a relationship with leaf area (Itoh et al., 2008); therefore, the tree crown surface area from the DCM using the Surface Volume tool in ArcGIS was used. The water regulation service was estimated by the crown coverage (%) calculated from the projection crown area referring to Yoshida and Hashimoto (1998).

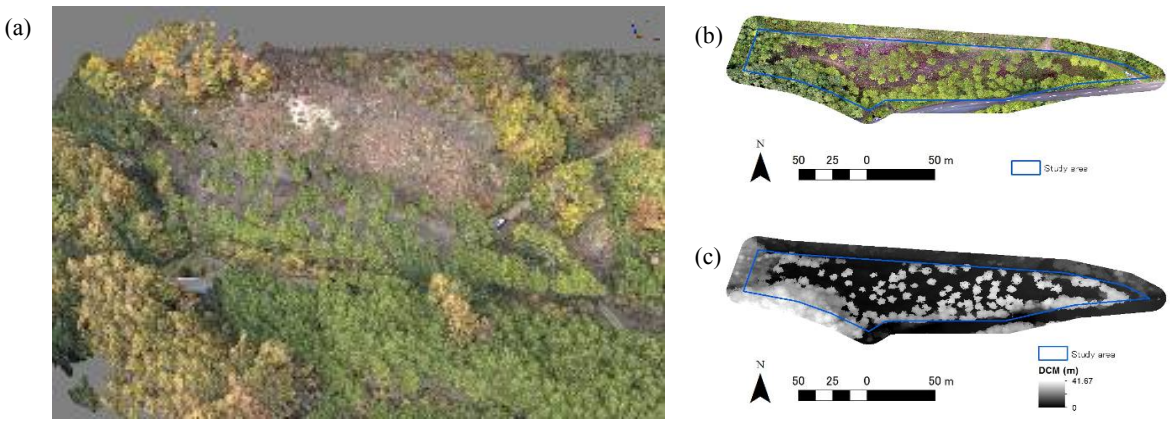


Figure 3. Results of analysis: (a) 3D point cloud (November flight); (b) Orthophoto (September flight), and (c) DCM

Table 3. Results of the ES estimation

ESs	Indicators	Unit	Estimated value
Supporting Services			
a) Carbon stock	Carbon stock	(tC/ha)	65.3
Regulating Services			
b) Climate regulation	Tree volume	($10^4 m^3$/ha)	7.8
c) Air purification	Surface area of crown	($10^4 m^2$/ha)	1.8
d) Water regulation	Crown coverage	(%)	36.8

CONCLUSION

In this study, four ESs were estimated using UAV-SfM data supported by a forest field survey. This showed the possibility of the future application of UAV-related datasets to forest ES assessment. These spatial high-resolution datasets can be got continuously with relatively low cost. Considering DTM, this method might be able to use in other planted forests if it is not so dense. However, several future issues remain. For example, it is difficult to obtain data from low tree layers using only UAV-RGB photos. Therefore, other tools and methods need to be considered, for example, near infrared radiation, laser scanning device. Also, an increase in the number of ES items is required in the future, such as, coverage of low tree layers, habitat.

ACKNOWLEDGEMENTS

The authors thank Chubu Forest Co. for giving us the opportunity to study the site. The authors also thank Machimura lab students and Wataru Kobayashi for their assistance with the field survey. This work is supported by the Collaboration Research Program of IDEAS, Chubu University (IDEAS201609), and the joint usage / research program of the IMaSS, Nagoya University.

REFERENCES

1. Albert, R., Andrea, L., Jeffrey E.H., Craig, W., Kris, H., Caiti, S. and Dawn, B. (2009): Unmanned aerial vehicle-based remote sensing for rangeland assessment, monitoring, and management,Applied Remote Sensing, Vol. 3, 33542.
2. Dunford, R., Michel, K., Gagnage, M., Piégay, H. and Trémelo, M.L. (2009): Potential and constraints of Unmanned Aerial Vehicle technology for the characterization of Mediterranean riparian forest, International Journal of Remote Sensing, Vol. 30, No. 19, pp. 4915-4935.
3. Hiruta, Y. and Ishikawa, M (2012): Research on indicators for evaluating the heat-reduction effect of green spaces,

Journal of the City Planning Institute of Japan, Vol. 47, No. 3, pp. 259-264. (in Japanese)

4. Honjo, T. and Takakura, T. (1986): Analysis of Temperature Distribution of Urban Green Spaces Using Remote Sensing Data, Journal of the Japanese Institute of Landscape Architects, Vol. 49, No. 5, pp. 299-304. (in Japanese)
5. Inoue, A. and Kurokawa, Y. (2001): Theoretical Derivation of a Two-way Volume Equation in Coniferous Species, Journal of the Japanese Forestry Society, Vol. 83, No. 2, pp. 130-134. (in Japanese)
6. Ishida, M., Naoi, S., Watanabe, Y., Tsuzuku, A. and Aoki, M. (2012): Evaluation of the Relative Stem Taper Curves Estimated Only from Tree Height and Diameter at Breast Height: A Case in Planted Forests of Cryptomeria japonica and Chamaecyparis obtusa in the Hida District, Journal of the Japanese Forestry Society, Vol. 94, No. 4, pp. 188-191. (in Japanese)
7. Itoh, T., Matsue, K. and Naito, K. (2008): Estimating forest resources using airbone LiDAR－Application of model for estimating the stem volume of Sugi (*Cryptomeria japonica* D.Don) and Hinoki (*Chamaecyparis obtusa* Endl.) by the tree height and the parameter of crown－, Japan Society of Photogrammetry and Remote Sensing, Vol. 47, No. 1, pp. 26-35. (in Japanese)
8. Kobayashi, W., Hayashi, K. and Ooba, M. (2016): Temporal and Spatial Assessment of Ecosystem Services in 1955 and 2008: Case study in Nagoya and its suburbs, Japan, IAIA16 Conference Proceedings.
9. Millennium Ecosystem Assessment MA, (2005): Ecosystems and Human Well-being: Synthesis. a Report of the Millennium Ecosystem Assessment. Island Press, Washington D.C.
10. National Institute for Environmental Studies (NIES), Center of Global Environmental Research (CGER), Greenhouse Gas Inventory Office of Japan (GIO), (2014): National Greenhouse Gas Inventory Report of Japan, Ministry of the Environment, Japan, NIES, CGER, GIO, , pp. 6_10-6_14.
11. Silva, C.A, Crookston, N.L., Hudak, A. T., Vierling, L.A. (2015): LiDAR Data Processing and Visualization, web link: https://cran.r-project.org/web/packages/rLiDAR/rLiDAR.pdf.
12. Tadaki, Y. (1990): A Trial on Quantitative Estimation of Degrading Vegetational Ability for Environment Conservation Occurred by Land Development, Ann. Environ. Sci., Shinshu Univ., Vol. 12, pp. 36-45. (in Japanese)
13. Takahashi, E. (2015): Sunny Crown Diameter as a Tree Selection Indicator for Thinning at a Mature Sugi Artificial Forest: An Analysis of Sanbe Educational and Research Forest, Shimane University, Journal of the Japanese Forestry Society, Vol. 97, No. 4, pp. 186-190. (in Japanese)
14. Takahashi, T., Kato, K. and Kamijo, T. (2011): Vegetation monitoring by satellite remote sensing after the 2000 year eruption of Miyake-jima Island, Japanese Journal of Ecology, Vol. 61, No. 2, pp. 167-175. (in Japanese)
15. Tamura, T., Kato, A., Obanawa, H. and Yoshida, T. (2015): Tree height measurement from aerial images taken by a small Unmanned Aerial Vehicle using Structure from Motion, Journal of the Japanese Society of Revegetation Technology, Vol. 41, No. 1, pp. 163-168. (in Japanese)
16. Yone, Y., Ogura, H. and Yamagata, Y. (2002): Development of Measurement System for the Carbon Sinks under the Kyoto Protocol－Measurement of Stem Volume and Carbon Weight of Larix leptolepis Stand by Airborne Lidar－, Journal of The Remote Sensing Society of Japan, Vol. 22, No. 5, pp. 531-543. (in Japanese)
17. Yoshida, H. and Hashino, M. (1998): Influence of Canopy Density on Flood Alleviation Function in Forests, Proceedings of Hydraulic Engineering, Vol. 42, pp. 223-228. (in Japanese)

Scoping of Impact Assessment in Canada – Are We Losing our Focus?

Earle Hickey, M. Sc. and Heather Giddens, MES
Stantec Consulting Ltd. Dartmouth, Nova Scotia Canada

Introduction

Scoping is a critical component of impact assessment (IA). When scoping is done well, proponents can deliver focused IA reports, addressing issues of greatest importance while excluding information extraneous to practical decision-making and environmental management. This approach of focusing an IA on environmental features that may be affected by a project and that have been identified to be of concern as identified by the proponent, government agencies, Aboriginal peoples or the public (also referred to as Valued Components [VCs]), is consistent with fundamental guidance (*e.g.*, Beanlands and Duinker 1984). Yet despite this understanding, it is evident that IA is losing its focus and trending toward a "kitchen sink" approach, spending time and resources on a long list of items that do not necessarily support an understanding of the predicted environmental effects or inform mitigation or follow-up programs.

This paper addresses the implications of broadly scoped assessments under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) from the perspective of IA practitioners and proposes recommendations to return to balanced and focussed IAs under the federal IA process in Canada.

Defining the Problem

In 2012, following a statutory review of the *Canadian Environmental Assessment Act*, recommendations intended to streamline and improve the IA process culminated in new federal IA legislation – the *Canadian Environmental Assessment Act, 2012* (CEAA 2012).

Critics of CEAA 2012 predicted the scope and content of federal IAs would be reduced compared to previous legislation. However, despite changes intended to focus on potential adverse environmental effects that are within federal jurisdiction, eliminate duplicative jurisdictional reviews and improve predictability of process, these changes have not necessarily had the intended effect. Ironically, these changes have contributed to many of the scoping problems we are facing today as IA practitioners in Canada.

Broad scoping can occur at various stages of an IA process and can affect the scope of the project, the assessment, or the approval. Broad scoping can be illustrated in IA documentation that is too generic or distracts attention and effort away from key project-environment interactions that may warrant more focused assessment and mitigation planning. Examples of poor scoping are most easily recognized at the early stages of assessment and can be seen in a proponent's Project Description or the federal government's preparation of scoping guidelines (referred to as Environmental Impact Statement [EIS] Guidelines in Canada).

Both of these documents are crucial components of the IA process. However, despite detailed guidance for project descriptions under CEAA 2012, proponents may not focus the scope of the project to be assessed on key interactions. Additionally, many scoping guidelines for project IAs have become broad and generic, while also becoming very prescriptive for some matters,

requiring proponents to consider factors that are not relevant to the project being assessed or require additional time and effort to justify why factors are not being addressed.

Broad scoping can also become apparent during the IA review and approval process where information requests to proponents or approval conditions expand the scope of the IA beyond the jurisdiction of federal authorities or become disproportionate to the predicted environmental risk. When unreasonable changes to the scope of IA are introduced during the IA review stage, this can introduce considerable costs and uncertainty regarding IA approval and project planning timelines.

Contributing Factors to Poorly Scoped IAs

Key regulatory changes associated with the implementation of CEAA 2012, including the narrowing of federal authority to conduct IAs and introduction of regulatory timelines, have contributed to the expansion of scope of federal IAs in Canada.

Under the previous IA legislation, numerous federal authorities were responsible for overseeing federal IAs. Under CEAA 2012 only three federal authorities were designated as Responsible Authorities under the Act: the Canadian Nuclear Safety Commission (CNSC), the National Energy Board (NEB), and the Canadian Environmental Assessment Agency (CEA Agency). While this change may have been intended to help make the regulatory system more predictable and timely, we believe this centralization of responsibilities has led to capacity issues, at least with respect to the CEA Agency, and in turn, contributed to the expansion of scope of IA in Canada. With the narrowing of Responsible Authorities to three federal departments under CEAA, 2012, expert federal departments which would have previously led certain IA processes, are now kept at arms-length and have no direct authority in the scoping or review process. An example of this is the offshore petroleum boards in Nova Scotia and Newfoundland and Labrador, which, as experts in offshore petroleum exploration and development activities were formerly Responsible Authorities leading IA processes for these types of projects subject to IA. These boards are now given no more authority than any other government department when it comes to IA under CEAA 2012; the level of involvement of an offshore petroleum board in these decisions is at the discretion of the CEA Agency staff.

Capacity issues, which can include a lack of understanding from a Responsible Authority's perspective, are sometimes reflected in broad scoping documents, and also in IA compliance checks and requests for supplementary information following submission of the project IA where proponents have used professional judgement and attempted to scope out irrelevant information from the EIS guidelines.

Another compounding factor to capacity issues is the regulatory timeline established under CEAA 2012. Under the Act, Responsible Authorities are required to produce draft EIS guidelines within 45 days of a project description being filed. The nature of the project and familiarity of the Responsible Authority with the file can greatly influence the quality of the scoping effort undertaken to produce these draft guidelines.

Barnes et al. (2013) cites examples of generic EIS guidelines for all standard IA with sector-specific "inserts". This approach, which was developed to facilitate timely release of draft scoping guidelines within a specified window of time under the Act, produced, according to Barnes et al. (2013) "less than good" scoping. Generic guidelines issued by the CEA Agency

would sometimes result in the inclusion of VCs with little or no relevance to the Project and omission of other VCs which the proponent had identified as being key issues in its project description documents (Barnes et al. 2013).

One example of broad or irrelevant scoping in EIS guidelines include the requirement for a human health risk assessment requiring all exposure pathways for pollutants of concern to adequately characterize potential risks to human health for an all-weather road in remote northern Saskatchewan (CEA Agency 2016). Another example is the requirement for the EIS to consider changes to the terrestrial environment, including landscape disturbance for a deepwater exploration drilling project occurring 250 km offshore Nova Scotia (CEA Agency 2015).

It is acknowledged that EIS guidelines allow proponents to justify exclusion of matters it feels are not relevant or significant to the project in the EIS, but this requires additional effort to justify why matters should not be considered rather than focusing time and resources on those matters of relevance to a focused IA of the project. Furthermore, these EIS guidelines are the standard against which a proponent's IA is measured in the public forum, and with respect to a completeness review by the CEA Agency. A proponent therefore potentially introduces risk to the IA process when using their own judgement to justify exclusions.

Another key contributing factor to broadly scoped IAs is not necessarily tied to CEAA 2012 itself but more related to an unprecedented level of public and Aboriginal involvement in IA processes in Canada. In many cases, project IAs have become forums for unresolved or difficult public policy discussions, simply because there is no other mechanism available for discussing those issues outside of project-specific IAs. Proponents of single projects therefore face the burden of resolving public policy related criticism misdirected at individual projects. Attempting to validate Aboriginal and public stakeholder concerns related in any form to an undertaking, Responsible Authorities tend to err on the side of caution and expand the scope of the IA through EIS guideline development and/or supplementary information requests during IA review to address broad issues of concern thereby reducing risk of legal action from dissatisfied intervenors (Barnes et al. 2010). In the absence of other forums to address these concerns, proponents inherit the responsibility of educating the public, Aboriginal communities, affected stakeholders, and sometimes even regulatory agencies on broader issues which are disproportionate to specific project interactions and effects.

Recommendations for Improving our Focus

In 2016, the Government of Canada launched a review of CEAA 2012, establishing an Expert Panel with a mandate to engage with Canadians, Aboriginal communities and key stakeholders and develop recommendations for improving the federal IA process. In April 2017 the Expert Panel issued a report containing 48 recommendations (Minister of Environment and Climate Change 2017). In advance of the federal government's response to the Expert Panel's report and with specific focus on addressing the contributing factors identified in this paper, we offer recommendations to improve scoping of federal IAs in Canada, recognizing required participation from proponents, IA practitioners, and Responsible Authorities.

Expansion of Responsible Authority Capacity

During the review of CEAA 2012 some federal authorities have advocated for a return to Responsible Authority status, recognizing the value that their specific expertise can bring in making the IA process more effective. Examples of this can be seen in the official submissions to the Expert Panel from the offshore petroleum boards in Nova Scotia and Newfoundland and Labrador (CNSOPB 2016; C-NLOPB 2016). Expanding the list of Responsible Authorities for federal IA beyond the NEB, CNSC and CEA Agency to include, for example, the offshore petroleum boards, could improve capacity and performance issues.

Reallocation of Scoping Time within Designated Timelines

Improvements in scoping will require more focus on scoping discussions at the beginning of an IA process. By allotting more time for the Responsible Authority review and public comment at the beginning of the IA process it will allow for improved understanding of how the project is being defined, the key issues of concern, and what to expect as the project progresses through the IA process. Without extending the overall timelines for federal IA review, this reallocation of effort to the early stages of an IA is likely to bring more certainty and transparency around the scope of the IA and the overall IA process.

Early Proponent-led Engagement and Education of Regulators

Proponents should be prepared to participate in the education of Responsible Authorities and should also be encouraged to unofficially engage other relevant and knowledgeable federal government departments and agencies to participate in draft reviews of project description and IA documents. Proponents should be encouraged to meet with the Responsible Authority during development of the draft project description to inform and initiate dialogue around key issues. This will help to improve capacity and preparedness of Responsible Authorities to respond effectively within established timelines once the project description is officially filed.

Use of Strategic Environmental Assessments

With respect to improving IA scoping and effectiveness in the public forum, strategic environmental assessments (SEAs) should be used more frequently as early planning tools. SEAs could be used to determine the acceptability of certain types of projects and activities in certain locations and identify key social and environmental concerns and ways of addressing these concerns prior to the advent of a specific project. Engagement with regulators, affected Aboriginal groups and interested stakeholders through mechanisms such as an SEA, allows for debate of public policy and determination of key issues and standards. The outcomes of these processes can then be incorporated into future project plans and project-specific IAs. Given this early forum for review and engagement, there is the expectation that there would be fewer surprises when specific projects are proposed and IAs for these projects can focus on key components to be addressed specific to the proposal.

Conclusion

Broad scoping, considering "everything under the sun", results in wasted time and resources on issues that do not effectively contribute to informed decision-making, increases regulatory uncertainty, and reduces proponents' abilities to effectively manage key environmental issues.

Focused scoping will require a more concerted effort on the part of proponents, IA practitioners and Responsible Authorities to communicate early and often with each other as well as with public stakeholders and Aboriginal peoples to produce IA documents which address key issues of greatest concern. Focused IAs will then, in turn, serve to facilitate more effective decision-making by federal authorities and project proponents.

References

Barnes, J.L., S. Webster, N. Cory, and M. Murdoch. 2013. Scoping under New Federal EA Regime in Canada. Presented at the 33rd Annual Meeting of the International Association for Impact Assessment, May 13-16, 2013, Calgary, Canada.

Barnes, J.L., L. Hardwick, and C. Chan. 2010. A Review of the Project Scope and Environmental Assessment Scope for Energy and Mining Projects Across Canada. Presented at the 30th Annual Meeting of the International Association for Impact Assessment, April 6-11, 2010, Geneva, Switzerland.

Beanlands, G.E. and P.N. Duinker. 1984. An ecological framework for environmental impact assessment. J. Environmental Management 18:267–277.

Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). 2016. Written submission to Ms. Johanne Gélinas, Chair, Expert Panel, Review of Canadian Environmental Assessment Act, 2012. November 9, 2016.

Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). 2016. Written submission to Ms. Johanne Gélinas, Chair, Expert Panel, Review of Canadian Environmental Assessment Act, 2012. December 23, 2016.

Canadian Environmental Assessment Agency (CEA Agency). 2015. Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act, 2012. Scotian Basin Exploration Drilling Project. BP Canada Energy Group ULC. October 27, 2015.

Canadian Environmental Assessment Agency (CEA Agency). 2016. Final Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act, 2012. Highway 905 – All Weather Roadway – Stony Rapids to Lake Athabasca near Fond-du-Lac. Saskatchewan Minister of Highways and Infrastructure. September 14, 2016.

Minister of Environment and Climate Change. 2017. Expert Panel Report. Building Common Ground: A New Vision for Impact Assessment in Canada. Available online: https://www.canada.ca/en/services/environment/conservation/assessments/environmental-reviews/environmental-assessment-processes/building-common-ground.html

Implication Measures between SDG and Korean EIA

- Alternative Dispute Resolutions on Environmental Conflicts of Mungjangdae Hot Spring Resort Development –

San-Pyo Hong

I. Background and Objective

Since democratization in 1987, as South Korea citizens have pursued quality of life and acknowledged the importance of environmental preservation, environmental conflicts has rapidly increased. EIA as Alternative Dispute Resolutions (ADR) needs to be applied to cope with the environmental conflicts which derived from the intrinsic characters of environment which connotes the concept of 'Tragedy of Commons' and externalities as public goods.

Environmental conflicts were provoked when local residents stood opposite to the regional development projects, especially the construction of environmentally obnoxious facilities. Thus, environmental value should be considered in balance with economic development, and EIA system needs to be established for resolving environmental conflicts by the participative governance of local communities including local residents, administrative authorities and NGOs.

For incorporating EIA into ADR, a local communicative governance which comprising social equity, economic development and environmental integrity can be useful to achieve the implication between EIA and Sustainable Development Goals (SDG). As a case study, 'Mungjangdae Hot Spring Resort Development (MHSRD)' was selected to verify the correlations among EIA, ADR and SDG.

II. Environmental Conflicts History of MHSRD

1. Defective definition of Hot Spring Act in Korea :

1) Water temperature should be above 25℃ as eruption state
2) Water qualities should not be harmful to human body
3) Water quantity should be more than 300m^3/day as suitable pumping rate

These meager definition of Hot Spring conditions has caused reckless development of Hot Spring Resort in Korea, which has resulted in aquatic ecosystem destruction by water contamination derived from inadequate treatment of sewage effluents.

2. EIA Act that Applies to Hot Spring Resort Development in Korea

1) Mayor/Governor shall request the head of a local environmental agency to perform a SEIA (Strategic Environmental Impact Assessment) or an EIA for a relevant hot spring development.
2) Where the development area of a hot spring is less than 300,000m^2 : To perform a SEIA under the EIA Act prior to approval of a development plan.
3) Where the development area of a hot spring is at least 300,000m^2 : To perform an EIA under the EIA Act prior to approval of a development plan. In such cases, a SEIA under the EIA Act shall not be performed.

3. Environmental Conflicts History of MHSRD

1985.02 : Designation of Hot Spring Hole Protection Zone(5,300,000m^2) by Kyungsangbukdo Province

1987. 12 : Designation of Munjangdae Hot Spring Resort (956,000m^2) by Ministry of Culture and Tourism

1988.10 : The 1st EIA Consultation by National Environmental Administration

1989.08 : Approval of ‘Munjangdae Hot Spring Resort Development(MHSRD) Plan’ by Kyungsangbukdo Province

1996.04 : The 1st Implementation Permission for MHSRD Project(134,920m^2) by Sangju City

1996.08 : Beginning of Groundwork Construction

1996.08 : The 1st Litigation for ‘Cancellation of Implementation Permission for ’MHSRD Project’ by Residents of Koesankun Who Have Lived in the Downstream Area

1998.02 : Court’s Adjudication of Stoppage of Construction

1998.03 : Consultation Alteration of Consultation Contents by Environmental Administrative Agency for Daegu Metropolitan City Region

1998.05 : 1989.08 : Alteration of ‘MHSRD Plan’ by Sangju City

2003.05 : The 1st Judgement on Revocation to ‘MHSRD Permission’ by the Supreme Court

2004.07 : The 2nd Implementation Permission for ‘MHSRD Project(215,070m^2)’ by Sangju City in Response to the Reapplication of ‘Landowners Association for MHSRD’

2005.01 : The 2nd Litigation for ‘Cancellation of Implementation Permission for ’ MHSRD Project’, by Residents of Koesankun Who Have Lived in the Downstream Area

2009.05 : Dismissal of Claim to Appellate of ‘Cancellation of Implementation

Permission for 'MHSRD Project' by The Daegu High Court

2009.10 : The 2nd Judgement on Revocation to 'MHSRD Permission' by the Supreme Court

2015.06 : The 3rd EIA Submission for 'MHSRD Project (956,000m2)' by 'Landowners Association for MHSRD' Based on Adjustment of Project Site

2015.08 : Retrocession Ruling to EIA of MHSRD by Environmental Administrative Agency for Daegu Metropolitan City Region Based on 1) Insufficiency of Data for Water Quality Prediction, 2) Absence of Public Participation Procedure at Koesankun Afflicted Area

2016.03 : Public Announcement for Public Inspection on EIS Draft for EIA renegotiation

2016.10 : Rejection to Public Inspection on EIS Draft by residents of Koesankun Afflicted Area

4. Predictions of Water Contamination by MHSRD

The construction of the Munjangdae Hot Spring Resort may incur water temperature increase and BOD loadings seriously, which may bring about excessive biomasses of periphyton and phytoplankton in the downstream, and ultimately deteriorate species diversity of aquatic ecosystem

III. Alternative Dispute Resolution on MHSRD by Applying EIA

1. Environmental Conflicts

Mungjangdae area was designated as hot spring district by the governments on Feb. 1st, 1985, after then this area was influenced by the full-scale development of hot spring resort. Sangju city, which belongs to Kyungsangbukdo Province propelled actively the hot spring resort development for the vitalization of retarded local economy. Landowners organized 'Landowners Association for MHSRD' as interest group for pushing ahead with the 'MHSRD Plan'.

In response to 'MHSRD Plan' propelled by Sangju city, residents of Koesankun which belongs to Chungcheongbukdo Province who have lived in the downstream area that are influenced by wastewater discharge from 'Landowners Association for MHSRD' established 'Countermeasure Committee for Restraining of MHSRD'. Sympathizing with 'Countermeasure Committee for Restraining of MHSRD', residents of Chungcheongbukdo Province and Environmental Movement Organization combined forces to disintegrate 'MHSRD', which resulted in environmental conflicts between provincial regions.

2. Settlement of Environmental Conflicts on MHSRD by EIA

In case of 'MHSRD', it is assumed that the principal factors of conflicts are the confrontation between the local communities for existence right, the insufficient acquisition of information about scarce environmental resources, and the differentiation of relative weights on values about conflict issues related with development profits of landowners, aquatic ecosystem destruction, and water supply source damage to downstream residents.

It is recommendable to recognize that the achievement of integrative governance on the basis of ADR for enhancing mutual benefits of all concerned parties through utilizing the methodology of EIA which is connected with the principles of SDG extensively is attainable.

IV. Conclusion

To reach ADR on MHSRD, the effective application of EIA which is a scientific and institutional instrument for the implementation of SDG can be a practicable scheme. Hot Spring Act should be amended as legislative approach : 1) Reflect mandatorily the intention of Mayor/Governor in afflicted region when Hot Spring Development plan is permitted. 2) Increase water temperature criteria from 25℃ to 40℃ above eruption state. As for Tourism Promotion Act amendment, 'Tourism Resort Development Plan' and 'Tourism Resort Development Designation' can be revocable when public interests are infringed significantly by environmental contaminations.

References

Bond A, Saunders A. 2011. Re-evaluating Sustainability Assessment : Aligning the Vision and the Practice. Environmental Impact Assessment Review 31(1): 1-7.

Carraro C, Campagnolo L, Eboli F, Farnia L. 2015. Assessing Sustainable Development Goals. SDSN Conference on 'Implementing the Sustainable Development Goals : Getting Started'.

Cho GJ. 2010. Research on SEA Methodology for Urban Master Plans. Korea Environment Institute.

Gao JJ, Kornov L, Christensen P. 2013. Do Indicators Influence Communication in SEA. Environmental Impact Assessment Review. 43: 121-128.

Hong SP. 2011. A Study on the Implication of Sustainability and Environmental Assessment. Journal of Environmental Impact Assessment 20(3): 269-279.

Kim BM, 2016, A Study on the Operation Mechanism of Environmental Impact Assessment System : with a Focus on the Effects of Conflict Prevention and Management Master Degree Thesis, Sungkyunkwan University.

Ko JK, Joo JH. 2015. Developing and Monitoring Indicators of Sustainable Development in Gyeoggi-do. Gyeoggi Research Institute.

Korean Ministry of Environment. 2015. Regulations on Preparations of Environmental Impact Statements etc. Notification of Ministry of Environment 2015-141.

Kwon YH, Oh JK, Ahn SE. 2014. Indicator Development for Policy-level Plan Strategic Environmental Impact Assessment. Korea Environment Institute.

Lee JS. 2015. A Study on the Analysis of the Opinion Gap Related to the Constituent Element of Sustainable Development and a Strengthening Plan of the Environmental Element. Ph. D. Dissertation, Chonnam National University.

Lim JH, 2016, A Study on the Causes and Characteristics of Environmental Conflicts in South Korea, Dispute resolution studies review, Vol 14 (No.2), Dankook Center for Dispute Resolution, Dankook University, pp.109-136.

Oh JK, Kwon YH. 2015. A Comparative Study on the Strategic Environmental Impact Assessment in Korea and Foreign Countries. Journal of Environmental Impact Assessment 24(3): 244-259.

Oh SG, Kim EK. 2014. A Study on the Sustainability Assessment for Improving Environmental Impact Assessment: A Case of Chungcheongnam-Do. The Korean Journal of Local Government Studies 17(4): 363-385.

UN SDSN. 2015. Why a Guide for Getting Started ? ; p.14.

Yoo HS. 2013. A Study on the Effective Management of the Strategic Environmental Assessment - Establishment Procedure and Characteristics of Policy Plan - . Korea Environment Institute.

Geographical and Social Characteristics of Landscape conflicts on PV projects in Japan

— Case Study of 12 small-large scale PV projects—

Ayumi HORI, Yuki SHIBATA

Department of Environmental Science, Faculty of Science, Toho University

Establishment of the FIT (Feed-in tariff) in 2012 triggered the rapid growth of renewable energy in Japan. Inter alia, installed volume (2012-2013) of Photovoltaic (PV) power accounted for 80% out of all renewable energy sources, due to the higher FIT price and the easiest procedure. On the other hand, development site permission criteria has not been established well. For this reason, PV developments frequently caused environmental conflicts around the project sites. Yamashita (2016) showed that the most common causes of the environmental conflicts at PV project in Japan were the concerns about the impact on the natural landscape. The purpose of this study is to clarify the factors of PV landscape conflict by analyzing 12 controversial PV projects from four aspects: (1) tourism, (2) regional planning, (3) community, (4) historical aspects. We concluded that the project site locations close to sensitive areas, the gaps between the regional planning policy and the actual development projects and the highly economic beneficial legislations might have risks for causing landscape conflicts.

Keyword: Photovoltaic (PV) Development, Landscape, Project Site, Conflict, JAPAN

1. Introduction

After the great earthquake and fatal nuclear accident at Fukushima in 2011, Japanese national government has promoted policies for quickly expanding renewable energy including photovoltaic (PV), wind, hydro, biomass and geothermal. FIT (Feed-in tariff) was introduced as one of the promotion policies in 2012, and the FIT procurement price of PV were relativity higher than other renewable sources. As the result, grid connected commercial PV is the most quickly introduced among the other renewable sources (Table 1).

Table 1. FIT procurement price and the installed volume renewable energy (ANRE, 2014)

Sources	FIT procurement price in 2012 [JPY]	Installed volume in 2012-2013 [MW]	Ratio [%]
PV (residential)	42*[1]	227.6	25.41%
PV (commercial)	40*[2]	643.9	71.90%
Wind	22-55	11.0	1.23%
Hydro	24-34	0.6	0.07%
Biomass (wood)	24-32	12.2	1.36%
Geothermal	26-40	0.1	0.01%

*1: Under 10kw, *2: more than 10kw

Add to this FIT scheme, an addition legislation regarding the renewable power promotion by effective utilization of countryside unutilized land[※1] triggered the widespread of PV developments in quiet rural area (Sakamura, 2014). Tsujita (2015) pointed that the disorderly PV developments were avoided by the landscape regulations linked with development permissions and the FIT procurement prices varied from area to area. On the other hand, environmental conflicts were frequently reported which has been caused by the relatively loose development permission since the FIT system started (Yamashita, 2016). Yamashita (2016) also presented the most common reason for objecting the PV development in conflicted cases was landscape destruction.

This paper aims to find the common characteristics from geographical and social perspectives on 12 PV project sites where have caused disputes in respect of the landscape.

2. Research Framework

In order to find the frequently common geographical and social characteristics of the project site, we examined 12 nationwide PV projects which caused landscape conflict between the project proponents and the local residents (Yamashita, 2016)[※2]. Table 2 shows the list of the 12 projects, but we prefer anonymity of the specific project names because some of the projects are under dispute condition.

As the first step of this analysis, we identified the locations of these 12 projects specific sites in the topographical maps, and we analyzed those locations from four aspects of the two different perspectives (Table 3). We assumed that distance to officially designated the National and Prefectural Natural Parks and distance to the Nationally/Prefectural designated Cultural Properties and municipally designated Scenic Spots may become the factors of landscape conflicts because those are recognized as one of the important tourism resources in those regions. Therefore, we examined the distances to those places from the project sites. From the same perspective, we also examined the distance to the closest residence and public elementary and/or junior high school because those are recognized as the center of those communities.

From the social perspective, we examined the consistency of land development policies with municipal planning documents and the PV development projects as an analysis of regional planning aspects. In this analysis, we read the Land Use Plan and the Landscape Plan of the municipal government that the PV project located, and we examined whether “inconsistent word” is present in the description of the Land Use Plans

Table 2. List of land scape conflict PV projects

Project	Prefecture	Project Initiation	Approx. Scale
A	Akita	Jun. 2015	1.7MW
B	Yamanashi	Aug. 2014	2.0MW
C	Nagano	May. 2014	10.5MW
D	Nagano	Mar. 2013	1.0MW
E	Nagano	Dec. 2014	6.0MW
F	Nagano	Sep. 2015.	24.0MW
G	Hyogo	Nov. 2015	2.0MW
H	Hyogo	Jul. 2014	1.5MW
I	Okayama	Nov. 2014	0.6MW
J	Oita	Aug. 2014	8.0MW
K	Oita	Nov. 2013	1.6MW
L	Oita	Nov. 2013	10.0MW

Table 3. Analysis items

Perspective	Aspect	Item
Geographical Perspective	Tourism aspect	Distance to officially designated Natural Parks, Cultural Properties and Scenic Spots.
	Community aspect	Distance to the closest residence and public school
Social perspective	Regional planning aspect	Examine whether “inconsistent word” is present in the Land Use Plan and the Landscape Plan.
	Historical aspect	Examine whether history of opposition movement for development project is present.

Box 1. List of “Inconsistent Word”.

Categories	Inconsistent words
Natural	Natural conservation area, Natural environment area, Protected area
Traditional	Traditional area, Traditional woodlands area, Traditional farming village, Traditional architecture area, Traditional cultural area
Tourism	Tourism area, Scenic spots, Natural landscape, Mountains landscape area, Forest landscape area, Coastal landscape area

and the Landscape Plans. In this study we defined the "inconsistent word" as the words in Box 1 with assuming that the area which described with those words in the planning documents may have risks for landscape conflicts. At the last part of the analysis, we examined whether history of opposition movements for development projects is presented in the articles of past issues of local newspaper from 1985 to 2014. We assumed that the past experiences of opposition movements for development projects with respect of the landscape might increase the local recognitions of the landscape values and enhance the risks of landscape conflicts.

3. Result of Analysis

3.1 Tourism Aspect

We measured all the distance to the National Parks, Quasi-national Parks and Prefectural Parks which are located within 20km radius from the 12 project sites. Table 4 shows the existence number of the Natural Parks by each distance categories. 9 projects (A, B, E, F, G, H, I, J, L) out of the 12, have one or two Natural Parks in the distance of 5km from the site. Project G is located in the Ordinary Zone[※3] of the National Park which is a area that large scale developments are limited by Natural Park Act. This table also shows all 12 projects have one or more Natural Parks within the 20km radius from the projects sites.

We also measured all the distance to the National Cultural Properties, Prefectural Cultural Properties and Scenic Spots which are located within a 5km radius from the 12 project sites.

Table 5 shows the existence number of those cultural properties and scenic spots by each distance categories. This Table shows 8 projects (B, D, E, F, G, H, J, K) have one or more officially designated cultural properties in the 3km distance from their project sites. And 10 projects (A, B, C, E, F, G, H, I, J, L) have one or more officially designated Scenic Spots in the 3km distance from their project sites. In total, every project except Project C has one or more National and/or Prefectural Properties, and the every project including Project C has one or more municipally designated scenic spots within a 5km radius from the projects sites.

3.2 Community Aspect

We measured all the distance to the closest residence and public school from the 12 project sites. Figure 1 shows the X-Y mapping of those

Table 4. The existence number of natural parks by distance categories from the project site

Project	0km	～5km	5～10km	10～15km	15～20km	Total
A	-/-/-	-/-/1	-/-/-	-/-/-	-/-/-	-/-/1
B	-/-/-	-/1/-	-/-/1	1/-/-	1/-/-	2/1/1
C	-/-/-	-/-/-	-/-/-	-/-/-	1/-/-	1/-/-
D	-/-/-	-/-/-	-/-/1	-/-/1	1/-/-	1/-/2
E	-/-/-	1/1/-	-/-/-	-/-/-	-/-/-	1/1/-
F	-/-/-	-/1/-	-/-/-	1/-/1	-/-/-	1/1/1
G	1/-/-	-/-/-	-/-/-	-/-/1	-/-/-	1/-/1
H	-/-/-	-/-/1	-/-/-	-/-/1	-/-/-	-/-/2
I	-/-/-	1/-/1	-/-/-	-/-/-	-/-/-	1/-/1
J	-/-/-	-/-1	-/-/-	-/1/-	-/-/-	-/1/1
K	-/-/-	-/-/-	-/-/-	-/1/-	-/-/-	-/1/-
L	-/-/-	1/-/-	-/-/-	-/-/-	-/-/-	1/-/-
Total	1/-/-	3/3/4	-/-/2	2/2/4	3/-/-	9/5/10

(National Park / Quasi-national Park / Prefecture Park)

Table 5. The existence number of Cultural Properties and Scenic Spots by distance categories from the project site

Project	0～1km	1～2km	2～3km	3～4km	4～5km	Total
A	-/-/-	-/-/1	-/-/-	-/2/1	-/-/-	-/2/2
B	-/-/-	-/-/3	1/ 3/1	-/1/-	-/-/1	-/4/5
C	-/-/-	-/-/2	-/-/4	-/-/1	-/-/-	-/-/7
D	-/1/-	-/-/-	-/-/-1	-/-/3	-/-/1	-/1/5
E	-/-/1	2/-/-	1/-/3	-/-/1	1/-/-	4/-/5
F	-/-/1	-/-/4	1/-/5	-/-/2	-/-/-	1/-/12
G	1/-/1	1/-/-	3/-/-	-/1/-	-/1/-	5/ 2/1
H	-/1/-	-/-/-	-/-/1	1/-/-	-/-/-	1/1/1
I	-/-/-	-/-/1	-/-/-	1/-/1	-/1/-	1/1/2
J	-/-/-	-/-/-	15/ 29/1	-/1/-	1/13/-	16/43/1
K	-/-/-	-/-/-	-/1/-	-/1/1	-/1/-	-/3/1
L	-/-/-	-/-/1	-/-/1	-/-/1	-/-/-	-/-/3
Total	1/2/3	3/-/12	21/33/17	2/6/11	2/16/2	29/57/45

(National Cultural Properties / Prefectural Cultural Properties / Scenic Spots)

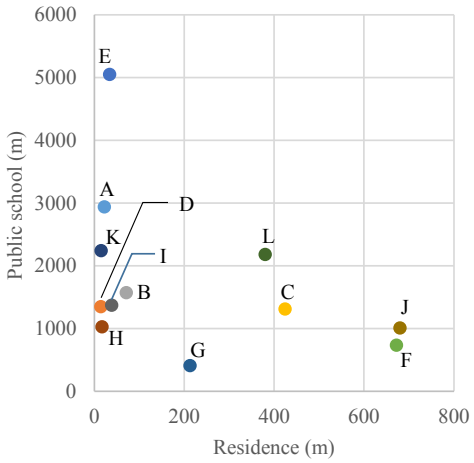


Figure 1. Distance to the closest residence and public school

distances of each project. This figure shows the 7 projects (A, B, D, E, H, I, K) have closest residence within a 200m radius from the project sits. And 8 projects (B, C, D, F, H, I, J, G) have a public school within a 2km radius from the project sites. Especially, regarding the 6 projects are located in less than 50m form the closest residence (A=22m, D=14m, E=34m, H17m, I=38m, K=15m).

Table 6. The described number of "inconsistent word" in planning documents

	Land Use Plan								Landscape Planning							
Project	Traditional	Nature conservation	Tourism	Scenic spots	Natural landscape	Natural environment	Protected area	Total	Traditional	Nature conservation	Tourism	Scenic spots	Natural landscape	Natural environment	Protected area	Total
A	-	✓	✓	-	-	-	-	2	✓	-	-	-	✓	-	✓	3
B	-	-	-	-	-	✓	-	1	✓	✓	✓	✓	✓	-	-	5
C	✓	-	-	-	✓	✓	-	3	-	-	-	✓	-	-	-	1
D	-	✓	-	-	✓	✓	-	3	-	-	-	-	✓	-	-	1
E	✓	-	-	-	✓	-	✓	3	-	-	✓	✓	✓	-	✓	4
F	✓	-	-	-	-	✓	-	2	-	-	✓	-	✓	-	✓	3
G	-	-	✓	-	✓	-	✓	3	-	-	-	✓	✓	-	✓	3
H	-	✓	-	-	✓	✓	-	3	✓	✓	-	-	-	✓	✓	4
I	-	-	✓	-	-	✓	-	2	-	-	-	-	-	-	✓	1
J	-	-	-	-	-	✓	-	1	✓	-	-	✓	✓	-	-	3
K	-	-	✓	-	✓	-	-	2	✓	✓	-	-	✓	-	-	3
L	-	✓	✓	-	-	✓	-	3	-	✓	-	-	✓	✓	-	3
Total	3	4	5	0	6	8	2		5	4	3	5	9	2	6	

Table 7. The experience of past conflict

Project	Year	Type of development project
A	1990	Tourist resort development
B	1996	Resort condominium development
C	-	-
D	2007	Wind power generation development
	2011	Wind power generation development
E	1991	Resort condominium development
	2001	Resort condominium development
F	1989	Golf course development
G	1992	Seaside resort development
H	2009	Large commercial complex development
	2015	Industrial waste treatment facility development
I	1991	Large resort development plan
J	1991	Golf course development plan
K	-	-
L	1991	Golf course development
	2006	Resort condominium development

3.3 Regional Planning Aspect

Table 6 shows the result of examination whether "inconsistent word" is present in the description of Land Use Plans and the Landscape Plans. This table shows that one or more inconsistent words were used as terms, which describe the area where the project sites are located in all 12 Land Use Plans and 12 Landscape Plans. And the most commonly used "inconsistent word" were "Natural Environment" in Land Use Plans and "Natural Landscape" in Landscape Plans.

3.4 Historical Aspect

Table 7 shows the list of past development conflicts related to landscape destruction in the each project site area. As this table shows, the all areas of projects except project C and K have an experience of opposition movements for landscape conservations by those residences in these decades.

4. Conclusion and Discussion

In this paper, we analyzed the geographical and social characteristics from four aspects on 12 PV project sites where have caused disputes in respect of the landscape. As the results, we found that all 12 PV project sites have one or more officially designated Natural Park within a 20km radius, and they have one or more officially designated Cultural Properties and Scenic Spots within a 5km radius. From the geographical analysis, we also found that 6 projects out of 12

have closest residences in the 50m radiuses, and 8 projects out of 12 have public schools in the 2km radiuses. These are though to be important tourism resources of each community or community living spaces. From these reason, we deduced that a project site location close to those sensitive areas might has risks for causing landscape conflicts.

From the analysis of social perspectives, we found that one or more inconsistent words were used in the policy descriptions of all 12 Land Use Plans and 12 Landscape Plans as the result of regional planning aspect analysis. Based on this result, we can point out that there is the gap between the regional planning policies and the actual PV development projects. As the result of historical aspect analysis, we found that the area of 10 projects out of 12 have an experience of opposition movements for landscape conservations. One of the common causes of past conflict was the development related to resort facilities. Actually these development projects were triggered by Resort Development Promotion Act (1987). And after the two decades, FIT Law (2012) has caused landscape conflicts in same areas. These highly economic beneficial promotion legislations powerfully advance the development projects, but they also cause various problem. This study suggests that a fine-grained careful site selection guidance and a pre-zoning are effective for operate the FIT without causing landscape conflicts.

※1: Act on the Promotion of Renewable Energy Electric Power Generation Harmonized with Sound Development of Agriculture, Forestry and Fisheries.

※2 Yamashita (2016) reported 16 landscape conflict projects, but four projects out of the 16 projects the specific geographical site were not be identified.

※3 The area of each National Park is divided into ordinary, special and marine park zones.

References

ANRE: Agency for Natural Resources and Energy (2014) FIT database information disclosure. (URL: http://www.fit.go.jp/statistics/public_sp.html)

Sakamura. Kei, Kaneko. Takahiro, Nakai. Norihiro, Numada. Asami (2014) “Study on the site character of the ground standing Photovoltaic Power Generating System” *Journal of City Planning Institute of Japan*, 49(3), pp633-638.

Tsujita. Yurina, Kyakuno. Takashi (2015) “Trend of the installments of photovoltaics equipment in Erlangen of Germany and its influencing factors” *Journal of City Planning Institute of Japan*, 50(3), pp844-850

Yamashita. Noriaki (2016) “Research on troubles and Corresponding policies in utility scale solar PV project developed in Japan” Institute for Sustainable Energy Policies. p12.

Focusing on Receptors

Celesa L. Horvath[1] and Nathan Braun[2]

Abstract

Effect pathways are often complex, comprising multiple components of the natural and human environment. In some recent environmental assessments (EAs), the British Columbia (BC) Environmental Assessment Office (EAO) has differentiated between Valued Components (VCs) that are *intermediate components* (ICs) along effect pathways and *receptor components*[3]. These EAs describe changes in ICs expected to result from the project, and the consequence of those changes to receptor components is then examined. Thus, the analysis, and particularly the discussion of significance, is focused on the receptor components, instead of physical media through which effects are transferred. The use of ICs has been one effort to reduce duplication and overlap, and increase clarity, in assessments. This paper reviews the benefits of and challenges related to differentiating between intermediate and receptor components as a means of focusing EA in provincial EA practice in BC.

Introduction

EAs in BC use a values-based framework to promote a comprehensive, yet focused, understandable, and accessible assessment of potential effects, while making the most effective and efficient use of resources. This framework relies on the use of VCs as a foundation for the assessment (EAO 2013).

Selecting appropriate VCs allows the assessment to be focused on those aspects of the natural and human environment that are of greatest importance to society. Using VCs also improves the effectiveness and efficiency of assessment, in part by helping to focus the analysis on key project-environment interactions and ensure appropriate study methods are used (EAO 2013).

The VCs required to be assessed in a provincial EA[4] in BC are specified in project-specific Application Information Requirements (AIR) issued by EAO following public and Working Group[5] consultation. In some cases, this is supported by the proponent providing an initial rationale for the VCs proposed to be assessed.

As in many jurisdictions, over time, EAs in BC have become larger and more complex, as both EA process and practice have evolved and awareness of and participation in EA has increased. It is very important that the EA process remains accessible to a wide range of participants and

[1] Principal, Ventus Development Services Inc., P.O. Box 1051, Pincher Creek, Alberta, T0K 1W0, Canada. E-mail: clh@ventus.ca.
[2] Executive Project Director, BC Environmental Assessment Office, PO Box 9426 STN PROV GOVT, Victoria, British Columbia, V8W9V1, Canada. E-mail: nathan.braun@gov.bc.ca.
[3] An IC is defined as a component of the natural or human environment that is measurably changed by the project, which change then causes an effect on another component of the natural or human environment. A receptor components is defined as a component of the natural or human environment that is measurably affected by the project and which forms an endpoint of a given effect pathway.
[4] The proponent's EA is contained in its Application for an EA Certificate submitted to EAO. Following its review of the Application, EAO prepares its own EA Report to support statutory decision-making.
[5] Comprised of government representatives and Aboriginal groups.

that it generates the information required to support robust decision-making. Therefore, it is a priority in EAs to maintain the focus of assessment on key project issues and impacts, while continuing to improve the consistency, efficiency, and quality of the EA.

EAO's Approach

In 2013, EAO established the *Guideline for the Selection of Valued Components and Assessment of Potential Effects* (EAO 2013) (the VC Guideline), which aimed to address these and other challenges. The intent of the VC Guideline was, in part, to promote the selection of VCs that are appropriate and have desired attributes, to minimize the degree of duplication and redundancy in the assessment, and therefore to focus the analysis on the project-environment interactions of greatest importance and consequence and on the components most valued by society (EAO 2013).

EAO advises proponents to develop a list of candidate VCs on the basis of comprehensive issues scoping and then to evaluate the relevance and suitability of those candidate VCs for assessment against a range of criteria. These criteria encourage the practitioner to explicitly examine whether each candidate VC is measurable, whether it could be better represented by another VC or is itself representative of one or more other VCs (*e.g.,* other species from the same guild or occupying a similar ecological niche or affected by the project in a similar way), and whether the candidate VC is a component of an effect pathway upon which other candidate VCs depend (*e.g.*, aspects of the natural environment upon which fish, wildlife, or people depend).

With respect to effect pathways, EAO recognized the significance of adverse effects to physical media – which are intermediate on an effect pathway – was usually being assessed in relation to the significance of effects on (usually biological) receptor components. EAO therefore advised proponents in most cases, rather than include these physical media, or ICs, as VCs, the assessment should focus on the ultimate receptor component that is of concern. Since the VC Guideline requires significance to be determined for VCs, this has often led to focusing the determination of significance on receptor components. EAO's VC Guideline noted that, in some cases, for some kinds of projects, it may be appropriate to select an IC as a stand-alone VC, particularly if there is potential for significant adverse effects on the IC and/or the IC is of particular concern. An IC may also be selected as a VC when the IC is more amenable to measurement and monitoring than the receptor component.

Since 2013, following the VC Guideline, some provincial EAs have differentiated between ICs and receptor VCs. Some of the most common ICs have been air quality, water quality, acoustic conditions, and soil and terrain, as well as some human components, such as population. These assessments have described the changes that would result from the project and discussed the interaction with receptor components, but generally have not determined the significance of changes to the ICs. Rather, significance has been determined in relation to consequential effects on receptor VCs, drawing on the information pertaining to all the relevant ICs on which the receptor VC depends.

Our Experience

What's Worked Well

Implementation of the VC Guideline has contributed to improvement in the transparency of IC and VC selection. In some cases, EAO has directed proponents to provide a stand-alone report documenting the proposed ICs and VCs (based on the Guideline) and the rationale for their

selection. This has supported engagement of government, Aboriginal groups, and the public regarding the scope of the EA specified in the final AIR.

The new guidance has also led to greater consideration of effect pathways and use of ICs in provincial EAs, particularly for physical media. The increased discussion about and use of ICs has improved understanding of the linkages between components on effect pathways. Use of ICs can reduce related or redundant significance determinations by focusing significance on receptor VCs. For example, the threshold of significance for a change in a physical medium has often been defined in relation to whether a consequential effect on a receptor VC is considered to be significant. Thus, a significant adverse effect for air quality, for example, would typically be defined as one that results in a significant adverse effect on human health or exceeds a criterion that was established to protect human health. If both air quality and human health are assessed as VCs, the significance determinations would be largely duplicative. By shifting the focus of significance determination to the receptor VC only, a single but more relevant and meaningful significance determination can be made in the context of the effect pathway.

Use of ICs can also decrease the duplicative content in EAs, as chapters describing the changes in ICs do not need to draw in as much material from dependent receptor chapters to support a determination of significance for the IC. At the same time, cross-referencing robust IC chapters can avoid duplicating descriptions of the changes in various effect pathways in each dependent receptor chapter. This improved documentation has the potential to improve the efficiency and effectiveness of the Application review by EAO and other EA participants, and to improve clarity of issues for decision-makers.

What Challenges Have Arisen

Notwithstanding these beneficial outcomes, some EA participants and EAO have identified challenges with using ICs, based on the experience of some EAs.

Because the VC Guideline differentiated between ICs and VCs, this led to a perception among some EA participants that ICs are not inherently valued. It is common for some participants to view some physical components of the environment, such as air or water, as having intrinsic value of their own. Further, for professional or personal reasons, some EA participants are particularly interested in ICs and want or expect to see changes in ICs dealt with at the same level of detail as receptor VCs. These factors have led to strong views in some EAs that ICs should be treated the same as receptor VCs (and particularly include a determination of significance). Seeking to resolve whether an IC should have its own significance determination (a decision made by EAO based on input from the Working Group, the public, and the proponent) takes time during the EA review process and can contribute to process delays and uncertainty. In response to concerns, in some cases, intermediate physical media have been assessed as VCs. Consequently, physical media are not consistently assessed as ICs in EAs across BC.

Concern about the use of ICs has sometimes arisen due to inadequate documentation or assessment of ICs by proponents. Neither EAO's VC Guideline nor its other complementary guidance are prescriptive with respect to the assessment of ICs; this has resulted in varying approaches by different practitioners. While some EAs provide comprehensive, well-documented descriptions of project-induced change in ICs, others provide a lighter treatment. As a result, EA participants sometimes find it difficult to understand or track how effects may propagate along effect pathways to receptor VCs, or even which receptor VCs may be affected by changes in an IC.

Concern has been raised about whether the assessed receptor VCs adequately capture the range of potential project effects along an effect pathway. If some relevant receptor VCs are

omitted from assessment, this can impact the credibility of an EA and require additional discussion and analysis during the EA review process to resolve, potentially contributing to process delays and uncertainty. Further, if the linkage between ICs and receptor VCs is not clear, it can be difficult for the reader to understand the importance (or significance) of changes along the effect pathway and how these are influencing receptor VCs. This clarity is important to support EA and post-EA decision-making (*i.e.*, permitting).

Lastly, in some cases, measuring the impacts of a project can be more difficult for a receptor VC than an IC. For example, measuring potential project impacts on water quality can be relatively straightforward, while estimating the impacts of changes in water quality to fish or fisheries as a result of the project can be more challenging. This increases the importance of ensuring changes in ICs and the linkages between ICs and receptors are adequately described.

Conclusion and Next Steps

In consideration of the challenges identified in the first few years of practical use of ICs in EA in BC, EAO is currently exploring opportunities to clarify its guidance for proponents and practitioners to, among other things, better describe the role and purpose of ICs, refine criteria for identifying intermediate and receptor components, and strengthen guidance regarding the appropriate level of detail required for the assessment and documentation of both intermediate and receptor components and the pathways that link them.

EAO continues to stress the importance of proponents appropriately documenting their rationale for component selection to better support effective engagement of government, Aboriginal groups, and the public regarding the appropriate focus of the EA.

EAO also continues to promote approaches that ensure assessments remain focused on the key issues and impacts for each project, by guiding the technical assessment to focus on the important pathways and components, facilitating reader comprehension of and access to information of interest in the EA, and realizing efficiencies in EA documentation and the overall EA process.

When properly selected, assessed, and documented, the identification of intermediate and receptor components shows promise as a tool to focus EA and improve the clarity and efficiency of EA review processes. To realize this outcome, guidance for practitioners must be clear and establish minimum information requirements to promote quality EAs that enable effective participation by government, Aboriginal groups, and the public. In particular, transparency regarding effect pathways, linkages between intermediate and receptor components, and determination of significance appears to be an essential factor in effective use of ICs in EA.

References

EAO (British Columbia Environmental Assessment Office). 2013. Guideline for the Selection of Valued Components and Assessment of Potential Effects. Available on-line: http://www.eao.gov.bc.ca/VC_Guidelines.html. 45p.

A case study on the use of on-site offsets to mitigate impacts to caribou from diamond mining in Canada's north

IAIA 2017 - ID#604

Author: Chuck Hubert
Senior Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT

Introduction

In February 2016, the Mackenzie Valley Environmental Impact Review Board (Review Board) completed its report of environmental assessment and reasons for decision for a proposed diamond mine expansion. A key issue in the environmental assessment was the cumulative impacts of continued mining and road expansion from the project within a critical migration corridor of the Bathurst caribou herd. In addition to direct and indirect impacts to caribou, Indigenous communities who rely on caribou for food and as part of their traditional lifestyle, expressed serious concern that the expansion would erode their way of life and ties to the land.

In its report, the Review Board determined that the project is likely to cause significant adverse project-specific and cumulative impacts on the Bathurst caribou herd. In addition, the Review Board concluded that the mine development would prolong significant impacts to Indigenous culture and traditional way of life by de-valuing the area for traditional uses, leading to the loss of cultural sharing between generations.

In order to address these residual impacts and allow the project to proceed, the Review Board recommended specific offsetting measures at other locations around the mine to achieve net neutral impacts to caribou. In the Review Board's view, these on-site offsets would reduce existing impacts on caribou and the traditional Indigenous lifestyle based on caribou so that the cumulative impacts of the proposed expansion project were no longer significant.

Description of the proposed mine expansion

The Jay Project is an expansion of the existing Ekati diamond mine, located 300 km northeast of Yellowknife, near Lac de Gras in Canada's Northwest Territories. The Ekati diamond mine has been in operation since 1998 and consists of multiple open pits, and various related infrastructure including waste rock piles and roads. In 2013, the mine owners proposed a new open pit mine 30 kilometers from the main Ekati mine site in order to continue supplying the mill with ore for an additional ten years or more.[i] The project includes the construction of a new road to the Jay open pit and continued use of an existing access road to transport ore to the mill site.

The project crosses a critical migration corridor of the Bathurst caribou herd

The Jay Project and Ekati Mine are located in an arctic tundra landscape with no trees and little relief. Lakes account for about 30% of the landscape and ridges known as eskers are a dominant

terrestrial feature. Barren-ground caribou migrate hundreds of kilometers through this area twice a year using eskers and spaces between lakes, or "Tataá" in the Tlicho language, as movement corridors.[ii]

The proposed mine expansion and associated road network crosses a critical migration corridor for the Bathurst caribou herd along an esker travel route at a narrow area between two lakes. There are other mining operations along the herd's migration route and cumulative impacts from the Jay open pit and road will increase partial barrier impacts to caribou movement. Large mine haul trucks will pass along the Jay road an average of once every 5 minutes.

Bathurst caribou population continues to decline

The population of the Bathurst caribou herd has declined by more than 90% from its historical high of over 400,000 in 1986[iii]. Recent photo survey results from the calving grounds indicate a continuing declining trend from an estimated total population of 35,000 animals in 2012 to between 16,000 and 22,000 in 2015. According to the Government of the Northwest Territories, this decline is "extremely worrisome", given that surveys also indicate a 50% decline in breeding females over those same three years[iv]. This continued decline is occurring despite a harvesting ban since 2009 along with incentives to harvest caribou predators.

The mine developer commits to mitigate impacts on caribou

During the course of the environmental assessment, project-specific and cumulative impacts to caribou emerged as the key issue to Indigenous groups, regulators and other organizations. In order to address these concerns, the developer proposed a suite of mitigations that, in its view, would reduce residual impacts to caribou so that they were no longer significant.

Specifically, a Caribou Road Mitigation Plan was prepared by the developer to; minimize the risk of caribou mortality from traffic; minimize barrier effects of vehicle use of the road to caribou movement and migration; and, limit the effects of sensory disturbance from roads and traffic on caribou health and behaviour.[v]

Parties advise the Review Board that residual impacts to caribou are significant

The Review Board held public hearings for the Jay Project in Yellowknife and in three Indigenous communities directly affected by the mine expansion in order to hear the public's views on the impacts of the project on caribou, and on the traditional Indigenous lifestyle related to caribou. During the public hearings, the Review Board heard that impacts on caribou from existing mining development on the herd's range are already significant, and that the Jay Project expansion would add to those impacts.

Parties also observed that there was uncertainty in predicting project impacts on caribou as well as a lack of detail on how proposed caribou monitoring would detect those impacts and trigger appropriate and effective management actions. Parties described specific ways that construction and operation of the Jay Project could impact caribou including: dust from trucks degrading the

smell and taste of caribou forage; visual and acoustic disturbances from road traffic creating a partial barrier to caribou migration and energy losses resulting in reduced pregnancy success[vi] [vii].

Parties advised the Review Board that these potential impacts would likely pass the threshold for significance due to the already vulnerable state of the caribou herd at a time of declining population trend.

Indigenous communities contend that adverse impacts to well-being and traditional way of life are significant

During public hearings in Indigenous communities, people told the Review Board that the decline in caribou numbers has occurred over the same two decade time period that the Ekati mine and other developments have been in operation. Extremely low and declining caribou numbers has resulted in reduced traditional harvesting and less time spent on the land by Indigenous people. This has resulted in a significant loss of cultural experience and knowledge transfer in the area for an entire generation. Indigenous people stated that this mine expansion will continue to degrade the value of the area for harvesting and continue to discourage traditional use of the land during the operational life of the mine expansion[viii]. In the view of members of Indigenous communities, any activity that inhibits the recovery of caribou, prevents traditional harvesting of caribou, and limits the transfer of intergenerational cultural knowledge and on the land experience is significant[ix].

Public hearings and follow-up compensatory mitigation meetings

During public hearings held by the Review Board, it was clear that Indigenous communities and other organizations did not agree that the developer's proposed mitigations would be sufficient to mitigate adverse impacts to caribou from the project. The developer proactively addressed this shortcoming by hosting a meeting following the public hearings with all parties to address the insufficiency of the proposed caribou mitigations. The purpose of the meeting was to find ways to positively compensate for or "offset" impacts from the mine expansion on caribou. As a result of the meeting, the developer submitted a plan for additional compensation (offsetting) beyond what could be achieved through standard mitigation techniques[x].

Review Board finds that project-specific and cumulative impacts on caribou and Indigenous use of caribou are significant

The Review Board's findings were based on both written evidence on the public record and on testimony presented during public hearings in the communities. In its February 2016 *Report of Environmental Assessment and Reasons for Decision*, the Review Board determined that the Jay Project is likely to cause significant adverse project-specific and cumulative impacts to the Bathurst caribou herd because:

1. The mine expansion is located at a critical migration corridor during a time when herd numbers are declining;
2. Existing cumulative impacts on the caribou herd are already significant and Jay Project impacts are additional stressors;

3. The new roads, powerlines and pipelines create physical barriers to caribou movement along their migration corridor, in addition to sensory disturbance from lights, smells, dust and noise; and
4. Cumulative effects on the caribou herd and its range that inhibit the ability of the Bathurst herd to recover, will adversely affect the well-being, health and culture of Indigenous communities [xi].

Why the Review Board recommended offsetting measures

Mitigation measures proposed by the developer were not sufficient in the Board's view to reduce the impacts of the project on caribou below the significance threshold. Additional actions to reduce residual impacts were thus required. The purpose of offsets is to reduce the impacts from the mine expansion on caribou to a neutral or even positive degree, so that the Bathurst caribou herd would at least be no worse off if the project were to proceed. Implementation of additional actions, such as offsets, is intended to compensate for residual effects that cannot be addressed through other forms of mitigation alone.

The Review Board's novel and creative approach: on-site offsets

The Review Board's solution to mitigating impacts on caribou and Indigenous way of life was to incorporate on-site offsetting measures. On-site offsets are actions taken to set aside areas of the project footprint that result in an overall net neutral or positive effect.

In this case study, offsets had to be developed in a way that caribou and Indigenous uses of caribou would directly benefit from the development. This is consistent with the concept of "like for like" in ecological function expectations as described by Australian environmental assessment practitioners on the effectiveness of offsetting[xii]. For this reason, financial compensation offsets unrelated to caribou or human use of caribou, were not acceptable. Similarly, impact offsetting was necessary near the location of the residual impact in order to achieve a net neutral effect on caribou and human use of caribou as close as possible to any predicted adverse effects.

Determining the effectiveness of impact offsetting can be a challenge. The results of offsets need to be measurable so that their effectiveness in mitigating adverse residual impacts during the operational phase of a project can be evaluated. The Review Board recognized this challenge, given that offsetting terrestrial impacts had no precedent in the Northwest Territories.

Due to the critical importance of caribou to the Northwest Territories and to Indigenous communities that rely on them, the Review Board recommended the following offsetting actions at the Jay Project to ensure that net impacts on caribou from the mine expansion were neutral:

- Accelerate progressive reclamation at the existing mine tailings pond.
- Construct caribou access and egress ramps on existing waste rock storage areas at the main Ekati site, as part of progressive reclamation.
- Incorporate options for scheduling of other Ekati mine operations during caribou migration periods.

- Indigenous elders group to advise on construction and operation of the Jay road esker crossing and waste rock pile egress ramps for caribou.
- Construct and operate an on-the-land culture camp in a traditionally-used area near the mine expansion in order to maintain traditional Indigenous uses of the land and to transfer that knowledge between generations.
- Determine and implement a methodology to measure offsets so that a net neutral or positive impact on the caribou herd can be achieved.

Conclusion

During the environmental assessment of the Ekati mine, the Review Board determined that significant adverse cumulative impacts to caribou and the Indigenous use of caribou were likely, and that residual impacts could not be mitigated below a significance threshold using standard mitigations proposed by the developer. The Review Board's novel and creative approach using offsets to achieve a net neutral effect on caribou and to Indigenous use of caribou and the surrounding landscape was achieved by recommending on-site offsetting actions that had tangible benefits for caribou habitat that would not otherwise have occurred. In addition, the construction and operation of a nearby culture camp intended to retain indigenous ties to the land will further offset project impacts and provide benefits to local Indigenous communities.

References

[i] Mackenzie Valley Review Board, Report of Environmental Assessment and Reasons for Decision, Jay Project, 01-Feb-2016, pi-iii
[ii] Tlicho Government Intervention, Jay Project, EA1314-01, 03-Aug-2015, pp5-6
[iii] Deninu Kue First Nation, EA1314-01, Jay Project - intervention, 31-Jul-2015, pp2-3
[iv] Government of the Northwest Territories, correspondence to the Review Board, 2015 Bathurst caribou herd survey results, 08-Sep-2015, pp1-2
[v] Dominion Diamond, Caribou Road Mitigation Plan, in Appendix B of Conceptual Wildlife Effects Monitoring Plan for the Jay Project, 31-Jul-2015
[vi] Independent Environmental Monitoring Agency Technical Report, EA1314-01, Jay Project, 31-Jul-2015, pp 2-12
[vii] Tlicho Government Intervention, Jay Project, EA1314-01, 03-Aug-2015, pp4-10
[viii] Yellowknives Dene First Nation, Jay Project, Technical Report, 03-Aug-2015, pp4-6
[ix] Mackenzie Valley Review Board, Jay Project Hearing Transcripts, Lutsel K'e, 19-Sep-2015, p61
[x] Dominion, Diamond, Caribou mitigation measures in Responses to Jay Project Hearing Undertakings, 09-Oct-2015, pp8-15
[xi] Mackenzie Valley Review Board, *Report of Environmental Assessment and Reasons for Decision*, 01-Feb-2016, p81
[xii] Nicole Hayes & Angus Morrison-Saunders (2007) *Effectiveness of environmental offsets in environmental impact assessment: practitioner perspectives from Western Australia*, Impact Assessment and Project Appraisal, 25:3, 209-218

Title: Public Participation Window, Time and Outcome

Abstract ID # 221

Hung Shiu Fung and Thomas B Fischer

Abstract

In this paper, two EIAs from Hong Kong are evaluated with regards to the role played by public participation for project design. For this purpose, cases are chosen where public participation in EIA was said to have made a positive contribution to the project. Our cases show that environmental requests need to be made early enough in order to have an impact to the project implementation. Furthermore, stakeholders should have specific knowledge to connected their environmental concerns with overall project elements. EIA should take a more active role in establishing the connection between environmental concerns and project implementation.

Introduction

The importance of public participation for effective Environmental Impact Assessment (EIA) practice has been highlighted by many authors (see e.g. Nadeem & Fischer, 2011). It has become widely recognised that public participation can generate information for decision making and help resolve social-environmental conflicts. O'Faircheallaigh (2010) noted that public participation is not only a way for obtaining information, it could also help solving problems through suggestions of concepts, solutions and mobilising resources. Glucker et al (2013) noted that public participation should contribute to the identification and resolution of conflicts and facilitate project implementation.

EIA practice in Hong Kong is guided by the legislative framework of the Environmental Impact Assessment Ordinance. The statutory EIA procedure in Hong Kong has three major stages; (1) application of the EIA study brief, (2) application for approval of the EIA report, and (3) application of the Environmental Permit (EP). To trigger EIA, a project proponent needs to submit a project profile for the application of an EIA Study Brief. The project proponent then needs to prepare an EIA report according to the legislative requirements and the EIA study brief. They can apply for the approval of the EIA report and the EP at the same time or separately. However, the EP can only be obtained after the EIA report has been approved. Within the EIA process, there are two statutory public inspection windows; the first one is the public inspection of project profile during the application of the EIA study brief; the second one is the public inspection of the EIA report before the Director's decision of approval. Occasionally, the environmental permit would require the project proponent to conduct stakeholder/community liaison, which acts as the third public participation window.

EIA is usually conducted in parallel to the engineering design stages, and the outcome of the EIA would be incorporated into the project design and contract documentations (see e.g. Leung et al., 2011). While the project profile and the EIA report require a different level of engineering details, additional requirements with regards to the details required reflect an expectation of project development during the preparation of an EIA report. The two statutory public inspection windows of project profile and EIA report as well as the optional stakeholder/community liaison are therefore not only aligned with a different stage of EIA, but also to a different stage of project development.

Case Studies

Two cases were selected for examining how public participation in EIA can positively influence project design. These are subsequently described. In this context, with regards to examining public participation, particular attention is paid to the timing of requests and the procedural stages at which these were subsequently addressed.

Case 1: Conservation of biodiversity in Tung Chung River and Bay

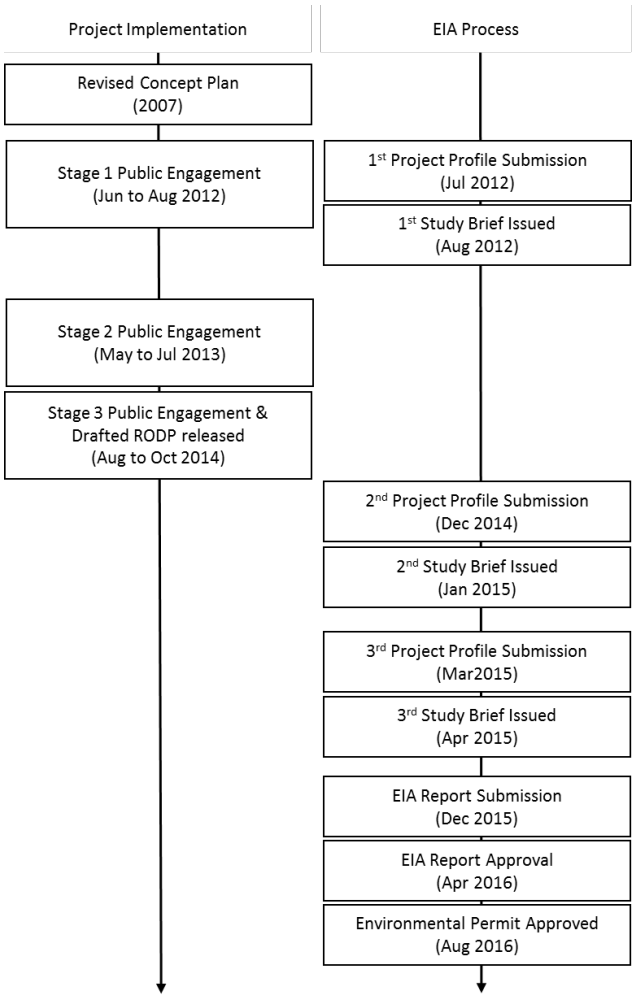
According to the Project Profile, Tung Chung New Town Extension is a planning study project driven by the Civil Engineering and Development Department (CEDD). It aims at reviewing and establishing the feasibility of further development of Tung Chung. It is also supposed to help meeting planning and population targets. **Diagram 1** shows the timeline of the major events of the project.

During the submission of the Project Profile in 2012, several environmental NGOs made submissions about the potential impact of the natural habitat and ecological biodiversity of the Tung Chung River. Several of the major environmental NGOs issued joint statements about their objection to any civil engineering work at the Tung Chung River and Bay, while pointing out that the area contains species with conservation importance, including trees, freshwater fishes, butterflies and others. As a response, the EIA Study Briefs contains provisions requiring the project proponent to conduct investigations into the existing wildlife, covering all the concerned habitats and species. At the same time, the requests of the environmental NGOs are also documented in the Stage 1 Public Engagement report.

During Stage 2 Public Engagement which occurred one year later, the CEDD provided a response to the issue, stating that the Recommended Outline Zoning Plan (RODP) would incorporate measures to protect the natural environment and 'features of high ecological value'. The ecological survey and EIA study conducted in parallel are supposed to confirm and detail conservation boundaries.

During the Stage 3 Public Engagement which took place in 2014, the CEDD provided an updated response on the subject. Here, it stated that while ecological surveys were conducted when formulating the land use proposals in the RODP, the proposed zonings (e.g. Conservation Area, Costal Protection Area and Green Belt) have included appropriate conservation and protection measures, including a proposed River Park. Here, the conservation zoning and the proposed river park are the major outcome and response to the requests of the environmental NGOs, although the original request was to prohibit any civil engineering work in the area. The proposed River Park was later also reflected on in the submitted Project Profile and EIA report in 2015, and as part of the requirements in the Environmental Permits issued in 2016.

Diagram 1 Events and Timeline of Tung Chung New Town Extension Project



**Information from various documents listed in Appendix A.*

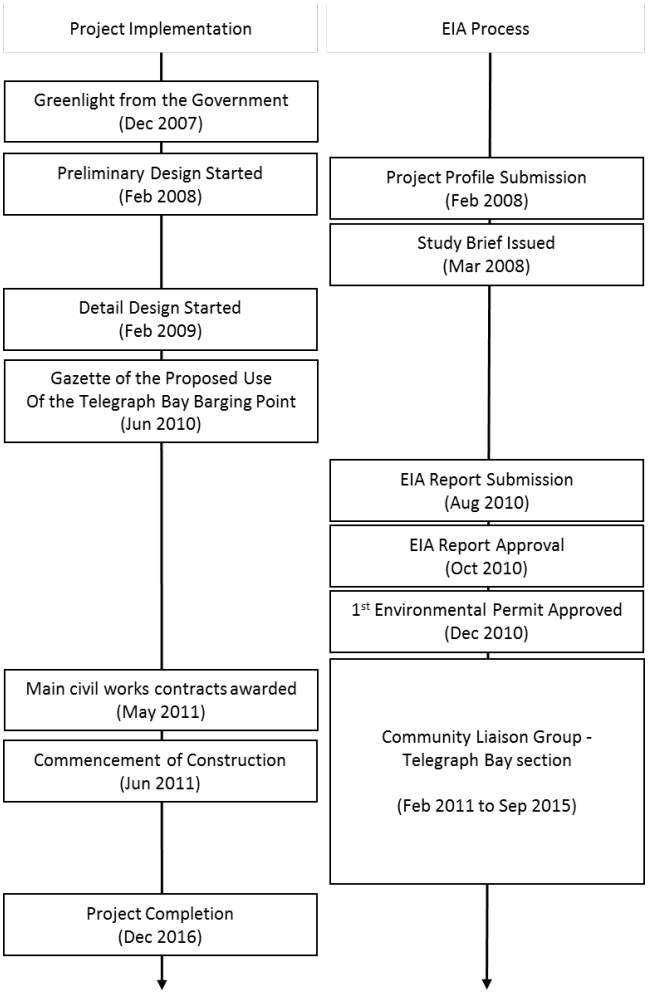
Case 2: Mitigation of nuisance associated with Telegraph Bay Barging point

The South Island Line (East) project is a railway extension project by MTR Corporation Limited. As stated in the EIA report, an existing barging point at Telegraph Bay was proposed for loading of spoil transportation. However, this proposed site was not mentioned in the Project Profile and the EIA Study brief. The first public announcement of the plan happened when it was included in a Gazette in June 2010. The proposal received an immediate objection from the local community. The timeline of the associated major events of the project are shown in **Diagram 2**.

The local community made objections to the proposal of using Telegraph Bay Barging Point for the project. Objections were submitted to the relevant authorities when the work was announced in the government Gazette and during the public inspection of the EIA report. While the objection to using the barging point was dismissed, the Environmental Permit which was issued required MTR Corporation Limited to set up Community Liaison Groups (CLG), comprising representatives from concerned and affected parties. The permit also required MTR Corporation Limited's Construction and Demolition Materials Management Plan to include the results of the outcome of CLG meetings.

During the First CLG meeting, the local community made requests with regards to the minimization of the nuisance caused by the barging activities and the truck traffic induced by the project, including lower emissions trucks, monitoring of contractor performance, and extended enclosures of the barging point. MTR Corporation Limited responded positively to these requests. During the second CLG meeting in Apr 2010, it was announced that specifications would be made for the contractor to use lower emissions trucks, and that a monitoring scheme would be introduced to monitor the route and the speed of trucks. In the fourth CLG meeting in Oct 2011, MTR Corporation Limited confirmed that a full roof with side enclosures would be provided for the barging point.

Diagram 2 Event and Timeline of South Island Line (East) project



**Information from various documents listed in Appendix A.*

Analysis and Discussion

The two cases show that public participation in the EIA process can bring positive environmental outcomes for projects and influence project design. In both cases, EIA findings facilitated the negotiation between the concerned parties and the project proponent. Several observations are made.

Firstly, it takes time to develop environmental queries. Besides the time needed for the preparation of information, subsequently the requests can only be addressed when the project proceeds to a stage at which concrete decisions can be made. In case 1, requests of the environmental NGOs were about restricting the land use of the area with high ecological value. The drafting of the ROPD had only started after the Stage 2 of the Public Engagement, in which the project started to consider the details of the land use in the area, and formulating solutions. It took two years to address the queries. In case 2, the queries were associated with the contractor and site management, which took place after the project proponent obtained the environmental permit and finished the engineering designs of the main works. The queries were addressed one year after the first objection was made. On the other hand, the EIA process does not have a provision to transform or link the environmental queries to project queries. In both cases, it was up to the concerned parties to make the linkages between the two processes.

Secondly, providing for early participation windows is crucial for allowing time for the environmental concerns to build their connections with project implementation, before the corresponding decisions are made. However, in such early windows, requests needed to be made with minimal project and environmental information available. In case 1, the requests were made before the EIA started; in case 2, the EIA did not cover the contractual details of the project. It required stakeholders to have specific knowledge to be able to act before decisions were made. In case 1, the environmental NGOs used in-house survey data to support their queries; in case 2, members of the CLG had a high educational and professional engineering background and were able to understand how the contracting document would work. However, it is not often the case that the concerned party has such high levels of knowledge to act ahead of the project implementation decisions.

The two cases show that public participation can influence project design. However, this ability relies on the concerned parties having the knowledge and determination to link environmental queries to project queries, and an ability to negotiate with the project proponents themselves. It would be worth discussing whether EIA should have a provision to link the environmental queries to project queries on behalf of the stakeholder, and whether EIA should provide interim information to the concerned parties during different project implementation stage, before submission of the EIA report is attempted.

Conclusions

In the paper we examined two EIA cases in Hong Kong with regards to how queries in public participation practice influenced project design, bringing about positive outcomes. Due to the intertwined development of the EIA study and the project engineering stages, the EIA process could help environmental concerns develop into project imlementation elements and be incorporated into project designs. However, it took time for developing the connection and also for formulating solutions. Generating information of the concerned subjects takes additional time, and environmental requests can only be addressed when the project is developed in a number of stages. If requests are made early enough, they can effectively influence the project process; however, it requires good knowledge on of subject in order to be able to act ahead of project developments. We suggest that there should be a provision for EIA to connect environmental concerns with project implementation, and to provide interim information for concerned parties in different project implementation stages.

References:

Glucker, A.N., Driessen, P.P.J., Kolhoff, A. & Runhaar, H. a. C., 2013. Public Participation in Environmental Impact Assessment: Why, Who and How? *Environmental Impact Assessment Review*, 43, pp.104–111.

Leung, H., Frommer, G. & Chan, S., 2011. Managing Expectation on Major Railway Expansion in Hong Kong. In *IAIA11 Conference Proceedings*.

Nadeem, O. & Fischer, T.B., 2011. An evaluation framework for effective public participation in EIA in Pakistan. *Environmental Impact Assessment Review*, 31(1), pp.36–47.

O'Faircheallaigh, C., 2010. Public Participation and Environmental Impact Assessment: Purposes, Implications, and Lessons for Public Policy Making. *Environmental Impact Assessment Review*, 30(1), pp.19–27.

Appendix A Source of Information

Tung Chung New Town Extension

1) Project Profile (PP-523/2015, PP-519/2014, PP-470/2012)
2) Study Brief Issued or DEP's decision on permission to apply directly for permit (ESB-285/2015, ESB-283/2014, ESB-251/2012)
3) EIA report (AEIAR-196/2016)
4) Environmental Permits (EP-519/2016)
5) Stage 1Public Engagement Report
6) Stage 2 Public Engagement Report
7) Stage 3 Public Engagement Report

Item 1 to 4 are accessible on EPD's archive:
http://www.epd.gov.hk/eia/english/alpha/aspd_652.html

Item 5 to 7 are accessible on project website: http://www.tung-chung.hk/

South Island Line (East)

1) Project Profile (PP-244/2008)
2) Study Brief Issued or DEP's decision on permission to apply directly for permit (ESB-181/2008)
3) EIA report (AEIAR-155/2010)
4) Environmental Permits (No. EP-407/2010, No. EP-407/2010/A, No. EP-407/2010/B, No. EP-407/2010/C, No. EP-407/2010/D, No. EP-407/2010/E, No. EP-407/2010/F)
5) Monthly EM&A Report No.1
6) Gazette No.3204
7) Project Website http://www.mtr-southislandline.hk/en/home/
8) Community Liaison Group meeting presentation materials and meeting minutes (accessible through Project Website)

Item 1 to 5 are accessible on EPD's archive:

http://www.epd.gov.hk/eia/english/alpha/aspd_542.html

Item 6 is accessible on the Government of Hong Kong Gazette archive

http://www.gld.gov.hk/egazette/

Time series Changes and Future Prospects of Green space and the Ecosystem Services

— Case Study of Funabashi City in Tokyo Metropolitan Area, Japan —

Natsuki ITO[1], Yuki SHIBATA[1], Satoru SUGITA[2],
Kiichiro HAYASHI[3], Makoto OOBA[4]

1 *Toho University,* 2 *Chubu University*, 3 *Nagoya University,*

4 National Institute for Environmental Studies

In Funabashi City, which is located in Tokyo Metropolitan Area (TMA), Japan, the population has been increasing since 1960s and then the population increase has led to a greens pace reduction. However, recent studies predict that the city's population will see a declining trend in the coming decade. The purpose of this study is to clarify how the development of Funabashi City after the 1990s has changed / will change the provisions of the ecosystem services (ESs). To evaluate this, we took the following three categories of the ESs into consideration: provisioning, regulating and cultural services. Core to this assessment, we estimated long-term changes in green space distribution and the provisions of the ESs for the study area. Furthermore, we predicted how the provisions of the ESs would change in the future based on several depopulation scenarios.

Keyword: Urban green space, Ecosystem services, Depopulation, GIS analysis, Funabashi, Japan

1. Introduction

Over the past half century, the population of the Tokyo Metropolitan Area (TMA) has increased with population increase commensurate with a reduction in green spaces around the urban area. In the TMA, the 2,190 km^2 of green space including farmlands, forests and urban parks were lost over a 38 year (1965-2003) period, translating to a 22% loss in green space (MLIT, 2006). Table 1 reports relevant population growth rates and green space reduction estimates and shows for bedroom suburb areas (*i.e.*, locations 20--50 km from the Central Business District "CBD" of Tokyo) that owing to high economic growth periods since the 1960s, the rapid population growth has led to the definitive destruction of suburban green zones, including forests and farmlands (Table 1.). However, national population data indicated a downward turn of Japanese total population in 2005 and declining trends will be appeared in some suburban areas around Tokyo in the coming decades. One of the most typical settlements in the Tokyo suburban area is Funabashi City, and its population data indicate the city's population will soon be facing a declining trend.

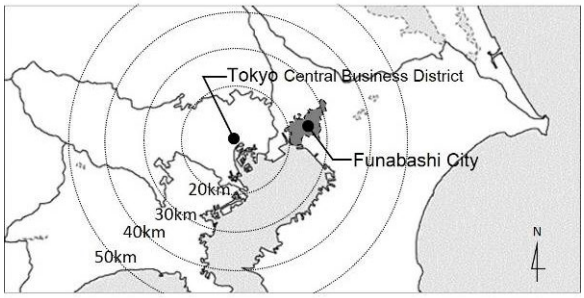


Fig 1. Funabashi City in Tokyo Metropolitan Area

As populations decline, there will be a possibility to enhance the benefits and opportunities of the provisions of the ecosystem services (ESs) through green space conservation, in depopulating areas. The purpose of this study is to clarify how the development of Funabashi City has changed the provisions of the ESs since 1996 and to visualize the long-term future changes of green space distribution and the provisions of the ESs for various population scenarios.

2. Analysis framework

2.1 Overview of Funabashi City

In order to estimate future patterns and trends for urban green space and the provisions of the ESs in the TMA, we focused on Funabashi City, as a typical suburban city in the TMA, which was located 20-30 km east from the Tokyo CBD (Figure 1, Table 2).

2.2 Analysis method

This study applies time-series geographic information system (GIS) analysis whereby land use and population distribution geographical digital data were collected and then statistically analyzed (Figure 2). As a first step in the GIS analysis, we distinguished the 21 land use categories (Table 3) for every single land lot polygon (1996; 44,608 polygons, 2001; 42,820

Table 2. Overview of Funabashi City

Area Surface	85.64 km^2
Designated Urbanization Area Surface	54.56 km^2
Urbanization Control Area Surface	31.08km^2
Population (2016)	624,473Pop.
Population Density	7.292/km2

※City official paper in 2016

Table 3. Definition of land use types and items

Land use Type	Items of land lot
Green space	Paddy Field, Farm, Grazing Land, Grassland, Forest, Green Park
Urban Land Use	Residential Area, Commercial Area, Industrial Area, Transportation Facilities, Public Space, Education, public welfare Area, Building Plot, Unbuilt Area, Parking Lot ,Military Area, Road, Railway
Water Area	River, Surface of water, Waterway, Beach, Riverbed

Table 1. Population growth and green space reduction (Hashizume, 1979)

Area	Population growth rate 1960-1970 [%]	Green space reduction rate 1960-1970 [%]	Green space rate in 1970 [%]

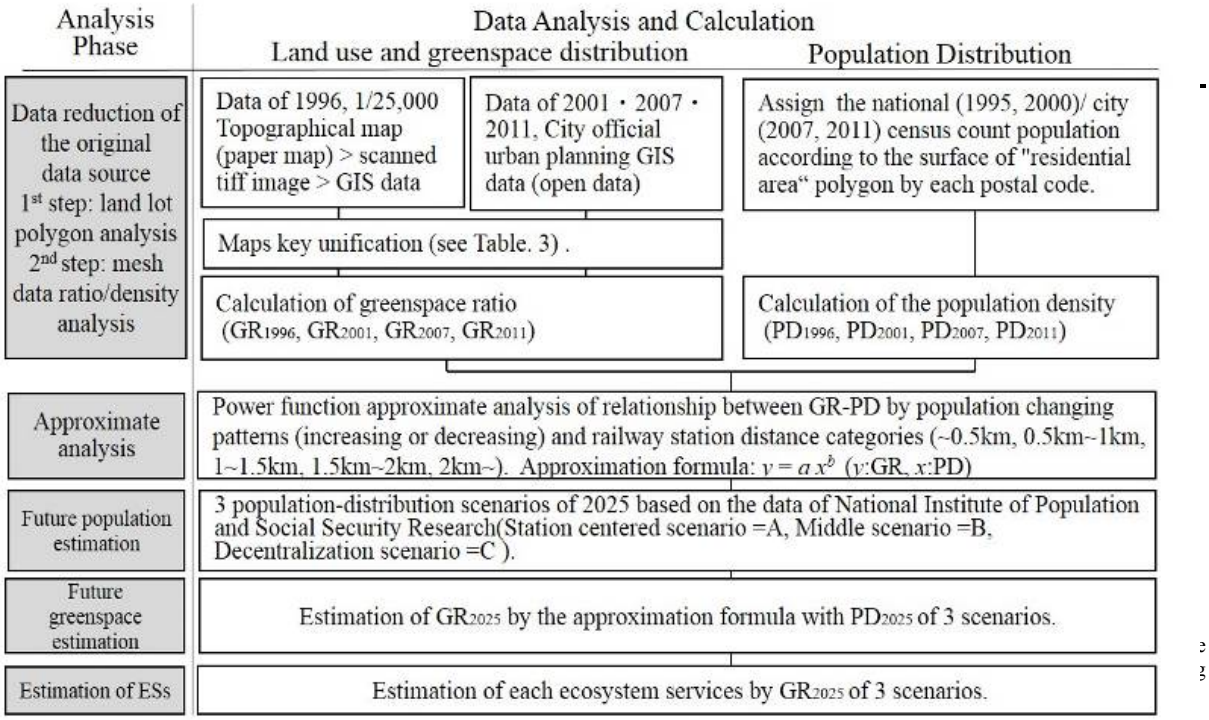


Fig 2. Data sources and analysis framework

polygons, 2007; 68,642 polygons, 2011; 153,905 polygons) in the study area. As a second step, we counted all the land lots on a 100m square mesh (in total 9,103 meshes), and then we calculated the surface ratio of green space in each mesh "GR_i" and the population density of each mesh "PD_i" at four time points (i: 1996, 2001, 2007, 2011).

Regulating services

(Totsuka and Miyake, 1991)

Uco_2: CO_2 absorption (t/year)

Uso_2: SO_2 absorption (t/year)

Uno_2: NO_2 absorption (t/year)

Uco_2 (t/ha・year) = $0.4 \times Pg$

Uso_2 (t/ ha・year) = $20.7 \times Cso_2 \times Pg$

Uno_2 (t/ ha・year) = $15.5 \times Cno_2 \times Pg$

Cso_2: Atmospheric SO_2 density ($\mu g/cm^3$)
= 0.002ppm※3 (=$52 \times 10\text{-}7$ $\mu g/cm^3$)

Cno_2: Atmospheric NO_2 density ($\mu g/cm^3$)
= 0.018ppm※3 (=$44 \times 10\text{-}6$ $\mu g/cm^3$)

(PV=nRT, MW; SO_2=64, NO_2=46, P:=1(Pa), R= 0.0082, T=298(K))

Table 4. Pg: Total amount plant production

(t/ha・year) (Totsuka and Miyake, 1991)

Paddy field	18
Farm	20
Grazing land	13
Glass land	16
Forest	67
Green park	10

Provisioning services

Gross of agricultural production (JPY/mesh)
$= 73.2\ x_i + 6.99 \times 10^2\ y_i$

x_i : Area of Paddy Field in mesh i (m^2)

y_i : Area of Farm in mesh i (m^2)

Table 5. Agricultural production

(Ministry of Agriculture, 2014)

	Area (ha)	Production in Funabashi (JPY)	Production (JPY/m^2)
Paddy Field	123	900×10^6	73.2
Farm	1120	$7{,}830 \times 10^6$	699

Cultural services

Green park utility; (pt/mesh)
$= Pop_i \times Pt_i$

Pop_i: Population of mesh i

Pt_i: Point of liner distance to the closest green park of mesh i

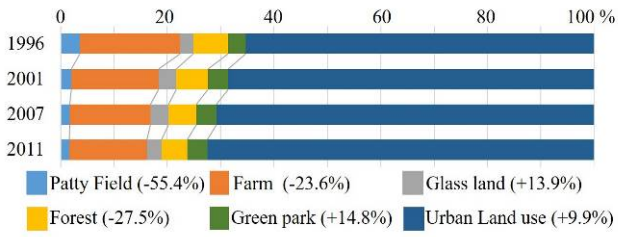
Distance	pt
0km	7
0~100m	6
100~200m	5
200~300m	4
300~400m	3
400~500m	2
500m over	1

Box 1. Estimation method of Ecosystem Services

For the next phase, we classified all meshes by the population behavior patterns (*i.e.* increasing or decreasing) and 5 station-distance categories (*i.e.*0-0.5km, 0.5km-1.0km, 1.0km-1.5km, 1.5km-2.0km, 2.0km-). Then we applied a power function approximate formula:

$y = a\ x^b$ (y_i: Ave. GR_i, x_i: Ave. PD_i)

which gave us the estimation of GR_{2025} by using PD_{2025} calculated from 3 population-distribution scenarios for 2025 (Scenario A: Station-centered scenario, B: Middle scenario, C: Decentralization scenario, see upper section of Table 8). These 3 scenarios were designed on the basis of a population forecast given by IPSS (National Institute of Population and Social Security Research)※1 (2013) and Chiba Prefecture Official※2 (2016). Finally, we calculated the changes of provisions of each ES including Regulating services (absorption of CO_2, SO_2, NO_2; t/mesh) (Totsuka and Miyake, 1991), Provisioning services (agricultural production; JPY/mesh) and Cultural services (green parks utility; pt/mesh) by using evaluation formula listed in Box 1 (Box 1 contains Table 4, Table 5 and Table 6.).



※ (%)shows the change ration of 1996-2011.

Fig 3. Time Series changes of land use items 1996-2011

Table 7. Result of Approximate Analysis

$y = a\ x^b$ (y_i: GR_i, x_i: PD_i)

		Station distance	a	b	R^2
Population behavior	Increasing	0~0.5km	0.0007	-1.158	0.9502
		0.5~1km	0.0043	-0.872	0.9652
		1~1.5km	0.0050	-0.846	0.9978
		1.5~2km	0.0343	-0.473	0.9127
		2km~	0.0148	-0.570	0.5645
	Decreasing	0~0.5km	0.8332	0.4436	0.9881
		0.5~1km	0.4279	0.2541	0.8127
		1~1.5km	0.5338	0.2087	0.9974
		1.5~2km	1.2155	0.2564	0.9005
		2km~	0.3853	-0.0800	0.7040

R^2: determination coefficient

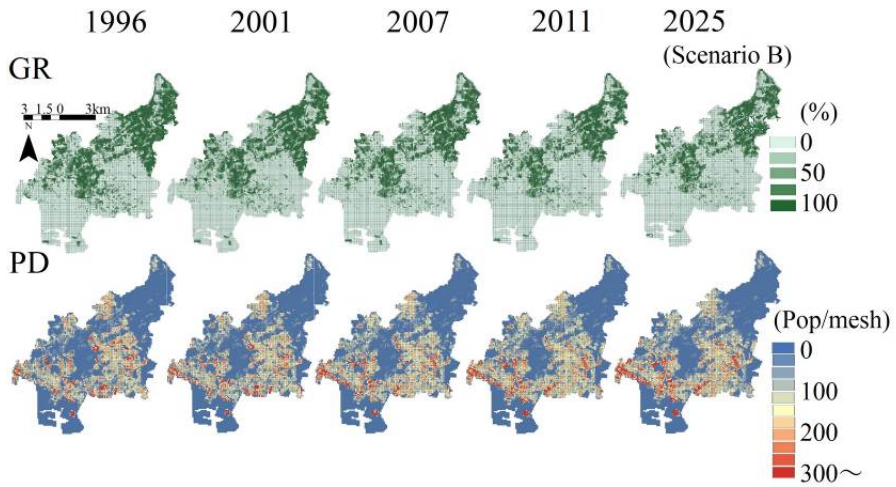


Fig 4. Time Series changes of population density and green space ratio

3. Result of analysis

3.1 Time series Changes in 1996-2011

For the first phase of this analysis, we calculated and visualized the time series changes of population density distribution and area surface for each land use item (Figure 3, Figure 4). The upper section of Table 8 shows the population and green space change data for several station distance categories. As Figure 3 and Table 8 show, total population of the city increased 13.4% over 15 years (1996 compared to 2011), where green space continuously decreased (by 21.5%) owing to the 9.9% increase of urban land use. Notably, the area of paddy field was down by half (-55.4%), and farm and forest areas were decreased more than 20% in this period. On the other hand, the area of grassland and the green park showed increases of 13.9% and 14.8% respectively. The increase of grassland was assumed to be due to the closure of factories and warehouses in suburban areas and the green park increase was due to the positive urban park improvement program of the municipal government.

Station distance category results in Table 8 show that the population in 2011 for the station distances >1.5 km showed slight downward trends. Nevertheless, the green space data for those areas showed decreases (e.g., 1.5km～2km: -15.8%, 2km～: -11.7%), but values were lesser in

Table 8. Green space ratio and the ESs in 2025 by population distribution scenarios

	Station distance categories	2011 (%: 1996 level)	2025 (%: 2011 level) Scenario A		Scenario B		Scenario C	
Population (2011: Pop.) (2025: Pop. growth)	～0.5km	217,121 (+20.7%)	+13,500	(+6.2%)	+9,000	(+4.1%)	-10,000	(-4.6%)
	0.5km～1km	257,932 (+14.7%)	+12,000	(+4.7%)	+8,000	(+3.1%)	-12,400	(-4.8%)
	1km～1.5km	109,725 (+3.7%)	-23,000	(-21.0%)	-17,600	(-16.0%)	+12,300	(+11.2%)
	1.5km～2km	23,335 (-4.1%)	-6,500	(-27.9%)	-3,900	(-16.7%)	+3,700	(+15.9%)
	2km～	4,981 (-1.8%)	-1,400	(-28.1%)	-900	(-18.1%)	+1,000	(+20.1%)
	Total	613,094 (+13.4%)	607,763 (-0.88%)					
Green space ratio (%)	～0.5km	12.0 (-36.5%)	11.2	(-6.7%)	11.4	(-4.6%)	11.7	(-2.1%)
	0.5km～1km	20.1 (-27.8%)	19.3	(-3.9%)	19.6	(-2.6%)	19.9	(-1.2%)
	1km～1.5km	30.3 (-19.5%)	28.9	(-4.8%)	29.3	(-3.6%)	27.7	(-8.6%)
	1.5km～2km	42.7 (-15.8%)	39.3	(-8.0%)	40.8	(-4.6%)	39.9	(-6.7%)
	2km～	60.1 (-11.7%)	61.7	(+2.7%)	60.4	(+0.5%)	54.2	(-9.9%)
	Total	27.0 (-21.5%)	26.0	(-3.7%)	26.3	(-2.6%)	25.4	(-6.0%)
Green space area (km^2)		23.4 (-21.5%)	22.5	(-3.7%)	22.8	(-2.6%)	22.0	(-6.0%)
SO_2 absorption (t/year)		6.63 (-24.1%)	6.39	(-3.7%)	6.45	(-2.7%)	6.21	(-6.3%)
NO_2 absorption (t/year)		42.0 (-24.1%)	40.5	(-3.7%)	40.9	(-2.7%)	39.4	(-6.3%)
CO_2 absorption (10^3C-t/year)		24.6 (-24.1%)	23.7	(-3.7%)	24.0	(-2.7%)	23.1	(-6.3%)
Green park utility (10^6pt)		3.27 (-12.3%)	3.24	(-0.98%)	3.24	(-0.96%)	3.25	(-0.83%)
Agric. Production (10^6JPY)		8,744 (-23.5%)	8,387	(-4.1%)	8,488	(-2.9%)	8,253	(-5.6%)

magnitude than for station distance <1.5 km.

3.2 Relationship of PD and GR

With respect to results of the approximate analysis (*i.e.*, exploring the relationship between PD and GR), we obtained formulas for each station distance category with results separated based on population increasing and decreasing areas (Table 7). Overall, these formulas mean the multiplier factor *b* provides the change in value of green space ratio GR against the changes of population density PD. The results show a trend that the more distant from the station, the less green space ratios decrease for an increasing population. They also suggest that green spaces within 2.0 km of the station were in a gradual decline in spite of population decreasing.

In contrast, for areas where the population has been decreasing, *b* values are expectedly positive for most station distances. However, for results more than 2.0 km distant of the station, the value of *b* is turned to negative. This result shows that green spaces of those areas have been increasing slightly against the population decrease.

3.3 Green space and Ecosystem services in 2025

We estimated the green space ratio of each station distance category and the citywide provisions of ES with respect to each population distribution scenario (Table 8). Green space ratios in 2025 for the scenarios considered are slightly decreased from the 2011 level, where Scenario B shows the least change (-2.6%) and Scenario C, which representing the widespread distribution of population shows the most significant decrease (-6.0%) among the three scenarios.

For results relating to the provisions of the ESs estimation, the patterns (*i.e.*, decreasing ratios) of the amount of regulating services and provisioning services correspond closely to the patterns reported for green space (Regulating services (CO_2 absorption, SO_2 absorption, NO_2 absorption); Scenario A:-3.7%, B:-2.7%, C:-6.3%, Provisioning services (Gross of agricultural production); Scenario A:-4.1%, B:-2.9%, C:-5.6%). However, the results returned for Cultural services (Green park utility) show difference that are lesser in magnitude and are similar regardless of GR differences among the scenarios (Scenario A:-0.98%, B:-0.96%, C:-0.83%).

4. Conclusion

From these results, we can deduce that there is a fair chance for increase the green space around the suburban area in the population-decreasing era.

From the estimation of the green space ratio and the provisions of the ESs in 2025 by three population distribution scenarios, we found that the total green space area of the station-centered scenario will be smaller than the area of middle scenario. The total provisions of the ESs of each scenario were also estimated that will change in similar order as the green space area of each scenario.

Based on these results, we can conclude that there is a possibility of green space increase among the population declining suburban area. However, even if the population growth is focused on the urbanization are, the green space area around the suburban will not increase effectively. It also suggests that green space restoration measures in the area work effectively for green space increase.

※1: IPSS forecasted a decline in the Funabashi city population of 5,400 by 2025.
※2: Chiba Prefecture Official forecasted a 17,000 population increase among the urbanization area (almost fall under the station distance categories 0km-0.5km and 0.5km-1km) by 2025.
※3: Annual average value indicated by Funabashi-city Environmental Report 2013.

Acknowledgment

This work is supported by the Collaboration Research Program of IDEAS, Chubu University IDEAS201632.

References

MILT: Ministry of Land, Infrastructure, Transport and Tourism (2006) “Current situation and problems of Greenland Policy”

Naomichi HASHIZUME (1979) “Open Land in Tokyo Metropolitan Area” Komazawa geography 15, 83-92.

IPSS: National Institute of Population and Social Security Research (2013) “Japanese Regional demographic forecast Report”.

Chiba Prefecture Official (2016) “Urban Masterplan of Funabashi Urban Are”.

Tostuka. Tsugumu and Miyake. Hirishi (1991) "Air purification function of green space" Japan Society for Atmospheric Environment, 26(4), A71-A80.

Ministry of Agriculture (2014) "Agricultural output value by municipalities in 2014 (estimation)"

Improving EIA for roads at the landscape-scale

Jochen A. G. Jaeger
Concordia University Montreal, Department of Geography, Planning and Environment, 1455 de Maisonneuve Blvd. West, Suite H1255, Montreal, QC, H3G 1M8, Canada

1. Introduction

Wildlife populations are increasingly threatened by the expansion of road networks and built-up areas worldwide. However, ecological effects of roads and traffic at the level of landscape functions, communities, and ecosystems are complex and potentially unexpected. They are usually not well studied and not considered in environmental impact assessments (EIAs) and road planning. Major efforts are necessary to improve the quality of project-specific EIAs, landscape-scale cumulative effect assessments (CEA), strategic environmental assessments (SEA), road planning, and land-use planning. I draw 12 lessons from recent advances in Road Ecology science that are important for EIA at the landscape-scale (based on Jaeger 2015).

2. Twelve lessons from Road Ecology for improving EIA

2.1 EIAs of road projects are generally poor and require substantial improvements

Recent reviews of EIAs from Europe, the UK and USA (e.g. Gontier et al. 2006; Tennøy et al. 2006; Karlson et al. 2014) have concluded that many EIAs were deficient, for example:

- It was generally unclear whether reasonable searches had been carried out to detect rare or protected species;
- Fragmentation and barrier effects were seldom considered.

Thus, the assessment of impacts related to biodiversity is still far from meeting its goals (Gontier et al. 2006; Karlson et al. 2014). For example, the width of corridors investigated in EIAs is often only a few hundred meters. Thus, they will miss many effects of roads, since declines in species abundances range between 40 and 2800 meters from the road for birds, between 250 and 1000 meters (and possibly more) for amphibians, and up to 17 kilometers for mammals (Benítez-López et al. 2010). The road-effect zone for mammals is about 6 km wide on average on either side of the road. This means that the usual width of the corridors in road EIAs does not even cover the road-effect zone.

EIA needs to link much more closely to recent advances in science and needs to be combined with research, using experimental designs as proposed by Rytwinski et al. (2015). Each road is an experiment that we can learn from, it needs to be monitored well according to a study design that will allow us to draw meaningful conclusions.

Cumulative effects deserve particular attention because they constitute the most relevant effects worth assessing in most EIAs. However, CEA has largely failed to deliver on its promises (Dunker and Greig 2006). Fundamental improvements are required, for example through regional environmental assessments in combination with regional land-use planning, in addition to more rigorous CEA within project EIAs.

The poor quality of EIAs poses a significant concern considering that guidelines on biodiversity/ecological assessment issues have been available for two decades now. These guidelines are not effectively applied, probably because many consultants depend on continued support from their clients. Concluding that there are significant environmental effects might result in being cut off from the preparation of EIAs in the future, which is not in their interest. This is a structural flaw of the current EIA system that needs to be fixed, e.g. through independent peer review.

2.2 Landscape-scale effects of road networks are neglected in EIAs

Even though landscape-scale effects are highly important for wildlife populations, they have not yet been studied very well (van der Ree et al. 2011) and are usually not covered in EIAs. For example, long-distance dispersal of animals is ecologically important for re-colonizing empty habitats (e.g. in meta-population dynamics), allowing range shifts of populations in response to climate change. However, data on long-distance movements are difficult to collect, and studying populations across multiple sites requires longer time scales and greater investments than studies at individual sites.

2.3 There is a lack of knowledge of thresholds in the cumulative effects of landscape fragmentation and habitat loss on the size and viability of wildlife populations

There are thresholds in the effects of increasing road density on the viability of wildlife populations, after which there is a dramatic decline (Jaeger and Holderegger 2005). For example, roads are a primary cause of the decline of endangered brown hare populations in Switzerland. Roads have made the hare populations much more vulnerable to unfavourable weather, to the intensification of agriculture, and to habitat loss (Roedenbeck and Voser 2008). However, little information is available about these thresholds (Robinson et al. 2010), which implies that nobody knows how close wildlife populations already are to their thresholds: The next new road may cause extinction. Long-term studies would be required to elucidate these thresholds. As a consequence of the current practice of considering only endangered species in EIAs, many species that are not (yet) endangered are pushed closer and closer to their threshold.

2.4 Wildlife populations often have long response times to increases in landscape fragmentation ('extinction debt')

Wildlife populations react to the fragmentation of their habitats with variable response times. Their responses may take several decades (e.g. Findlay and Bourdages 2000). Their response times to the main four mechanisms affecting a population may differ: The effect of (i) habitat loss is almost immediate, while the effects of (ii) reduced habitat quality and (iii) traffic mortality may take longer, and (iv) reduced connectivity even longer still. After this time lag, the population is smaller and more vulnerable to extinction. The response times are not known for most species. The term "extinction debt" denotes the number of populations that will go extinct because of changes that have already occurred (Tilman et al. 1994) and should be taken into account in EIAs.

2.5 There are large uncertainties about many potential ecological effects of roads; they need explicit consideration in EIA, and decision-makers should more rigorously apply the precautionary principle

Examples of uncertainties about the landscape-scale effects of roads include the influence of the configuration of the road network on wildlife populations, effects of roads on source-sink dynamics, predator-prey dynamics, changes in food chains, and cascading effects. In general, the bundling of transportation infrastructure to leave other parts of the landscape unfragmented decreases the impact of road networks (Jaeger et al. 2006). Even though the barrier effect of a bundle of transport routes will be higher than the barrier effect of a single transport route, bundling is preferable because more core habitat remains unaffected by barriers and by edge effects. Research about the role of road network configuration is lacking, even though it is urgently needed to inform EIA and landscape-scale road planning. Since we do not know the thresholds in road density, etc., these uncertainties need to be explicitly incorporated into decision-making. We cannot wait another 40 years for research to identify thresholds and response times before they will be considered in EIA. This requires a shift from a reactive to a proactive mode of mitigation and a more rigorous application of the precautionary principle (EEA 2001). This shift is supported by the insight that the failure of detecting environmental impacts that exist (Type II error) usually has more detrimental consequences than the erroneous detection

of impacts that do not exist (Type I error) (Kriebel et al. 2001). In addition, EIA practitioners should be more explicit about their assumptions and knowledge gaps and disclose uncertainties such that decision-makers can make more informed decisions (Tennøy et al. 2006).

2.6 Landscape fragmentation should be monitored because it is a threat to biodiversity and a relevant pressure indicator

Many countries monitor their biodiversity, and some monitoring systems already include an indicator to measure the pressure on landscapes caused by fragmentation due to transportation infrastructure and urbanisation. It can be calculated using the method of effective mesh size and effective mesh density (Jaeger et al. 2008). Further increases in the level of landscape fragmentation need to be avoided because it is a threat to biodiversity and many ecosystem functions and services. Monitoring landscape fragmentation reveals if and how fast landscape fragmentation is increasing, and it can detect any changes in the trends (EEA & FOEN 2011).

2.7 Limits to control landscape fragmentation are needed

In 1985, the German Federal Government declared the goal to 'reverse the trend in land consumption and landscape fragmentation' (BdI 1985). There is also an explicit intention to preserve large, un-fragmented spaces with little traffic, which is a central principle of regional planning in Germany. However, landscape fragmentation has continued to increase unabatedly since 1985. Therefore, the German Environmental Agency has proposed to establish limits to the rate of increase of landscape fragmentation (Penn-Bressel 2005). Targets and limits can be evaluated to assess whether or not they have been achieved and they provide a regulatory ground for administrative action for curtailing fragmentation when the targets are exceeded.

2.8 Maintaining ecological corridor networks is less costly than paying for their restoration at a later date

In Switzerland and in the Netherlands, the restoration of wildlife corridors of national importance has required a large amount of money (van der Grift 2005). Therefore, it is a good strategy to map ecological corridors and keep them sufficiently wide and free from development from the very beginning. Countries can save a lot of money by addressing the issue of landscape fragmentation now rather than ignoring the need for mitigation measures during road construction and having to deal with the increased costs of adding them later.

2.9 Caring about the quality of the entire landscape is essential, not just protected areas and wildlife corridors

Many wildlife species suffer from high mortality when moving outside of protected areas. This implies that we should *always* be concerned about the ecological effects of roads and about how to improve the ecological quality of the landscape – inside and outside of protected areas.

2.10 Make use of the road-effect zone for assessing large-scale effects of road networks

A new method for assessing the impacts of road networks on wildlife has recently been proposed by Torres et al. (2016), based on road effect zones of birds and mammals. This approach should be applied for cumulative impact assessment when new roads are planned, for different types of habitat and for different groups of species. Torres et al. (2016) propose an internationally coordinated a network of studies about road effect zones across ecosystems and geographical areas.

2.11 Increases in the populations of species that are positively affected by roads and traffic are not desirable, either

Many small mammals benefit from higher densities of roads, for example through predation release. However, these increases in population density are *not desirable* either. Therefore, we

should prevent community shifts towards more road-tolerant species in the first place by protecting the predators from the effects of roads.

2.12 We need an experimental approach to road mitigation and better long-term collaboration between transport agencies and road ecologists

The only way to achieve "environmental sustainability" is to support long-term and credible scientific research. Road mitigation experiments are the most informative and most efficient approach because they can more reliably reveal the effects of important design and landscape parameters on mitigation effectiveness.

3. Conclusion

It is dangerous to think that roads could be built anywhere if they come with wildlife crossing structures and fences. Crossing structures and fences mitigate only *some* of the effects of roads, but not all. A central database of road EIAs should be established to enable learning from previous studies and share experiences in a more systematic way. It is necessary to establish long-term collaborative links between ecologists and transportation agencies and to modify our approach to evaluating the effectiveness of mitigation measures. Multiple road projects in different regions can be combined and studied as part of integrated and well-replicated larger research projects (Rytwinski et al. 2015).

4. References

BdI (Bundesminister des Innern). 1985. *Bodenschutzkonzeption der Bundesregierung*. Bundestags-Drucksache 10/2977 vom 7. März 1985, Kohlhammer, Stuttgart, Germany.

Benítez-Lopez A et al. 2010. The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. *Biological Conservation* 143: 1307-1316.

Duinker PN, Greig LA. 2006. The impotence of cumulative effects assessment in Canada: Ailments and ideas for redeployment. *Environmental Management* 37: 153-161.

EEA (European Environment Agency). 2001. *Late lessons from early warnings: the precautionary principle 1896–2000.* Environmental Issue Report No 22, EEA, Copenhagen.

EEA & FOEN (European Environment Agency & Swiss Federal Office for the Environment). 2011. *Landscape fragmentation in Europe. Joint EEA-FOEN report*. EEA Report No 2/2011. Luxembourg, Publications Office of the European Union. 87 pp.

Findlay CS, Bourdages J. 2000. Response time of wetland biodiversity to road construction on adjacent lands. *Conservation Biology* 14: 86-94.

Gontier M et al. 2006. Biodiversity in environmental assessment – current practice and tools for prediction. *Environmental Impact Assessment Review* 26: 268-286.

Jaeger JAG. 2015. Improving environmental impact assessment and road planning at the landscape scale. In: van der Ree R et al. (eds.): *Handbook of Road Ecology*. John Wiley & Sons, Oxford, pp. 32-42.

Jaeger J, Holderegger R. 2005. Thresholds of landscape fragmentation (in German; Schwellenwerte der Landschaftszerschneidung). *GAIA* 14: 113-118.

Jaeger JAG et al. 2006. Does the configuration of road networks influence the degree to which roads affect wildlife populations? In: Irwin CL, Garrett P, McDermott KP (eds.): Proceedings of the 2005 International Conference on Ecology and Transportation (ICOET). Center for Transportation and the Environment, North Carolina State University, Raleigh, NC, pp. 151-163.

Jaeger JAG et al. 2008. Implementing landscape fragmentation as an indicator in the Swiss Monitoring System of Sustainable Development (MONET). *Journal of Environmental Management* 88: 737-751.

Karlson M et al. 2014. Road ecology in environmental impact assessment. *Environmental Impact Assessment Review* 48: 10-19.

Kriebel D et al. 2001. The precautionary principle in environmental science. *Environmental Health Perspectives* 109: 871–876.
Penn-Bressel G. 2005. Begrenzung der Landschaftszerschneidung bei der Planung von Verkehrswegen. *GAIA* 14: 130–134.
Robinson C et al. 2010. A conceptual framework for understanding, assessing, and mitigating ecological effects of forest roads. *Environmental Review* 18: 61–86.
Roedenbeck IA, Voser P. 2008. Effects of roads on spatial distribution, abundance and mortality of brown hare (*Lepus europaeus*) in Switzerland. *European Journal of Wildlife Research* 54: 425–437.
Rytwinski T et al. 2015. Experimental study designs to improve the evaluation of road mitigation measures for wildlife. *Journal of Environmental Management* 154: 48-64.
Tennøy A et al. 2006. Uncertainty in environmental impact assessment predictions: The need for better communication and more transparency. *Impact Assessment and Project Appraisal* 24: 45-56.
Tilman D et al. 1994. Habitat destruction and the extinction debt. *Nature* 371: 65–66.
Torres A et al. 2016. Assessing large-scale wildlife responses to human infrastructure development. *PNAS* (*Proceedings of the National Academy of Sciences of the United States of America*) 113(30): 8472-8477.
van der Grift EA 2005. Defragmentation in the Netherlands: A success story? *GAIA* 14: 144–147.
van der Ree R et al. 2011. Effects of roads and traffic on wildlife populations and landscape function: Road ecology is moving towards larger scales. *Ecology and Society* 16: 48.

The role of EIA in greenhouse gas mitigation

International Association of Impact Assessment Conference 2017 (ID 88)

Bryan Jenkins

Abstract

The role of EIA in Western Australia and New Zealand in addressing greenhouse gas emissions is compared. Since the mid-1990s, Western Australia has had provisions requiring greenhouse gas emissions to be considered in EIA. With major mining and energy projects, limiting greenhouse gas emissions has been a priority. EIA has played a significant role in managing greenhouse gas emissions through improved design, carbon sequestration and forestry offsets. New Zealand's resource management legislation was amended in 2004 to introduce climate change considerations but greenhouse gas emissions were specifically excluded from the EIA process managed by regional government: they were to be addressed by a National Environmental Standard which has not been promulgated. Agricultural emissions are the dominant source in New Zealand with the greatest increases coming from dairy farm conversions often from forested land. With no EIA provisions this has led to increased emissions and loss of sinks.

Western Australian Situation

Australian Government Greenhouse Gas Policy

The Australian Government has set its 2030 target of reducing emissions to 26-28% below 2005 levels. In 2017, the Australian Government is commencing another review of its climate change policies including the opportunities and challenges of reducing greenhouse gas emissions (Australian Government, 2017). In 2011 legislation was passed to create a carbon pricing mechanism (a cap-and-trade emissions trading scheme). This commenced in July 2012 but was repealed in July 2014 and the "Direct Action Plan" implemented with the centre piece of the Emissions Reduction Fund which is to purchase emissions reduction through a reverse auction.[1]

Initial Commonwealth policies were primarily voluntary, such as the National Greenhouse Challenge Program for industry aimed at capturing the potential for reductions in emissions through voluntary and cost-neutral steps. Australia gained concessions from the international community at the 1997 Kyoto Conference by arguing that unlike most other developed countries, Australia's economy was heavily reliant on energy-intensive industries. Australia was allowed an 8% increase in 1990 emissions by 2010.

In 2013, Australia's greenhouse gas emissions were calculated under the UNFCCC accounting framework to be 538 $MtCO_2$-e (million tonnes of carbon dioxide equivalent). This is a 1.2% increase compared with 1990 levels of 532 $MtCO_2$-e. Energy is the main contributor (76%) which increased

[1] The Emission Reduction Fund operates in three parts: (1) *crediting*, where businesses identify emission reductions that go beyond business-as-usual activities; (2) *purchasing*, where the Clean Energy Regulator runs auctions to select lowest cost abatement among registered projects, and (3) *safeguard mechanism*, to ensure emission reductions paid for by the Emissions Reduction Fund are not displaced by business-as-usual levels elsewhere in the economy. Through the first two reverse auctions the government has contracted to purchase 92.9 $MtCO_2$-e of abatement (Commonwealth of Australia, 2015). Its cost effectiveness is a matter of debate (Ward, 2015)

40% in greenhouse gas emissions since 1990. This was primarily offset by the land use, land use change and forestry sector which shifted from contributing 19% of emissions in 1990 to providing a sink for 4% of emissions in 2013: principally due to land clearance controls. Australia has the highest per capita emissions of any OECD country. It was 23.3 tCO_2-e per person in 2013 which is a 25% decline from 31.2 tCO_2-e per person in 1990. While GDP grew 103% between 1990 and 2013, the emissions intensity of the economy was halved from 0.71 $kgCO_2$-e per dollar in 1990 to 0.35 $kgCO_2$-e per dollar in 2013 (Commonwealth of Australia, 2015).

Environmental Impact Assessment in Western Australia

With a heavy emphasis on resources and energy development, primarily for export, Western Australia is a major contributor of greenhouse gas emissions. The top ten emitters from mining and hydrocarbon projects emit an estimated 34.7 $MtCO_2$-e (6.5% of Australia's total emissions) (Chapple, 2012).

Environmental impact assessment (EIA) for new developments is primarily the responsibility of state governments. The Western Australian Environmental Protection Authority has recommended conditions aimed at reducing greenhouse gas emissions on development proposals using EIA since the late 1990s. Proponents of projects with significant greenhouse gas emissions are to (1) identify all greenhouse gas emission sources and calculate emissions in accordance with the National Greenhouse and Energy Reporting Act; (2) demonstrate that the proposal is designed and will be operated in a manner which maximises energy efficiency and minimises greenhouse gas emissions as far as practicable; and, (3) provide an analysis of greenhouse gas intensity (i.e. quantity of CO_2-e generated per tonne of product produced) and consider published benchmarked best practice for equivalent plants and equipment (Environmental Protection Authority, 2015).

In the initial form of the EPA policy (Environmental Protection Authority, 1998) the benchmarking was also against Australia's target from the 1997 Kyoto Climate Change Conference. The 108% target represents a 25% reduction from "business-as-usual" predictions of greenhouse gas emissions for the year 2010 (which was 143% of 1990 levels). The expectation was that companies producing greenhouse gas emissions would go beyond a "no regrets" approach.[2] Examples of the outcomes from the EIA processes for major mining and hydrocarbon projects are presented below:

- The Murrin Murrin Nickel-Cobalt project expansion was to increase to 250% of its original capacity. It involved the mining of a new ore body and transporting the ore to an expanded plant. The commitment in relation to reducing greenhouse gas emissions from the EIA process were: (1) the adoption of a recent development of nickel laterite processing – a no regrets measure achieving an estimated 10-25% reduction in greenhouse gas intensity; (2) indirect heating (rather than direct steam injection into the process); (3) rail transport of ore (rather than truck); and, (4) tree farming to offset emissions. This was estimated to achieve a 16-30% greenhouse gas emission reduction compared to 1990 business-as-usual (Environmental Protection Authority, 1999).

[2] "No regrets" approaches are greenhouse gas emission reduction measures that have positive net benefits because they generate direct or indirect benefits that are large enough to offset the costs of implementing the measures (IPCC, 2001) "Beyond no regrets" measures have net costs.

- The Gas to Synthetic Hydrocarbons Plant on Burrup Peninsula was to process natural gas to produce 1,240 tonnes per day of synthetic crude oil which can then be processed into specialty products such as lubricants and diesel fuel. The commitments in relation to reducing greenhouse gases from the EIA process were: (1) a 50% improvement in thermal efficiency compared to the pilot plant, (2) improved life cycle analysis of products, e.g. sulphur-free diesel fuel, and, (3) use of process steam for the state government's water desalination plant eliminating the need for an alternative fuel source (Environmental Protection Authority, 2000).
- The Gorgon Gas Development Expansion on Barrow Island Nature Reserve was to expand liquefied natural gas production from 10 million tonnes per annum (MTPA) to 15 MTPA by the addition of a third gas processing train. The commitments to reduce greenhouse gas emissions from the EIA process were: (1) sequestering carbon dioxide emissions into a saline aquifer 2,000m beneath the ground, (2) LNG technology improvement, (3) use of sub-sea production system, and, (4) improved waste heat recovery. This reduced the greenhouse gas emission intensity from 0.89 tCO_2-e per tonne of LNG from the 1998 concept design to 0.35 tCO_2-e per tonne of LNG (Environmental Protection Authority, 2009).

New Zealand Situation

New Zealand Government Greenhouse Gas Policy

The New Zealand Government's provisional gross emission target for 2030 is 30% below 2005 emissions (a target which is only 10% below 1990 levels). The Emissions Trading Scheme is the principal means that is currently in place to generate greenhouse gas reductions. The Climate Change Response Act 2002 put in place the legal framework to enable New Zealand to meet its international obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

An amendment in 2008 established a greenhouse gas emissions trading scheme (ETS). The ETS was to cover all gases and all industries but with different entry times. Compliance for industries would require the surrender of a New Zealand emission unit or an international unit for each tonne of greenhouse gas emissions. New Zealand emission units were to be capped in number and were to be allocated by grandparenting (gifting) or auctioning. Trade-exposed industries were to receive a 90% free allocation of units to 2018 with phasing out by 2030. Forest owners with pre-1990 forests were to receive a fixed one-off free allocation of units. Post-1989 afforestation would earn credits while units would have to be purchased for deforestation.

With a change of government there were amendments to the ETS in2009 (the Climate Change Response (Moderated Emissions Trading) Amendment Act 2009) and 2012 (the Climate Change Response (Emissions Trading and Other Matters) Amendment Act 2012). The current scheme has removed the cap on New Zealand emissions and has permitted unlimited importation of international units. Compliance now only requires one unit for every 2 tonnes of emissions. Trade-exposed, emission-intensive industries get free allocations based on production. The phase out of free allocations is now over a longer time period. There are no free allocations to industry that can pass on costs to consumers. There is an indefinite deferral of including agricultural emissions in the ETS.

The outcome of the ETS has led to significant deforestation before the commencement of the commitment period in 2008 (Ministry for the Environment, 2016b). The purchase of international units of dubious efficacy has removed the carbon price signal to motivate reduction in greenhouse gas emissions (Sustainability Council of New Zealand, 2015). The free allocations to industry transfer the costs of compliance to the taxpayer (Sustainability Council of New Zealand, 2015). The uncapped system with low carbon cost has led to growth in current and projected emissions. In 2014, gross emissions were calculated as 81.1 Mt CO_2-e which is an increase of 23% above 1990 levels (Ministry for the Environment, 2016a).

Agriculture is the main contributor to gross emissions (49%), the highest for an OECD nation. Energy is also a significant contributor (40%); with a high percentage of hydro generation this is low for an OECD country. In 1990, forestry was a significant sink for New Zealand (28.9 MtCO_2-e) reducing net emissions to 36.9 MtCO_2-e. With deforestation and harvesting, there has been a reduction in forestry as a sink (to 24.4 MtCO_2-e in 2014) so that net emissions are 56.7 MtCO_2-e in 2014, a 54% increase since 1990. Per capita emissions are lower than Australia at 17.2 tCO_2-e per person in 2014 and have decreased by 7% since 1990. The emission intensity of the economy has decreased from 0.82 kgCO_2-e/$GDP in 1990 to 0.55 kg$CO_2$-e/$GDP in 2013. Between 1990 and 2014 agricultural emissions increased 15% mainly due to a 95% increase in the dairy herd (increasing methane emissions) and a more than five-fold increase in the application of nitrogen-containing fertiliser (increasing nitrous oxide emissions). In the energy sector the major change was the increase in road transportation greenhouse gas emissions (72%) (Ministry for the Environment, 2016a).

Assessment of Environmental Effects in New Zealand

New Zealand's principal legislation relating to natural resources management is the Resource Management Act 1991 (RMA). The legislation includes the provisions for the assessment of environmental effects of new projects which are primarily the role of regional councils. The RMA was amended in 2004 to incorporate renewable energy and climate change provisions. However, the 2004 amendments **preclude** regional councils from having regard to the effects of greenhouse gas emissions on climate change (RMA Sections 70A and 104E). The intention was that climate change would be addressed as a national issue through a National Environmental Standard (NES): no NES has been promulgated.

There is no policy instrument to address agricultural emissions as they are not part of the ETS and greenhouse gas emissions from land use intensification, such as dairy conversions and forest clearance, is not subject to EIA evaluation under the RMA. The agricultural sector is projected to provide 77% of the growth in emissions (Sustainability Council of New Zealand, 2015).

Dairying is a significant component of the New Zealand economy. In 2013, dairy exports were $13.7 billion which was 29% of New Zealand exports and 40% of the world export market. Milk solids production increased from 599 million kg in 1990/1 to 1,890 million kg in 2014/5. The greatest growth has been in the Canterbury region increasing from 6 million kg of milk solids in 1984/5 to 376 million kg of milk solids in 2014/5 (Livestock Improvement Corporation and Dairy NZ, 2015). Conversion to dairy farms from dryland sheep and beef farms and deforestation leads to land use intensification with irrigation and increased fertiliser application. This increases methane emissions from ruminant animals and nitrous oxide emissions from nitrogen fertiliser.

Furthermore, net removals from forestry have decreased due to increased harvesting of plantation forests as a larger proportion of the estate reaches harvest age, and forest being converted to pasture. Between 2003 and 2012, New Zealand's planted forest has declined from 1,827,333 ha to 1,719,501 ha (6% decline), while in Canterbury the planted forest has declined from 122,773 ha to 110,055 ha (10% decline) (Ministry of Agriculture and Forestry, 2004) (Ministry for Primary Industries, 2013). Deforestation intention surveys indicate 86% conversion from forestry to dairying (Manly, 2013).

The greenhouse gas emissions from dairy farms are variable: Ledgard examined 26 dairy farms in Rotorua and estimated an average of 9,067 $kgCO_2$-e per ha with a range from 4,504 to 12,198 $kgCO_2$-e per ha (Ledgard, Judge, Smeaton, & Boyes, 2010). Smeaton modelled a base dairy farm model of 9,300 $kgCO_2$-e per ha compared to a sheep and beef farm of 3,400 $kgCO_2$-e per ha (Smeaton, Cox, Kerr, & Dynes, 2011). Thus for a conversion from a sheep and beef farm to a dairy farm would increase greenhouse gas emissions by about 5,900 $kgCO_2$-e per ha.

Mason and Ledgard are developing a calculator for greenhouse sinks from radiata pine plantation on the basis that one hectare of pine plantation can absorb 11,800 $kgCO_2$-e, allowing for harvesting (Mason & Ledgard, 2013). Thus for a dairy conversion from a plantation forest the net increase in greenhouse gases is about 20,100 $kgCO_2$-e per ha.

In terms of greenhouse gas mitigation the most promising options for nitrous oxide have been identified as: nitrogen inhibitors that keep nitrogen in the less mobile ammonium form for longer, the use of herd shelters that can minimize the deposition of urine patches at high-risk times of the year, and, replacing nitrogen fertilizer inputs to boost pasture production with inputs of maize or cereal silage to reduce the amount of nitrogen ingested and excreted (De Klein, Monaghan, Ledgard, & Shepherd, 2010). Potential methane reduction strategies are only in the research stages. These are selective breeding of low emission sheep and cattle, changing animal feed, and biotechnologies that target microbes in the rumen that produce methane (Parliamentary Commissioner for the Environment, 2016). There are avenues for offsets through farm forestry and hydro generation as a component of irrigation storage (Jenkins, 2015).

For management of greenhouse gas emissions in New Zealand there would be value in incorporating consideration of such emissions in the assessment of environmental effects for proposals like dairy conversions.

Concluding Comments

Management of greenhouse gases requires effective government policy. In the absence of mitigation measures greenhouse gas emissions can be expected to continue to grow. The use of EIA in Western Australia has been shown to provide a mechanism for evaluating new mining and hydrocarbon development proposals leading the adoption of "beyond no regrets" measures. However the preclusion of the consideration of greenhouse gas emissions in EIA in New Zealand has allowed land use intensification and deforestation to occur significantly increasing greenhouse gas emissions. EIA can be an effective component in the policy mix to address greenhouse gas mitigation.

References

Australian Government. (2017). 2017 Review of Climate Change Policies. Retrieved 13 Jan, 2017, from https://www.environment.gov.au/system/files/pages/64722841-01ab-4067-a978-40d63174d4c7/files/tor-climate-change-review.pdf

Chapple, R. (2012). Western Australia Greenhouse Gas Estimates 2012. West Perth, Western Australia: Office of Robin Chapple MLC.

Commonwealth of Australia. (2015). *Australia's Second Biennial Report*. Canberra: Commonwealth of Australia.

De Klein, C., Monaghan, R., Ledgard, S., & Shepherd, M. (2010). *A system's perspective on the effectiveness of measures to mitigate the environmental impacts of nitrogen losses from pastoral dairy farming*. Paper presented at the Proceedings of the 4th Australasian Dairy Science Symposium

Environmental Protection Authority. (1998). *Guidance Statement No. 12: Minimising Greenhouse Gas Emissions*. Perth, Western Australia: Environmental Protection Authority.

Environmental Protection Authority. (1999). *Bulletin 931 Murrin Murrin Nickel-Cobalt Project Stage 2 Expansion, 60km east of Leonora: Report and Recommendations of the Environmental Protection Authority*. Perth, Western Australia: Environmental Protection Authority.

Environmental Protection Authority. (2000). *Bulletin 985 Proposed Gas to Synthetic Hydrocarbons Plant, Burrup Peninsula, Western Australia: Report and recommendations of the Environmental Protection Authority*. Perth, Western Australia: Environmental Protection Authority.

Environmental Protection Authority. (2009). *Gorgon Gas Development Revised and Expanded Proposal: Barrow Island Nature Reserve: Report and recommendations of the Environmental Protection Authority*. Perth, Western Australia: Environmental Protection Authority.

Environmental Protection Authority. (2015). *Environmental Protection Bulletin No. 24 Greenhouse gas emissions and consideration of projected climate change impacts in the EIA process*. Perth, Western Australia: Environmental Protection Authority.

IPCC (2001) No Regrets Options. IPCC. http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=292.

Jenkins, B. R. (2015). *Implications of climate change for water management in Canterbury*. Paper presented at the World Water Congress XV, Edinburgh.

Ledgard, S., Judge, A., Smeaton, D., & Boyes, M. (2010). *Greenhouse gas emissions from Rotorua dairy farms: Summary report*. Hamilton: AgResearch.

Livestock Improvement Corporation and Dairy NZ. (2015). New Zealand Dairy Statistics 2014-15. Hamilton: LIC and Dairy NZ.

Manly, B. (2013). 2012 Deforestaion Survey. Wellington: Ministry for Primary Industries.

Mason, E., & Ledgard, S. (2013). Making your farm greenhouse gas neutral. Retrieved 29 Dec 2013, from www.forestry.ac.nz/euan/carbonStockUnits.htm

Ministry for Primary Industries. (2013). *National Exotic Forest Description as at 1 April 2012*. Wellington: Ministry for Primary Industries.

Ministry for the Environment. (2016a). New Zealand's Greenhouse Gas Inventory 1990-2014. from https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/greenhouse-gas-inventory-snapshot-2016.pdf

Ministry for the Environment. (2016b). The New Zealand Emissions Trading Scheme Evaluation 2016. Wellington: Ministry for the Environment.

Ministry of Agriculture and Forestry. (2004). *A National Exotic Forest Description as at 1 April 2003*. Wellington: Ministry of Agriculture and Forestry.

Parliamentary Commissioner for the Environment. (2016). Climate change and agriculture: Understanding the biological greenhouse gases. Wellington: Parliamentary Commissioner for the Environment.

Smeaton, D., Cox, T., Kerr, S., & Dynes, R. (2011). Relationships between farm productivity, profitability, N leaching and GHG emissions: a modelling approach. *Proceedings of the New Zealand Grassland Association, 73*, 57-62.

Sustainability Council of New Zealand. (2015). New Zealand's Climate Change: Targets, Projections and Liabilities. from http://www.sustainabilitynz.org/nzs-climate-change-targets-projections-and-liabilities/

Ward T (2015) Direct action can be turned into a real climate policy. Grattan Institute. https://grattan.edu.au/news/direct-action-can-be-turned-into-a-real-climate-policy/.

How to improve EIA system in developing countries? A quantitative literature review

Tetsuya KAMIJO*

Abstract: EIA was introduced in many developing countries from the early 1980s. They have implemented EIA over the past 30 years but the weak enforcement has been a major problem. This study built a sample of 82 documents between 1985 and 2016 about EIA system in developing countries, and examined constraints of EIA system and recommendations using quantitative text analysis (QTA). The constraints and recommendations changed before and after 2000 and in particular, a ratio of constraint on report quality nearly doubled after 2000. The study proposes to focus on improving the quality of an environmental impact statement (EIS) in order to improve the EIA system in developing countries, because EIS is a product of an EIA process and is a fundamental indicator of an effective EIA system. Further research is needed to review the quality of EIS in developing countries in order to find determination factors for improving their quality.

Key Words: Environmental impact assessment, Developing countries, Constraints, Quantitative text analysis, Environmental impact statement

Introduction

EIA was introduced in many developing countries from the early 1980s. Many studies evaluated EIA in developing countries over the past 30 years. Despite the early introduction of mandatory EIA system in Southeast Asia, the practice was still limited in the 1990s (Briffett 1999). The World Bank revealed that project design did not yet sufficiently reflect EIA (Scholten & Post 1999). After 10 years, weak enforcement was yet a major problem in many developing countries in East and Southeast Asia. The weak enforcement was reflected through late implementation, insufficient consideration of alternatives, weak consultation, and a lack of information disclosure (World Bank 2006, p. 15). Previous studies about evaluation of EIA in developing countries proposed recommendations to improve EIA system such as capacity building and public involvement (Marara et al. 2011; Panigrahi and Amirapu 2012; Al-Azri et al. 2014). However, little is known about the solution mechanism for constraints at the present. There is a possibility to find a solution by comparing time series text data of constraints and recommendations using quantitative text analysis (QTA). QTA analyzes textual information of documents quantitatively, and applied to environmental studies such as the analysis of discussions and newspapers. This study applied QTA to documents of EIA system in developing countries over the past 30 years for the purpose of proposing a way to improve the EIA system.

1. Data and methods

1.1 Documents of EIA system in developing countries

This study focused on peer-reviewed articles published in international journals, books, and conference papers in the field of EIA system in

* JICA Research Institute, Japan International Cooperation Agency

developing countries. A search query of the EBSCO Environment Complete database was conducted for documents that contained 'environmental impact assessment' or 'EIA' in their title. This initial search returned 1,184 documents. The documents were then manually screened to ensure that each was relevant to the fields of interest. This reduced the total to 31. Because a database search cannot fully assemble all relevant documents, the author added articles and books based on his previous experience in the field, bringing all documents reviewed to 82, and spread across 11 journals, 8 books, and 4 reports of international organizations between 1985 and 2016 (Table 1). Asian countries established EIA legislation at an early stage, so the documents in Asia were available in 1985 to 1990. Asia has most documents in each period (43 documents in total). Next to Asia, 22 are from Africa, 9 from Middle East, 4 from Latin America, and 4 from the whole developing countries. The constraints and recommendation of 82 documents were summarized and this summary was used as raw data.

1.2 Quantitative text analysis

The documents were analyzed using QTA via KH Coder, free analytical software (Higuchi 2014). The QTA provides a quantitative overview of text data. One benefit is to allow analysts to search the data using coding rules. The coding rules were prepared to focus on seven subjects (law and administration, capacity building, public involvement, monitoring, information, report quality, and alternative) were prepared. They were identified as major constraints on EIA system. The KH Coder shows an appearance ratio for each coding rule. The appearance ratio is calculated by dividing the number of documents in which specific coding rule words appear by the total number of all documents. According to the coding rules, (1) law and administration were suggested by the words administrative, agency, authorities, authority, bureaucracy, bureaucratic, commitment, comply, cooperation, coordination, decentralization, enforcement, framework, fund, government, institution, integrate, integration, law, legal, legislation, license, link, linkage, modification, policy, policies, political, procedure, process, regulation, regulator, rule, system, or treatment; (2) capacity building by capacity, education, empowerment, experience, expert, expertise, guideline, knowledge, manpower, professional, qualification, qualified, research, resource, skill, skilled, trained, or training; (3) public involvement by awareness, communication, consultancy, consultation, debate, involvement, or participation; (4) monitoring by evaluation, follow-up, monitor, or monitoring; (5) information by access, baseline, data, inaccessible, information or map; (6) report quality by report, review or quality; and (7) alternative by alternative. These words were selected from words appearing in the raw data. Articles, pronouns, figures, punctuation marks, and so on were excluded from the analysis.

The constraints and recommendations were compared before and after 2000 using QTA. By 2000 many developing countries introduced EIA systems and since 2000 they have experienced EIA operations. An evolution of EIA systems was therefore expected to clarify by comparing before and after 2000. Six documents were excluded from an analysis of recommendations because relevant descriptions were not present.

2. Results

2.1 Differences between constraints and recommendations before and after 2000

A number represents the number of documents and a percentage represents the appearance ratio. Law and administration, capacity building and public involvement were major constraints and major recommendations before and after 2000 (Table 2). Before 2000 there was no difference between constraints and recommendations about six subjects except alternatives. The difference of alternatives was significant ($*p < .05$). The reason was because it could be difficult to address the alternatives due to weaknesses of related laws and administration before 2000 (Brown et al. 1991; Nor 1991; Ebisemiju 1993; Lohani et al. 1997).

Table 1. Number of documents by period, regions, journals and books between 1985 and 2016

Region, journal and book	1985-1990	1991-2000	2001-2010	2011-2016	Total
Region					
Asia	6	10	19	8	43
Africa	0	6	12	4	22
Middle East	0	1	5	3	9
Latin America	0	3	1	0	4
Whole developing countries	2	1	1	0	4
Total	8	21	38	15	82
Journal and book					
Environ Impact Assess Review	6	12	16	5	39
Impact Assess Project Appraisal	0	2	11	6	19
Books	1	3	3	1	8
International Organizations	1	1	2	0	4
Int Dev Plan Review	0	1	1	0	2
J Environ Assess Policy Manag	0	0	2	0	2
The Environmentalist	0	0	2	0	2
Int Association Impact Assess	0	1	0	0	1
J Environ Manag	0	1	0	0	1
Int J Human and Social Sci	0	0	1	0	1
Environ Monitor Assess	0	0	0	1	1
Environ Natural Resources Research	0	0	0	1	1
J Environ Protect	0	0	0	1	1
Total	8	21	38	15	82

Table 2. QTA results of constraints and recommendations before and after 2000 (Significant at *$p < .05$, **$p < .01$)

Period	Law and administration		Capacity building		Public involvement		Monitoring		Information		Report quality		Alternative		Documents
1985-2000															
Constaints	22	76%	19	66%	19	66%	10	34%	11	38%	7	24%	6	21%	29
Recommendations	21	78%	13	48%	13	48%	5	19%	9	33%	7	26%	0	0%	27
Total	43	77%	32	57%	32	57%	15	27%	20	36%	14	25%	6	11%	56
Chi-square		0.00		1.09		1.09		1.09		0.01		0.00		4.28*	
2001-2016															
Constaints	47	89%	39	74%	38	72%	28	53%	21	40%	24	45%	20	38%	53
Recommendations	39	80%	39	80%	35	71%	17	35%	10	20%	20	41%	4	8%	49
Total	86	84%	78	76%	73	72%	45	44%	31	30%	44	43%	24	24%	102
Chi-square		0.98		0.23		0.00		2.70		3.58		0.07		10.79**	

Table 3. QTA results before and after 2000 of constraints and recommendations (Significant at *$p < .05$, **$p < .01$)

Period	Law and administration		Capacity building		Public involvement		Monitoring		Information		Report quality		Alternative		Documents
Constraints															
1985-2000	22	76%	19	66%	19	66%	10	34%	11	38%	7	24%	6	21%	29
2001-2016	47	89%	39	74%	38	72%	28	53%	21	40%	24	45%	20	38%	53
Total	69	84%	58	71%	57	70%	38	46%	32	39%	31	38%	26	32%	82
Chi-square		1.45		0.26		0.11		1.85		0.00		2.72		1.79	
Recommendations															
1985-2000	21	78%	13	48%	13	48%	5	19%	9	33%	7	26%	0	0%	27
2001-2016	39	80%	39	80%	35	71%	17	35%	10	20%	20	41%	4	8%	49
Total	60	79%	52	68%	48	63%	22	29%	19	25%	27	36%	4	5%	76
Chi-square		0.00		6.58*		3.12		1.50		0.94		1.10		0.98	

After 2000 there was no difference between constraints and recommendations in law and administration, capacity building, public involvement, and report quality. The difference in monitoring information, and alternatives became large. In particular, the difference of alternatives was more significant than before 2000 (**$p < .01$). After 2000, laws and administration about capacity building and public involvement were improved but ones about monitoring, information, and alternatives could have still weaknesses amid growing need for their enforcement (Clausen et al. 2011; Momtaz & Kabir 2013; Heaton & Burns 2014).

2.2 Differences before and after 2000 in constraints and recommendations

The differences before and after 2000 in constraints and recommendations were shown in Table 3. The appearance ratio of constraints on the seven subjects remained constant or increased after 2000. In particular, the ratio of report quality nearly doubled from 24 to 45 percent, which was growing concern after 2000.

The appearance ratios of recommendations of five subjects (capacity building; public involvement; monitoring; report quality; and alternative) increased after 2000. Particularly, the appearance ratios of capacity building and public involvement showed a large increase after 2000. They were expected to solve constraints. In particular, the difference of recommendations in capacity building before and after 2000 was significant (*$p < .05$). The QTA results offer a hint on how to improve EIA system in developing countries.

3. Discussion

3.1 Solutions to constraints of the EIA system

Developing countries have strengthened their EIA legislation and gained the experience of EIA operations over the past 30 years (Briffett et al. 2004; Coşkun & Turker 2011; Suwanteep et al. 2016). The EIA law and administration are developing as a whole but monitoring, information, and alternatives are still weak. The appearance ratios of seven subjects in constraints did not decrease, and remained constant or even increased after 2000. These seven subjects in constraints have basically not been solved yet despite the lapse of time. Capacity building and public involvement are expected to improve EIA practices in developing countries after 2000. But it is not certain that they solve the constraints, because solution mechanisms are not clear. An effective EIA system can be defined as one that includes three major dimensions: adequate institutional arrangements; the quality of an environmental impact statement (EIS); and implementation of mitigation measures (Sadler 1996; Momtaz & Kabir 2013). The appearance ratio of report quality in constraints nearly doubled after 2000. Developing countries improve their EIS quality after institutional arrangements (laws and administration). Improvement of EIS quality could be one solution to improve EIA system in developing countries.

3.2 Solving constraints of EIA system focusing on improving the quality of EIS

Developing countries faced issues to improve the EIS quality after 2000. EIS could be the fundamental indicator of an effective EIA system for the reason that the information presented in an EIS reflects the technical and scientific quality of the EIA process. The EIS document is the only way to incorporate and present scientific knowledge in an EIA study. EIS is the product of an EIA process (Momtaz & Kabir 2013). There is a clear relationship between the quality of EIS and the effectiveness of the EIA system (Wende 2002). The quality of EIS is useful in indicating the likely effectiveness of its proposed mitigation measures (Gwimbi & Nhamo 2016a). Available evidence suggests that the EIS were of satisfactory quality when mitigation measures were implemented well (Gwimbi & Nhamo 2016b). The quality of EIS could have a positive effect on monitoring too.

EIA practitioners collect environmental and social information, consider alternatives, reflect public involvement, predict impacts, propose

mitigation measures, and prepare EIS according to EIA legislation and guidelines. The EIA authorities review EIS, which are revised when necessary. The quality of EIS is likely to reflect other six subjects.

It can be said that the EIS is the fundamental indicator of an effective EIA system. It is proper to focus on improving the quality of EIS compared to addressing seven constraints individually. However, little is known about methods for improving the quality of EIS. One reason is that the number of EIS quality studies in developing countries is still limited (Sandham & Pretorius 2008; Badr et al. 2011; Momtaz & Kabir 2013; Sandham et al. 2013; Chanty & Grünbühel 2015).

Conclusions

This study showed that the constraints and recommendations of EIA system in developing countries changed before and after 2000, and in particular a ratio of constraint on report quality nearly doubled. This study proposes to focus on improving the quality of EIS in order to solve the constraints of EIA system in developing countries. The previous research identifies constraints to EIA system but little is known about solutions. This study is a first literature review using QTA methodology with respect constraints and recommendations of EIA system in developing countries, and the quantitative overview of constraints and recommendation provides the hint how to improve EIA system. The literature review using QTA advances the knowledge to improve EIA system in developing countries.

The quality of EIS is an indicator of an effective EIA and could reflect other six constraints including capacity building, public involvement, monitoring, information, and alternatives. Determination factors for improving EIS quality and their improving methods could be concrete recommendations to improve not only EIS quality but also EIA system in developing countries. There must be many EIS in developing countries at the present. More EIS quality review research is needed.

References

Al-Azri NS, Al-Busaidi RO, Sulaiman H, Al-Azri AR. 2014. Comparative evaluation of EIA systems in the Gulf Cooperation Council States. Impact Assess Project Appraisal 32(3):136-149.

Badr EA, Zahran AA, Cashmore M. 2011. Benchmarking performance: environmental impact statements in Egypt. Environ Impact Assess Rev. 31:279-285.

Briffett C. 1999. Environmental impact assessment in Southeast Asia. GeoJournal 49:333-338.

Briffett C, Obbard J, Mackee J. 2004. Environmental assessment in Malaysia: a means to an end or a new beginning. Impact Assess Project Appraisal 22(3):221-233.

Brown AL, Hindmarsh RA, McDonald GT. 1991. Environmental assessment procedures and issues in the Pacific Basin-Southeast Asia Region. Environ Impact Assess Rev. 11:143-156.

Chanthy S, Grünbühel CM. 2015. Critical challenges to consultants in pursuing quality of Environmental and Social Impact Assessments (ESIA) in Cambodia. Impact Assess Project Appraisal 33(3):226-232.

Clausen A, Vu HH, Pedrono M. 2011. An evaluation of the environmental impact assessment system in Vietnam: the gap between theory and practice. Environ Impact Assess Rev. 31:143-156.

Coşkun AA, Turker O. 2011. Analysis of environmental impact assessment (EIA) system in Turkey. Environ Monitor Assess 175:213-226.

Ebisemiju FS. 1993. Environmental impact assessment: making it work in developing countries." J. Environ Manag. 38:247-273.

Gwimbi P, Nhamo G. 2016a. Benchmarking the effectiveness of mitigation measures to the quality of Environmental Impact Statements: lessons and insights from mines along the Great Dyke of Zimbabwe. Environ Develop Sustain. 18(2):527-546.

Gwimbi P, Nhamo G. 2016b. Translating mitigation measures proposed in Environmental Impact Statements into planning conditions: Promises and practices by multinational platinum mining forms along the Great Dyke of Zimbabwe. Environ Sci Policy 57:10-21.

Heaton C, Burns S. 2014. An evaluation of environmental impact assessment in Abu Dhabi, United Arab Emirates. Impact Assess Project Appraisal 32(3):246-251.

Higuchi K. 2014. Quantitative text analysis for social researchers: a contribution to content analysis. Kyoto:

Nakanishiya (in Japanese).

Lohani B, Evans JW, Ludwig H, Everitt RR, Carpenter RA, Tu SL. 1997. Environmental impact assessment for developing countries in Asia. Manila: Asian Development Bank.

Marara M, Okello N, Kuhanwa Z, Douven W, Beevers L, Leentvaar. 2011. The importance of context in delivering effective EIA: case studies from East Africa. Environ Impact Assess Rev. 31:286-296.

Momtaz S, Kabir SMZ. 2013. Evaluating environmental and social impact assessment in developing countries. Waltham, MA: Elsevier.

Nor YM. 1991. Problems and perspectives in Malaysia. Environ Impact Assess Rev. 11:129-142.

Panigrahi JK, Amirapu S. 2012. An assessment of EIA system in India. Environ Impact Assess Rev. 35:23-36.

Sadler B. 1996. International study of the effectiveness of environmental assessment: final report. Ottawa: Canadian Environmental Assessment Agency/International Association for Impact Assessment.

Sandham LA, Pretorius HM. 2008. A review of EIA report quality in the North West Province of South Africa. Environ Impact Assess Rev. 28:229-240.

Sandham LA, van Heerden AJ, Jones CE, Retief FP, Morrison-Saunders AN. 2013. Does enhanced regulation improve EIA report quality? lessons from South Africa. Environ Impact Assess Rev 38:155-162.

Scholten JJ, Post RAM. 1999. Strengthening the integrated approach to impact assessments in development cooperation. Environ Impact Assess Rev. 19:233-243.

Suwanteep K, Murayama T, Nishikizawa S. 2016. Environmental impact assessment system in Thailand and its comparison with those in China and Japan. Environ Impact Assess Rev. 58:12-24.

Wende W. 2002. Evaluation of the effectiveness and quality of environmental impact assessment in the Federal Republic of Germany. Impact Assess Project Appraisal 20(2):93-99.

World Bank. 2006. Environmental impact assessment regulations and strategic environmental assessment requirements: practices and lessons learned in East and Southeast Asia. Washington, DC: World Bank.

As Time Goes By: Considering the Updating of the Rapid Environmental Impact Assessment

Charles Kelly
Disaster Management Consultant[1]

Abstract

Work on the Rapid Environmental Impact Assessment (REA) began in 1999. The idea was to provide humanitarian responders with a way to rapidly identify critical environmental issues which would then be integrated into disaster assistance, to improve the effectiveness of relief operations and reduce collateral environmental damage. REA is a mature tool, tested and used in a range of disasters. At the same time, the development of other environmental impact assessment tools[2] and changes to how humanitarian assistance is provided, for instance the Cluster Approach[3] and shifts to financial transfers as a preferred relief modality (Overseas Development Institute, 2015), raise the question of what should come out of an ongoing review of the current REA. The paper briefly reviews the history of the REA, summarizes some lessons from the use of the REA and discusses what criteria a revised or new REA should meet to be effective.

Introduction

Assistance after disaster[4] is intended to save lives, preserve livelihoods which would be otherwise lost without the assistance, and support recovery. The life-saving priority usually overrides other due process controls on providing assistance, such as environmental screenings.

The primacy of saving lives over other procedural requirements is often incorporated into regulations. For instance, the "notwithstanding" clause used by the United States (US) Government permits the provision of immediate lifesaving assistance without a need to follow normal rules and regulations, such as procurement procedures and environmental regulations (US Government Printing Office, 2003).

Assistance providers and affected populations often see bypassing normal rules and regulations as justified given a fear these procedures will create delays that may cost lives. Disaster survivors are often driven by a desire to quickly return to pre-disaster conditions and can see normal rules and procedures as slowing this process.

However, evidence shows that not taking the constraints incorporated into normal rules and regulations into consideration can harm disaster survivors through the provision of poorly designed, poorly implemented and poorly managed disaster assistance. This outcome often is linked to inadequate consideration of environmental issues where the disaster assistance is being provided. Typical examples range from deforestation (Shepherd, 1995) to the construction of post-disaster housing in a flood zone, to the unsafe disposal of biohazard waste from humanitarian health operations.

---

[1] Contact: havedisastercallkelly@gmail.com.

[2] See http://www.proactnetwork.org/proactwebsite_3/index.php/resources/practitioner-s-resources-kit/environmental-assessments-and-environmental-action-plans for a sample of other tools.

[3] See https://www.humanitarianresponse.info/en/coordination/clusters/what-cluster-approach.

[4] Assistance after disaster can be termed disaster assistance or, when provided externally to a country or population, humanitarian assistance. The former term includes the latter for the purposes of this paper.

Faced with the reality that disaster assistance may be doing further harm to those already harmed by a disaster, efforts by individuals and environment-focused organizations have increased over the past twenty years to, among other things, provide procedures for environmental review of disaster assistance. This effort has focused on disasters where external assistance is significant and host government capacities for environmental review may be limited.[5] The remainder of the paper will summarize the development of the Rapid Environmental Impact Assessment in Disasters (REA) process designed to address these conditions, and draw key conclusions about the future of the REA.

Origins of the REA

In the late 1980s and early 1990s, the US, other governments and the United Nations (UN) Food and Agricultural Organization were implementing large programs across Africa to combat locusts and grasshoppers (hereafter, acridians). These programs were based on an expectation that swarming acridians were a further threat to food security in the aftermath of severe drought and widespread food insecurity in the mid-1980s in savannah regions of Africa.

The US Government considered acridian control efforts as emergency programs, not subject to environmental review procedures normally followed by the US Agency for International Development (USAID), which oversaw this assistance. However, after several years, the recurrent nature of the acridian problem and the similar responses each year, was judged as no longer meeting the immediate lifesaving justification of the "notwithstanding" authorization, (US Government Printing Office, 2003). As a result, the USAID acridian control programs were required to follow normal USAID environmental review procedures and develop formal environmental reviews.

In Niger, where the author managed the USAID acridian control program, the environmental review process was both frustrating and enlightening. It was frustrating because of the review sought explanations and justifications for what had been largely an ad hoc program. In many cases these were lacking. The review process was enlightening because it identified a range of significant improvements to the program which would reduce negative environmental impacts, but also increase effectiveness.

This experience led to the author realization that environmental reviews could be used to improve disaster assistance by providing an independent review of what was often hastily designed and implemented assistance. But it was recognized that any environmental review of disaster assistance had to operate under the same time and data limited conditions as other disaster assessments, and, most importantly, support a more effective disaster relief and recovery process. If the environmental review process did not meet these requirements it would be considered irrelevant to those providing assistance and recovering from a disaster.

Development of the REA[6]

[5] Concerns about the negative impacts of assistance led to the "do no harm" approach (Collaborative Learning Project, 2004), with increased attention to protection, equity, and gender, among other issues, topics generally linked to the environment.

[6] Development and use of the REA was funded by the Royal Gov. of Norway, USAID, the Joint UNEP/OCHA Environment Unit, and in-kind contributions from CARE International with the support of CARE USA and CARE Norge, and others involved in field work. The overall project was managed by the Benfield Hazards Research Center, University College London. The Chile 2010 earthquake REA was funded by Ministry of Environment, Gov. of Chile, World Wildlife Fund – Chile and Antofagasta Minerals. The 2015 Nepal REA was funded by USAID with in kind contributions of the Government of Nepal and WWF.

From its conceptualization in Niger, the REA went through the development steps summarized below.

- Defining the concept, through consultations and conference presentations[7]. These efforts, in the late 1990s, benefited from an increased awareness of disaster-environment links and attention of the environmental impact of refugees and engagement of Non-Government Organizations in efforts to address the environmental consequences of development[8] and disaster assistance.

- Developing the process. The initial idea was for a two to three page checklist covering salient environmental issues for all types of disaster assistance. What emerged after extensive consultations was a relatively comprehensive process based on the standard environmental impact assessment (EIA), but with modifications to match the disaster context, including:
    - Trading accuracy for timeliness (as is the case for most post-disaster assessments).
    - Using qualitative information, as reliable quantitative data are generally not available for weeks to months after a disaster.
    - Using a consensus-based non-expert approach, to reflect the fact that a full range of environmental experts is generally not available immediately after a disaster and to avoid single-expert bias.[9]
    - Focusing on relief and recovery operational issues, by prioritizing issues that were (a) life-threatening, (b) welfare- or livelihood-threatening, and, finally, (c) issues that affected only the environment but neither (a) nor (b).

    This last point was critical – the explicit focus of the REA was on saving lives and preserving livelihoods, even to the extent of accepting that harm might consequently come to the environment. Nonetheless, if the REA identified that immediate lifesaving actions would harm the environment, this assessment would provide a basis for remedial actions at a later stage.

- Review, Testing and Revisions. The initial REA process went through peer reviews and field testing, first in Afghanistan in 2003, and subsequently in Ethiopia and Indonesia. The REA also went through external reviews and two evaluations (Stone, no date, Alexander and Sutter, 2006).

    The REA process held up fairly well through testing, although modifications were needed to be make procedures more understandable (including to non-native speakers of English). The ranking process was switched from using numbers to words to avoid the use of mathematical calculations in ranking the impacts, which created false results.

    Concern was also expressed that the REA was too complicated and time consuming, leading to reformatting and efforts to make the process more intuitive. An initial hope that

[7] Including the Conference on Environmental Issues in Disaster Prevention, Preparedness and Response, The Environmental Response Network, Green Cross UK, London, March 1999, and Sharing Experiences on Environmental Management in Refugee Situations: A Practitioner's Workshop, UNHCR, Geneva, October 2001.
[8] The USAID Food for Peace program was instrumental in a deepening the engagement of NGOs in environmental issues through a requirement that food aid programs have environmental reviews.
[9] UNHCR noted that single experts conducting assessments tended to produce assessment only specific to their field of knowledge.

the REA could be done only based on the **Guidelines for Rapid Environmental Impact Assessment** (Kelly, 2005), was not met. It was eventually accepted that at least one person with experience in the REA process should be involved in, or directly advise on, field use.

- Training and Operational Use. Once a reliable process was worked out and tested, a training program was developed and rolled out together with operational use of the REA. The REA is currently available in English, French and Spanish, with a summary in Russian. The most recent uses of the REA have been in Haiti (Sun Mountain International, 2010) and Chile (Ministry of Environment, Government of Chile, et al, 2010) in 2010 and Nepal in 2015 (Ministry of Science, Technology and Environment, 2015).

Results and Lessons

After more than two decades of development and use, the REA is a road-tested tool able to identify and prioritize critical environmental issues after a disaster. Yet, it is not clear the assessments completed have had any significant long term impact on the relief operations which they reviewed.

The Haiti REA (Sun Mountain International, 2010) did influenced work by the Shelter Cluster to support the inclusion of environmental issues (e.g., reducing use of scarce local resources) into rebuilding. But a broad range of issues identified in the REA remained unaddressed, not the least of which was human waste disposal. The Darfur REA (Joint UNEP/OCHA Environment Unit, 2004) likely contributed to the subsequent Tearfund assessment by documenting environmental conditions and highlighting critical issues (Tearfund (2007), and may have encouraged the development of environment-related programming for displaced populations, but the linkages are indirect at best. The Chile REA (Ministry of Environment, et al, 2010) led to later consultations with a regional government in recovery and provided a basis for a recovery project, but it is not clear other actions were taken across the range of topics covered in the assessment.

One issue is that post disaster environment-focused assessments are infrequently required by donors, undertaken by aid organization based on their internal policies, or completed in compliance with national laws or regulations after disasters. Even where a REA has been completed, it does not automatically result in an environmental management and monitoring plan (EMMP), requiring action by those involved in the disaster response. (The REA is designed to identify issues but not to assign corresponding responsibilities to address these issues.)

Moving Forward

Efforts are underway by USAID and the UNEP/OCHA Joint Environment Unit, the two original REA funders, to consider what should be done with the REA (US Agency for International Development, et al., 2017). There is clearly a need to update materials in the REA linked to the **Sphere Standards for Humanitarian Assistance**[10], to incorporate developments over the last decade in areas such as land tenure and protection (e.g. human safety), to clarify the links between gender and environmental impacts, and to incorporate a clearer rights-based approach.[11]

[10] http://www.sphereproject.org/

[11] Details on the rights-based approach to humanitarian assistance can be found at http://www.actionaid.org/sites/files/actionaid/rba_approach_guide.pdf.

The REA can be adapted for use on electronic devices, with the prospect of facilitating data collection and analysis. Consideration of climate change issues in REA analysis could improve overall humanitarian assistance by informing the development of climate-smart relief and recovery programming.

Whether making changes to the current REA process, or developing a new tool based on new expectations and possibilities, four considerations should frame the results. First, assessment results should be designed to improve the delivery and impact of disaster assistance. The primary purpose should be to help disaster survivors, clear and simple, not to generate an assessment report or conduct field research.

Second, the assessment process needs to reflect the scope of a normal EIA. The breadth of coverage found in an EIA is necessary to ensure that significant, and possibly life-saving or life threatening, issues are not missed, leading to avoidable harm to disaster survivors. Tunnel vision is a significant challenge in disaster response, with responders often not considering indirect, collateral or longer term impacts of their actions. The REA forces a considerable widening of this vision.

Third, timeliness will always need to be traded for accuracy. A post-disaster assessment needs to deliver usable results in the same timeframe in which the disaster assistance is provided. A partial qualitative report, early, is much better than a comprehensive report late, particularly as the initial report can be quickly update as a crisis evolves (which is where a robust EMMP can play a significant role).

Finally, results need to be used. This will likely require a combination of more systematically conducting REAs, that is, making them a routine part of humanitarian response, and developing some level of an EMMP process. If results are not used then any future assessment process, however good, will have limited impacts on reducing harm to disaster survivors and avoidable damage to the environment. In the end, assessments need to lead to action, or they are not worth doing.

References

Collaborative Learning Project (2004), **The Do No Harm Handbook, The Framework for Analyzing the Impact of Assistance on Conflict**, The Do No Harm Project (Local Capacities for Peace Project), Collaborative for Development Action and CDA Collaborative Learning Projects, http://www.cdainc.com/dnh/docs/DoNoHarmHandbook.pdf.

Kelly, C. (2005), **Guidelines for Rapid Environmental Impact Assessment**, Benfield Hazard Research Centre, University College London and CARE International, http://www.preventionweb.net/english/professional/publications/v.php?id=8267.

Joint UNEP/OCHA Environment Unit (2004), **Darfur Crisis Rapid Environmental Assessment at the Kalma, Otash and Bajoum Camps**.

Ministry of Environment, Government of Chile, World Wildlife Fund – Chile and Antofagasta Minerals (2010), **Rapid Environmental Impact Assessment Chile Earthquake and Tsunami, 27 February 2010**.

Ministry of Science, Technology and Environment (2015), **Nepal Earthquake 2015 Rapid Environmental Assessment**, http://d2ouvy59p0dg6k.cloudfront.net/downloads/nepal_earthquake_2015_rapid_environmental_assessment.pdf.

Overseas Development Institute (2015), **Doing Cash Differently: How cash transfers can transform humanitarian aid**, Report of the High Level Panel on Humanitarian Cash

Transfers, UK Department for International Development, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9828.pdf.

Shepherd, G. (1995), The Impact of Refugees on the Environment and Appropriate Responses, Overseas Development Institute, http://odihpn.org/magazine/the-impact-of-refugees-on-the-environment-and-appropriate-responses/.

Sun Mountain International (2010), **Rapid Environmental Impact Assessment: Haiti Earthquake - January 12, 2010**, CHF International and US Agency for International Development.

Tearfund (2007), **Darfur: Relief in a Vulnerable Environment**, http://www.tearfund.org/webdocs/website/Campaigning/Policy%20and%20research/Relief%20in%20a%20vulnerable%20envirionment%20final.pdf.

US Agency for International Development, the Joint UNEP/OCHA Environment Unit and UNHCR (2017), **Coordination of Assessments for Environment in Humanitarian Action: A Joint Initiative**.

US Government Printing Office (2003), **Policy and General Authority, Section 491, Chapter 9, International Disaster Assistance, Legislation on Foreign Relations Through 2002**, Volume I-A of Volumes I-A and I-B, Current Legislation and Related Executive Orders, Committee on International Relations and Committee on Foreign Relations, U.S. House of Representatives and U.S. Senate, https://www.usaid.gov/sites/default/files/documents/1868/faa.pdf.

Climate Change in Korea and Algal Bloom Monitoring

TAE GEUN KIM, KYOUNG SIK CHOI*, SANG-PYO HONG, Jo Hee Yoon

Department of Environmental Engineering, Cheongju University, Korea

**Department of Energy Chemical Engineering, Silla University, Korea*

1. Introduction

Analyzing the 20th century temperature data observed in Korea shows that the annual average temperature has risen by 1.5 ℃, exceeding the global warming trend(1). The average precipitation amounts during the 20th century fluctuated so much respectively and forecasts indicate increasing trends in the long term.

Korea, which belongs to the monsoon climate zone, experiences about 70% of the annual rainfall in summer, and the torrential rainfall in summer is increasing due to the effects of climate change.

The Daecheong reservoir is the largest drinking water resource in central South Korea(Figure 1). The torrential rainfall increases the runoff of non-point pollutants, thereby promoting the eutrophication of several lakes including Daecheong reservoir. Further, the increase in temperature creates algal blooms in the stagnant waters and seriously affects the water quality of the drinking water resource.

In order to control the algal blooms, it is necessary to understand the concentration and distribution of the water quality parameters. Since the water quality of the wide-area water system such as Daecheong reservoir varies in time and place, it requires a lot of personnel and costs to observe the distribution and movement of pollutants using the point sampling method(2). . If large-scale development projects are planned within the watershed including the lake, the trophic state should be evaluated for an environmental impact assessment before and after the development project. At present, the trophic state evaluation method of the lake can not present the real trophic state of the lake because of the limitation of point sampling, but remote sensing can be used to grasp the trophic state of the lake. In this study, the distribution of chlorophyll-a and pollutants was analyzed by using satellite imagery (KOMPSAT-3) with the consideration of satellite transit time. The study area is the most severe algal bloom problem area in Daecheong reservoir.

2. Methodology

In this study, the concentration of chlorophyll-a was analyzed by sampling when KOMPSAT-3 satellite passes through the study area.

The optimal band and correlation between satellite image and chlorophyll-a concentration would be identified with the analysis of chlorophyll-a concentration.

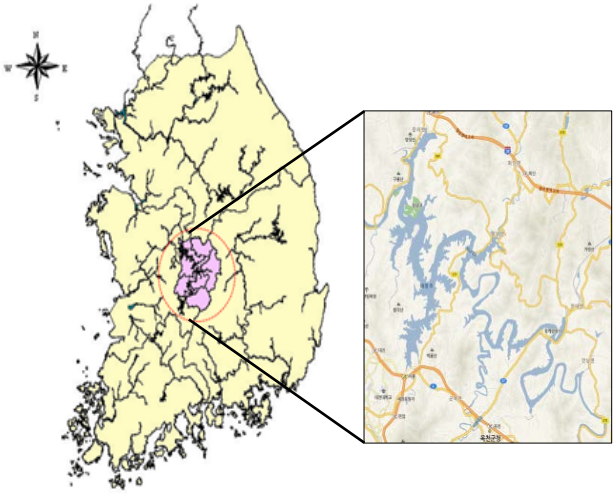


Figure 1. Location of Daecheong reservoir.

The regression analysis was performed using chlorophyll-a as a dependent variable and band reflectance as the independent variable.

The distribution of chlorophyll-a was calculated by applying a regression model to the satellite image, calculating the chlorophyll-a concentration of each pixel, and then classifying it according to concentration. The distribution of chlorophyll-a was mapped based on this procedure. The sampling point is shown in Figure 2, and the detailed procedure is shown in Figure 3. And the information of the KOMPSAT-3 satellite is presented in Table 1.

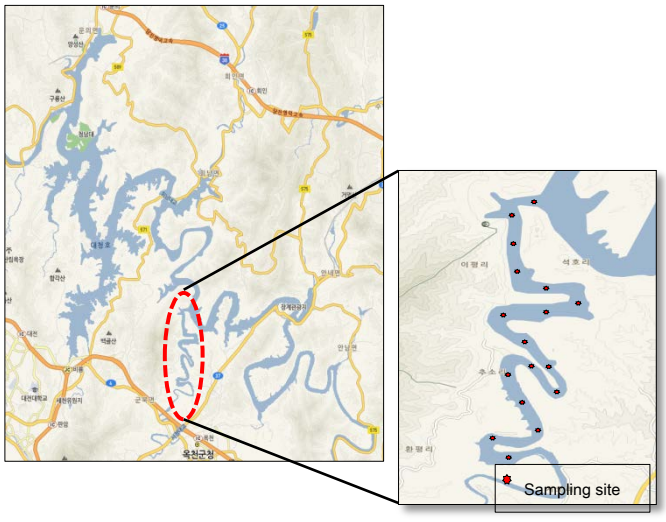


Figure 2. Daecheong reservoir and sampling sites.

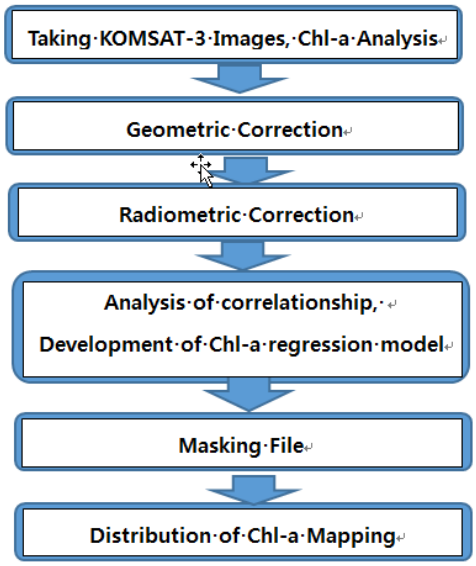


Figure 3. Detailed procedure.

Table 1. Information of KOMPSAT-3 satellite

Imaging mode	Band	Wavelength (nm)	Spatial resolution (m)
Multispectral	1	450~520	2.8
	2	520~600	
	3	600~690	
	4	760~900	
Panchromatic	PAN	450~900	0.7

3. Results

The KOMPSAT-3 images used in this study were taken on October 16, 2016 and May 11, 2017. When the satellite passed through the study area, samples were taken and analyzed for chlorophyll-a. After pretreatment of satellite images, the correlation between chlorophyll-a field values and satellite image bands was analyzed by comparing the reflectance converted from DN(Digital Number) value and chlorophyll-a. The reason for converting the DN value to reflectance is that if the date taken by the satellite is different, the DN value should be converted to the same physical dimension so that the satellite image data can be

standardized[3]. After the correlation analysis, a band with high correlation with chlorophyll-a was selected and a regression model was derived from chlorophyll-a as the dependent variable and band-specific reflectance as the independent variable.

The reflectance increased in most bands when chlorophyll-a concentration increased. A regression model was derived with using the 2nd band(green) as reflectance wavelength of the chlorophyll, 3rd band(red) as absorption wavelength and 4th band as near infrared wavelength closely related to the number of algae particles[4][5]. A regression model with an R^2 value of 0.71 was obtained as follows.

$$\text{Chl-a} = 1779.96*BA2-1029.99*BA3-16.66*BA4+78.88 \ (R^2=0.71)$$

BA : band

The concentration at each pixel was calculated by applying the satellite images at each time point. The distribution of the chlorophyll-a was obtained by dividing the ranges according to the concentration. In order to create a distribution map, a masking file was created to distinguishes between land and water. A regression model was applied to the masking file to create a chlorophyll-a distribution map. As shown in this study, if the water quality of the water body can be evaluated by using remote sensing, the representative trophic status would be expected in the environmental impact assessment of the lake.

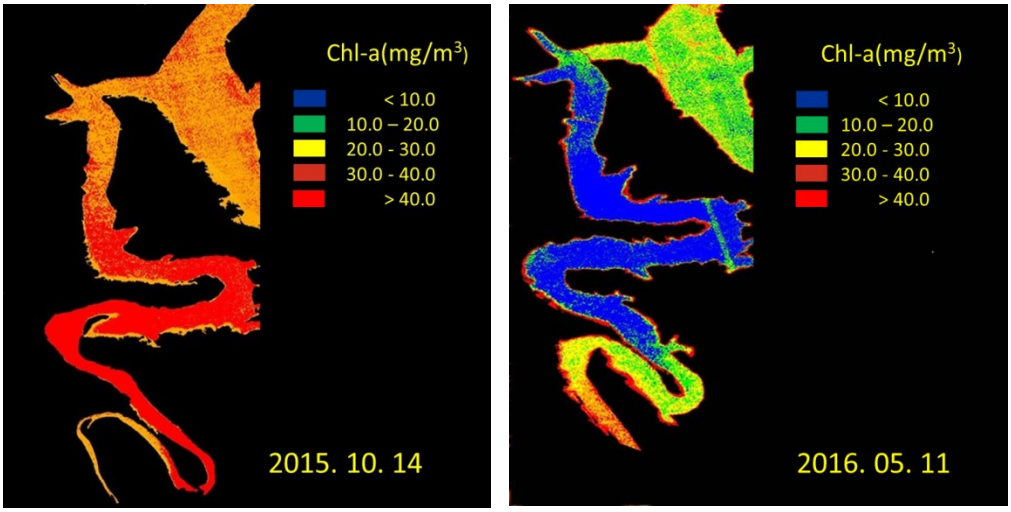


Figure 4. Chlorophyll-a distribution maps

4. Conclusion

A regression model was developed using KOMPSAT-3 satellite images and chlorophyll-a concentration. The spatial distribution of chlorophyll-a could be mapped by applying the model to the study area. The image data has very useful functions to understand the overall chlorophyll-a concentration of the wide-area and to detect a large concentration change. If continuous data accumulation is made in the future, it will be possible to manage the three-dimensional water quality.

Acknowledgement

This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(GOLDEN-Solution) (NRF-2015M1A3A3A04027614)

Reference

(1) http://www.ndsl.kr/ndsl/commons/util/ndslOriginalView.do

(2) E.J. Han, T.G. Kim, D.H. Jeong, S.Y. Cheon, S.J. Kim, S.J. Yu, J.Y. Hwang, T.S. Kim, M.H. Kim, Assessment of Trophic State for Daecheong Reservoir Using Landsat TM

Imagery Data, Journal of Environmental Impact Assessment, Vol. 7, No. 1, pp. 81~91, 1998.
(3) C. J. Rovinove, Computation with Physical Values from Landsat Digital Data, Photogrammetric Engineering and Remote Sensing, Vol. 48, pp. 781~784, 1982.
(4) A. M. Sheela, J. Letha, Sabu Joseph, K. K. Ramachandran, Sanalkumar S. P., Trophic state index of a lake system using IRS (P6-LISS III) satellite imagery, Environmental Monitoring and Assessment, 177(1-4), pp. 575~592, 2011.
(5) Jun Chen, Zhenhe Wen, Zhengqing Xiao, Spectral Geometric Triangle Properties of Chlorophyll-A Inversion in Taihu Lake Based on TM Data, Journal of Water Resource and Protection, 3, 67~75, 2011.

Ex-Post Evaluation on ODA Projects for Waste

Hi Sun Lee* · **Kongjang Cho** · **Kyung-Hee Shin** · **Aram Seo** · **Jeongmin Lee**

Korea Environment Institute

*E-mail : leehs@kei.re.kr

1. Introduction

The evaluation criteria of the ODA(Official Development Assistance) project is based on the five criteria of OECD DAC: relevance, efficiency, effectiveness, impact and sustainability. The detailed evaluation questions are set differently for each project.

Evaluation of ODA project is divided into an ex-ante evaluation[1], mid-term evaluation, terminal evaluation, ex-post evaluation. Among these, ex-post evaluation is generally performed for a specific project such as development projects after a certain period(1~3 years) after the end of the project, in order to obtain lessons for similar projects by measuring project sustainability, impact, effectiveness, etc.

Each phase of ODA project, which consists of planning, implementation, and evaluation, should be circulated and the outcome of the evaluation should lead to feedback on the implementation of another project. But globally, there are weaknesses in this system and the same is true for Korea.

This study analyzes a case of evaluation of ODA projects performed in Korea, and suggests the lessons for the ODA projects for waste and the development projects in Korea.

2. A Case Study of Ex-post Evaluation

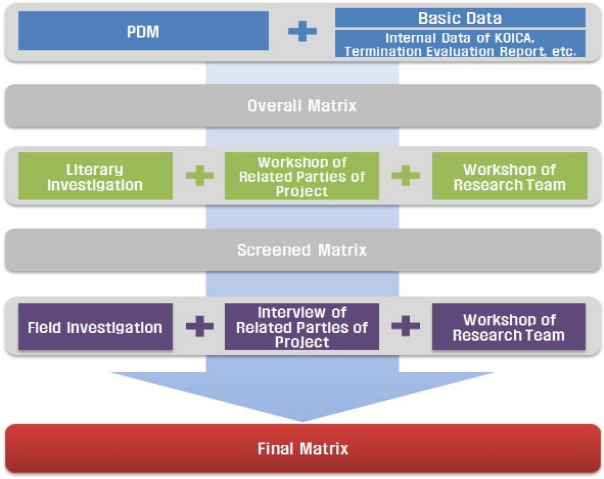
Project entitled the "Management of Mercury Waste in Egypt" was evaluated based on the improved evaluation methodology. This project was carried out from 2007 to 2010 with the aim of strengthening the hazardous waste management capability of the country by; supporting the waste treatment facilities, dispatching the specialists necessary for the operation of the facilities and implementing domestic training, etc.

2.1. Improvement of Evaluation Matrix Design Process

In the existing Ex-post evaluation, it is considered that the design of the evaluation matrix proceeded in the process of establishing the evaluation plan prior to the evaluation, Thereafter, it does not go through the process of verifying appropriateness by the project stakeholders. The evaluation matrix is an important part of the overall evaluation process as the evaluator improves very general and ambiguous universal questions into specific evaluation questions tailored to the evaluation subject. However, if the evaluation questions, indicators, and methods are selected by the evaluator before the accurate judgment of the project, the evaluation of the project may be difficult. Therefore, the matrix needs to be revised in a way that it can verify the adequacy of the question even during the field survey and interview survey, so that the characteristics of the business can be shown well.

[1] Evaluation conducted before the implementation of development assistance

Therefore, in this study, a Proposed Design Process of Evaluation Matrix was constructed, as shown in Fig.1. Specifically, an Overall Matrix is prepared through the research team brainstorming based on project data such as PDM, internal data of KOICA, and terminal evaluation report, etc. Then, a Screened Matrix is prepared through literary investigation and a workshop of the related parties and the research team on the feasibility study of the project. After the field investigation and interviews with the related parties of project within KOICA, a research team workshop was held to design the final matrix.



Reference: KOICA (2015) Ex-Post evaluation on the project for the management of mercury waste in Egypt, p.45.

Fig. 1. Design Process of Evaluation Matrix

As a result, The 38 evaluation matrices have been finally designed by reflecting all evaluation results such as literary investigation, workshop, field investigation and interview of related parties.

Through this, it was able to demonstrate the importance of finding core questions suitable for the project through the verification from related parties and field survey.

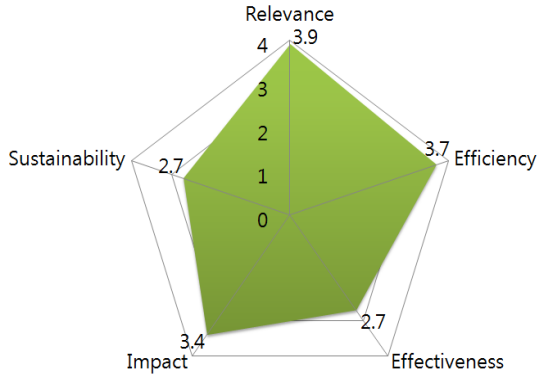
2.2. Improvement of Rating System

The ODA project evaluation result in Korea is quantified through the implementation of the rating system. Based on the total score calculated for each criteria, it was evaluated as "very successful"(14 points or more), "successful"(11~14 points), "partially successful"(8~11 points), and "unsatisfactory"(less than 8 points). This is in line with the objective of quantifying the outcome of the evaluation, but it may be difficult to obtain the objectivity of the result since the evaluators differ from project to project. In particular, in the evaluation of each item by the evaluation team, the discussions between the members of each evaluation team and the process of how the final score was calculated are not disclosed.

In order to improve this, this study proposed a method for each member of the evaluation team to give a score on each examination standard. Each member who has expert knowledge in their own field is to give a score for each standard in matrix, thereafter the average value is decided as the score of each standard. Thus, it was expected that the evaluation results would be more transparent and objective by disclosing all scores of the evaluation team.

Consequently, each of the evaluation team gave scores based on their expertise, so it was possible to make a more careful judgment and improve the objectivity by subdividing the scores. The final evaluation score of the five criteria is shown as Fig. 2. This project shows relatively good result in relevance and efficiency compared to effectiveness, impact and sustainability.

Although Egypt has set up a facility to properly treat the spent fluorescent lamps through the 'Management of Mercury Waste in Egypt' project, the operation and treatment rates are very low, since it is difficult to secure quantity of lamps as the collection system at homes or regular business sites are not secured at all at this time. Therefore, it was determined that "very successful" operation is possible only if the setup of collection system is possible.



Reference: KOICA (2015) Ex-Post evaluation on the project for the management of mercury waste in Egypt, p.149.

Fig. 2. Final Evaluation Score of the Project for the Management of Mercury Waste in Egypt

2.3. Improvement of Quantitative Evaluation Limitation

Korea's ODA evaluation often requires a high proportion of quantitative assessment. There are a lot of quantitative data necessary for evaluation. However, there are many cases in which it is difficult to collect the necessary data for evaluation. For example, in the case of a waste treatment facility support project, it is necessary to collect statistical data such as the waste generation amount and the collection rate of the recipient country in order to calculate the adequate treatment capacity of the facility. However, it is difficult to grasp the status of the recipient country ability to collect this data and set goals in the project planning stage.

This study proposed a method to secure objectivity of evaluation by presenting objective data for items that are difficult to quantify. For instance, in order to evaluate the sustainability of policy and system oriented supports, it has proved its objectivity by obtaining newsletters and cooperative official documents for other regions and ministries.

As a result of Improvement of Quantitative Evaluation limitations, there were some items that could be supplemented by qualitative evaluation method through objective data, but it was found that the items to which quantitative evaluation criteria could be applied was limited. For example, in order to evaluate the accomplishment level of the project goals, an attempt was made to obtain the collection rate of waste fluorescent lamps (ratio of spent fluorescent lamps collected against the spent fluorescent lamps generated throughout the year), but the annual collection quantity data did not exist. So it will be important to establish a system that can collect data throughout the project promotion phase, implementation phase, and ex-post phase.

3. Lessons

3.1. Importance of Ex-ante Evaluation

As a result of performing ex-post evaluation, it was determined that there are many challenges that could have been prevented in advance by identifying possible risks at the project promotion phase of the project. Therefore, this ex-post

evaluation presented a guideline while promoting ODA project in the waste related field in order to identify aspects that need verification in advance while promoting the project(Table 1.). This guideline can be used for evaluation questions even after the end of the project, and it will be possible to double check important matters.

Table 1. Examples of Guideline for Promoting ODA Projects Related to Waste Sector

- Guideline for Promoting ODA Projects Related to Waste Sector -

1. Relevance

- Check the following items while reviewing the location of the concerned facility
  - ■ The location alternative plan must be reviewed
  - ■ The general review must be performed while reviewing the location alternatives. (Simplicity of securing the site, risk factors such as opposition of residents and political situation, etc.)

2. Efficiency

- The preparations for completing the project within the initially planned period is necessary.
  - ■ Preparations on the local legal systems related to the licensing of facility must be made

3. Effectiveness

- Must be able to identify the purpose of waste related facility and identify the operation status.
  - ■ example) Must be able to verify the final recovery rate of mercury from the spent fluorescent lamp and whether the recovered mercury can be finally treated safely.
  - ■ example) Must be able to identify the operation status of recycle product sorting facility
  - ■ example) Must verify the energy making effect of waste through the RDF facility.

4. Impact

- Verify whether the concerned project has impact on the waste policies of the recipient country.
  - ■ Verify whether had impact on the change of awareness.

5. Sustainability

- Verify whether equipment and materials for solving facility repair and deterioration problems can be supplied on continuous basis
  - ■ Verify whether the equipment and materials can be supplied on a continuous basis within Egypt
  - ■ Verify whether the equipment and materials from the surrounding countries of Egypt can be supplied on continuous basis.
  - ■ Verify whether the equipment can be supplied on a continuous basis from Korea
- The resources and customers for operation the concerned facility must be secured.
  - ■ ex) The collection system of spent fluorescent lamp must be secured
  - ■ ex) The waste must be steadily supplied to the recycled product sorting facility.
  - ■ ex) The consumers to steadily use the RDF must be secured.

Reference: KOICA (2015) Ex-Post evaluation on the project for the management of mercury waste in Egypt, p.156~161.

Meanwhile, it is necessary to set up efficient system or policies for collecting generated waste due to the nature of the waste project. The fact that policies haven't been made although the project has ended could indicate a problem with sustainability of this project. So fundamentally, it is more desirable to perform ODA support project on setting up the system where facility can be operated properly rather than the construction of facility.

3.2. Importance of Participation of Various Stakeholders

As can be seen from the above case, current ex-post evaluation system has limited participation of various stakeholders. Fig. 3. Shows participation of stakeholders at each stage of the above case. In this case, the process has been improved for increasing

the participation of stakeholders. At the stage of creating evaluation matrix, workshop for identifying the characteristic of project was held with related parties of project, and at the stage of field investigation, representatives of recipient country participated in interviews and workshop. However, it was difficult to involve stakeholders in the rating stage. So, it was only evaluated by the evaluation team. But, for more accurate and objective evaluation, various stakeholders with different positions should be able to participate in the evaluation(Fig. 4.).

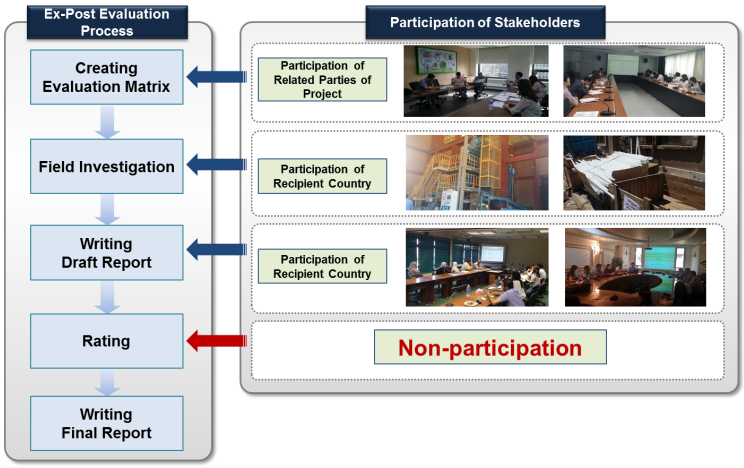


Fig. 3. Participation of Stakeholders in Ex-Post Evaluation Process

Fig. 4. Improvement of Participation of Stakeholders in Rating Process

4. Conclusions

There are evaluation systems for development projects in Korea as well as ODA projects(Fig. 5.). In particular, the pre-feasibility study system has been introduced as an ex-ante evaluation system for comprehensive evaluation of economic, social and environmental aspects of large-scale development projects. And the post-EIA system, which is one of the environmental impact assessment processes in Korea, is an ex-post evaluation of the environmental sector that compares and analyzes the environmental status and the results of the environmental impact survey in the EIA report.

However, in large-scale development projects that are likely to cause a lot of social conflicts other than the environmental field, there is little evidence that the output of the project is produced and the outcome is induced. Therefore, it is necessary to verify the actual effects and impacts of the projects that have caused many social controversies.

In the field of ODA, the accountability of the project is strengthened through the ex-post evaluation system. Therefore, it is urgent to introduce an ex-post evaluation system for Korea's large-scale development projects in terms of strengthening accountability of project operators, rationalization of policy, and efficient use of budgets. In this regard, five OECD DAC criteria are expected to give many lessons as an indicator of the overall evaluation.

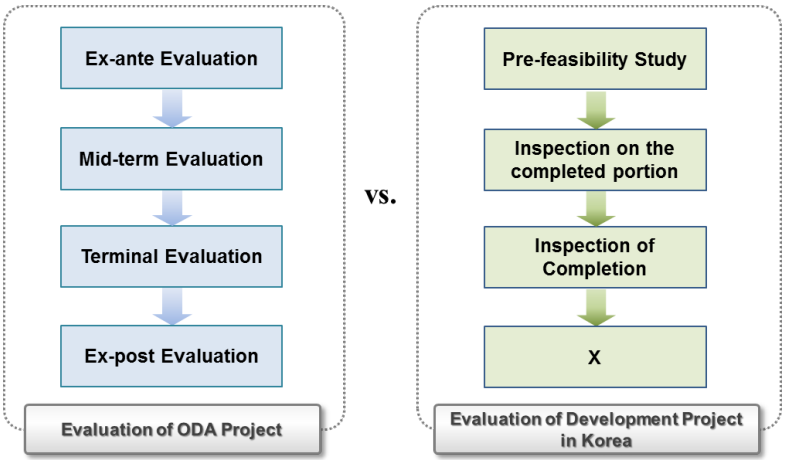


Fig. 5. Comparison of ODA Project Evaluation Process with Development Project Evaluation Process in Korea

References

Office for Government Policy Coordination (2014) *Integrated Evaluation Manual for International Development and Cooperation*

Office for Government Policy Coordination (2015) *ODA Project Rating System Implementation Guideline*

KOICA (2007) *Framework Plan on the Management of Mercury Waste in Egypt*

KOICA (2008) *Development Cooperation Evaluation Guideline*

KOICA (2015) *Ex-Post evaluation on the project for the management of mercury waste in Egypt*

Increasing climate resiliency of Philippine mangroves through Impact Assessment

Cassiophiea M. Madid, PhD
GHD Pty Ltd
11F Alphaland Southgate Tower 2258 Chino Roces Ave. corner EDSA 1232 Makati City, Philippines, +63 2 479 5600
cmmadid@yahoo.com

Over the years, the impacts of climate change have become prominent. Sea level rise, sea temperature, and increase/decrease in rainfall brought about by climate change exposed the Philippine mangroves to various vulnerabilities further increasing the vulnerability of small coastal communities. The Philippines was hard hit by one of the most intense tropical cyclone that hit Southeast Asia in 2013. After the onslaught of Typhoon Haiyan, villagers reported that they have been spared by the full impact of Typhoon Haiyan by the mere presence of healthy mangrove forests. While damage was also done to mangroves, with some suffering damage to at least 30% of their cover, their ability to soften the blows of extreme weather cannot be undermined. The Philippine Environmental Impact Statement System is a powerful tool to manage ecosystem services that may be provided by mangroves which will subsequently increase the resilience of small coastal communities to climate change.

Introduction

This paper presents an overview of the Philippines vulnerabilities to climate change as well as efforts to increase climate resiliency through mangrove conservation and management. This paper presents the Philippine Environmental Impact Statement System and how it can contribute to increasing climate resiliency, especially of vulnerable ecosystems such as mangroves.

Methods

This paper was developed by reviewing available literature including publicly available information specifically on the context of Philippine experience and legal framework.

Results and Discussion

The Philippine mangroves and their status

The Department of Environment and Natural Resources (DENR) in 1998 reported that mangrove area in the country has decreased greatly from an estimated coverage of 450,000 hectares (ha) in 1918 to less than 120,000ha in the late 1990's. Despite numerous researches and attempts to quantify remaining mangrove forest, a precise figure is still missing.

The greatest loss in mangrove forest occurred during the 1960s and 1970s when the national government motivated local farmers to expand aquaculture in the detriment of the mangrove forest which was unappreciated then. The clearing peaked from 1967 to 1988 with an unprecedented loss of 8,000 ha annually (FAO, 2007).

At present, much of the remaining mangrove stands in the country are found in the southern and western provinces and islands of Mindanao, eastern island provinces of the Visayas and the whole island of Palawan, largely due to their inaccessibility.

Vulnerability of the Philippines to Climate Change

In 2016, the Philippines ranked fourth in the list of 10 countries exposed to long-term climate risk as the most affected in the period of 1995 to 2014. The ranking is based on an estimated total loss of 2757 million US Dollars, with 337 climate risk events having occurred between 1995 and 2017 (Global Risk Index, 2016). This is largely due to the

Philippines geography – located in the western Pacific Ocean, naturally surrounded by warm waters that will likely get warmer as average sea-surface temperatures continue to rise. The projected additional heat in the ocean and air can lead to stronger and more frequent storms and this has been observed in the Philippines over the past ten years.

A collection of more than 7000 islands, the Philippines lack the natural geographic barriers that would protect these islands from the natural forces coming from the sea. Other natural factors such as regional wind patterns or currents also place the country at the certain of climate change related risks such as stronger tropical storms (Climate Reality Project, 2016). The Philippine Department of Environment and Natural Resources shows how the various regions in the country in terms of risk to climate threats, based on specific geographical location (Figure 1).

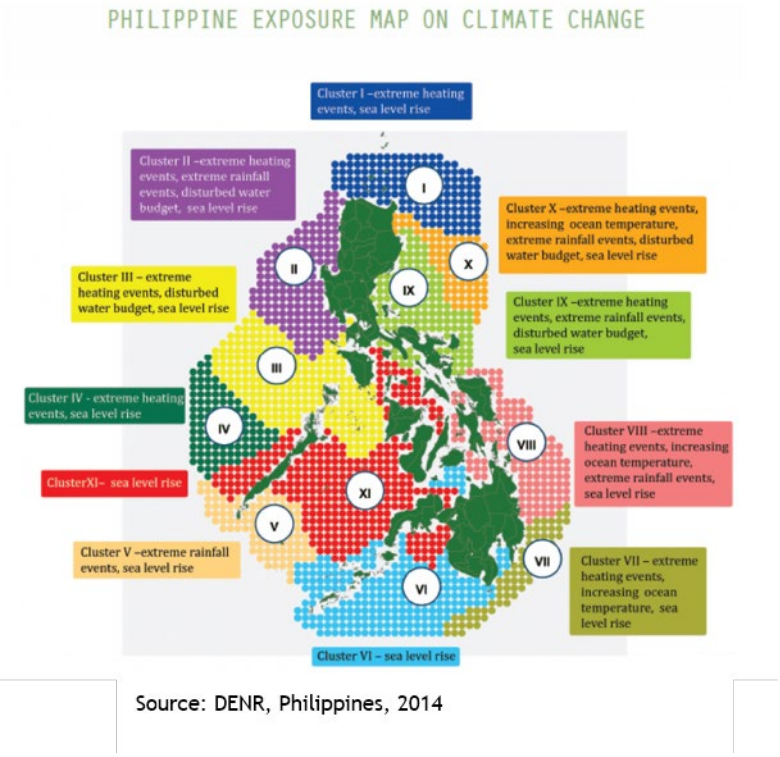


Figure 1 Philippine exposure map on climate change (DENR, 2014)

Out of the ten deadliest typhoons in the Philippines between 1947 and 2014, five have occurred since 2016, affecting and displacing thousands of people every time. The deadliest storm on record is Typhoon Haiyan, known locally as Typhoon Yolanda, which was responsible for more than 6000 lost lives and over four million displaced citizens, and $2 billion in damages in 2013 (Climate Reality Project, 2016).

Because of its geographical location, the Philippines experience an average of 20 tropical cyclones per year. Over the past decade, the number of tropical storms making landfall in the country is becoming more frequent and more severe and this trend is attributed to climate change effects.

The country's coral reefs and mangrove ecosystems remain the best natural buffers against various forces such as typhoons. Located in the upper intertidal zones, mangroves are adapted to live in saline environment. Their very location also entails them to the highest amount of disturbance from various anthropogenic impacts and recently from various impacts of climate change. These facts give some indication of their ability to cope with coastal hazards, or at least recover from perturbations.

Response of mangroves to Climate change

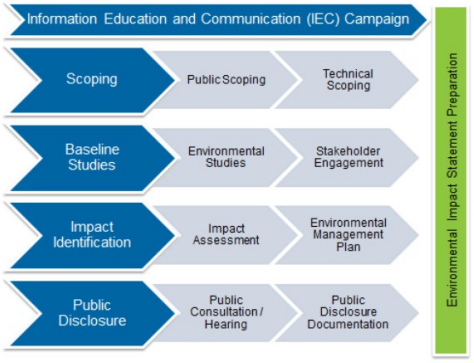
Both the island provinces of Samar and Leyte were in the direct path of Typhoon Haiyan. They suffered to serious damages and a large number of casualties. A small town in Eastern Samar known as General McArthur attributed the zero-casualty reported in their town due to the presence of mangrove forests that served as natural barrier between the town and the direct path of the Typhoon. This perception was widely echoed in other coastal municipalities in Eastern Visayas. Specifically, the

perception that mangroves pay an important role in coastal protection was high among residence with larger, ranging from 430 to 1463 hectares and more diverse mangroves, with a biodiversity index (H') ranging from 1.2 to 1.96 (Delfino et al, 2015).

Damage to existing mangrove forests in Eastern Visayas Region, directly hit by Haiyan accounts to 40 percent. The majority are monospecific tall and rigid mangrove forests (Villamayor et al, 2016). This was further proven by Spalding et.al (2014) in terms of the ability of mangroves to provide coastal defense. Wider mangroves as much as hundred meters in width can significantly reduce wave height by 13 to 66 percent per 100 meters of mangroves. While to significantly withstand against storm surges, hundred meter width of mangrove is needed to significantly reduce wind and waves on top of surge. More significant cover (thousands of meters) is needed to reduce flooding impact (storm surge height is reduced 5-50 cm/km).

Structurally complex mangrove forest can reduce the height and energy of wind and swell waves passing through them. Both from the experience in Typhoon Haiyan and more controlled studies prove that complex mangrove stands with young and small mangroves can already be effective – more effective than single-aged and monospecific stands.

The Philippine Environmental Impact Statement System



The Environmental Impact Assessment (EIA) System in the Philippines, officially referred to as the Philippine EIS System (PEISS), was established under Presidential Decree (PD) 1586 on 11 June 1978 stating that no person, partnership or corporation shall undertake or operate any such declared environmentally critical project or area without first securing an Environmental Compliance Certificate (ECC).

Figure 2 Basic elements of the Philippine EIS System

In 2007, a joint review of the World Bank and the Asian Development Bank revealed that the legal and institutional frameworks of the PEISS were sound and robust. While the ability of the system to be a good planning tool can be further improved, the system nonetheless is recognized as both effective and efficient. The PEISS was reviewed to have all the basic elements of a good Environmental assessment system, such as the presence of screening, scoping, independent review, public participation, disclosure, and monitoring (Figure 2).

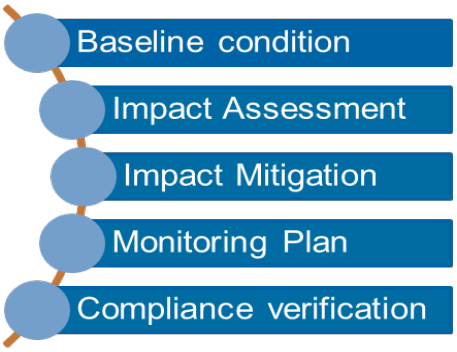


Figure 3 Basic elements of Impact Assessment process as per PEISS

Figure 3 shows the basic elements of the IA process as per the PEISS. Integrating important information in each of these elements can yield a more useful public document that can be utilised for further mangrove conservation and management. This can include the following:

Strengthening baseline assessment of mangroves

Currently, EIA reports typically includes biodiversity (e.g. species richness, importance value, etc). Baseline information can also be extended to site productivity indicators such as soil properties, salinity levels, and elevation. This information will prove to be valuable in future monitoring as well as options for enrichment planting or restoration.

The current PEISS does not include the assessment of ecosystem services in the preparation of the EIS. Ecosystem services, if discussed in the EISs, are insignificantly incorporated in the over-all discussion of baseline information. Incorporating ecosystem services, primarily of important ecosystem such as mangroves, can provide better understanding of the services including protective functions these ecosystems provide. Specifically, this can include information on previous exposure of the ecosystem to events related to climate change.

Inclusion of information on local community's perception of nearby mangrove areas is also important in establishing a higher appreciation of the value of the mangroves. This should also gauge the ability of key members of the community to be part of the impact assessment system in terms of public participation including taking part in monitoring activities post EIA.

In the Philippines, where strategic impact assessment is yet to be strengthened, there is a need for consolidated information on coastal resources including information on existing mangroves – their risk due to events related to climate change, with or without the proposed project. In the country, it is not unusual to find different EISs prepared by different proponents/consultants for different development projects co-located in the same larger ecosystem (i.e., along the same waterbodies such as bays) resulting in highly fragmented information unusable for more important decision making.

Strengthening mitigation measures through the implementation of mitigation hierarchy

The protection of mangroves in the Philippines is set in the legal context of a national law that prohibits the cutting of mangroves by the virtue of Republic Act 7161 (1991). It is therefore imperative that mangrove forests be avoided by project development at all cost. However, when all options have been exhausted and a certain portion of a mangrove forest needs to give way to national interest, options for mitigation should be fully exhausted. This includes transfer of suitable affected individuals. Project proponents need to show proof of closely monitoring survival of transferred individuals and implementation of uniform replacement ratio of 1:100 (1 dead trees to be replaced by 100 seedlings). This is commonly practiced in the Philippines and without proper technical guidance by restoration ecology specialists, this can also prove to be quite daunting for project proponents.

Coastal communities should also be involved in biodiversity offset efforts identified by impact assessment (Plate 1). Learning from the experience of these communities from Typhoon Haiyan and other similar weather perturbations, public participation should be stronger now, more than ever. This realization also initiated renewed efforts on mangrove rehabilitation in the Philippines.

Plate 1 Community members taught to do basic monitoring measurements

Sound mangrove management plan in the Environmental Management Plan

In the midst of climate change impacts to coastal communities, the functionality of mangrove forests was perceived to be high in terms of providing protective and productive functions to vulnerable coastal communities. This realization initiated renewed efforts on mangrove rehabilitation in the Philippines.

Ironically, in a tremendous effort to accomplish physical targets in terms of coverage, previously mangrove rehabilitation efforts have been considered to be of inferior growth and performance. This is attributed to ecological problems that arose from a neglect to pay attention to each of the ecological requirements of mangrove species used (Samson and Rollon, 2008) as well as the lack of understanding of the site where mangrove rehabilitation is undertaken. Even posing a threat to the other ecosystems mangrove support and needed (i.e. mangrove plantation in seagrass meadows).

For this very reason, in an effort to curb the adverse impacts of climate change, many organisations planted without understanding, resulting in the loss of valuable resources i.e., time, money and community's effort, therefore, robbing vulnerable coastal communities of the assurance that these efforts will help in abating the adverse effects of climate change.

A sound Biodiversity Management Plan should be incorporated in the Environmental Management Plan of EIS.

Conclusion

The recent climate change events experienced in the Philippines should provide valuable lessons on how to properly manage mangrove ecosystem in the country. The IA process can serve as guideline in making better management decisions for mangroves.

Through the IA process, information gathered specific for mangroves should include information that should be more useful for rehabilitation planning. Should development pass through important mangrove areas, seriously consider the mitigation hierarchy – avoid first. This should include re-routing or re-siting should be the first option. In case of restoration, consider site and species suitability and remembering specific mangrove species requirements. No mangroves are created equal.

In the Philippines and perhaps in other countries that have suffered the consequences of climate change, this is a great opportunity to strengthen community involvement when they are most willing to participate. This should be further integrated in the IA process especially during post EIA activities such as monitoring and compliance verification.

Other ways should be explore opportunities to align principles of better mangrove management though IA and subsequently provide ways to increase climate change resilience in communities where people and mangroves should co-exist.

References

Food and Agriculture Organization, 2007. The World's Mangroves 1980-2005. A thematic study prepared in the Framework of the Global Forest Resources Assessment.

Kreft S, Eckstein D, Dorsch L and Fischer L. 2016. Global Risk Index 2016. Who suffers most from extreme weather events? Weather related Loss Events in 2014 and 1995 to 2014. www.germanwatch.org/en/cri Accessed 08 February 2017.

Climate Reality Project. 2016. https://www.climaterealityproject.org/blog/how-climate-change-affecting-philippines Accessed 08 February 2017.

Delfino RJ, Carlos C, David L, Lasco R, Juanico DE. 2015. Perceptions of Typhoon Haiyan-affected communities about the resilience and storm protection functions of mangrove ecosystems in Leyte and Eastern Samar, Philippines. Climate, Disaster and Development Journal. Vol 1 Issue 1.
https://www.cddjournal.org/article/view/vol01-iss01-004 Accessed 28 January 2017

Villamayor, BM, Rollon R, Samson M, Albano, GM, Primavera J. 2016. Impact of *Haiyan* on Philippine mangroves: Implication to the fate of the widespread monospecific Rhizophora plantations against strong typhoon. Oceana and Coastal Management. 134.1-14.

Samson M and Rollon R, 2008. Growth Performance of Planted Mangroves in the Philippines: Revisiting Forest Management Strategies", Ambio Vol 34 No. 4.

Spalding M, Mclvor A, Tonnejick FH, Tol S and van Eijk P. 2014. Mangroves for coastal defence. Guidelines for coastal managers for policy makers. Published by Wetlands International and The Nature Conservancy. 42 p.
http://www.nature.org/media/oceansandcoasts/mangroves-for-coastal-defence.pdf Accessed 28 January 2017.

World Bank Report. 2009. The Philippines: Country Environmental Analysis.

Monitoring System of Greenhouse Gases Emissions Project in Rio de Janeiro Municipality

Presenting Author: Ivan Carlos Maglio. **Coauthor(s):** Eduardo Alves Neder, Leonardo Machado Maglio, Iara Verocai and Nelson Moreira Franco (in memoriam)

ABSTRACT

The Rio de Janeiro municipal government has set Climate Change as a priority. The aim is the consideration of global warming issues in the context of urban planning for defining actions and measures to reduce greenhouse gases (GHGs) emissions in the city.

In 2011 the Climate Change and Sustainable Development Municipal Policy has been implemented by the Municipal Environmental Secretariat (SMAC), which has required every four years updates of the municipal GHG emissions Inventory (2005 has been the monitoring base year) and the definition of emissions reduction targets.

After performing three gas emission inventories, Rio de Janeiro municipal government has developed a project with the support of the World Bank, for designing and operating a Web System on GHG Emission Monitoring and executing the 4th Inventory based on data collected in 2016.

The project also aims at capacity-building and staff training in order to maintain and update inventories of GHG emission, implement measures to reduce them, and elaborate mitigation, adaption and resilience measures on climate change effects.

This paper presents the fundamentals that helped devising the monitoring system framework and the possible system outputs. It also shows the benefits that other cities could obtain by implementing this type solution to help their countries to reach the Paris Agreement reducing targets.

INTRODUCTION

The first urban climate initiatives started in the early 1990s when a number of cities, mainly in Europe and North America adopted climate change policies in their agendas, focusing on measure to reduce GHG emissions. (BULKELEY, BROTO, EDWARDS G, 2012)

BULKELEY (2010) mentions that during the 1990s and 2000s the number of cities concerns about climate change grew significantly, mainly after the Rio United Nations Conference on Environment and Development of 1992. Then, important local organizations were formed in order to address climate change issues, including ICLEI´S (Local Governments for Sustainability).

The increase of extreme climate events frequency and intensity observed in recent years had its connection with climate change confirmed in 2011 by the IPCC (Intergovernmental Panel on Climate Change) (IPCC, 2012), attracting world attention to this theme.

In 2010, Brazilian government established its National Policy on Climate Change (PNMC - Law Nº. 12,187/2009 and Decree Nº. 7,390/2010). Although not included in the list of countries required to reduce their emissions (Annex 1 of the Kyoto Protocol), PNMC defined mitigation actions to reduce 36.1% to 38.9% GHG emissions by the year 2020 as a voluntary national commitment this is equivalent to 1,168 million to 1,259 million tonCO2eq (Decree 7,390 / 2010). To achieve these goals, the PNMC has established the developed sectoral mitigation and adaptation plans at the local, regional and national levels.

Brazil ratified the Paris Agreement on Climate Change on September 12 of 2016, confirming the Intended Nationally Determined Contribution (INDC) goals to reduce GHG emissions by 37% below 2005 levels in 2025 and by 43% below 2005 levels in 2030 (INDC, 2015). On 4 November 2016 the Paris Agreement entered in force, after the minimum conditions was achieved (UNFCC, 2016).

The achieved of these goals will require a strengthening of local government actions. Stern N. (2006) and IEA (2008) (apud Bulkeley, 2010. 230p) stated that the cities may be responsible for up to 75% of the carbon dioxide anthropogenic emissions. Such rate should raise once two-thirds of the global population are expected to live in urban areas until 2050 (GHGP-GPC, 2014).

Against this backdrop, municipalities should be more actively involved in combating climate change by drawing up their inventories of greenhouse gas emissions and efficient public policies to define and achieve their emissions reduction targets.

For GHGP-GPC (2014) an inventory of emissions is the first step in the creation of a local action plan to reduce their emissions, monitor progress, and take effective action on mitigating climate change.

Despite the importance of urban centers for reducing GHG emissions, Brazil still has a lack of mandatories elements to ensure municipalities actions towards the compliance of these reduction targets. The Brazilian Climate Change Policy (PNMC – Política Nacional de Mudanças Climáticas) has as one of its guidelines the encouragement and support for regional and local governments, productive sectors, academia and NGOs in the development and execution of policies, plans, programs and actions related to climate change (Brazil – PNMC, 2009). However, there is no obligation for these federative entities to carry out their inventories.

METHODS

In 2007, Dubeux and Rovere discussed the importance of controlling GHG Emissions in Rio de Janeiro, concluding that *"planning activities at the municipal level can incorporate the greenhouse effect problem in their variables (…). This new attitude can contribute to the climate issue and raise resources under the clean development mechanism. This additional income from GHG emissions reduction projects can help control local pollution and achieve other types of benefits such as lower public expenditure, traffic improvement, reductions in atmospheric pollution, among other aspects important to the quality and everyday life of communities."*

Carloni (2012) suggests that cities GHG emissions inventories can be important tools for identifying opportunities to implement public and business emission reduction policies. The results of the inventory, together with other statistical information, such as population and economic growth, and urban occupation and expansion, allow the development of scenarios and the identification of the need for intervention by the authorities through the creation of public policies.

The first Rio's GHG inventory was presented in 2000 for the emissions of 1990, 1996 and 1998, considering the emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). This three main greenhouse gases were analyzed in 2010 in the emission inventory of 2005, and in 2012 for the sectors

of Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU) and Solid Waste.

A permanent international challenge was the adoption of different methodologies for the elaboration of city GHG inventories. The lack standardization makes comparisons between cities difficult and increases the questioning of data quality. To address this issue, in 2011, WRI, ICLEI and C40 launched a joint initiative to develop a global protocol for accounting and reporting GEE of cities: The Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC) (GHGP-GPC, 2014).

In the inventory of 2012, the municipality or Rio considered this Global Protocol methodology to present its emissions, which had been calculated in 22.6 million tons of CO_2 equivalent (Mt CO_{2e}). Also, the estimates for 2005 (11.6 Mt CO_{2e}) was reviewed and the action plan for emission reduction was presented for he sectors under municipal responsibility (Energy, AFOLU and Waste) for the years of 2016, 2020 and 2025.

After conducting three municipal inventories of GHG emissions and in accordance with the Municipal Policy on Climate Change and Sustainable Development (Law Nº 5,248/2011), Rio de Janeiro City decided for periodical update its inventories for which a GHG Emission Monitoring System has been decided to be implemented in accordance whit the GCP.

Using this background and the previous municipal experience on climate change, the monitoring system objectives and operational structure were determined. The system development is expected to begin in 2017 with the technical and financial assistance of the World Bank, as part of the Strengthening Public Sector Management Project, called *Rio de Excelência.*

The main system characteristics and functionalities and database are: in addition to the three gases mentioned previously, consider the hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and the black carbon: contemplate different categories of GHG emissions, separating them by type and origin; review of past inventories in events of significant methodologies actualization, as well as permitting the system actualization; and allow remote querying and data manipulation with different levels of editing permissions.

The implementation of the Web System will facilitate the control of GHG emission data through the elaboration of appropriate tools for collecting, processing and storing information, along with training the municipal technical staff for its continuous updating. Additionally, it will enable the follow-up of local Action Plan for reducing Greenhouse Gas Emissions, meet targets set by cities, and guide and identify in real time the most critical sectors.

Once the infrastructure is created and its acceptance test approved, the system will be completed with previous inventories information to create a historical emission database. This activity will enable the municipality to verify the evolution of emissions per sector and the effectiveness of the implemented policies.

Then, the 2016 emissions data will be gathered by an application of online forms under the supervision of the Environmental Secretariat to be then insert in the system. The 2016 GHG Inventory will be elaborated in 2017, through the system, providing all the necessary information for reviewing policies and action plans and checking emission reduction and mitigation targets.

In 2016, Rio Environmental Secretary also set the Strategy for an Adaptation Plan on Climate Change in the City with the collaboration of COPPE - Alberto Luiz Coimbra Institute for Graduate Studies and Engineering Research of Rio de Janeiro, Federal University (SMAC, 2016).

CONCLUSION AND DISCUSSION

This system aims to strengthen the municipality on facing climate change by creating a protocol for data collection and continuous analysis of the effectiveness of implemented policies.

An additional, the project has its focus on environmental secretariat capacity building and staff training for maintaining and updating GHG emission inventories, implementing measures to reduce GHG emissions, and elaborating mitigation, adaption and resilience measures on climate change effects, thus reducing financial needs and hiring of external consultants.

As the project follows all international standards on analyzing GHG emissions, it can be replicate for others local governments interested to improve their actions to combating climate change.

REFERENCES

Bulkeley H. 2010. Cities and the Governing of Climate Change. Durham. Annu. Rev. Environ. Resour. 2010; Vol.35: 229-253p.

Bulkeley H, Broto V, Edwards G, 2012 – "Towards Low Carbon Urbanism" from Local Environment" – The Sustainable Urban Development Reader. Third Edition. Edited by Stephen M. Wheeler and Timothy Beatley. p. 101-106, 2014

Brazil – PNMC, 2009 - Lei n° 12.187 de 29 de Dezembro de 2009 que institui a Política Nacional sobre Mudança do Clima - PNMC e dá outras providências: Brasília, 2009.

Brazil – 2010 - Decreto N° 7.390 de 9 de dezembro de 2010 que Regulamenta os arts. 6°, 11 e 12 da Lei no 12.187, de 29 de dezembro de 2009, que institui a Política Nacional sobre Mudança do Clima - PNMC, e dá outras providências: Brasília, 2010.

Brazil. INDC, 2015. Pretendida Contribuição Nacionalmente Determinadas para Consecução do Objetivo da Convenção-Quadro das Nações Unidas sobre Mudanças do Clima. Brasília, Brasil – 10p.

Carloni, 2012 - CARLONI, F.B.B.A - Gestão do inventário e do monitoramento de emissões de gases de efeito estufa em cidades: o caso do Rio de Janeiro – Tese de Doutorado – Programa de Planejamento Estratégico – Rio de Janeiro: UFRJ/COPPE, 2012. 180p.

Debeux, C.B.S; Rovere, E.L.L – 2007. Local perspectives in the control of greenhouse gas emissions – The case of Rio de Janeiro. Cities, Vol. 24, No. 5, p. 353–364, 2007

GHGP-GPC, 2014 – Global Protocol for Community-Scale Greenhouse Gas Emission inventories – As Accounting and Reporting Satandar for Cities. World Resources Institute, C40 Cities – Climate Leadership Group e ICLEI – Local Government for Sustainability. 176p.

IEA, 2008 - International Energy Agency (IEA). 2008. World Energy Outlook 2008. Paris: IEA

IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

UNFCC, 2016 – United Nations Framework Convention on Climate Change – available at http://unfccc.int/paris_agreement/items/9444.php. Accessed in 07 October 2016.

Rio de Janeiro (city), 2011 - Law Nº 5,248 / 2011 - Municipal Policy on Climate Change and Sustainable Development

SMAC, 2016 – Plano de Adaptação da Cidade do Rio de Janeiro às Mudanças Climáticas – Climate Change Adaptation Strategy for the City of Rio de Janeiro, SMAC-COPPE/UFRJ. December 2016.

Stern N. 2006. Stern review on the economics of climate change. London, HM Treas./Cabinet Off. http://www.hm-treasury.gov.uk/sternreview_index.htm

Impact of energy exchange in Iceland

Audur Magnusdottir[1], Gnyr Gudmundsson[2], Greta Hlin Sveinsdottir[1], Sigridur Droplaug Jonsdottir[1].

[1] *VSO Consulting, Borgartun 20, 105 Reykjavik, Iceland.*

[2] *Landsnet, Gylfaflot 9, 112 Reykjavik.*

Introduction

It is quite possible to exchange fossil fuels for green electricity in Iceland due to the small size of the population and abundance of renewable energy sources. Energy exchange in Iceland would lead to increased need for electricity which in turn would call for strengthening of the electric transmission grid. It would also reduce the emissions of greenhouse gases (GHG) such as carbon dioxide (hereafter referred to as CO_2) as electricity is generated from renewable resources which cause minimal CO_2 emissions (Magnusdottir, Gudmundsson, Sveinsdottir, & Jonsdottir, 2016).

This paper discusses an impact assessment (IA) of scenarios for a developmental plan of the electricity transmission grid in Iceland. The scenarios include different ratios of energy exchange in the year 2030 and the aim of the IA was to extrapolate how much energy demand and CO_2 emissions reduction that would lead to. By energy exchange we refer to the act/scenario where electricity will replace fossil fuels as an energizer.

This project was a part of a strategic environmental assessment (SEA) of a 10-year plan regarding the development of the electricity transmission grid in Iceland, operated by the state-owned company *Landsnet*. The paper covers the background of the project, it touches on the energy environment in Iceland, the approach of the IA and discusses the project's main conclusions.

Landsnet and the 10-year plan

Landsnet's role is to operate Iceland's electricity transmission grid (figure 1) and administer its system operations. The company is obliged to present each year a 10-year plan for the development of the transmission grid and that plan is subjected to SEA. The plan is based on scenarios which describe different energy demand and supply in 2030. Different grid alternatives are then suggested which vary in route and technological implementation (figure 2).

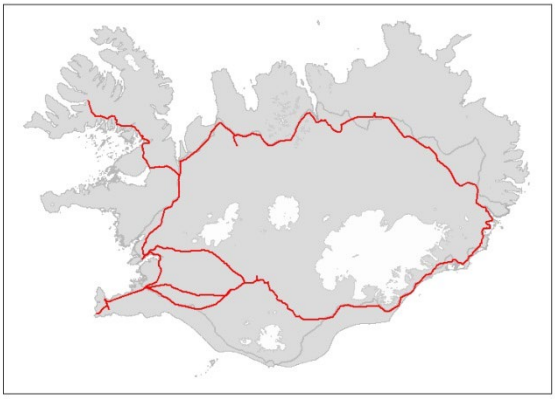


Figure 1. The current main electricity transmission grid in Iceland (red lines). Gray area is land, white areas represent glaciers.

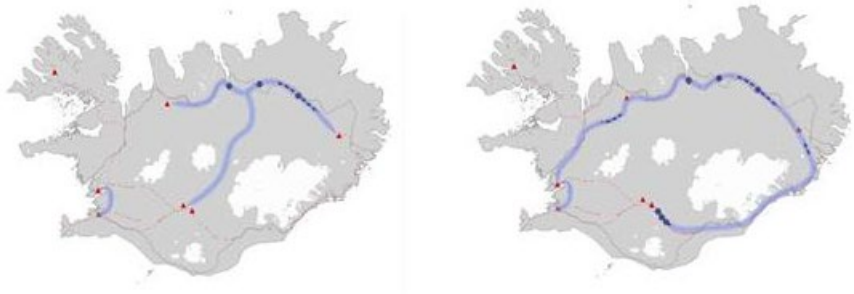


Figure 2. Two main alternatives in the future development of the main transmission grid (blue line).

This is the third time that the plan has gone through SEA but it is the first time the impact on climate change is addressed which was a pioneering effort of Landsnet. The interest and emphasis of regulators, NGOs and the public is more in nature preservation, principally the preservation of the uninhabited central highlands, the opposition of visual impacts and concerns of negative impacts on the tourism sector. Discussion on climate change in IA has been minimal to date. Thus, Landsnet received no comments or objections to the decision last year to refrain from addressing climate change matters due to insufficient data. The main objections and comments that year from regulators, NGOs and the public nearly uniformly regarded the opposition to the idea of taking a high voltage transmission line through the wilderness of the central highlands and concerns that overhead lines could harm the tourism sector by negatively affecting the experience of the tourists.

The approach to assessing the impact of energy exchange

It was not straightforward where to draw the line when deciding what to include in the IA of the transmission grid on climate change. Should we focus on the emissions due to the building and operation of the grid or should we regard the existence of the grid as enabling emissions from power plants on one end and users such as heavy industries on the other end?

We decided to do a bit of both. We calculated the carbon footprint of the grid and presented the results in the environmental statement and will not discuss that here. But we decided to place more emphasis on exploring what the future could possibly bring us with more environmental awareness and efforts to reduce impacts on climate change. What would it mean if so called green or electrified scenarios would come to realization? Would we have enough electricity to meet the demands of energy exchange and would the current and proposed grid on the 10-year plan be able to transmit that energy without many problems?

Scenarios looking to the year 2030 were put forward where different ratios of energy exchange were defined (table 1). Our main concern was to estimate possible energy demand should the energy exchange materialize. That said, it is not for us to say if energy exchange is likely to happen or if it is always feasible regarding technology and cost. The following are categories which we found likely to be able to undergo the exchange, based on available information:

a) Passenger cars, delivery trucks, buses and heavy trucks. The calculations were based on a prediction that expects increased number of cars and average travel distance per vehicle as today. As an example, it is estimated that number of passenger cars in Iceland will be approx. 304,000 in the year 2030 (Brynjarsson, 2013) and that the average travelled distance per car will be 13,000 km/year (Samgongustofa, 2016).

b) Rental cars and buses in the tourism sector. The growth of the tourism sector in Iceland is phenomenal and the latest predictions anticipate 3.5 million tourists in Iceland in 2030 (ISAVIA, 2016). Extrapolated number of rental cars in 2030 is approximately 48,600 and buses 10,500 (SAF, 2016).

c) Conclude the electrification of fish meal factories. Fish meal factories operate by the sea side around the country. Many of them run on electricity today but four of them still run on fuel oil but many parties are interested in electrifying them and thus finish the energy exchange in the fish meal factories sector (Althingi, 2016). In this case, we assume that commitment towards reducing the emission of GHG will override the fact that today it is less expensive to run those factories on fuel oil than electricity.

d) Various machineries in industries. A few aluminum smelters and other heavy industries operate in Iceland. Information on their consumption of fossil fuels for machineries and equipment is readily available and in the project, we assume that it is possible to exchange fossil fuels for electricity. Information on smaller industries is somehow limited and not included in this project. It can therefore be assumed that opportunities in energy exchange in this sector may be larger than shown here.

e) Ships in harbor will be able to connect to the electricity grid. Iceland is an island and ship traffic is considerable. While berthing at docks, the ships need to burn fossil fuels to keep necessary machines and equipment running. It is quite plausible, given an installation of the necessary infrastructure, to offer the ships a connection to the electricity grid and hence reduce the reduction of GHG emissions (Eythorsson, 2016).

Table 1. Proportion of energy exchange for different scenarios.

	Proportion of energy exchange: Scenarios			
Categories	**Business as usual**	**Increased demand**	**Electrified future**	**Further energy exchange**
Passenger cars	25%	25%	27%	100%
Buses	4%	4%	12%	100%
Delivery trucks	17%	17%	20%	100%
Heavy trucks	1%	1%	12%	100%
Rental cars for tourism	0%	0%	45%	100%
Buses for tourism	0%	0%	15%	100%
Fish meal factories	0%	0%	100%	100%
Machineries in industries	0%	0%	100%*	100%
Ships in harbors	0%	0%	100%	100%
Vegetables and flowers	0%	0%	100%	100%

*Limited information available for this category, thus 100% only stands for energy exchange for the fossil fuel we had information on.

The scenarios *Business as usual* and *Increased demand* both include the same ratio of electrification (table 1). The energy exchange in those scenarios only includes transportation on land, excluding the tourism sector vehicles. The scenario *Electrified future* includes partial energy exchange for vehicles on land but full exchange for fish meal factories, machineries in industry and docked ships. The last scenario shows full energy exchange in the categories in question (table 1).

As can be seen in table 1 the ratio of energy exchange varies between types of vehicles. That is due to the fact that technical solutions have not reached as far for larger vehicles as for passenger cars.

In addition, we envisaged a future were Iceland would be self-sufficient in growing tomatoes, cucumbers, salad, peppers and flowers. That would mean increased domestic cultivation and no import of those products which would lead to lesser GHG emissions. Increasing the cultivation of vegetables in Iceland is however not part of the energy exchange as today these products are cultivated in greenhouses heated with geothermal energy and lit by electricity. Nonetheless, when we started this project we tried to foresee how increased environmental awareness could lead to increased electricity demand. The importance of buying locally grown products is recognized today, partly because shorter transportation distances lead to reduced GHG emissions and cultivation of vegetables and flowers requires little supplies for the process. Therefore, we decided to include the calculation of energy demand and GHG reduction from that cultivation in the project.

Iceland could reduce the emission of CO_2 by 32%

Iceland could reduce its emissions by just less than 1.5 million tons of CO_2/year if the energy exchange as described in table 1 would be fully implemented without any new power plants being built. That equals 32% of Iceland's total CO_2 emissions (Umhverfisstofnun, 2016). In order to realize that reduction, we would need to put 660 to 880 MW of electricity from renewable resources into use instead of burning fossil fuels. If it is assumed that the increased energy demand will be met with new power plants, then the estimated emissions from those facilities will be less than 100,000 t CO_2 per year, and thus, the total reduction due to the energy exchange will be equivalent of 31% of Iceland's total emission per year.

Observing individual categories, the largest energy demand comes from energy exchange in the transportation sector (not counting the tourism sector vehicles), followed by the fish meal factories and industry, ships in harbors, rental cars and buses for the tourism sector and finally the self-sufficient cultivation of certain vegetables and flowers. The largest reduction in CO_2 emissions derives from the transportation sector, followed by the rental cars and buses for the tourism sector, ships in harbors, industries, fish meal factories and finally the increased cultivation of vegetables and flowers.

Table 2. Energy demand and reduction of CO_2 emissions for the scenario *Further energy exchange*

	Energy demand at min [MW]	**Energy demand at max [MW]**	**Reduction in emission [CO_2 t/year]**	**Proportion of Iceland's total emissions**
Land transportation	354	483	948,600	21%
Land transportation for the tourism sector	190	260	455,100	10%
Fish meal factories	65	68	12,100	0,3%
Machineries in industry	10	12	12,800	0,3%
Vegetables and flowers	30	38	5,000	0,1%
Ships in harbor	11	16	33,000	1%
Total	**661**	**877**	**1,466,600**	**32%**

Table 3. Energy demand and reduction of CO_2 emissions for different scenarios.

Scenario	Energy demand at max [MW]	Net reduction of emissions [CO_2 t/year]*	Proportion of Iceland's total emissions
Business as usual	69	139,100	3%
Increased demand	69	128,500	3%
Electrified future	346	339,600	7%
Further energy exchange	880	1,411,700	31%

*Having allowed for emission from power plants.

The total population of Iceland is only 340,000 (Statistics Iceland, 2017), the country is rich of renewable resources and therefore ambitious energy exchange is viable. It is however clear that it calls for strengthened transmission grid and generation of electricity to meet the energy demand since the current grid is getting old and already poses problems in securing the delivery of electricity to different parts of the country. The proposed alternatives in the 10-year plan would though be capable of meeting the demand (Landsnet, 2017).

It is our belief that by analyzing possible energy exchange in Iceland we have contributed to and initiated further discussion on how to reduce GHG emissions. Also, importantly, we have handed the government a useful tool in decision making for a better future.

References:

Althingi. (2016). Tillaga til thingsalyktunar um adgerdaraaetlun um orkuskipti.

Brynjarsson, F. I. (2013). *Umferdarspa 2012-2060.* Reykjavik: Vegagerdin.

Eythorsson, D. (2016). *Forkonnun a aukinni notkun endurnyjanlegra orkugjafa vid Faxafloahafnir.* Reykjavik: Faxafloahafnir.

ISAVIA. (2016). *Drog ad greinargerd adalskipulags Keflavikurflugvallar 2013-2030.* Keflavik: ISAVIA.

Landsnet. (2017). *Innvidirnir okkar - leidin ad rafvaeddri framtid. Kerfisaaetlun Landsnets 2016-2025.* Reykjavik: Landsnet.

Magnusdottir, A., Gudmundsson, G., Sveinsdottir, G. H., & Jonsdottir, S. D. (2016). *Moguleg orkuskipti a Islandi. Samantekt a aflthorf og sparnadi i losun CO2. Kerfisaaetlun 2016-2025.* Reykjavik: Landsnet.

SAF. (2016, October 6). *Lykiltolur*. Retrieved from SAF: http://www.saf.is/lykiltölur

Samgongustofa. (2016, October 20). *Umferd*. Retrieved from Samgongustofa: http://www.samgongustofa.is/umferd/tolfraedi/onnur-tolfraedi/

Statistics Iceland. (2017, February 10). *Mannfjoldi.* Retrieved from Hagstofa: https//hagstofa.is/utgafur/frettasafn/mannfjoldi/mannfjoldinn-a-4-arsfjordungi-2016

Umhverfisstofnun. (2016). *National inventory report. Emissions of Greenhouse Gases in Iceland from 1990 to 2014.* Reykjavik: Umhverfisstofnun.

TransCanada's Socio-Economic Impact Assessment Catalogue*

Gustavo Mendoza Gutierrez and Stevie Snyman[1]

Abstract

As an integral part of TransCanada's Socio-Economic Program, the authors developed a Catalogue for housing, analyzing, and reporting the potential socio-economic impacts of proposed energy infrastructure projects. Given the dynamic regulatory and stakeholder environment for pipeline development in North America, project proponents are challenged to perform increasingly rigorous socio-economic impact assessments (SEIA) to better anticipate and mitigate potential impacts on affected communities. The SEIA Catalogue was developed to assist TransCanada in realizing several benefits including: enhance the accuracy of identifying potential impacts; develop consistent and effective mitigation measures; support more informed stakeholder engagement; ensure efficient use of employee and consultant resources; and promote knowledge sharing. This paper provides an overview of the Catalogue, including its purpose, capabilities and benefits for socio-economic practitioners and the broader oil and gas community.

1. Introduction

TransCanada Corporation[2] (TransCanada), one of North America's leading energy infrastructure companies, established a Socio-Economic Program (the Program) to ensure a consistent and coordinated approach to managing the potential social and economic risks, effects and benefits to local communities and people from capital projects. The Program supports TransCanada's work to engage stakeholders and Indigenous communities, ensure people's safety and protect the environment adjacent to where we do business.

A key function of the Program is to manage the development of socio-economic impact assessments (SEIA) and related effects mitigation and enhancement measures[3] for pipeline and power generation projects. SEIAs are usually required in regulatory application processes across North America, and may play an important role in garnering social acceptance for project development. It is therefore imperative that TransCanada develops robust and consistent impact assessments.

2. Drivers of the SEIA Catalogue

Evolving regulatory requirements and an increased focus on socio-economic effects have created heightened expectations for impact assessments. In Canada, federal and provincial regulators (e.g. the National Energy Board [NEB], the Canadian Environmental Assessment

*The authors would like to thank Cyril Elbers for all his mentorship and support in developing the SEIA Catalogue and preparing this paper.

[1] Gustavo Mendoza Gutierrez and Stevie Snyman are Socio-Economic Advisors with TransCanada Corporation. Questions or comments may be directed to gustavo_mendoza@transcanada.com.

[2] More info at http://www.transcanada.com.

[3] "Enhancement measures" refers to the activities that a project may implement to incent or maximize potential positive socio-economic impacts for local stakeholders and communities.

Agency [CEAA] and the British Columbia Environmental Assessment Office [BC EAO]) are developing new requirements and scrutiny for the assessment and management of socio-economic impacts from energy projects. As a result, companies are being challenged to deliver higher quality socio-economic assessments that accurately identify potential human interactions and propose effective mitigation measures.

Stakeholders, including local and Indigenous communities, municipal governments and agencies, non-governmental organizations, etc., are also challenging project proponents on socio-economic impacts and have higher expectations on the solutions that proponents provide to resolve concerns. This is evident in the increasing participation of community members in public information sessions, regulatory hearings and social media.

The new landscape for SEIAs has resulted in greater challenges for how to manage the significant volume of information contained in these assessments. However, limited tools are available to bring together the effects and mitigation measures across regulatory jurisdictions. This lack of a centralized repository has made it challenging to assess information, identify trends, and ensure consistent best practices.

To address the constraints on the analysis of impact assessments, some regulators and agencies have enacted measures to improve access to information. For example, US's Environmental Protection Agency (EPA) and Canada's NEB have made significant efforts to compile and provide access to impact assessment documents through publically available online databases (EPA 2017 and NEB 2017). Despite these efforts, searching for specific information or conducting research across several impact assessments remains a difficult and time-intensive activity. Moreover, discussion among industry peers has shown that most energy companies, consultants and regulators in Canada do not possess the tools required to conduct analyses of their own historical SEIA data.

Farber (2008) identified the consequences of this gap in analytical capability and the lost opportunities for both environmental and socio-economic effects management. Furthermore, the gap allows for significant variations in the quality and consistency of impact assessments. This, in turn, may impact the ability of regulators and stakeholders to hold proponents accountable for the assessment quality and for mitigation implementation, and places constraints on the capacity of project proponents to make continued progress in the effective development of SEIAs. As a result, there is a distinct need among energy companies, policy makers and regulators for tools that can manage the data provided in impact assessments in a more consistent and effective manner.

3. Purpose

TransCanada developed the SEIA Catalogue as a tool for housing, analyzing and reporting socio-economic assessment data, including potential effects and mitigation measures, on for the company's capital projects. The intent is to support continuous improvement in the quality and

consistency of SEIAs and the effective management of potential socio-economic impacts in affected communities.

The Catalogue was designed for use throughout TransCanada's SEIA development process as potential impacts and mitigation measures are identified and assessed. It also supports analysis on a broader scale to examine trends, identify enhancements and promote knowledge transfer from one project to the next. In addition, the Catalogue enables informed discussions among project proponents, consultants, regulators and community stakeholders regarding the overall methodology and quality of SEIAs, and on questions regarding socio-economic effects and mitigation measures.

4. Design and Capabilities

Using Microsoft Excel (Microsoft 2010) and macro programming, the Catalogue was developed with accessibility and efficiency in mind; it needed to be flexible and easy to use for socio-economic assessment data analysis (see Appendix A for a couple visuals on the SEIA Catalogue and its structure). The Catalogue consists of three main components:

a. **Manual and references**
   Tools and information designed to guide and assist the practitioner on using the Catalogue including an instruction manual, dictionary of terms, and a list of references such as regulatory documents and socio-economic management plans.
b. **SEIA data**
   Assessment data from a wide selection of TransCanada SEIAs, representing various regions, regulatory jurisdictions and project types. The data is entered into the Catalogue on an ongoing basis as projects are developed to reflect new or revised assessments.
c. **Analysis tools**
   Tools that enable efficient data analysis and customized reporting including pre-built common queries, key-word searches and pivot tables. The pivot tables have been built to conduct specific queries based on key variables such as the socio-economic valued component, baseline indicators, type of socio-economic effect, project name, and mitigation measure.

Currently, the scope of the Catalogue includes SEIA data for TransCanada project applications submitted to the NEB and the BC EAO. Over time, the Catalogue will be expanded to include socio-economic data from different kinds of TransCanada projects across North America.

The Catalogue includes relevant data presented in a SEIA, as per the guidelines set forth by regulators (e.g. CEAA 2012, BC EAO 2013, MDDELCC 2016 and NEB 2016). This includes information on baseline conditions, the effects assessment, proposed mitigation or enhancement measures, residual effects assessment and significance assessment (Figure 1).

This comprehensive approach enables impact assessment practitioners to compare the thoroughness and consistency of SEIAs, identify commonalities and gaps, and inform best practices going forward.

Figure 1. Components or variables captured in the SEIA Catalogue

For example, the Catalogue can assist in resolving a question from a landowner or a community member on how TransCanada mitigates potential effects to road traffic, or on what are the enhancement measures that the company's projects usually take to incent local employment. To resolve these questions the practitioner could use the key-word search tool or the pre-built pivot tables for the variables described in Figure 1, and look for the mitigation implemented for the issues or effects of interest. With the SEIA Catalogue, the practitioner is able to develop an accurate and fast response to questions on the mitigation implemented for TransCanada's projects.

5. Benefits

The design and practical use of the Catalogue provides the following benefits for the assessment of socio-economic impacts:

a. **User-friendly access to SEIA information:** The Catalogue was developed in Microsoft Excel and structured in a standard format that allows the user to export the information to other data management software packages such as SPSS, STATA and SAS. By using macro programming, the Catalogue offers pre-built analysis tools that are user-friendly and provide instant information on socio-economic effects and mitigation (e.g. baseline conditions, project effects, etc.). As a result, the user is not required to program macros or create new commands to be able to conduct complex searches and queries. The Catalogue also offers the flexibility to create additional macros and analysis tools depending on the user needs.
b. **Capacity to analyze and enhance SEIAs:** The analysis tools developed within the Catalogue enable impact assessment practitioners to search, organize and report data from a variety of SEIAs across different projects and regulators. For example, the Catalogue can be used to search a specific term of interest (e.g. traditional hunting, employment, water quality, etc.) and generate a report indicating in which projects, baseline conditions and mitigation measures that particular term occurred.

Furthermore, the practitioner is able to ensure that their assessment is consistent with past projects, while also supporting the identification of gaps and inclusion of additional mitigation as required.

c. **Quality improvements of mitigation and enhancement measures:** The Catalogue can provide learnings on the variation and evolution of the mitigation and enhancement measures implemented across different projects. By supporting the tracking of mitigation effectiveness, the tool can help practitioners identify what has worked in past projects and support quality improvements. Having this capacity also enables companies to develop standard mitigation measures that are meaningful for communities, reduce potential risks and are aligned with industry best practice.
d. **Support for stakeholder engagement:** When a stakeholder or community raises concerns about the human interactions of project development, the Catalogue can be used to quickly analyze and communicate information around project effects and proposed mitigation measures to reduce the concern around the effect raised. It also provides practitioners with access to a variety of mitigation options for consideration with affected communities or stakeholders.
e. **Efficient resource management:** The structure and capabilities of the Catalogue enable the efficient upload, search and analysis of SEIA data, reducing the resources required to develop robust and consistent impact assessments. This can create substantial savings for proponents in the development and review of assessments, as well as reducing the need for corrective measures.
f. **Knowledge sharing:** The Catalogue is a tool that supports knowledge sharing across the organization on the development and review of SEIAs. Moreover, it can assist in training new practitioners on socio-economic assessment and raise awareness regarding the information included in SEIAs.

6. Future Development Opportunities

The Catalogue's design and capabilities create the possibility for further development of the tool. For example, while the Catalogue has been developed specifically for socio-economic assessment data, its structure and tools could also be used to store and analyze environmental assessment information (e.g. biophysical valued components). Moreover, its compatibility with other tools such as collaborative online work sites, advanced databases and mobile devices offers the possibility for new ways of using the Catalogue.

Overall, the SEIA Catalogue provides the opportunity for greater intra-industry collaboration and information sharing regarding best practices around impact assessment, mitigation measures and stakeholder engagement on socio-economic impacts. In addition, the Catalogue could be used to enhance the regulatory review processes and the policies and guidelines around impact assessment.

7. Conclusion

The Catalogue is a dynamic tool for housing, analyzing and reporting information from SEIAs. It has improved the efficiency of TransCanada's development and review process for SEIAs, and has enhanced the quality and consistency of these assessments. The capabilities of the Catalogue can help project proponents, regulators, consultants and stakeholders better understand the information contained in impact assessments and inform stakeholder engagement and regulatory analysis.

REFERENCES

BC EAO (British Columbia Environmental Assessment Office), 2013. Guideline for the Selection of Valued Components and Assessment of Potential Effects. Victoria: BC EAO. Available from http://www.eao.gov.bc.ca/pdf/EAO_Valued_Components_Guideline_2013_09_09.pdf.

CEAA (Canadian Environmental Assessment Agency), 2014. Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012. Ottawa: CEAA.

EPA (US Environmental Protection Agency), 2017. Environmental Impact Statement (EIS) Database. Washington, DC: EPA. Available from https://cdxnodengn.epa.gov/cdx-enepa-public/action/eis/search.

Farber, D.A. 2008. "Bringing environmental assessment into the digital age." In *Taking Stock of Environmental Assessment: Law, policy and practice,* Edited by Holder, J. and McGillivary, D. Abingdon: Taylor & Francis; p. 219-258.

MDDELCC (Quebec Ministry of Sustainable Development, Environment and the Fight against Climate Change), 2016. *Directive pour la réalisation d'une étude d'impact sur l'environnement d'un projet de construction de gazoduc*. Quebec: MDDELCC. Available from http://www.mddelcc.gouv.qc.ca/evaluations/documents/Gazoduc.pdf

Microsoft, 2010. Microsoft Excel 2010 [software program]. Redmond: Microsoft Corporation.

NEB (Canada's National Energy Board), 2016. Filing Manual Release 2016-02: Guide A.2-Environmental and Socio-Economic Assessment. Calgary: NEB.

NEB (Canada's National Energy Board), 2017. Regulatory Document Index. Calgary: NEB. Available from https://apps.neb-one.gc.ca/REGDOCS/Item/View/2000.

Appendix A SEIA Catalogue Pictures