A Study on Facilitating Factors and Barriers to Addressing Cumulative Effects

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Abstract

Consideration of cumulative effects (CE) has not been successful due not only to the nature of complexity and uncertainty of cumulative effects, but also to the lack of understanding about well defined facilitating factors and barriers for addressing cumulative effects. As a theoretical framework for understanding facilitating factors and barriers, this study used three criteria critical for improving knowledge systems: salience, credibility, and legitimacy. With an aim to understand how addressing CE is facilitated or obstructed in terms of salience, credibility, and legitimacy, the study reviewed three cases: Middle Humber in UK, Transboundary Crown of the Continent, and Great Sand Hills in Canada. As a result, it was found that salience of CE approaches is facilitated under cooperative consulting among key stakeholders, but is obstructed when fails to secure support from political sectors. Credibility of CE approaches is promoted when modeling allows flexible use of scenario sets for analyzing tradeoffs to arrive at a satisfactory option, but is weakened when modeling fails to coordinate different formats of data, scale, and local interests across various administrative jurisdictions. Legitimacy is elevated by early involvement of stakeholders in scenario development with ongoing communication through a variety of media, but is threatened when affected stakeholders are not fully considered and regulatory authorities are less involved.

1. Introduction

Cumulative effects of land use are emergent properties of coupled human-environment systems that manifest at relatively large spatial and temporal scales. Such properties in turn create hazards and risks for human societies that can be conceptualized as phenomena such as 'vulnerability' or 'lack of resilience' in the face of rapid and unpredicted change (Turner et al. 2007). These phenomena are social, economic, and biophysical in nature, and operate over a wide range of space/time scales, consequently exerting strong effects on water resources, air quality, local/regional climate, biodiversity, and infectious disease (Foley et al. 2005). Thus, the complex and uncertain nature of cumulative effects of land use has increasingly led scientists and policy-makers attempting to understand and address such problems to move away from top-down, one-size-fits-all, 'panaceas' as policy strategies (Ostrom et al. 2007). However, consideration of cumulative effects has not been successful due not only to the nature of complexity and uncertainty of cumulative effects, but also to the lack of understanding about well defined barriers for addressing cumulative effects in decision-making processes. While conceptual characteristics and measurement methods of cumulative effects have often been demonstrated, actual barriers to addressing cumulative effects effectively in decision-making process are rarely identified. This study uses a theoretical framework for understanding facilitating factors and barriers: salience, credibility, and legitimacy for improving knowledge systems (Cash et al., 2003). Salience refers to whether a CE approach is seen as important to relevant stakeholders, and legitimacy refers to whether a CE approach is seen as fair and

democratic. Credibility refers to whether an approach is seen as capable of generating new understanding of CE.

For the method to analyze how these theoretical frameworks explain facilitating factors and barriers, the study conducted a wide range of literature review focusing on three cases of CE approach: CEA on the Middle Humber in UK, CEA in the Transboundary Crown of the Continent, and Great Sand Hills, Canada. Through the critical review of these cases, the study explored how salience, credibility, and legitimacy interplayed to facilitate or impede addressing CE in decision-making process of environmental assessment. The illumination of these facilitating factors and barriers associated with the three concepts will help us understand important problems of our cumulative effect assessment and better prepare strategies to improve the process.

2. Case Studies

2-1. CEA on the Middle Humber in UK

Under the legislative changes by European Union to consider cumulative effects in environmental assessment, a CEA was conducted to examine and assess the likely effects of several major concurrent developments proposed along the north bank of the Humber, UK over a distance of approximately 5 km. This CEA was prepared by an environmental consultancy on behalf of the five developers in 1997-98 to obtain necessary consents from various authorities for five adjacent development projects: a new wastewater treatment works, a Combined Cycle Gas turbine power station, a roll on/roll off sea ferry berth, reclamation works for a ferry terminal, and flood defense works. For effective scoping and assessment, a steering group was formed and predicted that in construction phase all five projects would give rise to effects on the Special Protection Area and traffic, as well as in the operational phase on estuary hydrodynamics, water quality and aquatic ecology. Primary information for the CEA included the probable timing of various activities within the construction work programs, the manpower requirements for activities and associated traffic movements. Resource information included the range of bird species present at different times of the year on the Special Protection Area/Ramsar site, and their vulnerability to disturbance. The assessment of the levels and scheduling of impacts identified for individual projects was achieved via a series of tables and metrices, including: a combined timetable of major construction works, bird disturbance potential (sensitivity in each month), a timetable of work potentially affecting birds and monthly sensitivity, potential aquatic impacts of the Salt End developments, and traffic patterns. Mitigation measures proposed include the scheduling of construction activities away from sensitive periods (e.g. roosting), staggered working hours to reduce traffic loads, and the integration of design requirements for adjacent schemes, e.g. design of the roll on/roll off ferry structure to complement outfall design and enhance mixing of water in the estuary.

This Middle Humber case illustrates how salience, credibility and legitimacy interplayed for successful implementation of CEA. In terms of credibility, they found the new information gained from the developers about probable timing of various construction activities and subsequently affected wildlife species in different times contributed to improve the credibility of scientific knowledge of cumulative effects. Promotion of salience was also important to addressing the CE. For the developers, the cooperative consulting process of the CEA was acknowledged as a way to increase their limited understanding of the estuary and the potential development impacts. For example, the power station developer referred to increased understanding particularly in relation to impacts to the mudflats and birds as well as to potential traffic impacts, whereas the dock developer acknowledged greater understanding of the hydrodynamics

and morphology of the estuary and the relationship of the schemes to the Special Protection Area. A consenting authority, Department of Trade and Industry also stated that the CEA process facilitated consultation for decision-making by means of telephone conversation, occasional meetings and the provision of written comments on prepared drafts. According to the DTI, the power station project would not have been approved without the CEA. Local authorities engaged in the CEA pointed out that, however, most significant deficiency in the process had been little or no public participation or consultation. This indicates that, although cooperation amongst developers and local authorities was facilitated through steering meetings, a wide range of the affected stakeholders was not fully considered, reflecting limited legitimacy of the CEA process. The developers also learned that late involvement of the key stakeholders such as regulatory authorities had resulted in delay of the CEA process.

2-2. CEA in the Transboundary Crown of the Continent

The transboundary Crown of the Continent, a shared region of the Rocky Mountains between Alberta, British Columbia and Montana is internationally recognized for its ecological and geological uniqueness, serving as important wildlife movement corridor. However, it is currently facing an increase in human activities such as urban and rural residential expansion, recreation, and resource extraction. This concern has led land managers to consider cumulative environmental effects caused by fragmented land uses in multiple jurisdictions. For effective CEA, the Crown Manager Partnership (CMP) was initiated, comprising of representatives from more than 20 government agencies. The CMP helped maintain multiple agency involvement in a complex, multi-year project, providing formal access and input to the process.

For systematic analysis, they used a computer model known as ALCES (A Landscape Cumulative Effects Simulation) to explore and quantify the cumulative, dynamic effects of land-use practices and existing natural disturbance regimes. The implementation of this collaborative CEA, however, was obstructed by notable barriers associated with credibility, salience, and legitimacy. In terms of credibility, information produced from the modeling lacked credibility to predict cumulative effects. According to Quinn et al. (2004), data standardization process for modeling was extremely complex due to the number of jurisdictions involved, different scales of data, different standards of reporting, and different levels of understanding around the issues. This has led the model to rely on only small portion of data known and to be heavily supplemented with trajectories, predictions, and educated guesses (Gunn and Noble, 2009). In addition, capabilities and limitations of the model were not fully understood by the stakeholders resulting in their reluctance to provide data for prediction (Gunn and Noble, 2009). Salience has also imposed significant barriers. Quinn et al. (2004) pointed out that the predicted output of cumulative effects as a whole was unable to disaggregate results to a specific region or stressor. This has led the CMP to shift their focus away from using predictive modeling and to place greater emphasis on identifying what to track within the region, including valued ecosystem components that are potential indicators of ecosystem health (Gunn and Noble, 2009). The lack of salience was also evidenced from the fact that the CEA failed to secure support from political sectors at higher levels who manage budget and process. This resulted in the delay in advancing the project to the formal modeling stage. Quinn et al. (2004) advocated this salience issue arguing that a key precursor to higher level of engagement is the unambiguous articulation that the regional CEA will be directly helpful for them in their work. In terms of legitimacy, the CMP played an important role to facilitate participation and communication among regional resource managers. Through discussion at the

annual forum, the dissemination of the survey results, and information passed on via the steering committee and a project newsletter, the CMP members worked to develop a shared understanding of how the processes would unfold, the features of the CEA approach, and how the results might be used by the various agencies (Quinn et al. 2004). However, the CEA also faced notable limitations in legitimacy. Maintaining multiple agency involvement in a complex, multi-year project imposed a formidable challenge to the CMP because agencies are operating under different conditions in terms of budget, priorities, changing government, and limited human resources. Quinn et al. (2004) observed that the participants were hard-pressed to provide funding, time, and personnel, all of which had a detrimental effect on the ability to maintain engagement.

2-3. Great Sand Hills, Canada

The Great Sand Hills, situated in the southwest of the Saskatchewan province, is known for the largest sand dune complex providing home to several endangered species and for over 200 sites of archaeological significance. The region has been characterized by both large-scale and long-term anthropogenic-induced surface disturbance, especially natural gas development and livestock grazing (GLJ Petroleum Consultants Ltd, 2006; Nelson et al, 2006). The overall approach to regional CEA in the Great Sand Hills was based on a structured strategic environmental assessment (SEA) framework (after Noble and Storey, 2001) and underlying SEA principles (Scientific Advisory Committee, 2007). The CEA consisted of three main phases: 1) a baseline phase to assess the current and cumulative biophysical, economic, and social conditions of the region, 2) a trends and impacts phase to understand historic trends in land use and associated cumulative change, and 3) a scenario analysis and recommendation phase to develop, project, and assess alternative land use scenarios as well as to recommend a preferred scenario and guidelines for implementation, mitigation, and monitoring (Noble, 2008).

In the CEA for Great Sand Hills, a spatial analytical model was applied to integrate biodiversity, focal species, land use and climate data as well as to interpolate data across space and time for each scenario under a range of Valued Ecosystem Components (VECs) objectives and targets. This structured and systematic framework facilitated credibility, because the model: 1) enabled to identify systematically scenarios sets, 2) supported analysis of tradeoffs between scenarios to arrive at a satisfactory option, 3) enabled to run repeatedly under alternative scenarios with different scales and objectives, and 4) assured that the assessment output was produced based on an unambiguous set of decision rules. The regional framework of the model, however, has faced a challenge in credibility for the lack of attention to localized and point source problems that tend not to be a concern in regional scale. According to Noble (2008), the CEA in Great Sand Hills overlooked spatial characteristics of the regional biodiversity highly concentrated in several localized hot spots, each of which is vulnerable to the tyranny of smaller-scale, point-specific and project-induced stresses such as spills from gas well facilities, soil compaction, localized roads and infrastructure and cattle watering hole disturbances. This challenge has illuminated the critical need to identify the underlying drivers of regional change in smaller scale to better model future scenarios. Noble (2008) confirmed that in strategic-based approaches not all cumulative processes play out at the same spatial scale and multi-scaled analyses are essential to elevate credibility of strategically-oriented regional CEA. The lack of systematic follow-up and monitoring was also found to be undermining credibility of the CEA. Noble (2008) pointed that environmental monitoring efforts in the Great Sand Hills have been fragmentary focusing on specific activities of the gas industry rather than also monitoring regional environmental changes in broader scale. Despite recommendations

to monitor if the preferred scenario was achieving its objectives, monitoring capacity was significantly limited: there were only 16 government field officers responsible for 62,000 oil and gas wells the region-wide (Scientific Advisory Committee, 2007). This lack of systematic monitoring system and capacity has led to unclear direction about how such monitoring information can or should inform subsequent actions or downstream assessment, resulting in a significant threat to credibility of future assessment (Noble, 2008).

Legitimacy of the CEA process was increased by early involvement of stakeholders in scenario development. The CEA provided the public with opportunity for involvement by releasing scoping document for feedback and maintained ongoing communication through website and community newsletters. This effort helped clarify stakeholders' expectations in early stage of the process, integrate local concerns and values, and minimize opposition and conflict when the plan was finalized and presented for public review and approval (Noble, 2008). However, the range of stakeholders was not sufficiently wide enough to involve important decision-makers in higher political level who actually have power to handle budget and to assign necessary resources. According to Noble (2008), many recommendations emerged from the CEA in Great Sand Hills such as regulatory issues and long-term financial or socioeconomic commitment were beyond the capacity and authority of the government agencies in charge of the assessment process.

3. Conclusions

Based on an extensive literature review on theoretical and practical approaches in CEA, the study found critical factors that facilitate or impede addressing CE. From the case of the Middle Humber in UK, I learned that a cooperative consulting process involving key stakeholders of multiple projects is found to facilitate sharing of new information by elevating credibility and salience of scientific knowledge of cumulative effects. Great Sand Hills project illustrated that structured and systematic modeling frameworks facilitated credibility of CEA, enabling to incorporate a variety of spatial analytical models as well as to provide systematic sets of scenarios with unambiguous decision rules. It was also found that early involvement of stakeholders in scenario development through feedback and ongoing communication is critical to facilitate legitimacy of CEA.

Barriers to addressing cumulative effects are also illuminated. From the case of the Transboundary Crown of the Continent we learned that complexity of modeling, difficulty of data standardization process, and different scales of data across a number of jurisdictions have led to heavy reliance on small portion of data known, undermining credibility of scientific knowledge of cumulative effects. Difficulty in disaggregating the predicted output of cumulative effects in regional scale has imposed a barrier to identifying impacts or stressors on individual jurisdictions, resulting in decrease in salience. From the Great Sand Hill, I learned that credibility of modeling was threatened when multi-scaled analyses are not effectively considered and systematic monitoring efforts are not followed. The case of the Transboundary Crown of the Continent also illustrates that failure to secure support from political sectors at higher levels as well as difficulty in maintaining multiple agency involvement in a complex, multi-year CEA project have imposed a significant barriers to assessing cumulative effects. This reflects the lack of salience of CE knowledge for decision-makers who have power to control resources and processes. As was explained in the case review, these facilitating factors and barriers to addressing CE depend on the contexts, and are affected by the degree and interplay of the three concepts: salience, credibility, and legitimacy.

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