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Integrating spatial support tools into strategic planning—SEA of the GMS North–South Economic Corridor Strategy and Action Plan

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A B S T R A C T

The GMS countries, supported by the Asian Development Bank, have adopted a holistic, multidimensional approach to strengthen infrastructural linkages and facilitate cross border trade through (i) the establishment of a trans-boundary road connecting two economic nodes across marginalised areas, followed by (ii) facilitation of environmentally and socially sound investments in these newly connected areas as a means to develop livelihoods. The North–South Economic Corridor is currently in its second phase of development, with investment opportunities to be laid out in the NSEC Strategy and Action Plan (SAP). It targets the ecologically and culturally sensitive border area between PR China’s Yunnan Province, Northern Lao PDR, and Thailand. A trans-boundary, cross-sectoral Strategic Environmental Assessment was conducted to support the respective governments in assessing potential environmental and social impacts, developing alternatives and mitigation options, and feeding the findings back into the SAP writing process. Given the spatial dimension of corridor development—both with regard to opportunities and risks—particular emphasis was put in the application of spatial modelling tools to help geographically locate and quantify impacts as a means to guide interventions and set priorities.

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1. GMS development context

The Greater Mekong Subregion (GMS) comprises six countries that are linked by the Mekong River—Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam, and PR China (Yunnan Province and Guangxi Autonomous Region). The GMS has seen unprecedented economic growth in past decade, as part of its transformation into an integrated and robust economic zone. From 1992 to 2006, gross domestic product (GDP) in the region grew at an average annual rate of 11%, despite the 1997 Asian financial crisis, slowdown of the global and economics in 2001, outbreak of severe acute respiratory syndrome (SARS) in 2003, and thereafter the threat of the avian flu epidemic (GMS EPA Synthesis Report).

However, the benefits of growth have not always been equitably distributed, with remote rural and indigenous communities not being fully integrated and able to benefit from the expanded economic linkages and potential livelihood opportunities across the corridor. Moreover, ancillary infrastructure, processing chains and industrial clusters that have emanated from the enhanced transport linkages are often geared towards resource extraction. The resultant loss of biodiversity and pressure on natural resources is impinging on the productivity and stability of local livelihoods and the sustainability of productive sector investments. Environmental performance assessment reports indicate that notwithstanding the considerable efforts towards sustainable management of forest, biodiversity and water resources by the GMS countries, the environmental indicators continue to trend downwards and the magnitude of combined pressures continues to outpace responses (GMS EPA Synthesis Report).

To counteract these increasing disparities and realize its goal of a poverty-free and environmentally rich GMS, the Asian Development Bank has formulated and coordinated strategies focused on “Economic Corridors”. The economic corridor concept is a holistic approach to the spatial development of the poorer areas of the GMS by geographically focusing and prioritizing investments in priority sectors (transport, energy, telecommunications, trade and investment, tourism, agro-industry and forestry). Across these sector investments, opportunities for livelihood improvements to the poor in remote and underdeveloped regions are created by developing infrastructural links and networks into major markets, and establishing enabling policy and regulatory frameworks that include local communities through benefit sharing mechanisms.

Currently, the ADB supports four major corridors in the GMS: North–South Economic Corridor (NSEC, three sections), East–West Economic Corridor (EWEC), Southern Economic Corridor (SEC), and Southern Coastal Corridor (SCC).
Fig. 1. SEA of the NSEC SAP—focus area for spatial modelling tools.
2. SEA rationale and frame

The trans-boundary road 3 passes through an area broadly known as the “Golden Quadrangle”, the remote and relatively poor border region connecting PR China’s Yunnan province, Myanmar, Lao PDR, and Thailand (Fig. 1). ADB’s goal is to use this road as the backbone to develop a full-fledged North–South Economic Corridor (NSEC) around it. To achieve this, a Strategy and Action Plan (SAP) is being prepared for the NSEC, focusing on investments that achieve desired livelihood improvements for local communities while safeguarding the natural resource base of the area. The NSEC is in its initial phase (Phase 1) of development during which its transition to a logistics corridor is to be achieved, in time for the ASEAN and ASEAN/China Free Trade Agreements. The NSEC Strategy and Action Plan (SAP) will help to consolidate related infrastructure decisions and aims to increase the efficiencies within the corridor through the construction of missing links, improving logistics and stimulating associated developmental clusters.

As the focus of the SAP is on evaluating economic opportunities, a parallel Strategic Environmental Assessment was requested by the ADB and national stakeholders to evaluate the environmental and social impacts from investments in the NSEC as laid out in the SAP. Analytically, the Strategic Environmental Assessment (SEA) of the NSEC blends both post-evaluative and ex-ante features: an evaluation of past decisions on infrastructure (i.e. construction of Route 3—NSEC road) together with an assessment of predicted impacts of future measures on both hard and soft infrastructures associated with the economic corridor concept. Of particular interest in the SEA target area (Fig. 1) is the focus on enhancing the productivity and efficiency of the agro-processing and secondary wood processing industries. The SEA aims to have a pre-emptive and anticipatory role in shaping these investments and broader sector strategies. It adopts an objectives-led approach wherein the potential impacts of the SAP are assessed against a series of objectives for sustainable development using a range of spatial modelling and decision support approaches. The SEA timeframe is linked closely to the SAP timetable, with the ADB Core Environment Program (CEP, www.gms-eoc.org) providing regular input into this process. The SEA commenced in early 2008 and was finalized in June 2009.

3. Spatial support tools in the SEA of the NSEC SAP

Acknowledging that environmental and dependent social parameters are geographically unique and unevenly distributed, the SEA stakeholders decided to combine non-spatial analysis components (state and trend indicators from statistics) with a set of spatial support tools to better guide and focus the overall assessment process and the recommendations feeding back into the SAP writing process. Each individual spatial support tool plugged into a specific stage of the SEA process:

a) Baseline assessment: create an understanding of the present environmental and social hotspots through map overlays.

b) Scenario development and impact assessment: provide an outlook on potential future development/infrastructure changes and social hotspots, using a scenario-driven land conversion model, and

c) Identification of alternative and mitigation areas: introducing spatial land suitability assessments to provide spatial guidance on environmentally and socially sound areas for investment, or areas requiring mitigation measures.

3.1. Baseline assessment: thematic map overlays

The baseline assessment took stock of the present state of environmental conditions, socio-demographic benchmarks, and economic assets. Besides using statistical data to develop broader state and trend indicators under these categories, spatial datasets were collected on key environmental variables (forest cover, biodiversity value, land use and degradation risk), socio-demographic variables (population density, poverty and type of livelihood) and economic variables (roads, railways, mining/forest/agricultural concessions and tourism industry). The thematic map overlays produced from these spatial layers established the geographic context, in particular on the geographic distribution and association of variables in the study area.

In combination with non-spatial statistical information (state and trend indicators), the interpretation of these maps critically improved the SEA team’s ability to identify geographically specific causal linkages and hotspots (i.e. environmentally and/or socially sensitive) areas. These findings were used to inform the SAP team at a very early stage in the drafting process about present conflicts and corresponding geographic areas that should not be prioritized for investments, and provide an important thematic focus for the following SEA steps (scenario building/impact assessment, recommendations on alternatives and mitigation measures).

3.2. Scenario development and impact assessment: scenario-driven land conversion model

The baseline assessment provided a post-evaluative view of the past and present challenges, and the underlying drivers and pressures. Based on this knowledge, and combining it with economic development projections and corresponding land demand, the scenario development and impact assessment aimed to provide an expansive “outlook” on where land conversion and associated environmental and social challenges might occur or intensify in the future.

For this purpose the SEA team utilized a scenario-driven land conversion model. The CLUE-s model—short for Conversion of Land Use and its Effects for small geographic areas—consists of four major components: 1) land use requirements (land demand), 2) land use type specific conversion settings, 3) spatial restrictions, and 4) location characteristics. While the first two are non-spatial “qualitative” components that lay out potential development trends and pathways in the target region, the latter two are geographically specific, providing the “quantitative” dimension of the model (www.cluemodel.nl).

For each national section of the NSEC target area, two land demand scenarios were developed: one “business as usual”, focusing on maximised economic development, and one “environmentally sound”, putting more emphasis on keeping the natural resource base—and dependent local livelihoods and businesses such as ecotourism—intact. Land use type specific conversion tables were developed for each individual land cover dataset in consultation with national stakeholders and international experts. Each land demand scenario was run once with protected areas as spatial restrictions (no conversion allowed in these areas), and once without simulating a lack of law enforcement which remains a challenge in some remote areas of the NSEC. Present land use distribution was tested for correlation with a set of underlying “explaining” factors: elevation, slope, aspect, distance to stream, distance to main road, distance to minor road, population density, and distance to settlement. If a specific land use type shows a strong correlation with one or more of these factors, they are used to guide the future allocation process.

Results of this model show continuing and intensifying conversion processes in all three national sections of the NSEC. With larger valleys...
already being developed for agriculture and commercial plantations, future demand starts transforming smaller previously not utilized valleys. At the same time these areas are often economically less rewarding (more difficult terrain and less suitable soils), environmentally (remaining primary forests) and socially sensitive (ethnic minority groups highly dependent on NTFP’s and small scale subsistence farming). Without
appropriate law enforcement, land conversion will also encroach into protected areas, particularly if close to infrastructure developments (e.g. Nabanhe and Mangao in Xishuangbanna; Mae Paem, Doi Luang and Tham Pathai in Thailand). Besides environmental concerns, emphasis on commercial plantations such as rubber in Xishuangbanna (particularly around Mengla, Fig. 2) threatens food security (agricultural land conversion) and economic vulnerability (market price fluctuations). The Lao section of the NSEC might face the same threat as Chinese investors are increasingly “outsourcing” rubber plantations into Northern Laos.
Fig. 3. Estimated land conversion in Northern Thailand, based on a “environmentally/socially sound” scenario (focus on intensification and safeguarding of primary forest). Present land cover on the left side and land cover in 2026 on the right side. Modelled without protected areas as restrictions to simulate impacts of lack of proper law enforcement.
THAILAND: NSEC FOCAL AREA - EIGHT NORTHERN PROVINCES
CLUE OUTCOMES: LAND COVER 2026 (DEMAND VISION 2, PA NOT ENFORCED)

Fig. 3 (continued).
Compared to the “business as usual” scenarios, the more benign “environmentally sound” scenario puts considerably less conversion pressure on high value ecosystems, mostly by combining the potential of agricultural intensification (lower land demand) with focus on conversion of secondary forests over pristine forests. In Thailand, the pressure on pristine forests is reduced so significantly that even in case of lack of efficient law enforcement, land conversion in protected areas, remains minimal (Fig. 3).

Fig. 4. SMCA suitability layer and outcomes of a least-cost path calculation based on such a layer. Two options for railroad were calculated: least-cost routing with passage through protected areas allowed (red line), and alternative railroad routing avoiding protected areas (purple line).
The impact assessments’ land conversion maps were used to identify areas that will undergo particularly heavy land cover changes (both in area size and intensity) in the coming 20 years, which is an important geographic input in the SEA teams’ broader analysis on conflicts emerging from increased investment pressure. Together with the outcomes of the baseline assessment, a complete set of recommendations on safeguarding both present-day as well as projected future vulnerable areas was put forward to the SAP team during the drafting process.

3.3. Identification of alternative and mitigation areas: spatial land suitability assessment

The geographic tools used in the baseline and the scenario and impact assessment identified present and future vulnerable areas and put forward corresponding recommendations to the SAP team. However, an important role of the SEA was not only to bring environmental and social restrictions to the SAP teams’ attention, but also to guide them on potential investment areas that are fulfilling minimum criteria for economic, environmental and social feasibility. Many of these criteria are based on the (geographic) knowledge gradually established through the outputs of the baseline and scenario/impact assessment phases, providing seamless links between the different applications through the overall SEA process.

For the purpose of aggregating and mapping out feasibility criteria, the SEA of the NSEC SAP piloted a Spatial Multi-Criteria Assessment (SCMA). At the heart of this method is the development of a criteria tree. It hierarchically lists all spatial factors defining the feasibility for a specific investment—in the SEA of the NSEC SAP transport infrastructure development was used as a pilot example as the first line of investments is the development of feeder roads and railroads. The criterion tree included a range of economic factors such as construction costs and value of assets to be connected. It also included environmental and social factors such as biodiversity, water resources, livelihood and health/security related spatial layers—all factors that add indirect costs if the targeted investment if they are compromised beyond their level of resilience to change. SEA stakeholders then assigned individual weights to the individual factors, expressing their relative contribution to overall feasibility.

While the SMCA map output alone can serve as a rough guidance on areas feasible for railroad development, for example, it can also serve as an input into a least-cost path calculation, which calculates a potential alignment or “optimal route” (Fig. 4). The example of two railroad alignments through Xishuangbanna was used by the SEA team to raise awareness on such an integrated spatial planning tool both with a) the SAP writing team, and b) national stakeholders/sector line ministries. While this particular application fits more in individual sector planning processes due to its tailoring to specific assets, the lack of capacity and awareness on such an application for environmentally and socially sound sector planning was considered an important message for the SEA team to pass on to the SAP and through this to the broader NSEC stakeholder community.

Acknowledging the fact that the area in the triangle Xishuangbanna Prefecture (Yunnan, PRC), Northern Lao PDR and Northern Thailand is especially sensitive with regard to its environmental values and the complex dependence of local communities on corresponding ecosystem services, the ADB decided to develop a Strategic Environmental Assessment alongside the SAP to ensure the investment framework is environmentally and socially sound.

Considering the trans-boundary character of the focal area and the complex geographic constellation between environmental, social and economic assets, the SAP team decided to integrate spatial support tools to strengthen their analysis and better focus the recommendations made to the SAP writing team. In a three pronged approach, the team developed thematic map overlays for the baseline assessment, combined this information with resource demand scenarios to develop future land conversion maps, and ultimately condensed this knowledge in a Spatial Multi-Criteria Assessment for railroad alignment through Xishuangbanna, PR China to raise awareness on this environmentally and socially sound spatial planning tool that is currently not widely used in GMS sector and integrated spatial planning.

Together, the spatial support tools successfully demonstrated that they can geographically refine non-spatial SEA assessment steps. Particularly the land conversion model confirmed that existing infrastructure—and therewith future transport development—is the key driver for land transformation, and that corresponding alignments needs to be scoped out with care to avoid adverse affects on environment and social assets. New transport infrastructure needs to be 1) carefully routed to avoid passing through environmentally and socially vulnerable areas, and 2) be paired with environmentally and socially sound sector development to ensure that the enabling conditions they provide is mutually beneficial for investor and local communities. Corresponding recommendations have been made and communicated into the SAP writing process.

Utilizing spatial support tools in the SEA of the NSEC SAP has shown to add value to the spatial accuracy of the recommendations and positions itself as an important early entry point for integrated spatial planning. However, the application of these tools in an SEA should not be considered a replacement for more detailed integrated spatial planning frameworks (sector spatial plans, land use master plans etc.) that usually position themselves in between sector strategies and project identification/implementation.

While the SEA of the NSEC SAP piloted a set of sophisticated spatial modelling approaches and produced a useful set of results, challenges remain. Setting up and using a spatial planning system of this complexity requires investment in human capital and knowledge, hardware and data resources. Data availability and sharing is an ongoing challenge in the GMS and needs to be considerably improved if spatial modelling is to produce results that are reliable enough to support broader strategic planning and detailed project planning alike.

4. Conclusion and lessons learned

After completion of construction of the trans-boundary road 3 (Kunming–Bangkok) in 2008, ADB started developing a Strategy and Action Plan (SAP) to scope out an investment framework that will a) transform the area along the road into a wider economic corridor, and b) serve the purpose of poverty mitigation through tailoring investments to provide livelihood development and benefit sharing opportunities.

Further-reading

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