

Summary PhD thesis Andreas Heinemann

“Pattern of Land Cover Change in the Lower Mekong Basin. The relevance of Mesoscale approaches.”

Unchecked economic and population growth over the last three decades have left their scars on the landscapes of the Lower Mekong Basin. Widespread deforestation and rapid land cover changes have deprived structurally advanced Thailand and Vietnam of large parts of their original forests. The two less developed countries in the centre of the Basin, Cambodia and Laos, are still comparably well endowed with forest resources, partly due to their recent political history. The distinct development disparities between Cambodia and Laos in the centre of the Basin and the surrounding countries of Thailand, Vietnam and China have resulted in high dependencies mainly on the part of the poorer nations. The ongoing economic opening of Cambodia and Laos brought about by the recent political tendencies, coupled with the enormous economic growth in the entire region, puts the remaining forests in the centre of the Basin under ever-increasing pressure. As the riparian countries of the Lower Mekong Basin share a common resource pool, and consequently also the environmental impacts of land cover change in a watershed context, it is crucial that comprehensive and comparable information on land cover status and land cover change becomes available for the entire Basin. Such regional level knowledge, however, is not readily available as yet owing to the huge gap between the site-specific information provided by local case studies on drivers of change and the static large-scale land cover inventories based on remote sensing data. The widely available land cover inventories are frequently not exploited to their full potential due to the lack of appropriate methods and because of institutional obstacles related to the mandates of the data producers.

Against this background, the present study seeks to generate a comparable information and knowledge base about land cover change on a mesoscale level for the entire Lower Mekong Basin. Such information is crucial to both informed decision making and the transboundary negotiations on the use and protection of the shared natural resources in regional bodies such as the Mekong River Commission. It may form the basis for achieving a common understanding regarding resource management in the Basin despite diverging national interests.

The overall approach adopted in this study includes not only the exploitation of existing regional multi-temporal land cover inventories and indicators for change, but also the analysis of land cover in relation to spatially disaggregated indicators of the biophysical and socioeconomic conditions. Additionally, new approaches are proposed towards a cost-effective monitoring of human interventions with the land cover system over large regions which would allow additional insight to be gained into ongoing land cover change processes.

The present study argues that, while being of major policy relevance, regional-level or mesoscale approaches offer a large potential for land cover research as well. The mesoscale is highly appropriate for amalgamating the contrasting concepts and methods of both locally oriented and large-scale research realms. Furthermore, the mesoscale allows the multiscale nature of land cover change processes to be taken into proper account: On this scale large-scale external driving forces may still be detectable before disappearing in the heterogeneity of the local context, and local conditions may not yet have been aggregated to a level where the respective processes or proxies forming them are no longer recognizable.

A comparison of the wide array of publicly available, large-scale land cover-related datasets highlighted immense differences in the Lower Mekong Basin (LMB). While some of the variation may be explained by the different methodologies used, the fact remains that, depending on which data source is tapped, diametrically opposite conclusions may be drawn. The percentage figures of forest cover in Laos, for example, varied by a factor of 2, and deforestation rates even by a factor of almost 10. The main land cover inventories exploited in this study are the 1993 and 1997 assessments of the LMB – the only comprehensive assessments of the LMB to date – elaborated by a project of the Mekong River Commission.

Mesoscale analysis of the 1993 and 1997 land cover data shows the distinct scars that various long-term land cover change processes – related to the level of market integration and depending on the political context – left on the landscape in the riparian countries. While in Thailand and Vietnam only 5 percent of the areas less than 0.5 hours' travel time from any village are still covered with forest, this value is still well above 30 percent in Laos and Cambodia. Similarly, the threshold of population density at which the forest cover of an area drops below 25 percent is three to five times higher in Laos and Cambodia than in their neighbouring countries. This study proposes to use such figures as indicators for the status of natural resources in a region, instead of the classical indicators (e.g. how much forest remains in a given area). The advantage of such new indicators is that they are rectified with regard to different levels of development (e.g. infrastructure), and hence allow for a more precise comparison of different regions.

Despite the logging bans in place in all riparian countries, deforestation averages 0.55% per year and remains the dominant and most disturbing form of land cover change across the Basin. Assuming that deforestation rates remain stable, the forest cover of the LMB will be reduced by more than half – to below 16% – by the year 2100, with unpredictable consequences for the hydrological cycle and the livelihoods of millions of people. Secondary forests and shrubby vegetation types show by far the highest level of human interference. Considering the ecological value of these vegetation types, as well as their importance for the livelihoods of the rural population in the Basin, greater emphasis has to be placed on the sustainable management of the areas concerned.

The present study was able to confirm the global tendency that logging paves the way for agricultural expansion: This is also the case in the LMB. In all riparian countries besides Thailand, the increase of permanent agricultural areas is largely attributable to prior logging. There are, however, signs that the enhanced integration of Laos and Cambodia into the regional and global economy is leading to increased direct conversion of secondary forests to cash cropping.

The statistical models developed indicate that of all the factors considered, village accessibility and population density are the dominant large-scale factors "driving" deforestation. This applies to all riparian countries with the exception of Thailand, where protection (i.e. the presence or absence of protected areas) represents the most important factor. Even though the relative influence of village accessibility and population density varies greatly among the countries, village accessibility is generally more dominant throughout the LMB. Consequently, it is crucial that large infrastructure development projects, that will enhance market access, be flanked with adequate measures to ensure the sustainable use and management of natural resources.

The present study further highlights the varying impact of the vicinity of towns on the intensity of intensification and deforestation processes, depending on the general development of the urban centres in a country: While the vicinity of a town, decreases deforestation risk in Thailand,

it increases the same risk in Cambodia and Laos. On the other hand, improved accessibility of a town increases the probability of intensification to a much greater extent in Thailand and Vietnam than in Cambodia and Laos. Furthermore, empirical evidence is provided that total forest loss as well as deforestation rates in Cambodia and Laos are extraordinarily high in areas that are easily accessible from Thailand, Vietnam or China. With regard to protected areas, it is shown that the lower deforestation rates observed in protected areas in Laos are not mainly attributable to protection per se but are related to the rather remote location of these protected areas, in regions with very low population densities.

In terms of methodology, the overall approach developed and applied in the present study comprises a variety of techniques ranging from cross-tabulation matrix analysis and spatial modelling to multivariate statistics. This combination of analytical tools grants considerable insights into the land cover system of the LMB and the different larger-scale processes active in the riparian countries. The approach has the potential of being adapted and replicated for application in other regions of the world, thus enhancing knowledge of land cover systems and active processes on the policy-relevant mesoscale.

To overcome some of the shortcomings of classical large-scale land cover-monitoring approaches (e.g. cost, long intervals between cycles, limited resolution), first steps towards a new, more cost-effective approach are presented. Based on the characteristics of this approach – e.g. regarding spatial and temporal resolution– a fundamental shift in the manner of gaining insight into the nature of human interactions with the land cover system over large regions may be initiated. The geometric shapes of land cover changes, and their spatial and temporal arrangement on the landscape (i.e. patterns), may be linked to categories of proximate causes (e.g. shifting cultivation or infrastructure development) driving these changes. However, concrete pattern recognition algorithms and methodologies still have to be developed, or adapted to land cover science by other disciplines (e.g. statistics and computer science), respectively.

The present thesis concludes with a set of specific recommendations addressed to producers and users of regional land cover data (e.g. regarding the exploitation of available data, the need for a critical view of public domain large-scale data), researchers in the field of land cover science (e.g. regarding the desirability of linking patterns to processes) and policy makers in the LMB (e.g. regarding the aim of strengthening regional coordination, policies on secondary forests).

Citation:

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