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Reconstructing contested landscapes

Dynamics, drivers and political framings of land use and land cover change, watershed transformations and coastal sedimentation in Java, Indonesia.

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Abstract

Environmental governance involves regulation of complex, multi-scalar processes that are influenced by a broad range of interwoven factors. Some of these processes and their drivers are only rudimentarily understood. This particularly applies to watershed contexts. Watershed management is also confronted with a broad range of actors and sectors. It is prone to conflicts and politicisations. Thereby, specific political framings of environmental processes can confine debates, knowledge production and political action to a few selected issues and drivers and prevent other issues and drivers from being debated, explored and addressed. This can undermine the effectiveness of watershed management and lay the ground for unrealistic expectations.

The Indonesian island of Java is a prime example illustrating this. Substantial funds have been invested into watershed conservation to reduce upland degradation and the sedimentation of reservoirs, irrigation channels and coastal waters. Most efforts have targeted soil erosion on peasants' private lands by tree planting and terracing programmes. Despite long-standing investment, upland degradation is still considered a problem. In line with the spatial focus of political action, most research to date has focussed on soil erosion and cultivation practices on upland peasants' private lands. Other sediment sources, historical trajectories, and the political dimension of watershed management are underexplored. Also the knowledge of land use and land cover patterns and changes, a major determining factor of erosion and sedimentation, and their causes is limited.

My research explores these aspects with a focus on one of Java's priority areas for coastal and watershed management: the Segara Anakan lagoon and its catchment area. This shallow coastal lagoon on Java's south coast has rapidly shrunk due to riverine sediment input. To reduce sedimentation of the lagoon and adjacent irrigation schemes, the catchment has been targeted by particularly strong watershed conservation efforts. Yet, their effects are regarded as limited. My research combines a reconstruction of the historical dynamics of lagoon sedimentation, an exploration of watershed characteristics and transformations, and an analysis of land use and land cover change (LUCC) and its drivers with an inquiry into the trajectories and modes of watershed management, related political framings of environmental matters, and underlying political structures and interests. It thereby questions long-standing narratives about the drivers of high

river sediment loads and coastal sedimentation and contributes new insight into the dynamics and causes of these processes. In this way, the research deconstructs simplistic narratives about watershed and coastal dynamics and reconstructs these dynamics. Conceptually, it combines political ecology, land change science and historical cartography. It also integrates knowledge from a broad range of research fields. Methodologically, the research combines remote sensing, mapping of land use and land cover and other watershed characteristics, analyses of historical maps, reviews of literature and documents, transect walks, semi-structured interviews with a broad range of actors from various political levels, and focus groups.

My engagement with the cartographic history of the region directs attention to the large but underutilised potential of historical maps for research into environmental histories. It also provides insight into the production, replication, gradual development, and ignorance of cartographic knowledge. It shows how information from complete but comparably inaccurate maps was reproduced over long periods of time, while information from more accurate but incomplete maps was continuously ignored. It also directs attention to the varying levels of accuracy within specific maps. Such insights are crucial in using historical maps for analysing environmental change. A core issue in the context of such analyses is the question of how accurate historical maps must be at minimum in order to be used for what kind of analysis. My research addresses this to date barely debated question. It presents an approach to analysing historical maps with varying degrees of accuracy and proposes ratios between the rates of environmental change and quantitative map accuracy measures as well as combined uncertainty measures as indicators of the maps' analytical suitability and the reliability of results. This should be combined with a qualitative appraisal of map accuracy, taking into account carto-bibliographic information. The research demonstrates that in case of large magnitudes of environmental change an analysis of even fairly inaccurate historical maps can provide results with low levels of uncertainty. It also illustrates how qualitative analysis of very early, rather inaccurate maps and map makers' records can complement the analysis of more recent, quantitatively analysable maps – an approach that has barely been applied to date and that demarcates the limits and illustrates some pitfalls of cartographic inquiry into historical environmental change.

My shoreline reconstruction based on historical maps and satellite images shows that lagoon aggradation accelerated between 1857/60 and the late 1980s and early 1990s and slowed thereafter. In total, the lagoon's water surface area has declined by three fourths since 1857/60. My exploration of watershed characteristics and dynamics suggests that accelerated lagoon siltation has been the result of a much broader range of drivers than commonly presented in political and scientific debates. In addition to erosion on peasants' private lands, these drivers include profound watershed transformations induced by intensified resource extraction, immigration and infrastructure development between the mid-19th century and the 1920s; contestations of state forests and plantation lands; state forest management practices; slope cuts to enlarge the agricultural land in valley floors; agricultural use of riparian zones; erosion and mass-movements from roads, trails and settlements; volcanic eruptions; and river channel and floodplain modifications. This synopsis suggests that the choice and expectations of interventions aimed at reducing river sediment loads and coastal sedimentation need to be reconsidered and that related debates and research agendas must be broadened to include the numerous factors beyond the scale of peasants' private agricultural plots.

Yet, peasants' private lands do constitute an important sediment source. However, soil conservation has improved, and tree cover has increased on these lands over the past 1.5 decades.

The latter is the result of various factors, such as rising timber prices, off-farm employment, marketing opportunities, increased awareness among peasants about soil degradation and the potential of perennial crops, and the enhanced effectiveness of recent, more participatory tree planting programmes.

In contrast, on some of the state forest and plantation lands tree cover has declined and erosion increased. This is mainly a result of struggles over resource access and control. Following a history of exclusive, repressive forest management by the state forest corporation, many state forests were plundered during the political reformation in the late 1990s and early 2000s. Community forestry programmes aim to resolve these conflicts and combat illegal logging. However, their limited performance in building trust and a sense of ownership is reflected in scattered tree cover and crop cultivation with limited soil conservation, resulting in erosion. Crop cultivation on state forest lands has in some cases contributed to increased tree cover on peasants' private lands. While watershed protection programmes focus on the latter, degradation on state forest land is left to the outcome of struggles between the forest corporation and peasants. Yet, the programmes also aim at influencing these struggles by reducing peasants' use of state forest land. This dichotomy between state forest and peasants' private lands, the corresponding division of institutional responsibilities and the linking of struggles over maintenance of this dichotomy with watershed management undermine the effectiveness of the latter.

Some state forest and plantation areas are degraded as a result of conflicts over specific pieces of land. In these cases, peasants claim land ownership referring to displacements in the wake of political insurgencies and counter-insurgencies or illegitimate expansions of plantations in the 1950/60s. Strategic acts of contestation employed by the conflicting actors to assert their claims and tenure insecurity result in high erosion levels on these lands. The course and resolution of these tenure conflicts is a major determining factor of watershed degradation and river sediment loads. This part of the research also direct attention to tenure contestations as an important, but to date still underexplored cause of LUCC. Tenure contestations should be disentangled from other types of tenure insecurity in analysing their links with LUCC. Furthermore, the close links between factors like historically rooted injustice, struggles over land and forest resources and related strategic acts and LUCC questions the need or utility of the common separation into proximate and underlying causes of LUCC.

The framing of peasants' cultivation practices as the single-most important cause of watershed degradation is too simplistic as it neglects a large range of other factors. It is also linked with the political interest in upholding the tenure dichotomy between state forest and peasants' private lands. It has confined research and political action to a particular scale, i.e. peasants' private plots, and distracted attention from scales that are crucial to look at in aiming to better understand the processes that were to be managed: the entire catchment area comprising the whole range of sediment sources, the various causes of watershed characteristics and transformations, and historical trajectories. This confinement of the scales of observation in turn has contributed to the solidification of the political framings and confining of political debates to particular scales of intervention (upland peasants' private plots). These links help to explain the temporary persistence and dominance of specific political framings and related scales of knowledge production and political action.

Political power, interests and conflicts and specific framings of environmental matters have shaped and will continue to shape environmental management-related debates and action. Without assuming the possibility of a 'politically neutral', 'objective' search for something like an

'ideal' watershed management strategy, the research results suggest that the environmental outcomes of watershed and coastal management in Java could benefit from a broadened view on the entire range of historical and contemporary watershed characteristics and transformations and their drivers. The results also point to the need for an open societal debate that links watershed protection aims and strategies with the resolution of tenure conflicts and with future (re-)arrangements of the patterns of forest access and control. Such a debate should involve a reconsideration of the long-standing framing of professional state forest management as the epitome of watershed protection and acknowledge the role of peasants' mixed forests with regard to watershed conservation. Some of the dense, diverse, multi-layered, and only selectively logged forests that cover substantial portions of the peasants' private lands provide better watershed protection than some of the state forest corporation's rotationally clear cut monocultures of teak.

The research demonstrates the utility of linking analyses of environmental dynamics and their drivers with critical inquiry into related political framings and modes of action and the underlying political interests and struggles. It also illustrates that the combination of political ecology, land change science and historical cartography and the integration of fractured knowledge from different disciplines generates insights that would remain hidden if the inquiry adhered to one particular research field. Many of the most insightful findings of this research were generated through the combination or at the intersection of the different themes, approaches and methods.