

Fisheries, aquacultures and political ecology: Towards interdisciplinary and democratized research on Chilika Lake

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Abstract

Chilika Lake represents a complex and dynamic socio-ecological wetland system in regard to which researchers, officials, activists and local communities have defined and prioritized different environment and development problems. The objective of this paper is to identify potential questions for problem-oriented, interdisciplinary research on Chilika and to propose processes to make such research relevant for local stakeholders. The paper is based on a review of a fairly comprehensive social-science literature that is reinterpreted in a political-ecological framework and complemented by insights gained in a workshop and a short field exposure. Our analysis suggests that the commercial shrimp aquaculture by non-fishing communities is a, if not *the*, key environmental and social issue in Chilika. Unsustainable shrimp farming practices have affected fish stocks and led to the marginalization of traditional fishing communities and to environmental conflict. This socio-ecological problem represents a relevant field for future problem-oriented, interdisciplinary research. Such research would need to go beyond technical-institutional perspectives to take into consideration the political and cultural underpinnings of the ongoing environmental conflict and of its scientific (disciplinary and multidisciplinary) analyses. This is better achievable if partnerships between researchers and different stakeholder groups across the science-polity-society boundaries can be created and if the research process and its social framing can be made as transparent as possible.

1. Introduction

From various presentations at The Indo-Swiss Workshop on Ecology and Conservation of Chilika Lake from November 25-26, 2011, I came to realize that this lagoon represents a complex and dynamic ecological system that has so far not been fully understood or sufficiently researched by hydro-geologists, geomorphologists, biochemists, biologists, etc. There remains a great deal of uncertainty about the extent and causation of various biophysical processes, including sedimentation, siltation, water flow, changes in trophic state and salinity, chemical pollution, changes in fish and bird populations. Research presentations by social scientists, furthermore, showed that these processes are closely linked to manifold human activities (e.g., capture fishing and shrimp aquaculture in the lake, tourism, dwelling near the shores, rice cultivation and prawn aquaculture in the catchment areas) as well as to particular state interventions (river-flow control through dams upstream and the management of the sea mouth connecting the lagoon with the sea).

Clearly, biophysical and social processes need to be better understood in Chilika Lake and its catchment as they take place in state, national and global contexts. Because of the intertwined nature of the social and biophysical processes, furthermore, interdisciplinary research appears to be required to better comprehend this complex *socio*-ecosystem. However, interdisciplinary research is not self-evident. Particularly the collaborations between natural scientists and social scientists are not unproblematic because researchers follow and use strongly divergent epistemologies and methodologies. Truly interdisciplinary research (as opposed to multidisciplinary research) goes beyond adding a social component to an already designed natural-science project (and vice versa) to negotiating from the start the key research questions and conceptual frameworks. This necessitates careful consideration of respective roles and mutual expectations between different researchers.

Apart from scientific uncertainties, most workshop participants also expressed worries about particular developments in Chilika. Researchers identified, defined and prioritized different environment and development problems: weed infestation, eutrophication, species invasion, over-/under-salinization, overfishing, unsustainable aquacultures, conflict between fisher and non-fisher communities, etc. First, this is an indication of a strong demand for problem-oriented, applied research on Chilika, a type of research that

does not only need to meet the criteria of reliability and validity but equally that of social relevance. Second, the divergent definitions of “the problem” (which were to some degree shaped by the scientists’ respective fields of study) also suggest that science is a social construct and socially framed. Applied research needs to acknowledge this social framing, including the influences of political narratives on the research agenda.

Research may be relevant only for a specific social group of the local population or only for particular policymakers and –implementers. These two points imply that problem-oriented research on Chilika would need to problematize the relationships between science, society and polity.

The objective of this paper is to identify potential questions for problem-oriented, interdisciplinary research on Chilika (rather than to provide answers to its socio-environmental challenges) and to propose processes that can make such research relevant for local stakeholders. To illuminate issues related to interdisciplinary and applied scientific practice, I draw upon the approach of political ecology. First, political ecology represents an interdisciplinary approach to study complex and dynamic human-environment interactions. In order to identify key issues and potential questions for interdisciplinary research, this paper therefore reinterprets findings from the social-science literature on Chilika in the framework of political ecology. Second, political ecology provides some directions for making environmental science relevant, particularly for marginalized sections of society, through a process of democratizing science. This chapter points to some possibilities how this could be done in the context of Chilika.

It needs to be noted that this paper is explorative in character due to my very limited research exposure to Chilika. It is largely based on a review of social-science literature on Chilika, and complemented by information from presentations at the Indo-Swiss Workshop on Ecology and Conservation of Chilika Lake, and by insights from an informal conversation with a group of traditional fishermen in November 2011.

The chapter is divided in five parts. After this introduction, section 2 provides an overview of the approach of political ecology, focusing on its assumptions for the study of human-environmental systems as well as on the social framings and the politics of

environmental science. Section 3 attempts to summarize the existing literature on Chilika from a political-ecological perspective pointing out some possible further (interdisciplinary) research questions that have not been addressed so far. In section 4, I present some preliminary reflections on the challenges of including social and political actors in the interdisciplinary research process. The final section summarizes the main arguments of the paper.

2. Political Ecology

Political ecology has been defined as combining “the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and the land-based resources, and also within classes and groups within society itself” [Blaikie and Brookfield, 1987: 17]. This definition points to the importance not only of human-environment interactions but also of social relations between different groups of a society to explain environmental degradation.

Furthermore, political ecology tends to analyze local socio-ecological processes within their wider institutional and structural contexts; that is, in relation to policies and economic changes at higher spatial scales. Early “structuralist” political-ecological studies focused on larger political-economic structures influencing local-level resource management. This approach has been extended by the integration of poststructuralist theories – particularly, the consideration of the social construction of environmental knowledge and an increasing emphasis on local resource users as political agents [Walker, 1998].

Robbins [2004] classified the major concerns of political ecology in four fields. (1) Causal links between *environmental degradation and social marginalization* are suggested whereby the blame for environmental degradation is put away from the local poor to wider political and economic processes. Poor people are often structurally forced to overexploit their resource base, leading to their further marginalization. As indicated, this takes place because of structural factors and not because of a lack of awareness or knowledge of local resource users. Other political-ecological studies acknowledge, however, that unsustainable land-use practices are not only carried out by the poor but very often by local non-poor resource users [Moseley, 2005; Véron, 1999]. (2) Political ecology regards local communities as socially structured rather than homogenous. This

often implies that access to natural resources (or “environmental entitlements” [Leach *et al.*, 1999]) are structured by social class, ethnicity/caste, gender and other social markers. Unequal access to natural resources is then seen as a basis of *environmental conflict* between different social groups of resource users. Environmental conflict itself can aggravate processes of environmental degradation. Furthermore, political ecology takes into consideration that seemingly “environmental” conflicts may in fact be part of larger class-, gender- or ethnicity-based struggles, or that these struggles are carried out on the “environmental arena”. (3) Political ecology also critiques the state’s activities in environmental conservation, particularly the creation of protected areas such as national park that involve the exclusion of local communities, that are in contradiction with livelihood needs. Such state interventions are interpreted as an instrument to increase *control through conservation*. (4) Finally, political ecology regards local *social movements* as being primarily motivated by the protection of people’s livelihoods and their immediate environment and resources. Grassroots movements are seen as a basis for “liberation ecologies” [Peet and Watts, 2004]. As we will see in section 3, all these four fields of political ecology are relevant for the case of Chilika.

At a more fundamental level, a “critical political ecology” [Forsyth, 2003] shows how environmental knowledge is constructed socially by diverse groups, including local populations and natural scientists. He puts into question the objectivity and neutrality of environmental science models and policy, but not the idea that there are real biophysical processes beyond our social construction thereof. In particular, Forsyth analyzes the social and political framing of environmental science, a specific type of environmental knowledge that is powerful enough to shape environmental policies. Such a view starts from the assumption that science and policy, or knowledge and power, are closely interlinked in a way that power is also influencing knowledge, or what type of knowledge is regarded as valid [Foucault, 1980]. This perspective implies, for example, that one needs to understand the political and social processes of environmental problematizations; that is, the socio-political definition an environmental situation as an environmental *problem*. Similarly, environmental explanations are socially framed, for instance by the customary practices of an academic disciplines. Thus, environmental explanations put forward by scientists may not necessarily be meaningful for local populations. Therefore, Forsyth [2003] calls for a “democratization of environmental

explanations” through making transparent the tacit politics and assumptions of science models, as well as through avoiding environmental explanations that have little meaning and relevance for local people [see also *Callon et al.*, 2009]. Section 4 sketches out some possible directions to democratize environmental explanations within an interdisciplinary research team and within larger policymaker and local communities.

3. Recent political-ecological issues in Chilika

As mentioned earlier, this section is largely based on a review of existing social-science literature on Chilika. Many of the reviewed articles followed explicitly or implicitly (aspects of) a political ecology approach, and they revealed important links between environmental degradation and marginalization, environmental conflict, conservation and socio-environmental movements.

The literature on Chilika clearly points to the *marginalization* of traditional fishermen communities (mostly scheduled castes) for the past 20-30 years. Their socioeconomic marginalization is explained with a variety of factors. For instance, biophysical changes of the lagoon, in particular changing salinity levels and reduced exchange of sea and fresh water, led to smaller and inadequate fish stock [*Nayak and Berkes*, 2010; *Dujovny*, 2009, see below]. Dams upstream and a closing sea mouth resulted in the siltation in parts of the lake. Furthermore, fish stocks and their regeneration (and possibly the quality of fish for safe human consumption) were affected by (chemical) lake pollution stemming from different sources, including rice agriculture in Chilika’s catchment area where chemical fertilizers and pesticides are used, tourist boats and, particularly, intensive shrimp aquaculture in the lake and at its fringes where protein and possibly also chemical inputs are used. These shrimp *gherries* (bamboo-built enclosures in the lake) also affected the flow of water and the migration of fish [*Pattanaik*, 2007].

Furthermore, a group of interviewed local fishermen explained to us that aquaculturalists would adversely affect fish stocks and their regeneration by using very fine nets to catch shrimp seedlings entering the lake at the sea mouth. They use the baby shrimp for their *gherries*; the bycatch of baby fish of all sorts, however, is not returned to the lake but dried and used as fodder in the hatcheries.

The severe resource competition with shrimp aquacultures seems to be one of the main reasons for the fishermen's marginalization. These relatively small but very numerous (officially banned) shrimp farms operate on private and government land; they have been established by better-off non-locals (higher-caste agriculturalists, businesspeople, politicians, etc.) motivated by increased international market demand [Adduci, 2009; Mishra and Griffin, 2010; Pattanaik, 2006; Pattanaik, 2007; Nayak and Berkes, 2010]. The spread of shrimp cultures since the 1990s has also been aided by a new licensing/allocation system that allowed the entrance of aquaculturalists at the expense of traditional fishermen and their cooperatives [Adduci, 2009; Iwasaki and Shaw, 2009; Pattanaik, 2007].

Importantly, the traditional fishers' marginalization seems to have led to a certain disconnection from the lake and change in livelihood strategies (e.g., seasonal outmigration for wage labor), changes in consumption patterns (the "fishing" communities now eat more often chicken than fish), increased indebtedness and decreased social capital (weakening of fisher caste assemblies and the Fishers Cooperative Federation) [Nayak and Berkes, 2010; see also Sekhar, 2007]. When I asked a group of teenagers in the fisher village whether they want to work as fishermen like their fathers, they shrugged and shook their head.

Linked to the described marginalization process, the recent socio-environmental history of Chilika and its people has been shaped by *environmental conflict*, particularly between the traditional fishermen and the shrimp farmers [Adduci, 2009; Pattanaik, 2007; Dutta, 2011]. In the 1950s, Chilika fishermen were organized in a cooperative system to which territorial fishing licenses were allocated. In the context of general policies of neoliberalization, the cooperatives were allowed to rent out fishing rights to private agents and shrimp aquaculture was promoted with a view to increase production and exports [Adduci, 2009; Pattanaik, 2006]. A *social movement*, the *Chilika Bachao Andolan*, representing and an alliance of traditional fishermen, environmentalists and 'intermediate classes' (local businesspeople) successfully resisted a large-scale corporate shrimp-farming project. However, local businesspeople illegally set up smaller scale prawn cultivation and marketing operations since the 1990s [Adduci, 2009]. Fishermen (organized in fisher cooperative societies and the *Chilika Matsajibi*

Mahasanga, or Confederation of the Chilika Lake Fishers) protested against informal aquaculture practices; these protests culminated in the police shooting of four fishermen in 1999 [Adduci, 2009]. The nexus between agents, brokers, local politicians and now also “representatives” of local fisher cooperative societies has made the implementation of the official ban on shrimp cultures in Chilika all but impossible [Pattanaik, 2007; Dutta, 2011]. Moreover, the latent conflict and violence have further reinforced the insecurity and vulnerability of the traditional fisher households [Iwasaki and Shaw, 2009].

Apart from a source of livelihood, Chilika is a *nature conservation area*; it is a Ramsar Convention Wetland of international importance, particularly valuable as a waterfowl habitat. The late 1990s saw the fish stock declining sharply not only threatening traditional livelihoods but also the biodiversity of the wetland system. The cause was identified in a closing and permanently shifting sea mouth. Consequently, the Chilika Development Authority (CDA) opened a new artificial sea mouth in 2002. In the official narrative, the new sea mouth resulted in the restoration of biodiversity, fish stocks and “appropriate” exchange interactions between sea and fresh water [Ghosh *et al.*, 2006; Mohapatra *et al.*, 2007]. Indeed, the CDA received the Ramsar Wetland Conservation Award in 2002. However, the impacts of the sea-mouth opening seem to have been spatially very uneven [Mishra and Griffin, 2010]. Local narratives of traditional fishermen point to oversalinization and sea species invasion (particularly near the new sea mouth) and to increased seasonal unpredictability of fish landings [Nayak and Berkes, 2010]. The opening of the artificial sea mouth seems to have benefited mostly rice cultivators and shrimp farmers [Dujovny, 2009]. But even where fish stocks and fish landings increased, benefits did not reach the traditional fishermen but rather the middlemen in the fish market to whom fishermen are indebted [Iwasaki and Shaw, 2008].

Overall, the reviewed social-science literature offers a rich and fairly complete picture of the recent socio-ecological processes of Chilika through the description and analysis of socio-environmental marginalization, conflict, movements and state interventions. Nevertheless a few knowledge gaps still seem to exist from a political-ecological perspective, namely in the field of gender and state-society relations. Firstly, the

reviewed literature remains by and large silent on gender relations in the fishing communities (as well as in other local communities). While it is obvious that men are traditionally involved in the fishing operations, it would be important to know what the gender implications of the fishing communities' increased marginalization and disconnection from the wetland resource system have been. My explorative conversation with fishermen indicated that their women have started to work more frequently in nearby agricultural fields, a necessary livelihood practice that the men did not seem to appreciate culturally and that may have led to new gender conflicts. Secondly, the literature has, to my limited knowledge, not paid much attention to the question whether there is a history of distrust between local communities and state agencies. Yet it seems that there have been conflicts between fishing communities and the CDA (which has wide-ranging policing powers in Chilika) around the construction of the latter's office building on a former commons in the mid-2000s. During my visit in November 2011, neighbors had blocked the original access road to the CDA building. Local fishermen also joked to us that CDA stands for "choto dacoit association" (association of little bandits). Of course, one cannot generalize from these incidents and statements on the relationship between the CDA and all fishing communities in Chilika. From a political-ecological perspective, however, it would be important to have more detailed knowledge of the (history of) relationships between the CDA, other government agencies and different local social groups and communities in Chilika.

4. Implications for future interdisciplinary applied research

What do these findings from political-ecological studies imply for potential multi- and interdisciplinary research on Chilika by natural and social scientists?

The social-science literature on Chilika suggests that the principal cause of environmental degradation and the marginalization of traditional fishing communities are the illegal commercial shrimp *gherries* and farms run by better-off local social groups and non-locals. Given the described nexus, however, it seems politically nearly impossible to implement and enforce the ban on shrimp cultures in Chilika. Seeking compromises in resource use between traditional fishermen and the richer shrimp farmers (e.g., proper demarcation and delimitation of culture areas, harvest rules, adoption of sustainable and less pollution cultivation practices) may be the only way out

of the impasse. A possible research agenda for natural scientists could be to find ways to reduce the negative impacts caused by the current practices of shrimp cultivation with the objective to reduce chemical pollution and eutrophication. To assure a market for Chilika fish in the long run, it may also be necessary to try and minimize chemical residues in caught and sold fish. (A CDA representative mentioned at the Workshop that they initiated the process to have Chilika fish and shrimp certified as sustainably produced.) At the same time, a task for social scientists could be to help (re-)create a functioning common property resource system with clear resource-use rules and clearly demarcated use zones (between different fisher communities and, in particular, between fishers and aquaculturalists). Obviously, alternatives to the abovementioned current practice of harvesting baby shrimp at the sea mouth need be found. Such science-based techno-institutional measures may improve ecological, economic and social sustainability in the Chilika region and reduce environmental conflicts.

However, even when the best possible natural and social science is applied, these normative aims may not necessarily be achieved. The case of Chilika seems complicated by the class and caste differences and the long history of tensions that underlie the environmental conflict between the traditional fishermen and shrimp farmers that also have sociocultural underpinnings [see *Dujovny*, 2010]. Environmentally and economically “rational solutions” may not be perceived as acceptable or desirable. There might be little appetite for compromises. Still, one may ask whether there have been attempts to bring together organizations of the traditional fishermen and the shrimp cultivators, what role *panchayati raj* institutions or the CDA could play in mitigating this resource conflict. For example, *Venot and Narayanan* [2009] have pointed to the importance of multi-scalar environmental governance in the case of India’s wetland systems.

In any case, the issue is as much *cultural* and *political* as it is technical (biochemical) and institutional. I think the big challenge for a future research project on Chilika is not to bring together natural and social scientists, but different stakeholder groups amongst each other and with the researchers. An important task and challenge, in my view, is to create partnerships and networks across the science-polity-society boundaries. We may need to think about ways how traditional fishers (perhaps through their organizations

such as traditional caste *panchayats*, cooperatives or the CMM), aquaculturalists, agriculturalists, local and supra-local decision-makers can influence our research agenda. What would represent relevant natural- and social-science research from the point of view of different social groups? At least, we need to be aware of what and who is framing our research agenda, and making this transparent.

Apart from the issue of the shrimp farms, the reviewed social-science literature points to problems related to water (salinity and siltation) management of the lagoon through physical interventions in the catchment area (dams) and particularly at the coast (opening of the artificial sea mouth). It appears that more caution will be required for further physical interventions in coastal management; i.e., the management of sea mouths. Natural and GIS sciences may have the potential to better account for spatial variability of salinity-related changes and thus to inform future interventions with the objective to reduce negative effects on particular (fishing) communities. In parallel, social-science research may be able to discern how local fishers adapt to changing biophysical conditions of the lake – and how they have adapted in the past to such changes in this inherently dynamic socio-ecological wetland system.

In the case of interdisciplinary research on water management and community adaptation, too, it will be necessary to include local stakeholders, particularly the spatially differentiated fishing communities. What type of wetland is of most benefit to local communities of different micro-localities in Chilika, and how could science-based (physical) interventions coproduce such environments without compromising biodiversity goals? Social-science research should thereby also avoid regarding local (fishing) communities as homogenous, but rather take social (including gender) differentiations, as well as micro-politics, into account.

Furthermore, uncertainties about the sustainability of the Chilika fisheries persist. This was reflected in the above-mentioned workshop: While some presenters employed a crisis narrative of overfishing, the CDA presented figures of expanding fish stocks. However, the reviewed social-science literature also shows that higher fish productivity does not automatically lead to better livelihoods for the fishing population. From a socioeconomic point of view, the important question is not that of fish availability but

that of entitlements, including exchange entitlements (echoing Amartya Sen's work on poverty and famines). This implies that an exclusive focus on using natural sciences to increase fish productivity will be inadequate as long as institutional structures of fish marketing cannot be improved for the benefit of traditional fishermen. Recently, the CDA helped rejuvenating some local fisher cooperatives and it provided them marketing support, bypassing existing brokers and agents. While it is too early to draw any conclusions from this initiative, some fishermen (including the ones I was able to talk to) do not seem to view their existing market relationship as exploitative; brokers provide them with valuable services, including direct purchases from the boat at the fishing sites and food provision to the boat during long fishing expeditions. Still, the question remains whether fish marketing from Chilika can be further improved for the benefit of all stakeholders in the current context of liberalization and globalization.

Finally, the reviewed literature suggests that fishing communities have become more and more disconnected from the lake and from fishing. This leads to a number of more fundamental (and perhaps controversial) questions: Can and should fishing livelihoods be restored at all? Or would an altogether different focus be needed, such as focusing on enabling local people through education, training and improved health care to make the transition to new (diversified) livelihoods (e.g., ecotourism)? Indeed, local fishing communities have started to attempt improving their socioeconomic and sociocultural position through the education of their children.

5. Concluding remarks

For future policy-oriented, collaborative research on Chilika it will be necessary to clearly define the objectives. Surely, Chilika may be interesting from purely natural-scientific and nature-conservationist points of view. It could be a training ground for young and established natural research scientists; it could provide the natural base for the development of biotechnologically produced remedies, etc. However, Chilika does not only represent a highly complex ecosystem but it also embodies high social and socio-ecological complexity. Because of the strong anthropogenic influences on the ecosystem, the inclusion of the social sciences seem necessary to better understand this *socio-ecological* wetland system. Chilika Lake represents not only an important habitat for endangered and endemic animal species but also a source of livelihoods for

thousands of people. Interdisciplinary research may therefore become a basis for livelihoods-oriented nature conservation. However, this chapter has shown that the environment and development issues of Chilika Lake have strong political and cultural dimensions – dimensions from which science and interdisciplinary research cannot escape. It seems therefore necessary to render the political framings of our research transparent and to attempt *democratizing* our socio-environmental explanations, in particular through the inclusion of local stakeholders.

I would like to conclude this paper with a carefully optimistic quote by *Nayak and Berkes* [2011] that points into this direction. *If* the aim is to create sustainable fishing livelihoods and to restore common property management, supporting political processes are required: “... [T]o keep the Chilika commons as commons will require, as a starting point, a policy environment in which legal rights and customary livelihoods are respected. The timing may be good for a policy change: international prawn markets have stabilized and the ‘pink gold rush’ is over. Under new policies, political space for negotiation needs to be created, and processes causing marginalisation reversed. Fishers need to be empowered to re-connect to their environment and reinvent traditions of stewardship, without which there will be no resources left to fight over. Networks and partnerships are central to this process of capacity-building and social-ecological revitalization” [*Nayak and Berkes*, 2011: 143].

References

- Adduci, M. (2009), Neoliberal wave rocks Chilika Lake, India: Conflict over intensive aquaculture from a class perspective, *Journal of Agrarian Change*, 9(4), 484-511, doi:10.1111/j.1471-0366.2009.00229.x.
- Blaikie, P., and H. Brookfield (1987), *Land Degradation and Society*, Methuen, London, UK.
- Callon, M., P. Lascoumes, and Y. Barthe (2009), *Acting in an Uncertain World : An Essay on Technical Democracy*, MIT Press, Cambridge, MA.

- Dujovny, E. (2009), The deepest cut: Political ecology in the dredging of a new sea mouth in Chilika Lake, Orissa, India, *Conservation and Society*, 7(3), 192-204, doi:10.4103/0972-4923.64736.
- Dujovny, E. (2010), Casteing the net: The making of a lagoon and the emergence of caste as social network, Ph.D. thesis, Univ. of Georgia, Athens, Georgia, USA.
- Dutta, K. (2011), Chilika's fishermen set to battle prawn mafia themselves, Infochange Website, <http://infochangeindia.org/environment/features/chilika-s-fishermen-set-to-battle-prawn-mafia-themselves.html>.
- Forsyth, T. (2003), *Critical Political Ecology: The Politics of Environmental Science*, Routledge, London, UK and New York, NY.
- Foucault, M. (1980), *Power/Knowledge : Selected Interviews and Other Writings, 1972-1977*, Vintage, New York, NY.
- Ghosh, A. K., A. K. Pattnaik, and T. J. Ballatore (2006), Chilika lagoon: Restoring ecological balance and livelihoods through re-salinization. *Lakes & Reservoirs: Research & Management*, 11(4), 239-255, doi:10.1111/j.1440-1770.2006.00306.x.
- Iwasaki, S., and R. Shaw (2008), Fishery resource management in Chilika lagoon: A study on coastal conservation in the Eastern Coast of India, *Journal of Coastal Conservation*, 12(1), 43-52, doi:10.1007/s11852-008-0022-y.
- Iwasaki, S., and R. Shaw (2009), Linking human security to natural resources: Perspective from a fishery resource allocation system in Chilika lagoon, India, *Sustainability Science*, 4(2), 281-292, doi:10.1007/s11625-009-0084-2.
- Leach, M., R. Mearns, and I. Scoones (1999), Environmental entitlements: Dynamics and institutions in community-based natural resource management, *World Development*, 27(2), 225-247.

- Mishra, S. R., and A. L. Griffin (2010), Encroachment: A threat to resource sustainability in Chilika Lake, India, *Applied Geography*, 30(3), 448-459, doi:10.1016/j.apgeog.2009.12.001.
- Mohapatra, A., R. K. Mohanty, S. K. Mohanty, K. S. Bhatta, and N. R. Das (2007), Fisheries enhancement and biodiversity assessment of fish, prawn and mud crab in Chilika lagoon through hydrological intervention. *Wetlands Ecology and Management*, 15(3), 229-251, doi:10.1007/s11273-006-9025-3.
- Moseley, W.G. (2005), Global cotton and local environmental management: The political ecology of rich and poor small-hold farmers in Southern Mali, *The Geographical Journal*, 171(1), 36-55, doi:10.1111/j.1475-4959.2005.00148.x.
- Nayak, P. K., and F. Berkes (2010), Whose marginalisation? Politics around environmental injustices in India's Chilika lagoon, *Local Environment*, 15(6), 553-567, doi:10.1080/13549839.2010.487527.
- Nayak, P., and F. Berkes (2011), Commonisation and decommonisation: Understanding the processes of change in the Chilika lagoon, India. *Conservation and Society*, 9(2), 132-145, doi:10.4103/0972-4923.83723.
- Pattanaik, S. (2007), Commercialization of shrimp trade, environment and rural poverty: A socio-ecological exploration in coastal Orissa, Working Paper Series E/274/2006, Institute of Economic Growth, Delhi, India, http://www.cised.org/wp-content/uploads/Sarmi%20Patt%20workpap_274.pdf.
- Pattanaik, S. (2007), Conservation of environment and protection of marginalized fishing communities of Lake Chilika in Orissa, India, *Journal of Human Ecology*, 22(4), 291-302.
- Peet R., and M. Watts (Eds.) (2004), *Liberation Ecologies: Environment, Development, Social Movements*, 2nd edition, Routledge, London, UK.

- Robbins, P. (2004), *Political Ecology: A Critical Introduction*, Blackwell, Malden, MA.
- Sekhar, N. U. (2007), Social capital and fisheries management: The case of Chilika Lake in India, *Environmental Management*, 39(4), 497-505, doi:10.1007/s00267-006-0183-0.
- Venot, J.-P., and N. C. Narayanan, N. (2009), Echelle(s) communes(s) ou échelles multiples ? Pour une gouvernance démocratique des ressources naturelles : Les zones humides en Inde. *Vertigo*, 9(1), <http://vertigo.revues.org/8276>, doi:10.4000/vertigo.8276.
- Véron, R. (1999), *Real markets and environmental change in Kerala, India : A new understanding of the impact of crop markets on sustainable development*, Ashgate, Aldershot, UK.
- Walker, P. (1998), Politics of nature: An overview of political ecology. *Capital, Nature, Society*, 9(1), 131-144.