Land Use Policy 57 (2016) 499–513

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

A comparison of influences on the landscape of two social-ecological systems

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ARTICLE INFO

Article history:
Received 5 May 2015
Received in revised form 4 June 2016
Accepted 15 June 2016

Keywords:
Eastern Panama
Governance
History
Indigenous
Land cover
Ostrom's social-ecological systems framework

ABSTRACT

Case studies of social-ecological landscapes that consider local, spatially explicit land cover changes are necessary for the development of generalised knowledge on deforestation. This study focussed on two indigenous territories of eastern Panama that share the same settlement history, size and location but are perceived by local dwellers to differ in terms of land cover. By considering the territories social-ecological systems made up of Resource Systems, Resource Units, Actors and Governance Structures, following Ostrom's framework for analysing the sustainability of social-ecological systems (McGinnis and Ostrom, 2014), we sought to determine which social-ecological factors could have led to divergent land cover outcomes to address local leaders' concerns and inform future land management strategies. We conducted quantitative, spatial analysis using ArcGIS and multivariate statistics from numerical ecology on land cover data from participatory maps, and household level socio-economic data from semi-structured interviews and surveys. Results illustrate that the Resource System's topography and Actors' socioeconomics, namely number of people at home and household land ownership, are constraining variables on land cover and help explain divergent forest cover. To reconstruct the influence of history and Governance Structure on the landscapes, we conducted qualitative data collection, namely participatory pebble scoring of historical land cover, interviews with key informants, an archival search, and creation of a participatory historical timeline. Historical governmental timber extraction in the region pre-settlement, guided by topography constraints, may have led to degraded Resource Units (forests) susceptible to clearing. The Governance Structure's self-organizing, monitoring and networking activities with outside institutions in scientific projects, enabled by Actors' leadership and social capital, likely encouraged forest conservation in the forest-rich territory. Future land management could therefore benefit from establishment of a local non-governmental organisation to coordinate a communal vision of management and harness external conservation resources. Our findings suggest that inputting both qualitative and quantitative data obtained by participatory methods into Ostrom's framework can help diagnose territories with divergent landscapes, and thereby inform both forest conservation science and local land management.

1. Introduction

Global deforestation is a well-documented phenomenon, with 13 million hectares of forest estimated as lost yearly between 2000 and 2010 worldwide (Food and Agriculture Organization, 2010). In Central America and the Caribbean, satellite imagery and literature analysis show that 1.4% of forest cover was lost between 2000 and 2005 (Asner et al., 2009). A 'conversion of land cover and its effects' model for the neotropics predicted that Central America would be a hotspot of deforestation in 2010 (Wassenaar et al., 2007). These forests are also home to local people; in Latin America and the Caribbean, about 40 million Indigenous peoples live in forests (World Bank, 2004), and Indigenous peoples in Latin America own

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http://dx.doi.org/10.1016/j.landusepol.2016.06.018

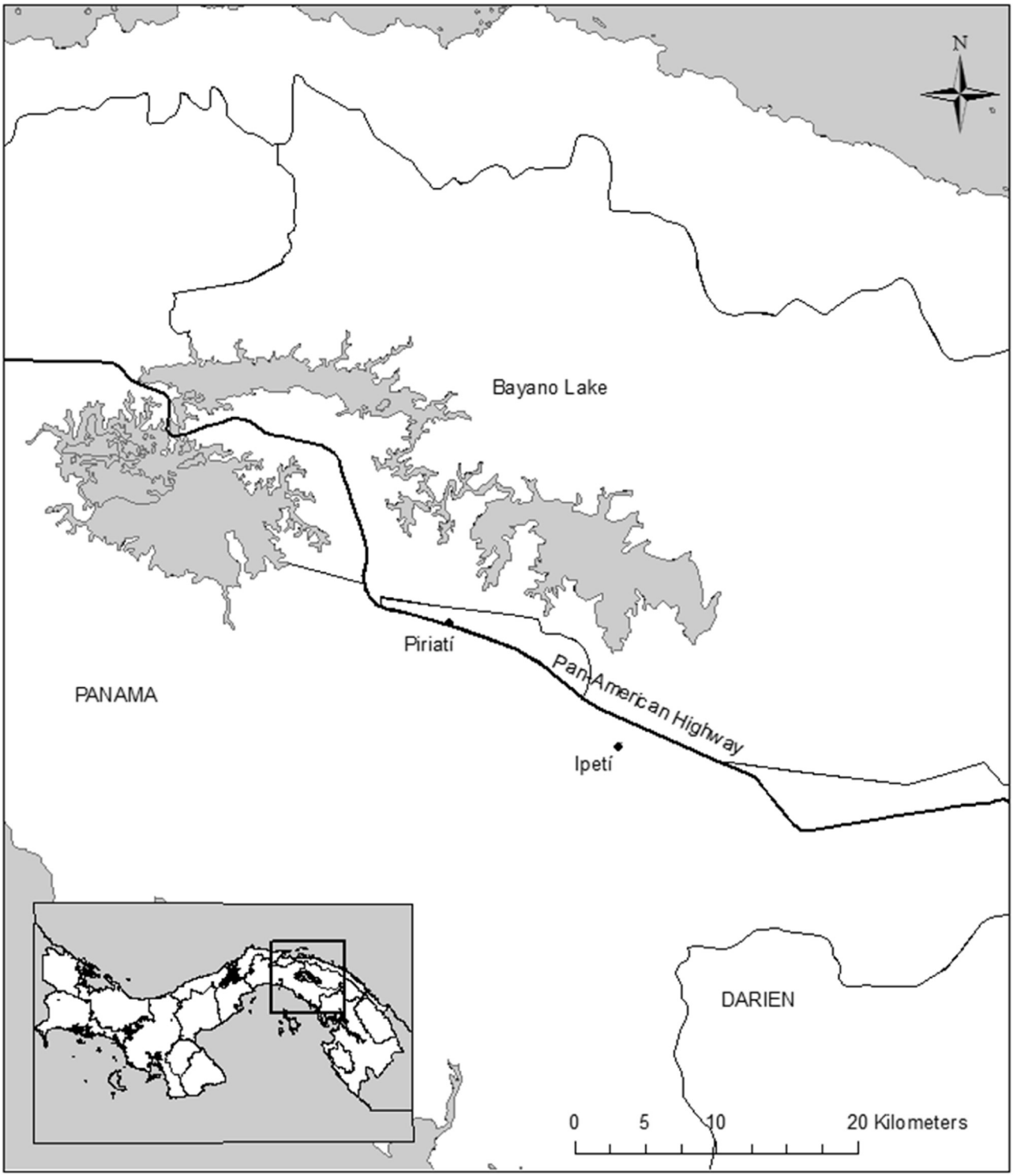

Fig. 1. Location of the two territories studied, Piriatí- and Ipetí-Emberá, off of the Pan-American Highway in eastern Panama.

almost half of the 9.1% of global forests that are community-owned (van Dam, 2011).

Landscapes are formed from a composite of local changes in land cover (Lambin et al., 2003) and can be viewed as social-ecological systems in which particular landscapes emerge from an array of environmental and human interactions. Thus case studies that consider fine-grained nuances on land cover change are necessary for the development of generalised knowledge on deforested landscapes (Lambin et al., 2001; Chazdon et al., 2009; Ellis et al., 2010). Furthermore, there is a need to relate ecological and social factors to the landscape in a spatially explicit manner (Field et al., 2003; Pijanowski et al., 2009; Shkaruba and Kireyeu, 2013).

This paper adopts a spatially explicit approach to understanding factors that influence forest cover in Panamanian social-ecological systems. According to national reports and remote sensing, Panama had 44% forest cover in 2010 and, between 2005 and 2010, lost 0.36% of its land cover annually to deforestation (Food and Agriculture Organization, 2010). Eastern Panama, home to the