Universiteit
Leiden
The Netherlands

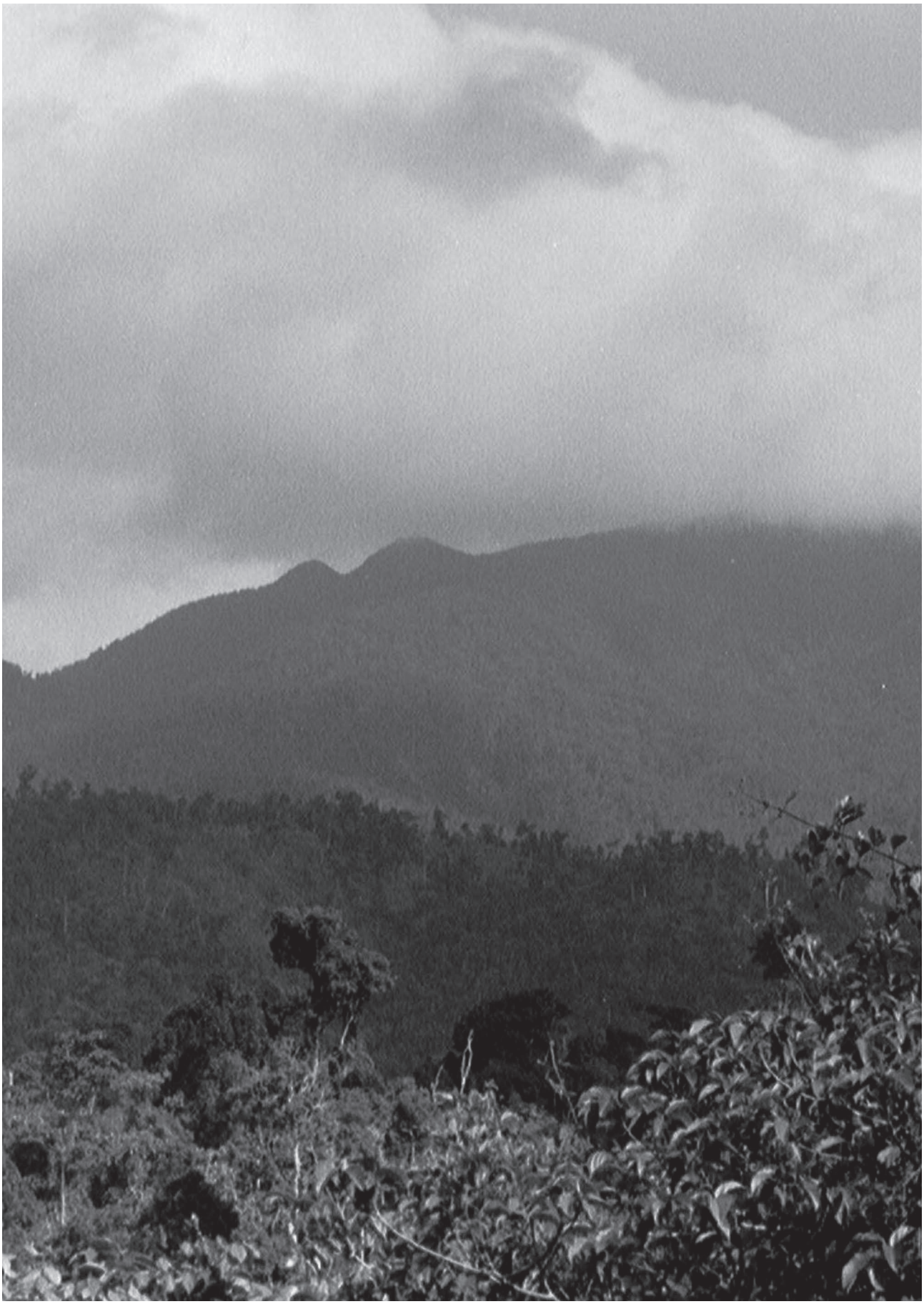
Linking processes and pattern of land use change

Overmars, K.P.

Citation
Overmars, K. P. (2006, June 19). *Linking processes and pattern of land use change*. Retrieved from https://hdl.handle.net/1887/4470

Version:	Not Applicable (or Unknown)
License:	Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden
Downloaded from:	https://hdl.handle.net/1887/4470

Note: To cite this publication please use the final published version (if applicable).



Summary

Overmars, K.P. 2006. Linking process and pattern of land use change, illustrated with a case study in San Mariano, Isabela, Philippines. Thesis Leiden University, the Netherlands.

The conversion of the earth's land surface by human actions has been extensive in the pa and is still on-going at a fast rate. Land use change does not aff ect all regions in the wor in a similar way. One of the countries that is highly aff ected by land use changes is the Philippines. In the past century, a large part of the country was deforested as a result of intensive commercial logging activities and expansion of the agricultural area. Land use changes in the Philippines have major consequences for the landscape and the functions it can provide. Land use changes have caused biodiversity to be under threat and slopes have become unstable, which may cause landslides. Unsustainable land use practices restrict the opportunities for people to make a living in the future. These land use chang and their eff ects also apply for the study area of this research. The study area is a part o the municipality of San Mariano in the northeastern part of the Philippines. This area, which comprises 48,000 ha, transformed from a forested area with few inhabitants in the 1900s to an area that is currently largely cleared and which is home to approximately 4,(families, which are predominantly dependent on agriculture. The area is situated in the transition zone between the lowlands of the Cagayan valley and the uplands of the Sierr Madre mountain range. At present, the study area has a land use gradient from intensiv agriculture near San Mariano, with mainly rice and yellow corn, via a scatt ered patt ern rice, yellow corn, banana, grasses and trees to residual and primary forest in the eastern part. Large-scale commercial logging stopped in the area. Currently, the main land use changes are agricultural expansion and small-scale (illegal) logging activitie

Land use change forms the interface where the human and the natural system interact. Land change science is therefore a fi eld that involves many disciplines. To study land u these various disciplines have developed their own paradigms and methods. However, disciplinary approaches can only cover part of the complex system responsible for land changes. To understand the dynamics of land use change in a comprehensive way, new, interdisciplinary methodologies that integrate the many aspects of the land use system a necessary

To position the research approaches of this dissertation in the wide array of methodolog in land use science two broad methodological approaches are identifi ed: 'from patt ern to process' and 'from process to patt ern'. The patt ern-based method can be described a spatially oriented, GIS (Geographical Information System) based approach, which starts with analysing land use patt erns by identifying correlations between land use and its explanatory factors. The process-based approach originates from the social sciences and starts with analysing actors and processes and aims at modelling the land use patt ern fr these relations. Broadly speaking, the distinction between patt ern-based and process-ba research coincides with the distinction between inductive and deductive methodologies The former is strong in describing patt erns empirically, but has a weak connection with causal processes. The latt er is strong in describing causal structure, but is oft en less eas parameterise, calibrate and validate for real world case

The main objective of this dissertation is to develop methodologies to identify and integ factors that are important in the land use system in order to describe and model the com

plex land use system in a comprehensive manner. To facilitate the integration of human and natural sciences both 'patt ern to process' and 'process to patt ern' research is carrie out. The methodological challenges that are addressed in this study include bridging diff erences in spatial scales, organisational levels and temporary scales; identifi cation o appropriate units of analysis; combining diff erent disciplinary paradigms and developi new paradigms that unify the disciplines into one concep

As an exploratory study two datasets were analysed to identify the explanatory factors land use in the area. First, a statistical analysis was performed on household survey dat from interviews. This analysis included fi eld characteristics as well as household variab and aims at explaining the occurrence of corn, banana or wet rice on a particular fi eld. The results from this study were used to inform a second, spatial analysis. The factors th turned out to be important for the allocation of the land use types in the study area can be categorised in three groups: accessibility, origin of the land managers and biophysica constraints. Despite the eff orts to integrate the approaches the factors that were selected by the stepwise procedure varied between the household analysis and the spatial analys as well as the relative importance of the variables. These diff erences stem from diff eren in unit of analysis, diff erences in sample design, diff erences in the themes included anc diff erences in the methods that were used to collect the da

The statistical, inductive approach from the exploratory study reveals correlations rathe than causal relations. To bett er understand, structure and describe the processes of land in the area a theoretical, deductive framework was adopted, which consists of a qualitat model (the Action-in-Context framework) describing causal relations in actor decision-making. This framework was used to construct a quantifi ed deductive model explainin crop choice on fi elds. This model was tested using the household data and compared w a statistical (inductive) analysis of the same data. The performance of both approaches is similar. A major diff erence between the two approaches is that the deductive approach tests the full causal structure, which leads to a bett er grip on causal relations and suppo theory building whereas the statistical model is constructed to fi t the data as best as pos sible.

An important way to integrate diff erent disciplines is to integrate the levels of analysis of these disciplinary approaches. A statistical approach to combine diff erent organisatio levels and spatial scales is multilevel analysis. This method explicitly addresses the hier chical levels in the data and shows what proportion of the variance occurs at which leve Aggregating or disaggregating variables to the unit of analysis, which may violate the statistical assumption of the model use, is not necessary with this method. The multileve model for the case was informed by the results from the analyses above and incorporate the fi eld, household and village level. The case study revealed the importance of the household level in explaining land use at the detailed level of the study area. In some of the constructed multilevel models the village variability could partly be explained by fi variables. Generalising this observation, it can be concluded that in land use studies all organisational levels between the resolution and the extent should be examined on their potential importance in explaining land use. The strength of multilevel analysis is that it allows to make a multitude of propositions between higher and lower levels and scales to test these relations

Subsequently, the information from all preceding analyses was integrated in a dynamic spatial model, which is used to make projections of land use under diff erent scenario

conditions. The relations of the deductive household model were translated to the spatia level to create suitability maps that are used as input in a modelling exercise using the CLUE-S model (Conversion of Land Use and its Eff ects at Small regional extent). This approach was compared with a CLUE-S model that incorporates suitability maps derive with the statistical spatial analysis. For a land use projection for 2015 these two modellir approaches are diff erent in 15 % of the cells, which can be contributed to the diff erent specifi cations of the suitability maps. However, considering only the cells that actually changed the two approaches have only 50 % in common. The two diff erent approaches to specify the land use model each have consequences for the use of the model in policy making. Inductive, statistical approaches are weaker in the description of causality and processes. This restricts models that are based on an inductive analysis to model large changes in processes, for example the introduction of a new land use type. If instead a theoretical, deductive approach is used to derive and describe relations between land us and its explanatory factors the models can be made more fl exible and the introduction c new land use types and changes in processes during the modelling period can be facilita The CLUE-S model with the deductive approach to specify the land use suitability is mc valuable in small study areas where detailed actor research can be carried out. Large-sca studies can best be carried out with an inductive approach and can be used for the rough identifi cation of hotspots of land use chang

In order to use land use models in policy-making eff ectively the projections of future la use patt erns should be translated into normative indicators. The Philippines are a globa hotspot of biodiversity and the study area borders the largest contiguous forest area of the country. Therefore, an assessment of the eff ects of land use change on biodiversity was made. For three land use scenarios land use maps are projected for the year 2015 using the CLUE-S model with the deductive specifi cation mentioned above. The scenar are diff erent in the level of agricultural expansion and forest conservation management Furthermore, the relation between landscape characteristics and endemic forest bird spe cies richness was determined. This relation was used to create maps with an indicator fc the value of a location for endemic bird conservation for the present situation and for th projected land use maps. The results showed that the patt ern of the eff ects of land use changes can be diff erent from the patt ern of land use changes themselves because land changes have off -site eff ects and land use changes have diff erent eff ects at diff erent lc tions. The scenarios clearly show the areas that are under threat. The combination of a st of the art land use model and biodiversity mapping can provide quantitative indicators project changes in biodiversity due to land use change. The land use model is capable of incorporating the human dimension of land use change and the competition between la use types. This is important to project the eff ects of policy measures on the land use sys The biodiversity assessments of the projected landscapes can be used to evaluate policy options for conservation management

The main land use developments in the area are agricultural expansion and small-sca*i.e.* non-commercial) logging. Especially under a high growth scenarios agricultural expansion poses a threat to the forest. So far, the area that is currently under forest was spared by its natural defence of steep slopes and inaccessibility. In a negative scenario all forest areas will eventually be used for agriculture. If the agricultural system practiced is unsustainable this development would only provide a solution until the area has degraded As an alternative a large part of the foreseen agricultural expansion could be realized in

areas that are currently under grassland. Furthermore, productivity of the current land use systems may be improved. The key to a sustainable future in San Mariano is to control agricultural expansion due to population growth (natural and migration), to direct agriculture expansion to appropriate areas, to invest in viable agricultural systems and to conserve natural resources. However, this approach demands strong governance and suffi cient investment

In this thesis it is especially the combination of approaches that have led to a greater understanding of the land use system in the study area. Qualitative information was used describe land use processes in the area. Quantitative data were used to analyse the land system at the household level and in a spatially explicit way for the complete study area the analyses both deductive and inductive research methods were used. All methods we aimed at integrating diff erent levels and thematic information that originated from diff ent disciplines. Moving between empirical, inductive methods and theoretical, deductiv methods is a useful approach to stimulate theory building. Methods that can deal with multiple levels proved to be valuable for integration of disciplinary approaches, which oft en greatly diff er in their unit of analys

Some scholars argue that the time is ripe for an overarching theory of land use change. I doubtful if it is possible to fi nd a theory that would be acceptable for all disciplines invo in land use science and which can cover all the important phenomena. An all-encompas ing theory of land use change is still far off . I would argue that it is currently more fruit to develop methodological theories of parts of the system that describe interactions and feedbacks between components of the system. This dissertation includes some examples such theories and methods. The joint understanding from these analyses was combined a modelling framework that added to the insights in the overall land use syster