

The land managers who have lost control of their land use: implications for sustainability

ERIC F. LAMBIN* & HELMUT J. GEIST

Department of Geography, Université Catholique de Louvain, Place Louis Pasteur 3, B-1348 Louvain-La-Neuve, Belgium

Abstract: This paper explores the conditions under which local land managers in the tropical world lose some control over their land use. Driving forces of land use change within the control of a community are referred to as endogenous, while exogenous forces are considered to be out of control of local land managers. It is argued that, with economic liberalization and globalisation, driving forces of land use are becoming increasingly exogenous to the communities holding land under transformation, which has major implications for the transition to sustainability. Supportive evidence is taken from most recent international comparative studies of land use and land cover change, with cases mainly taken from the tropics. They were evaluated by means of a framework to analyse causes of land change. Both original case studies, following a common data protocol, and indirect meta-analyses indicate that synergetic factor combination drive land-use changes. Prominent among them are people's responses to economic opportunities as mediated by institutional factors. From a local land manager's perspective, these opportunities and constraints for new land uses are created by markets and policies, increasingly influenced by external global factors.

Resumen: Este artículo explora las condiciones en las que los administradores locales de la tierra en el mundo tropical pierden parte del control sobre el uso de su tierra. Se hace referencia a las fuerzas directrices del cambio del uso de la tierra que están bajo el control de una comunidad como las fuerzas endógenas, mientras que se considera que las fuerzas exógenas están fuera del control de los administradores locales de la tierra. Se argumenta que con la liberalización económica y la globalización las fuerzas directrices del uso de la tierra se están tornando cada vez más exógenas para las comunidades que mantienen tierras bajo transformación, lo cual tiene fuertes implicaciones para la transición hacia la sostenibilidad. La evidencia que apoya esta idea se deriva de los más recientes estudios internacionales comparativos del uso de la tierra y el cambio de cobertura de la tierra, con casos tomados principalmente de los trópicos. Éstos son evaluados por medio de un marco de análisis de las causas del cambio en la tierra. Ambos son estudios de caso originales que siguen un protocolo común para la obtención de datos, y los meta-análisis indirectos indican que lo que rige el cambio del uso de la tierra es una combinación sinérgica de factores. Entre ellos destacan las respuestas de la gente a las oportunidades económicas, de acuerdo a cómo éstas son mediadas por los factores institucionales. Desde la perspectiva de un administrador local de la tierra, estas oportunidades y limitaciones para nuevos usos de la tierra son creados por los mercados y las políticas, y éstos están cada vez más influenciados por factores globales externos.

Resumo: Este artigo explora as condições sob as quais os gestores locais do solo no mundo tropical perdem controlo sobre o uso da terra. As forças que impulsionam as mudanças de uso no contexto do controlo exercido pelas comunidades são referidas como endógenas enquanto as forças exógenas são consideradas estarem for a do controlo dos gestores locais. Argumenta-se

*Corresponding Author: E.F. Lambin; tel.: +32 1047.44.77; fax: 32 1047.28.77; e-mail: lambin@geog.ucl.ac.be

que, com a liberalização económica e a globalização, as forças impulsionando as mudanças são crescentemente exógenas às comunidades proprietárias das terras em transformação, mudanças que têm implicações substantivas na transição para a sustentabilidade. Os mais recentes estudos internacionais comparativos do uso e da cobertura da terra, com casos provenientes principalmente dos trópicos, suportam esta constatação. Eles foram avaliados por intermédio de um quadro de referência para analisar as causas nas mudanças do uso da terra. Em ambos os casos de estudo, seguindo um protocolo comum de dados, ou uma meta-análise indirecta, indicam que a combinação sinérgica de factores impulsionam as mudanças no uso do solo. Proeminentes entre eles situam-se as respostas das pessoas às oportunidades económicas mediadas pelos factores institucionais. Na perspectiva dos gestores locais da terra, estas oportunidades e constrangimentos para novos usos do solo são criadas pelos mercados e pelas políticas, que são influenciadas, de forma crescente, pelos factores externos globais.

Key words: Causes, deforestation, driving forces, endogenous, exogenous, globalisation, global-local interplay, land use change, scales, sustainability, tropics.

Introduction

Land-use changes have important implications for species and genetic diversity associated with endangered habitats, soil conditions, water and sediment flows, vulnerability of ecosystems and social groups etc. Land-use changes are also the medium through which many human responses to global change occur. Sustainable land use refers to the use of land-based resources to produce goods and services in such a way that over the long term the natural resource base is not damaged and that the basic needs of land managers can be met (Cai & Smit 1994; Jeffers 1999). To ensure sustainable land use, a community of local land managers needs to exert control on the driving forces of land change in their surroundings. The driving forces within control of the community are referred to as *endogenous* forces. However, local land use is also impacted by *exogenous* driving forces, i.e., forces outside the control of land managers.

Redman (1999) argued that, in ancient societies, the development of complex urban societies and regional trade has led to a loss of control on land use by local land managers. Sustainable land management depends on who is perceiving (and experiencing) a stress on land resources, who is in a position to do something about it, and what is the interest of actors to do what they do. Self-sufficient farmers have the opportunity to adjust directly their land use to balance needs, production and environmental stresses. When farmers are

producing for a market rather than for their own needs, their decisions is in part controlled by price changes and may thus be encouraged (or forced, under certain political regimes) to increase their production, thus putting a further strain on the environment. This is especially the case where the flow of information between producers, consumers and decision-makers is ineffective, slow and subject to distortions (Redman 1999).

With the globalisation of economies and socio-political systems, it could be argued that driving forces of land-use change are becoming increasingly exogenous to the communities holding land under transformation. This would imply that it has become increasingly difficult for local communities to manage their land in a sustainable way. This paper discusses the relative importance of exogenous *versus* endogenous driving forces of land-use change. It relies on recent and systematic comparisons of case study evidence on the causes of land-use change.

Generalising from case studies

In the study of land-use change, case studies allow building a compendium of robust knowledge about local land use decisions and land cover dynamics. Comparative studies are important to generalise understanding about relevant processes at work. These structured case study comparisons can either be achieved through common, standardised data protocols leading to original research or

through systematic literature reviews following high quality standards (Fig. 1). In the following, we report results from the most recent worldwide case study comparisons carried out.

The structure of the first comparison (Indian National Academy of Sciences *et al.* 2001) is representative of some of the comparative international studies related to global environmental change carried out in the 1990s (for example, Kasperson *et al.* 1995; Turner *et al.* 1990). In these investigations, a diverse group of researchers developed a common research protocol and produced a set of case studies that yielded interesting analogies rather than formal comparisons. The so-called Tri-Academy study (Indian National Science Academy *et al.* 2001) had a focus on six study regions in the world's three most populous countries (China, India, United States of America). The project was focused on the way rapidly increasing population use their land and the impact this has on the standard of living, quality of life and quality of the environment for this and future generations. The relations among population growth, consumption patterns and land use change were explored and issues that illuminate the principal forces driving the observed changes were identified, primarily for the period of 1970 to 1990.

The second comparative study (Geist & Lambin 2001, 2002) is a systematic literature review of already published high quality case studies of tropical deforestation. It is representative of some of the meta-analyses carried out qualitatively or quantitatively since the late 1990s, based on already published work (e.g. Lambin *et al.* 2001; Petschel-Held *et al.* 1999; Rudel *et al.* 2000). In this quantitatively oriented meta-analysis of the causes of tropical deforestation, the reported proximate causes were held apart from underlying driving forces, and both set of causes were analysed in terms of their frequency of occurrence and interlinkages with the years 1940 to 1990 being the most frequently covered period.

Both comparative analyses take the local (or subnational) scale as platform of investigation. In the Tri-Academy study (Indian National Academy of Sciences *et al.* 2001), case studies were undertaken in China (Pearl River Delta of Guangdong Province, Jitai Basin and adjacent mountains of Jiangxi Province), in India (Kerala & Haryana Province), and in the United States of America (southern Florida, Chicago). The deforestation meta-analysis (Geist & Lambin 2001) comprises 152 tropical cases from ten countries in Asia (55 cases), eight countries in Africa (19 cases) and

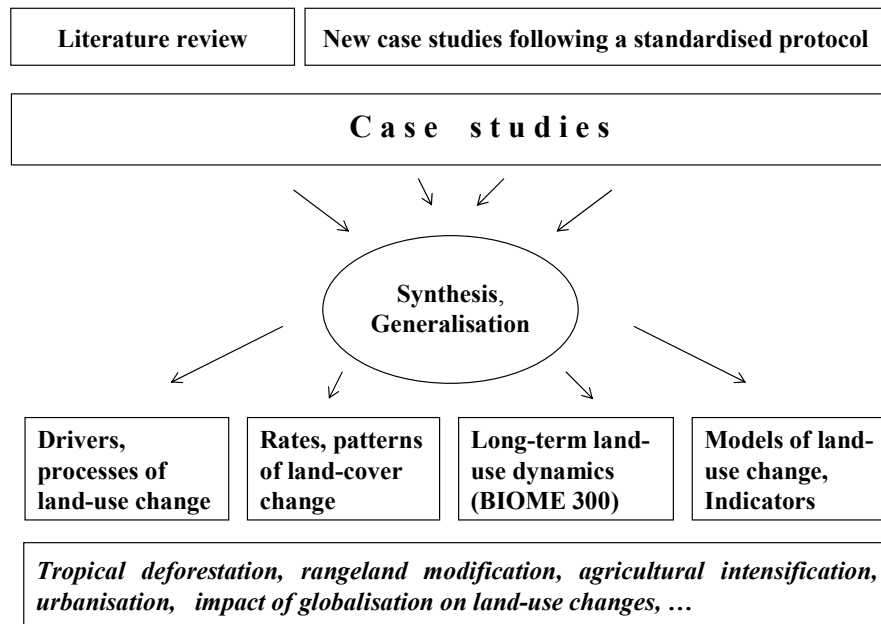


Fig. 1. Case study comparison is a major tool to derive generalisations on land-use change.

eleven countries in Latin America (78 cases), with case study areas ranging from small villages to large multi-province regions. When exploring the two comparative studies for commonalities on exogenous *versus* endogenous causes of land change, it has been assumed, as a working hypothesis, that the scale of the respective case study areas – called local scale in the following – represents the level at which local land managers exert control on driving forces and where, consequently, endogenous forces could be identified. Such an analysis first requires an appropriate framework to analyse the causes of land-use change.

Multiple dimensions of the causes of land-use changes

There is a high variability in bio-physical environments, socio-economic activities and cultural contexts which are associated with land-use change. Identifying the causes of land-use change requires an understanding of how these different factors interact in specific environmental, historical and social contexts to produce different uses of the land (Turner *et al.* 1995). Fig. 2 presents a general framework to analyse the causes of land-

use change. One should first distinguish between proximate causes and underlying driving forces of land-use change. *Proximate causes* constitute (near-) final human activities or immediate actions that originate from intended land use and directly impact upon land cover. Different from structural, systemic or initial conditions, they are the more immediate direct factors which originate from land use and directly impact upon land cover (Ojima *et al.* 1994). For example, broad clusters of proximate causes of tropical deforestation are: agricultural expansion, wood extraction, infrastructure extension etc. *Ultimate underlying driving forces* are fundamental forces that underpin the more proximate causes of land-cover change. They are formed by a complex of social, political, economic, demographic, technological and cultural variables that constitute initial conditions in the human-environmental relations that are structural (or systemic) in nature (Contreras-Hermosilla 2000; Geist & Lambin 2002; Ledec 1985). The interplay between underlying and proximate causes may be shaped or modified by a number of *mediating factors* (e.g. gender, access to resources, wealth status or ethnical affiliation). Actually, the risk of specific adverse outcomes for a household, a community or

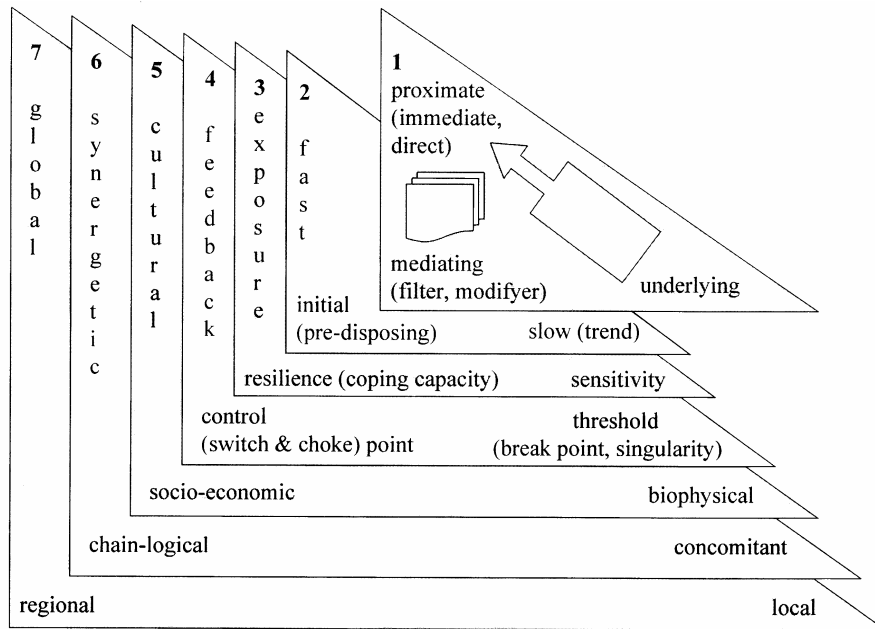


Fig. 2. A framework for a causative factor analysis of land change. 1 = filtered proximate/underlying divide, 2 = turnover rate, 3 = vulnerability, 4 = systems dynamics, 5 = natural/social divide, 6 = mode of causation, 7 = spatial scale.

an ecosystem in the face of a variety of stresses varies according to its vulnerability. This depends on the *exposure* of the unit of concern – the degree to which a human group comes into contact with particular stresses; its *sensitivity* – the degree to which an exposure unit is affected by exposure to any set of stresses; and its *resilience* – the ability of the exposure unit to resist or recover from the damage associated with the convergence of multiple stresses (Clark 2000).

The nature of driving forces of land-use change may be *biophysical*, *socio-economic* or *cultural*. These can be *slow variables*, with long turnover times, which determine the boundaries of sustainability and collectively govern the land use trajectory – such as the spread of salinity in irrigation schemes, or declining infant mortality -, or *fast variables*, with short turnover times – such as food aid, climatic variability associated with El Niño oscillation. ‘Disparities in turnover times make ecological legacies possible’ (Carpenter & Turner 2001). The effects of human land use persisting long after the activity has ceased is just one example (Turner & Dale 1998; Turner *et al.* 1998). Land use change is also controlled by pre-disposing environmental factors or *initial conditions* (land characteristics or features of the biophysical environment which are difficult to manipulate), and biophysical or social *trigger events* (e.g. a drought, war or sudden policy change). The latter are fast variables which work as catalytic forces leading to sudden and abrupt changes in the human-environment condition. They have properties of *switch and choke points* in the system dynamics, i.e. points at which sudden, abrupt and irreversible shifts from one land use into another occur. Driving forces may also push the system beyond *thresholds*, which results in fundamental changes in system behaviour. Another important system property associated with changes in land use are *feedbacks* which can either accentuate or amplify speed, intensity or mode of land change or constitute human *mitigating forces* (Turner 1989), e.g. via institutional actions that dampen, impede or counteract factors or their impacts. Examples are the direct regulation of access to land resources, market adjustments or informal social regulations (e.g., shared norms and values that give rise to shared land management practices).

Proximate causes generally operate at the *local level* (individual farms, households or commu-

nities). By contrast, ultimate drivers may also originate from the *regional* (districts, provinces or country) or even *global levels*. In the latter case, they are uncontrollable by local communities and thus can be considered to be exogenous to these communities. Different factors driving land-use change can intervene in *concomitant occurrence* – i.e. independent, separate operation of individual factors leading to land change- or can be connected as *causal chains* - i.e. interconnected in a way that one, or several, variables (underlying factors, mainly) drive one, or several other variables (proximate factors, mainly). They also often intervene in *synergetic factor combinations* – i.e. several mutually interacting variables driving land-use change.

Results of case study comparisons

The tri-academy study

Although initially it was assumed that population growth alone might be a significant driver of land use change in many of the regions studied (Indian Academy of Sciences *et al.* 2001), results indicate that many other factors play at least equally important roles. These factors include government policies, changes in consumption patterns and the effects of economic integration and globalisation. The three general findings can briefly be summarised as follows: First, there exist intertwined effects of population, consumption and technology: population in all areas is increasing, however, not due to natural growth in these case studies, but due to migration; internal consumption impacts less on land than external demand; subsistence croplands decrease, while land for market demand increases; technology impacts can be positive or negative (depending on time and situation); and agricultural intensification is a major player in land transformation. Second, land under transformation is characterised by both stability and change: grasslands and wetlands are at higher risk of transformation than forest areas which are stable or increasing, even in areas of high population density; population growth is not uniformly associated with decreases in croplands availability; recovery or restoration of land is possible with appropriate land use policies; and land use dynamics affects social groups differently, e.g., upland *versus* lowland groups, landless people *versus* landowners, and women *versus* men. Third,

national government policy is crucial: clearly, it has the greatest single and measurable effect on land use change; main policy impact comprises price controls on agricultural inputs and outputs, infrastructure support, taxation, privatisation and reforestation programs; policies are mainly external to the region and not motivated by growing population pressure within the region; and some policies result in land use change which provoke increased migration and other movements of people.

The tropical deforestation study

The systematic review of empirical case study evidence on tropical deforestation (Geist & Lambin 2001, 2002) suggested that no universal cause-effect linkage exists. The study concluded that tropical forest decline is determined by different combinations of various proximate causes and ultimate drivers. Some of these combinations are robust geographically (such as the development of market economies and the expansion of permanently cropped land for food), while most of them are region specific. Synergetic driver/cause combinations were observed, with tropical deforestation being best explained by multiple factors rather than by single variables. The nature of the interactions between multiple causal factors was important to understand the systems dynamics leading to deforestation. This challenged simple explanations which put most of the blame of deforestation upon single actors (e.g. shifting cultivators) or single variables (e.g. population growth caused by high fertility). Except for demographic factors, deforestation is largely driven by interacting forces which originate from several scales (Table 1). The

dominant synergetic driver combinations at multiple scales driving deforestation are described in Geist & Lambin (2001).

Even the factors of deforestation which seem to be local are clearly influenced by external processes. For example, major local scale *economic factors* driving deforestation are the growth in demand from wood processing and furniture industries and agricultural modernization and cash crop development for export purposes. These factors are, in part, driven by the demands of the local population but are also strongly linked to the expansion of export markets, commercialisation and outside demands. Thus, one could hardly speak of endogenous factors since they only result, at the local level, from the growth of international and national markets for timber and agricultural products. In general, *technological factors* driving deforestation are in part within control of local land managers, such as technologies applied in the processing of wood and in the agricultural sector, both of which having often a low efficiency and thus leading to further forest clearings. Many of these technologies are capital-intensive and might be improved by internal changes in investment and production patterns but also by outside intervention (e.g. through subsidies).

Only few of the *policy and institutional factors* driving deforestation fall under the control of land managers at the local level as they relate to the regulation of land use and management by governmental authorities, e.g. zoning of land into protected areas and areas open for cultivation, allocation of logging concessions and unclear assignment of ownership titles to individual users. Farming households, most of them migrant families, tend to

Table 1. Driving forces of tropical deforestation by scale of influence.

Scales	% of all cases					
	All factors (range) (n=152 cases)	Demographic factors* (n=93)	Economic factors (n=123)	Technological factors (n=107)	Policy and institutional factors (n=119)	Cultural or socio-political factors (n=101)
Local	2 - 88	88.2	2.4	23.4	4.2	15.8
National	1 - 14	1.3	13.9	2.6	2.1	7.4
Global	0 - 1	0.0	1.4	0.0	0.0	0.0
Several scales: global to local interplays	11 - 94	10.5	82.3	74.0	93.7	76.8

* 6 cases of 'population pressure' (unspecified) could not be attributed to scales.

Source: Own data; see Geist & Lambin (2001).

disobey or resist such regulations, for example, by squatting state forest land to obtain legal titles. Among the few *cultural or socio-political factors* found to be important at the local level are beliefs, attitudes, views and behaviours. Imitation, for example, is important as local farmers tend to copy slash-and-burn activities of in-migrating settlers, and both groups may copy unsustainable logging practices of timber companies operating in their area. Cash orientation dominates views and attitudes: forests or forest products are regarded as sources of 'free' goods for quick cash; no personal responsibility is felt for sustainable management (especially when land tenure security is not clear); and short-term rent-seeking is the dominant behaviour (though, the latter can also be interpreted as a rational response by locals to increased profitability under terms of uncertainty). Rather than being truly endogenous in character, these factors reinforce or amplify on-going forest removal rather than mitigate the process.

Counter to the other driving forces of deforestation, several *demographic factors* could be viewed as being *endogenous* – e.g. various fertility control measures under conditions of land scarcity. However, the literature survey reveals that natural population increment is reported to cause deforestation in only ten percent of the cases, and that issues of rising population pressure are predominantly related to in-migration (by colonists and migrant settlers). One could argue that migration from outside a region of interest into a formerly sparsely populated forest zone is an exogenous force, even though it contributes to population increase at the local level. At the national level, population increase due to high fertility is rarely the main reason for pushing people to the forest frontier. Rather, the latter process is often caused by socio-political factors such as landlessness, social discrimination in other parts of the country or geopolitical interests. Regulation of human population dynamics under these circumstances is largely beyond the capacity of local communities.

Other studies

Similarly, another synthesis of extensive local case study evidence on a broader range of processes of land-use change (Lambin *et al.* 2001) supported the conclusion that neither population nor poverty are the primary causes of land-use change

worldwide. Rather, peoples' responses to economic opportunities, as mediated by institutional factors, drive land-use changes. Opportunities and constraints for new land uses are created by markets and policies, increasingly influenced by global factors. Extreme biophysical events occasionally trigger further changes. Various human-environment conditions react to and reshape the impacts of drivers differently, leading to specific pathways of land-use change.

Barbier (2000), by examining case study evidence from Ghana and Mexico on the effects on the degradation of rural resources of economic liberalization and globalisation - in particular, trade liberalization and reforms to 'open up' the agroindustrial sector - identifies land use and cover changes (modifications as well as conversions) as the immediate and principal impact on resources. He separates direct from indirect effects: directly, increased agricultural productivity triggers forest conversion and increases land degradation from unsustainable production methods, while, indirectly, agroindustrial development displaces (near) landless and rural poors, who then are pushed to marginal agricultural lands or to the forest frontier.

Another synthesis of subnational cases of land change from Nepal, Laos, South Africa, Malawi, Tanzania, Botswana, Brazil, Argentina and the Dominican Republic (Petschel-Held *et al.* 1999) explored in particular converging or diverging coping strategies by smallholders with respect to other 'social players' and external dependencies. It concludes that: (i) all regions studied exhibit a serious degree of marginality of agricultural land-use; (ii) several impacts of global processes upon local strategies are evident (occasionally, of particular relevance even); (iii) the role of state policies as mediating factor is decisive, however, and (iv) all local coping strategies can be typified as risk management by diversification. Smallholders are seen to obey to the same set of basic coping rules, which is a rational decision between wage labour and agricultural activities. The diversification of labour allocation between these options is considered to be in favour of a sustained livelihood within the region, and out-migration is seen to be the only way out if the degradation-impoverishment spiral should really start to work.

In comparing modelling results from some 150 deforestation models, Angelsen & Kaimowitz (1999)

conclude that land change tends to be greater when forested land are more accessible, agricultural and timber prices are higher, rural wages are lower, and when there are more opportunities for long distance trade. Population and migration both affect slow or fast turnover rates of forest clearings 'but in a complex fashion that cannot simply be reduced to saying population growth promotes deforestation' (Angelsen & Kaimowitz 1999). Though any clear-cut relationship between macro-economic variables and policies and land change was generally difficult to identify, they stress as a significant finding that a number of the policy reforms included in current economic liberalisation and adjustment efforts may increase pressure upon forests.

Following a workshop which analysed recent evidences on desertification, Lambin *et al.* (2002) concluded that desertification is influenced by several international-scale drivers, including technological change, trade and governance. For example, international institutions (including organizations within the United Nations system and non-governmental organizations) can be instrumental in promoting and funding policies aimed at combating desertification, setting political agendas and building consensus. Although international conventions do not manage the land at the local scale, they do create constraints and incentives for sustainable land management. While the environmental effects of macroeconomic policies and trade liberalization are particularly important in countries with fragile semi-arid lands, international trade can also improve environmental conditions (e.g. through green certification and ecolabelling, wider and more rapid spread of technologies, better media coverage allowing international pressures on states which degrade their resources). International level factors contributing to desertification are not easy to detect given the complex causal chains leading to the process, the synergy between drivers, and the role of the nation-state as a mediator between international forces and local-scale processes.

Managing sustainable land use locally

It is clear from the general results of case study evidence summarised above that land-use changes are, at the ultimate level, largely driven

by external factors, while socio-economic and socio-cultural attributes of the communities managing the land have mostly a mediating role. For example, the impact of a new national policy to subsidise cash crops will have a different impact on land use depending on whether land is under a private or communal property-rights regime. Thus, while few ultimate driving forces of land-use change seem to be within the control of local communities, these communities can decrease the vulnerability of their land use through buffering mechanisms, diversification strategies and flexible resource mobilisation.

Whether a driving force is endogenous or not for a social group depends on the system boundaries, and thus on scale. The market price of a cash crop is exogenous to a community engaged in producing that crop but may be endogenous to a region which produces large quantities of this crop, unless the market price depends on global production. Rate of population growth is exogenous to a community if in-migration is important, and over a time scale of a few years (given the demographic inertia), but is endogenous at the scale of a political entity which can control in-migration and on the long-run, as families can control their fertility.

The scale effect described above raises the issue of the possible impact of globalisation on the management of sustainable land use by local communities (Barrett *et al.* 2001; Kaimowitz *et al.* 1998; Reardon & Barrett 2000; Taylor *et al.* 1995; Watts 1996). While, on one hand, globalisation endogenise many variables to the global socio-economic and socio-cultural system as the system boundaries are expanded, on the other hand, it results on a loss of control by local communities on their land use. However, it also provides a greater range of economic opportunities of land managers, with alternative land uses becoming potentially profitable. This is not to state that external functional imperatives unilaterally impact upon the local scale, but that specific webs of interactions at several scales exist and that these 'global-local interplays' vary regionally, as mediated by mainly socio-cultural and political contexts.

Starting from the current formulation, that global environmental change is a result of changing modes of production and consumption, two current lines of arguments will have to be tested against these varying regional and cultural con-

texts (Stern *et al.* 1992). First, the global expansion of markets increases robustness and flexibility of local land managers and will contribute positively to meet basic needs and sustain the environment. Second, local socio-cultural systems function as security networks for individuals to guarantee life chances and survival in local natural environment not yet mined. Stern *et al.* (1992) stress that a large body of case studies points to varying expressions of global-local interplays in different regions and according to different social processes occurring. In the case, for example, of land degradation in West African savannah regions, environmentally threatened modes of rural subsistence production tend to be mitigated by chances of urban wage labour through a network of social relations (e.g. through remittances). Differently, in the case of Brazil – and thus related to deforestation in the Amazon Region – wealthy economic agents following profit signals sent from the market are about to marginalize local people (though they have developed socio-cultural response systems) with the overall result that the latter lose their land and have no access to urban wage labour but opt for outmigration to the forest frontier.

Conclusions

Interestingly, the results gained from direct, empirical studies of land use (Indian Academy of Sciences *et al.* 2001) are matched by those gained from indirect or meta-analytical exploration (Geist & Lambin 2001, 2002) and are fully consistent with other recently published syntheses. All case study comparisons reveal qualitatively common sets of cause-consequence relations and regionally identifiable variations of synergetic cause-driver combinations in which economic factors, institutions, national policies and remote influences are prominent. Although one could initially have assumed that either population growth or poverty alone (or in combination) might be a significant driver of land use change in many of the regions studied, results indicate that many other factors play equally important roles, at least. These factors include government policies, changes in production and consumption patterns, and the effects of market expansion and economic integration. Several of these forces could be included under the broad trend of globalisation, even though one should not assume that these are recent trends.

Moreover, there are regionally and culturally different modes of these global-local interplays. With the growing importance of these exogenous driving forces for local communities, it becomes increasingly difficult for local land managers to maintain control on their land use and ensure a sustainable management of local land resources.

Implications from such understanding of land-use change in the tropical world suggest that the centrality of the sustainability principle to the international agendas on environment and development indeed raises serious research issues (Turner 1997).

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