Development Intervention Disparities and the Poverty-Environment Nexus in the Lower Mekong Basin:

Understanding Environmental Services in a Meso-scale Perspective

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1. Introduction

"Linking Research to Strengthen Upland Policies and Practice" - This overall theme of the SSLWM conference 2006 suggests that policies and practices in upland development are generally deemed to be of better quality and higher impact if they are knowledge-driven or research-based. Nevertheless, the linkages between policy and research are not always smooth. This can partly be imputed to knowledge production itself, as among other: decisions-makers are often provided with contradicting answers for one question, levels of aggregation of results are frequently incompatible with the politico-administrative levels of decision making, simplistic blueprint solutions are offered for complex realities, or vice versa it seems impossible to make any generalisation beyond specific case studies. Such misunderstandings between development practice and knowledge production frequently emerge from ignoring some fundamental questions, which are important to researchers and practitioners alike.

- What kind of development shall be pursued?
- What knowledge is necessary to support such a development?
- What approaches are necessary that allow the production of such knowledge?

The research project presented in this paper is committed to sustainable development in Lao PDR. As it still stands at its' very beginning, these questions have been at the centre of initial conceptual reflections. As a general introduction to this paper, we therefore propose to re-examine briefly these questions, illustrating the motivation, the overall goal, as well as the challenges guiding our work.

1.1. What kind of development shall be pursued?

Policy makers and practitioners working in the uplands of Lao PDR are often concerned with either socio-economic development (poverty alleviation, sustainable livelihoods) or issues of natural resource management, or a few may even already try to address these two dimensions of development at the same time. Even if it is generally admitted, that all these efforts should ultimately contribute to 'sustainable development', this paradigm is nowadays far from shap-

ing agendas of development interventions. Not only do many influential actors pursue very specific economic, social, or environmental interests, but with the Millennium Development Goals (MDGs) (UN, 2005; ADB and UNDP, 2006) also the global agenda has again increasingly turned towards sectoral objectives and interventions (WGBU, 2005).

Nevertheless, the links between economic development and environmental sustainability can not be ignored. Figure 1 shows unmistakably that a country's economic development unavoidably leads to an increased ecological footprint. Taking into account the current and future strong economic growth of the riparian countries of the LMB and Laos and Cambodia in particular (Hirsch, 2001), it becomes clear that economic development can neither be understood nor planned independently of natural resource management; and vice versa. Hence interventions targeting natural resource management cannot ignore the socio-economic context of the LMB. Finally, it must be acknowledged that sustainable development is always multi-dimensional and that diverging rather than converging objectives are more often the rule than the exception. Nevertheless, figure 1 also shows that there is not just one uniform development pathway implying a linear increase in ecological footprint for each dollar of GDP gained. There is scope for avoiding the errors that many countries have already committed[1] and for pursuing more sustainable development pathways. The margin of manoeuvre to achieve more economic growth with less environmental degradation is essentially determined by the quality and efficiency of decision- and policy-making processes and their capacity of involving relevant development stakeholders to negotiate necessary trade-offs.

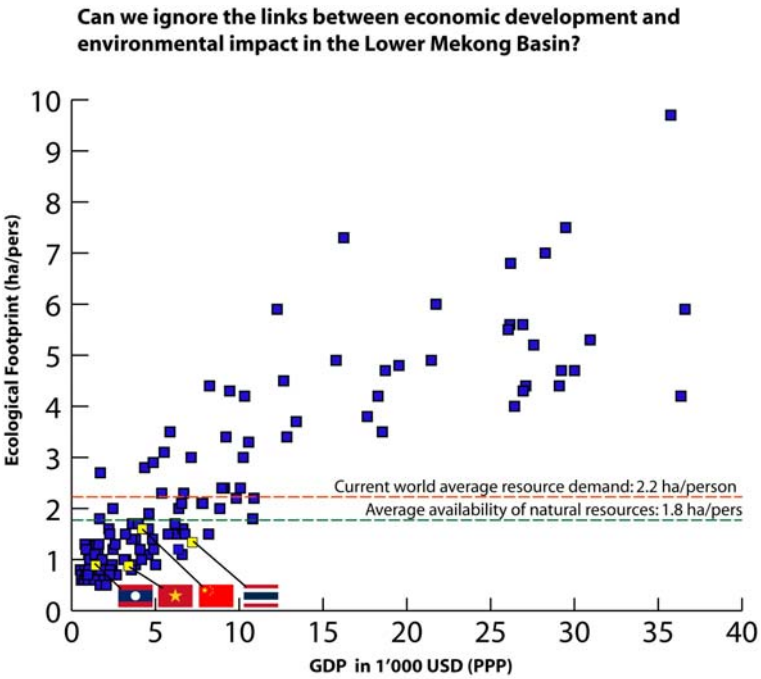

Figure 1: Correspondence of GDP(PPP) and Ecological Footprint for 131 countries across the world. Selected countries of Southeast Asia are highlighted and labelled with their flags.
Data source: World Development Indicators (WB, 2005) and Global Footprint Network, 2005. National Footprint and Biocapacity Accounts, 2005 Edition.

1.2. What knowledge is necessary to support such a development?

Acknowledging that sustainable development must remain the goal of joint research and development efforts, we may ask for the main characteristics of knowledge that must be pro-

[1] e.g. achieving the same GDP with an ecological footprint that is almost three times higher (cf. figure 1).

duced. Even if it may not be possible to answer this question conclusively, the concept of sustainability itself allows us to call for three key features (Hurni et al., 2004; Nölting, 2005; Wiesmann, 2006)

- *Multiple interactions of economic, socio-cultural, and environmental processes call for integrative knowledge*:
  Any development intervention targeting the economic, socio-cultural, or environmental sub-system will inevitably imply changes in one or all other subsystems. It is therefore crucial to understand and anticipate such processes of interaction. Knowledge production must therefore focus on such dynamic links from the onset. Knowing that human and financial resources are often restricted in research, a better balance between 'filling boxes' and 'understanding the arrows' must be found.
- *Trade-offs always imply potential winners and losers - we need knowledge on valuations of development and processes of decision-making*:
  The terms sustainability is a normative concept meaning that diverging interests must always be negotiated and balanced against each other. Therefore it is crucial to understand who the different stakeholders of development are, to know their interests and valuations, and how decisions are taken among them. Sustainable development can only be supported if knowledge on such social and political aspects is available.
- *Context matters – sustainability must be linked to the understanding of concrete social, environmental and ecological spheres*:
  The negotiation of future goals of development must always be related to a concrete space defined by its specific economic, environmental, and socio-cultural problems and potentials. Furthermore, such a context should also be related to the stakeholders involved and the decision-making processes governing its development.

1.3. What approaches are necessary that allow the production of such knowledge?

The foregone mentioned key features of knowledge production supporting sustainable development are often quite challenging to fulfil. Many projects aiming at such a holistic understanding tend to turn to case-study research approaches. Only very localised studies, often focusing on single households and field plots, are deemed to overcome the high complexity of variables to be taken into account. Yet, this general tendency of "zooming in" to the micro-level can also be seen as a trap, because the relevancy for decision-making at higher politico-administrative levels is increasingly lost: the more we know about each specific case, the less

it seems comparable to another place. Likewise, innovations produced for one problem are almost impossible to out-scale to a broader region or to up-scale to higher levels.

Such challenges are currently being addressed by the newly established research project of the Swiss National Centre of Competence in Research (NCCR) North-South in the Lower Mekong Basin, with a special focus on Lao PDR. It pursues the overall goal of exploring innovative pathways of integrated socio-economic and ecological development by identifying adequate levels and spatial references for negotiation and decision-making on sustainable development in Lao PDR. In this paper, the chosen approach shall briefly be illustrated and first results will be presented.

2. A meso-scale research approach to study the effect of development intervention disparities on the poverty-environment nexus in Lao PDR

Given the overall goal of the research project, we developed a research approach that consists of the following elements (cf. figure 2):

1. To describe the agro-ecosystem of Lao PDR as a generalised landscape mosaic consisting of different shares of land cover;
2. To describe socio-economic disparities by producing a high-resolution map of poverty and welfare at sub-district level based on population census 2005 data as well as the Lao expenditure and consumption survey 2003;
3. To describe spatial configurations of the so-called poverty-environment nexus, describing the combined outcomes of development in terms of poverty and environment for a given area;
4. To systematically describe what actors, interventions, and institutions drive decision-making leading to development interventions in different areas and at different levels;

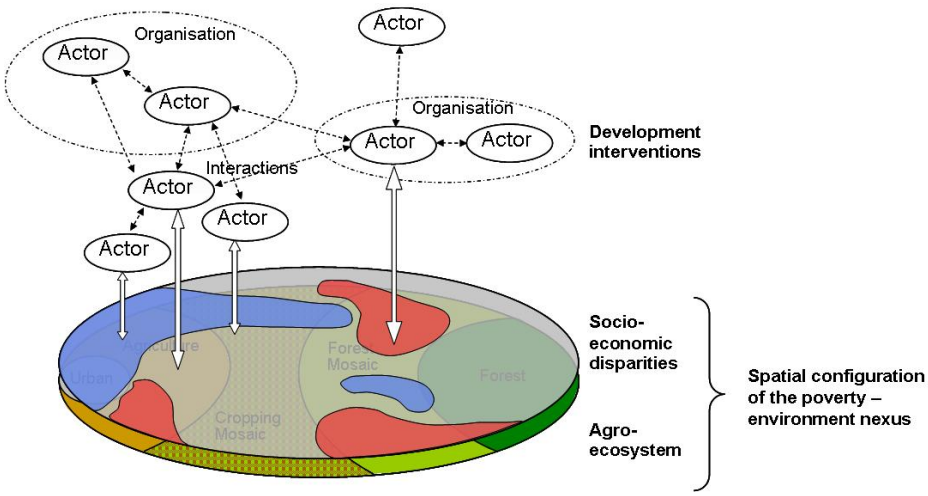

Figure 2: A meso-level approach to study the impact of development intervention disparities on the poverty-environment nexus

Based on the expected results, we hope to describe different types and spatial patterns of development contexts, each characterised by specific decision-making processes and configurations of the poverty-

environment nexus. By understanding such patterns we expect to generate new insights for innovative pathways towards sustainable regional development.

3. First results on linking regional land cover dynamics to environmental service provision

3.1. Land Cover Trajectories in Lao PDR

Even though this research project stands at its very beginning, first research results can already be presented. They essentially stem from a preceding PhD research project (A. Heinimann, 2006), which focused on patterns of land cover change in the Lower Mekong Basin. This work provides the basis for describing the agro-ecosystem as a generalised landscape mosaic representing a general state of the environment in Lao PDR.. It has to be mentioned that all the following research results do not refer to the entire territory of Lao PDR, but only to the large shares within the Lower Mekong Basin (LMB) (88% of territory).

An evaluation of the different available comparable regional datasets for the LMB revealed, in line with findings of other authors (Heinimann, 2006; MRC, 2003;) that the land cover datasets of MRC/GTZ for 1993 and 1997 are currently the most reliable comparative and multi-temporal land cover information of the entire basin. This data has been elaborated based on visual interpretation of Landsat TM data at a nominal scale of 1:250th accompanied by extensive field verifications (Stibig 1996). Even though these datasets are now somewhat dated, they form the basis of the following analyses, mainly because of their quality. Another consideration was that the land cover change processes recorded in these datasets are still valid today.

Figure 3a gives an overview of different land cover classes and their net dynamics from 1993 to 1997 for the shares of Lao PDR within the LMB. We observe that in 1997 wood and shrub land is the single most important land cover type. Considering that this type together with forest mosaics (11%) often represent the fallow land for the cropping mosaic, we may estimate that this combined unit covers about 58% of Lao land resources. The surface of this rather extensive resource use is overwhelming compared to the 12’171 km^2 or 5.9% share of agricultural land. The relatively undisturbed dense forests (FHD) constitute only 14’917 km^2, which is 7.2% of the land area or 17% of entire forest of the Lao part of the LMB

	1993 ['000 km²]	1997 ['000 km²]	Change [km²]
Forest high density (FHD)	15'095	14'917	-165
Forest medium - low density (FMD)	45'102	43'755	-1'236
Forest mosaic (FM)	24'093	23'649	-403
Regrowth (REG)	3'144	2'921	-211
Other forest (OTHFO)	18	18	0
Wood- & shrubland (WOSH)	60'830	80'056	19'774
Grassland (GRAS)	5'601	5'502	-99
Mosaic of cropping (CROP)	35'863	16'858	-18'501
Agricultural land (AGRI)	11'279	12'171	897
Others (OTH)	5'830	5'775	-55
Cloud & Nodata	391	1'624	1'233

Figure 3a: Net change analysis of different land cover classe sfor the Lao part of the LMB (1993 – 1997) Source: Heinimann, 2006, based on MRC/GTZ land cover datasets

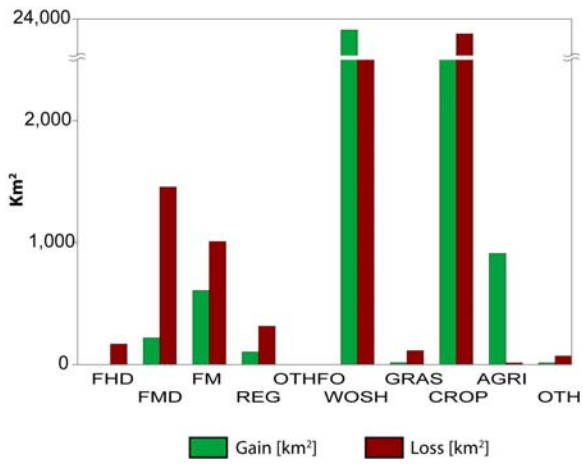

Figure 3b: Dynamics of selected land cover classes for the Lao part of the LMB(1993 – 1997) Source: Heinimann, 2006, based on MRC/GTZ land cover datasets

The analysis of net-dynamics of different land cover classes between 1993 and 1997 shows that while almost 1'236 km^2 or 2.7% of medium to low density forests (FMD) have disappeared, the area of forest mosaics (FM) has undergone much smaller changes. Differentiating the net change analysis of figure 3a into total gains and losses of the corresponding category, however, reveals that considerable dynamics are hiding behind this apparent stability (cf. figure 3b). The Forest Mosaic (FM) with apparently only small changes actually suffered high losses, which were then "neutralized" by gains elsewhere. These gains are often due to conversion of FMD to FM as a result of forest degradation. This is highly relevant as the forests in these areas are just likely to continue their degrading trajectory as there are already human inventions in the region. This highlights that standard net-change analysis of land cover changes is far from sufficient to lay open the entire complex of ongoing dynamics. To gain insight into the full range of land cover dynamics, class specific cross tabulation-matrix analysis must be carried out. The cross-tabulation depicted in figure 4 shows that the actual dynamics (gains plus losses) in Lao PDR are in fact much higher then the net-change analysis in figure 3a can capture. At the same time it reveals that deforestation is not a process which transforms undisturbed dense forests into agricultural land. Rather the strongest deforestation processes are taking place through conversion of medium to low cover density forests (FMD) and forest mosaics (FM) into a mosaic of cropping (CROP). Conversely, agricultural transformation is almost always a two-step process, passing through the mosaic of cropping – wood and shrubland system. It should be noted that agricultural intensification already accounts for considerable 18.8% of all land cover dynamics considered in Lao PDR.

	FHD	FMD	FM	REG	OTFO	WOSH	GRAS	CROP	AGRI	OTH
Forest high cover density		0.5	1.3	0.0	0.0	0.7	0.0	1.0	0.7	0.1
Forest medium - low cover density	0.0		13.8	0.0	0.0	7.6	0.1	13.6	2.4	0.0
Forest mosaic	0.0	0.0		0.0	0.0	4.7	0.0	18.1	3.2	0.0
Regrowth	0.1	5.1	0.5		0.0	1.2	0.0	1.2	0.0	0.0
Other Forest	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Wood- & shrubland	0.0	0.0	0.0	2.6	0.0		0.0	**	4.6	0.2
Grassland	0.0	0.0	0.0	0.0	0.0	0.0		2.7	0.2	0.0
Mosaic of cropping	0.0	0.0	0.0	0.1	0.0	**	0.3		11.3	0.0
Agricultural land	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0		0.1
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.0	

Background colors indicate the following processes:

Color:	Process:	%	km2
	Deforestation	54.5	2117
	Forest Degradation	15.6	607
	Intensification	18.8	729
	Reforestation	2.7	104
	Forest Rehabilitation	5.7	220
	Extensification	0.5	20
	not classified	2.1	83
	Total:	100.0	3880

Note: ** indicates the main trajectories, which have been excluded from the
due to methodological reason

Figure 4: Cross-tabulation matrix for different land cover classes in Lao PDR showing the dynamics between any two land cover classes as % of entire land cover dynamics in the Lao part of the LMB 1993-1999.
Source: Heinimann, 2006. (based on MRC/GZT land cover datasets)

With a view to characterizing the environmental dimension of developments in Laos , we are obviously most interested to understand how the different processes of deforestation, forest degradation, but also intensification and reforestation are manifesting in space. Figure 5 shows a clipping for northern Lao PDR covering the provinces of Luang Namtha, Bokeo and Oudomxay, but also some parts of North Thailand.

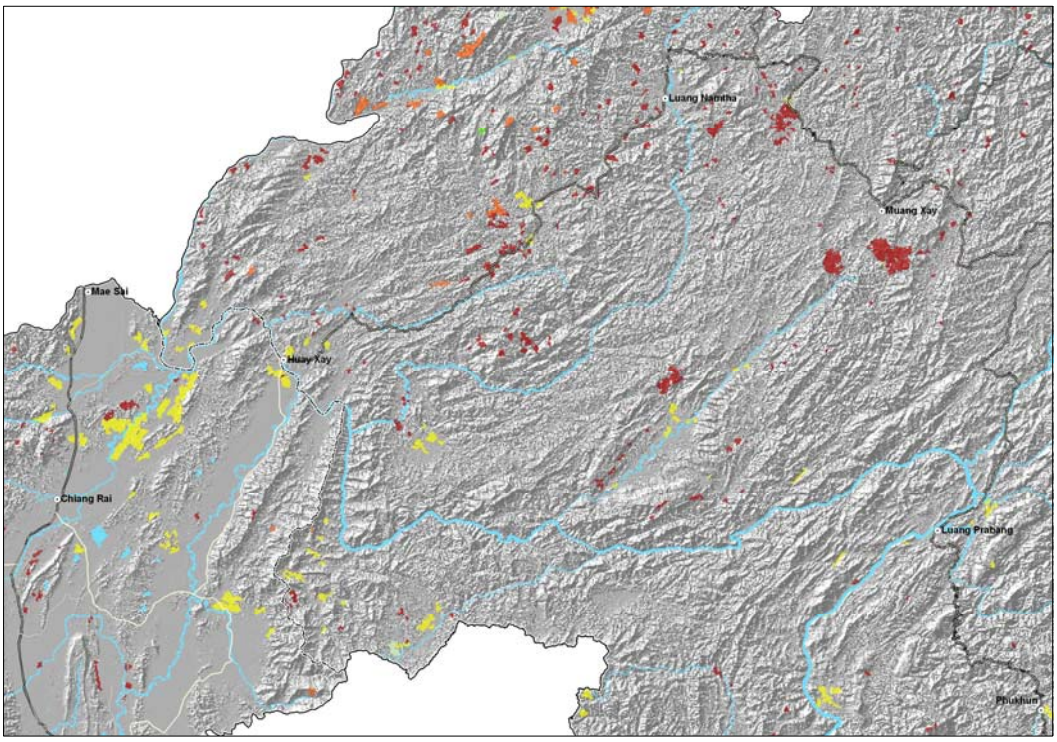

Figure 5: Land cover trajectories in northern Lao PDR from 1993 to 1997.For colour key refer to figure 4.
Source: Heinimann, 2006 (based on MRC/GTZ land cover datasets)

At a first glance we perceive how different the land cover trajectories are from Laos to Thailand. Whereas in Laos we observe mostly forest degradation and deforestation processes, Thailand seems to be characterized by agricultural intensification processes, i.e. transforming different non-forest land cover classes into agricultural land and cropping mosaics. Put into very simple terms, we may retain that the agro-ecological setting of a region is by far not the determining factor of land use in this area. Factors linked to the economic, political and socio-cultural domains of the respective countries seem to have a much higher influence on the decisions taken by the users of land resources.

Apart from this very general pattern at aggregated level, we may now turn to the spatial patterns of land cover trajectories within Lao PDR, which seem to be far less obvious. The pattern seems to be more complex and we will have to let our further investigations be guided by the project's research hypothesis. This hypothesis states that decisions on the management of land resources (forest, fallow land, agricultural land, etc.) are increasingly influenced by actors, institutions, policies, etc. intervening at levels beyond the local level and determining the environmental services ultimately claimed. In other words we hypothesize that we will be able to explain specific patterns of the poverty-environment nexus at a national level by analysing decision-making at multiple levels for different areas.

3.2. Accessibility – a first proxy for estimating stakeholders' claims for environmental goods and services

As stated earlier, the project will undertake a detailed analysis of stakeholders, their places and levels of intervention, as well as their claims towards environmental service extraction. As we cannot draw on these results yet to explore the above-presented spatial patterns of land cover trajectories (cf. figure 5), we will use accessibility as a proximate indicator for the influence of various external stakeholders on local land use decision.

The degree to which a specific parcel of land can be reached naturally has an influence on what cover it bears. Accessibility is therefore generally considered as a key determinant of present land cover systems (e.g. Geist and Lambin, 2002; Kaimowitz and Angelsen, 1998; Verburg et al. 2004). Simple approaches which correlate the Euclidean distance to roads with defoerestation (e.g. Cropper et al., 1997), tend to overestimate the causality (Verburg et al., 2004). Travel time and cost can be estimated to provide a more realistic measure. Heinimann (2006) has established a cost-distance model for the LMB that basically calculates the travel time from any point within the basin to the nearest village, province capital or neighbouring

county's border or vice versa. The model takes different factors into account to determine this travel time, namely the road network, the slope, the land cover, main rivers and lakes, country boundaries and border check points.

Figure 5 shows the result of this accessibility model for the same area of northern Laos taking the province capitals as a starting point. The graduated colours from green to dark red show us how far a person can travel starting in one of the province capitals of Luang Namtha, Oudomxay, Huay Xay or Luang Prabang. As an example, the green to yellow range indicates all places where one can travel within three hour or less using whatever means of transport available (road transport with different categories and slopes, walking through different land cover types and topographies etc.). Even though it is generally known that accessibility in Laos is more difficult than in neighbouring Thailand - where any place can be reached within approximately one hour as indicated by the predominantly green colour - the relevance of these results shall not be underestimated: if we consider any development agent leaving the provincial capital for a one-day trip to any village in his province, his range corresponds just about to a 3 hour accessibility provided the agent will return on the same day. Calculated in terms of land surface, about 30% of the provinces can be reached during such a day trip, whereas the remaining 70% would need more the 4 hours travel time.

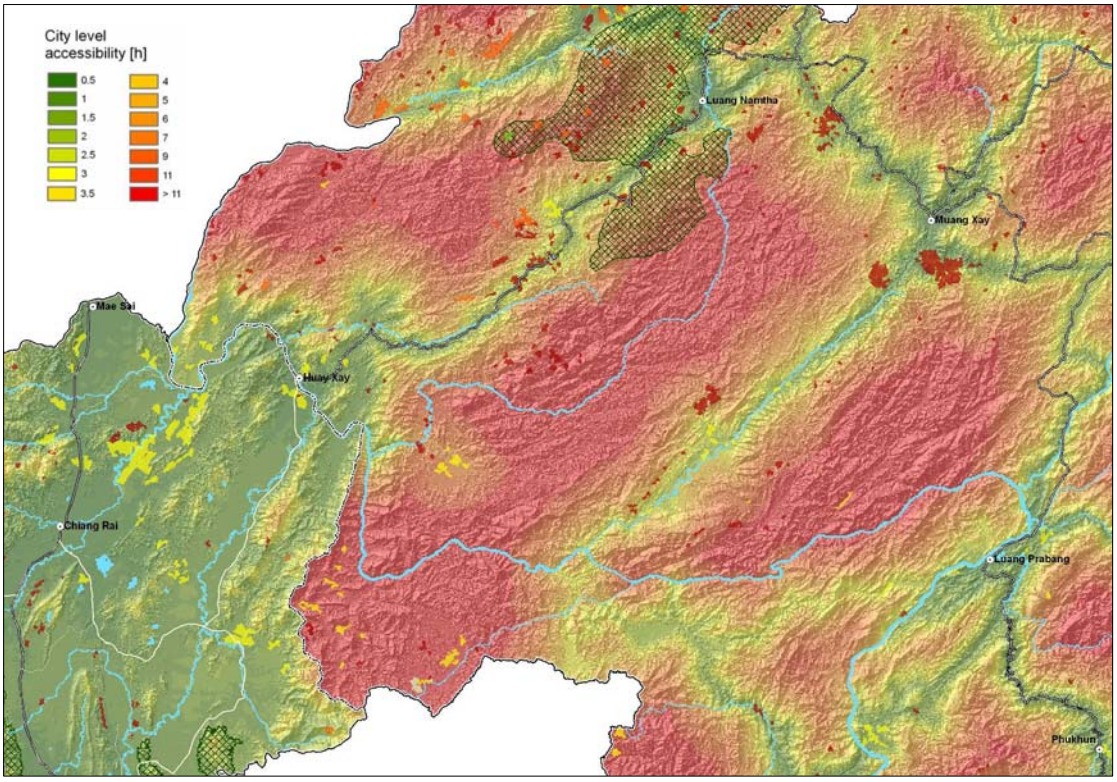

Figure 6: Land cover trajectories and city level accessibility in northern Laos based on cost-distance algorithms. Friction surface based on various input variables (e.g. roads, DTM) based on 50th and 100th base maps (partly provided by MRC). Provincial capitols provided by MRC. Source: Heinimann, 2006

3.3. First insights related to environmental service provision and related actors in Lao PDR

Figure 6 does not only represent the different accessibility classes but depicts also the major change trajectories of figure 5 as an overlay. A first visual examination reveals that the patterns of deforestation and forest degradation (red and orange patches) can generally be found in areas, which are well accessible from province capitals. We observe important change events in the vicinity of these towns as well as along the corridors connecting Oudomxay, Luang Namtha and Huay Xay. The numerous deforestation and degradation events that can be found close to the Chinese border would probably have to be explained by the good accessibility from this neighbouring country. Heinimann (2006) produced empirical evidence that total forest loss as well as deforestation rates in Laos are extraordinarily high in areas that are easily accessible from Thailand, Vietnam or China. In general terms we may retain that whereas good village accessibility may be an important precondition for deforestation and forest degradation, influences related to economic and political actors beyond the local level are key to explain these processes.

The importance of accessibility as a determinant factor for land cover trajectories can also be illustrated by observing the degradation and deforestation patterns in the Nam Ha National Biodiversity Conservation Area (NBCA) shown with a green hatched pattern. Although deforestation rates inside the NBCAs of Laos are in average only half of the deforestation rate outside of NBCAs, it would be wrong to attribute this achievement to the fact that a certain area is declared and managed as a protected area. Empirical evidence (Heinimann, 2006) has shown that only 14% of this slow-down effect of deforestation can be correlated with the fact that it is a protected area; rather population density and accessibility are the most important determinants. This seems to be confirmed by the case of Nam Ha NBCA, which manifests a high number of degradation and deforestation events, which must most probably be attributed to its, from a purely conversationalist perspective, “unfortunately” good accessibility.

Finally, we may use city accessibility as a proximate indicator to explore how economical, political, and institutional developments influence the use of land resources in more general terms. Figure 7 reveals the specific patterns in the distribution of land cover classes along the city-level accessibility continuum.

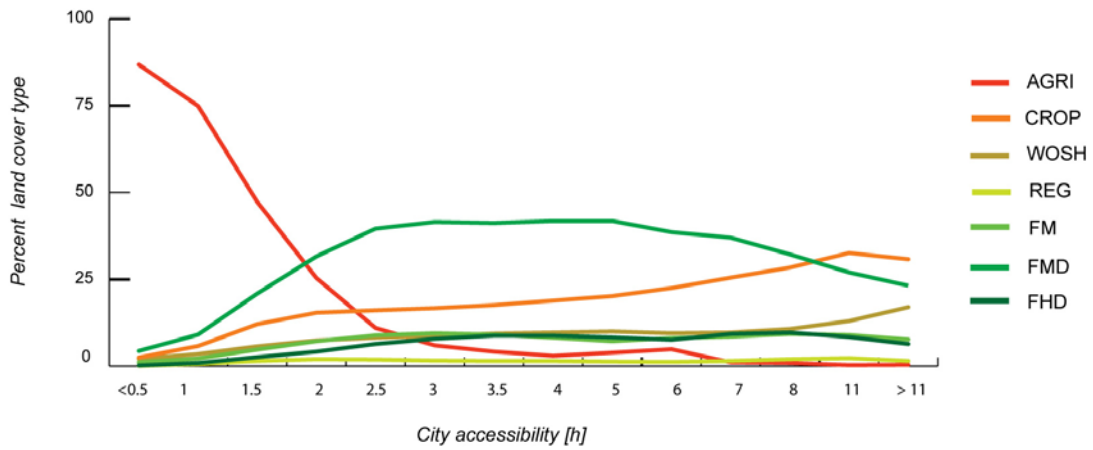

Figure 7: Distribution of selected land cover types in the Lao part of the LMB across city-level accessibility. AGRI: Agricultural lands; CRP: mosaic of cropping; WOSH: Wood and shrublands; REG: Re-growth; FM: Forest mosaic; FMD: Medium to low cover density forests; FHD: Dense forest. Source: Heinimann, 2006

We observe that the share of agricultural lands drops sharply in the first three hours of travel time from province capitals to remain at an almost insignificant level in areas, which are farther away. At the same time the mosaic of cropping, which consists to a considerable part of shifting cultivation , raises continuously with longer travel time. After only 2.5 hours, the mosaic of cropping already dominates over agricultural land. The continuous raise of mosaic of cropping is accompanied by an increase of wood and shrublands and forest mosaics, which may be seen as the corresponding fallow land. Medium to low cover density forests increase more quickly with increasing travel time from city centres and occupy an almost constant share of land beyond 3 hours travel time from cities.

4. Conclusions and Outlook

This paper presented the overall conceptual ideas as well as first results of a research project, which aims at understanding poverty-environment linkages in Lao PDR through disparities of development interventions by stakeholders at multiple levels. An initial sectoral focus on the environment revealed important insights in meso-scale resource dynamics. It was shown that ordinary net-change analysis of land cover classes often hide the dynamics related to total gains and losses in each class. The highest land cover dynamics are clearly related to the interface between upland agriculture and secondary forests as well as fallow land. Although these processes were observed between 1993 and 1997 they are most likely to persist at present. In view of future development pathways of Lao PDR embedded in a highly dynamic context of its neighbouring countries, this has two obvious but not the less important consequences: On

the one hand we must retain that the future of environmental- and biodiversity-conservation will not depend on the protection of few relatively undisturbed forests, but rather on the important surfaces of secondary forests undergoing rapid change. At the same time, the different environmental and economical functions of these secondary forests are often undervalued (Schmidt-Vogt, 1998). Peasants, for whom they represent an important basis to secure their livelihoods, are often their sole and weak advocates. Nevertheless, issues of poverty alleviation, which stand on top of national and international agendas, can not be disconnected from the future of this natural resource.

Moreover, it was argued that local land use decisions are increasingly influenced by actors, institutions, and policies beyond the local level. Using accessibility to provincial capitals as a proximate indicator for the influence of such stakeholders, we could reveal that the highest environmental dynamics are not taking place under remote subsistence agriculture. Forest degradation and deforestation rates are significantly higher in the vicinity of towns and borders to the neighbouring countries. Conversely, agricultural intensification is also linked to development opportunities emerging from the vicinity of bigger towns. In other words, sustainable development pathways can and should not be sought and developed outside the reach of development interventions. However, it will be crucial to understand the different trade-offs that are being produced between environment and poverty alleviation, and what are the underlying decision-making processes.

These are the tasks, which the research project will pursue in the near future. On the one hand it will undertake to produce high-resolution poverty maps that can be linked to the environmental information currently available. On the other hand, a systematic analysis of stakeholders intervening on poverty and the environment will be conducted. We will thereby ask who is doing what, where, and at what politico-administrative level.

The ultimate goal of our research is to understand specific configurations of poverty and environment linkages in Lao PDR through development interventions by different stakeholders at different levels. With this, we hope contribute to a better understanding of phenomena such as the ongoing transformation of secondary forest into land concessions. Not only that we hope to understand the environment- and poverty-outcomes of such transformations at a country level, but we also expect to obtain a more realistic picture on the involved stakeholders and the underlying decision-making processes.

We are convinced that innovative development pathways balancing economic growth and environmental sustainability can only be conceived if knowledge production is improved in

the following two domains: first, we need spatially differentiated but at the same time generalised knowledge on development problems and potentials such as poverty (i.e. welfare) and environment. Second, we must explore innovative processes for negotiation and decision-making to increase the freedom of choice to proactively plan future development. Only by combining these two domains of knowledge will it be possible to inform policies and development interventions that allow for spatially differentiated, balanced, and equitable trade-offs between economic development and environmental conservation.

Acknowledgements

The authors acknowledge support from the Swiss National Centre of Competence in Research (NCCR) North-south: Research Partnerships for Mitigating Syndromes of Global Change, co-funded by the Swiss national Science Foundation (SNSF) and the Swiss Agency for Development and Cooperation (SDC).

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