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Adaptation dynamics shaped by multiple tiers of governance: Climate change and deforestation in Indonesia

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Abstract

A critical science challenge in times of climate change and increasingly depleted natural resources is how policy and management can be improved to attain a pathway to sustainability. This paper argues that multiple scales have to be considered in order to achieve sustainable outcomes. Decision makers operate on different scales and respond to decisions made on other scales. Sustainability is determined by conditions defined by this process of interactive decision making, and across various tiers of governance. To improve understanding at one scale in isolation with constant assumptions on responses at other scales is likely to lead to unsustainable unintended side-effects.

Based on applied research in Indonesia, consequences for research design, methodological aspects of modelling and the process of decision support are discussed and a multi-scale assessment framework is developed. This framework employs a blend of methodologies to feed the needs of decision makers on multiple scales. The analysis includes the links between household livelihoods, deforestation, energy price changes and climate change. Furthermore, process-related aspects of decision support are discussed and linked back to adaptability of decision making at multiple scales in times of mounting climate change impacts.

Keywords*: Participatory Modelling, Multi-level governance, Agent-based modelling, Indonesia*

1. INTRODUCTION

Participatory research is increasingly employed to design and conduct applied science (Jones et al. 2008). Cornwall and Jewkes (1995) describe participatory research as "reflexive, flexible and iterative" while traditional approaches are based on "linear designs". A critical feature of participatory research is that the research process aims to have local stakeholders seek their own solutions instead of research outputs being delivered outside the decision making system after conducting research in isolation. As Gramberger (2001) points out, participation goes beyond one-way connections of information and consultation. This creates an operational overlap between management and research or policy making and research (Armitage et al., 2009). Participatory research has been trialled very successfully (Jones et al., 2008) and close links to management and policy suggest improved information in relation to the decision making processes.

But most of the participatory applications have been established with one governance level only; predominately at the village scale. From a *problem perspective*, it would be rare that only one decision making entity determines outcomes. Instead, sustainability related problems are by nature cross-sectoral *and* cross multiple levels of governance. Historically, governance has evolved in sectoral specialisation. This means that developing participatory processes with multiple horizontally organised entities is necessary to feed into sector-focused decision making processes.

At the same time, most sustainability related problems are determined by decisions made at multiple tiers of governance (Smajgl, 2009). For instance, a decision and investment by a local government can target the protection of a natural resource. A sudden change in financial incentives implemented by the central government for different purposes can contradict such local efforts. The central decision can change use levels of natural resources as it impacts on households livelihoods. As a consequence of the participatory process, multiple vertically organised decision makers have to be included to allow (a) for design and delivery of relevant research findings and (b) to improve the vertical coordination between the relevant decision makers. Figure 1 conceptualises these dimensions.

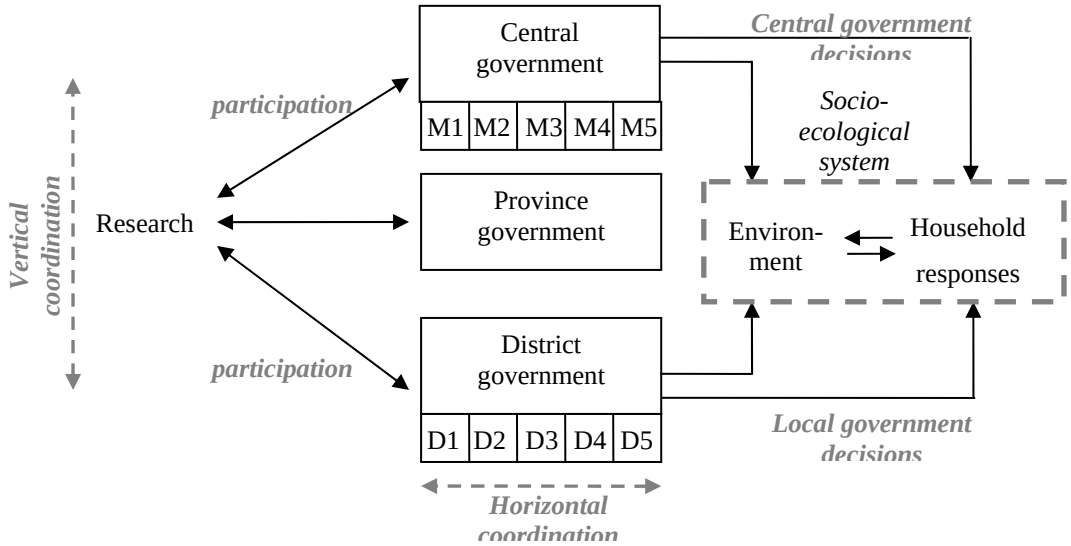

Figure 1: Participatory and coordinative linkages of decision making and research

The body of work analysing the relevance of multi-level governance situations for participatory research – participatory modelling specifically – is yet to be developed. While multi-level governance questions have been discussed form a political point of view (Bache & Flinders, 2004) the links to sustainability issues have mostly been discussed for the purpose of designing effective institutional arrangements (Ostrom, 2006; Bromley, 2006). But the relevance of multi-level governance for research design and participatory processes lacks analysis and implementation.

Generally, multi-level governance results from the dispersing of authority from central governments to supranational entities or to regional and local governments (Marks & Hooghe, 2004). Such an evolution stems from growing beliefs that de-centralised governance systems are superior to centralised monopolies (Hooghe & Marks, 2003). Findings on institutional diversity emphasise the benefit of decentralised options for the sustainability of socio-ecological systems, and the relevance of local context for governance issues (Ostrom, 2006). Conflict is a central topic for governance and sustainability related questions and decentralised authority can effectively reduce such conflict (Paavola, 2007).

Most of these institutional studies are focused on first order impacts of governance and on the state of an environmental variable. Considering the complexity of socio-ecological systems we argue that the pathway to sustainability of regions is highly determined by second order and third order impacts. For instance, changing commodity prices might not have a direct link to water quality and fish populations. But by changing prices, land use is likely to change and this might trigger changes in variables such as fertiliser application rates or erosion rates.

Therefore, the research documented in this paper aims to analyse the process related to, and modelling related aspects of, participatory research in a multi-level governance situation in Indonesia. From a modelling perspective, the aim is to quantify the impacts of decisions made at the central and the district level. The central perspective was developed in a participatory process and was comprised of various aspects around energy prices and poverty payments. The local perspective was also developed in a participatory process and targeted expansion strategies for logging and mining. Such a multi-level participatory approach creates the additional challenge of vertical coordination of the research design and, in this case, model development in addition to the horizontal coordination between sectoral interests. The emerging process reduces the clear distinction between decision making and research process, adding to adaptive capacity for managing regions sustainably through shared learning (Armitage et al., 2009).

This paper steps through such a participatory process in Indonesia by showcasing the approach to involve, across sectors, decision makers from multiple levels of governance. It lists the analytical results that were developed from agent-based methodology for the case study of East Kalimantan, and it explains how the participatory process allowed the analytical results to feed into the relevant decision making processes. The following section provides the contextual background for the participatory research.

2. BACKGROUND

The participatory modelling approach presented in this paper was triggered by questions from central Ministries of the Government of Indonesia on how macro policy questions are likely to play out for Indonesia. Initial discussions identified a high diversity between regions in Indonesia; diversity created by, for instance, natural resource conditions, economic activities, population density, and poverty levels. This variety in local conditions provided some local governments with a rich portfolio of governance options, especially due to the decentralisation that increased financial independence of regions (Resosudarmo, 2004). This budgetary change created significant additional income to improve regional economies and infrastructure, particularly for regions rich in natural resources such as forests and minerals. However, since the fall of the Suharto regime, district governments gained new budgetary opportunities and Indonesia witnessed previously unexperienced levels of deforestation (FWI/GWI, 2002). This peak in the use of natural resources was partly explained by a legislative grey zone that did not assign unambiguously approval rights to district or central governments but left details open, which created additional opportunities of excessive resource use (Resosudarmo, 2004).This happened partly in order to improve local economies and hence to reduce poverty.

From a central government perspective poverty reduction was and still is a major goal. However, inherited economic decisions such as the fuel subsidy scheme increased the pressure on the national budget, especially with the increasing price for crude oil and the increasing domestic consumption (which made Indonesia a net importer). In 2005 the Government decided to reduce fuel subsidies and hand out cash payments to poor households to protect them from the cost increase; as of 1 October 2005 petrol prices increased by 87.5% and kerosene prices by 186%. However, oil prices surged during 2007 and the first half of 2008 imposing again a substantial threat to Indonesia's budget. The Indonesian government decided to reduce fuel subsidies for a second time, effective from 1 June 2008, which led to an increase in petrol prices by 27.5% and of kerosene prices by 15%. In order to reduce the impact on poverty, each poor household received a quarterly direct cash payment of IDR300, 000.

From July 2008 on oil prices decreased due to the global economic downturn and the central government discussed increasing fuel subsidies to reduce the petrol price by either IDR 500, IDR 1,000, or by IDR 1,500 (from IDR 6,000 in October 2008). Additionally, the discussion started about extending poverty cash payments beyond June 2009.

This participatory modelling exercise evolved from the central government decision to change fuel subsidies, poverty cash payments and district government options to reduce poverty.

3. PARTICIPATORY PROCESS

3.1. Scoping Phase

Early in 2006, a series of workshops was organised with central government ministries to identify the problem domains, the important decision making processes and the indicators relevant to those decisions. Fuel subsidy changes and poverty cash payments were identified as critical cross-sectoral decisions. The central government was interested in understanding how such decisions are likely to play out in different regions of Indonesia. Indicators relevant to the central government included highly aggregated information such as GDP, poverty level (measured in number of households below the poverty line), and the deforestation rate. Following on from there, methodologies were discussed. It was decided that a Computational General Equilibrium model would best suit the needs of the central government if indicators such as the Gini coefficient and forest stocks could be included and that the model disaggregated Indonesia into at least five sub-regions.

In further workshops with the central government, scenarios were discussed as to how district governments and households could respond to the pending macro policy decision. Based on this discussion, 'critical regions' that may provide an improved understanding of grassroots-level responses were identified. It was decided to develop agent-based models for parts of East Kalimantan and for parts of Central Java. See for details on agent-based modelling Gilbert (2008).

In a next step workshops were conducted with district and province governments of East Kalimantan to identify from their perspective, problem domains, important decision making processes, and relevant indicators for those decisions. The district governments listed the likely impact of investments in forestry and mining on poverty as the most relevant decisions. The agent-based model is therefore designed to simulate in parallel decisions from central, provincial, and district level. The development was undertaken with a core team that involved representatives from all three levels and from the local university. The linkage between all three levels was defined by emphasising that the achievement of individual goals is dependant on decisions made at other scales and that the model could allow for improving strategies in anticipation of changes. Then two validation workshops were conducted on (a) model design, and on (b) assumptions the model makes for on behavioural typologies.

3.2. Model results

This paper is solely focused on the agent-based model developed for the East Kalimantan case. This agent-based model[1] aimed to analyse the outcomes of the decision from June 2008, which was the impact of reducing petrol prices and the change to poverty cash payments. These results targeted cross-sectoral interests at the level of the central government. In addition to this horizontal property, the model aimed to facilitate some effective vertical links crossing multiple levels of governance. Therefore, options relevant to district government in response to their expectations derived from central decisions were also simulated. These scenarios were comprised of additional approvals in logging and mining licenses.

Model results suggest that the decision from June 2008 to increase petrol prices by 27.5% and kerosene prices by 15% while handing out quarterly poverty cash of IDR 300,000 reduced poverty by between 5-6%. This stands in stark contrast to expectations by the district governments who expected there would be either

[1] Further model results and technical details with model functions, model structure and model operation can be found in Smajgl *et al.* (2009) and pseudo code in Smajgl & Carlin (2009), downloadable on http://www.csiro.au/science/IndonesianPathways.html.

neutral or negative effects on poverty and considerable additional approvals for logging and mining licenses to reduce poverty.

Model results indicate that poverty drops seasonally by 30-40% during the harvest of fruits and honey. This fluctuation puts all policy levers into perspective.

Simulations show that petrol price reductions have diminishing marginal effects. Reducing the price for petrol by IDR 500 leads to a reduction of poverty by between 1.8% and 3.4%. Doubling the public investment in fuel subsidies increases the impact sub-proportionally by just 0.4% on average. Reducing in the model the petrol price even further by IDR 1,500 triggers an increased use of natural resources such as fish (lower operating costs) and existing stocks have to be shared by more people. In total more people are poorer than under the scenario of petrol prices decreasing by IDR 1,000. In January 2009 it was decided that the petrol price will be reduced by IDR 500.

Model results indicate non-linear responses in poverty to changes in poverty cash payments. While payments around IDR100k have nearly no impact, payments around IDR 200k reduce the number of households below the poverty line by up to 8,660 persons. Increasing to IDR300k delivers average values of up to 35,850, which is an efficient additional investment compared with further increases. Model results indicate that further increases deliver sub-proportionally, with extremes like stepping form IDR 400k to IDR 500k delivering zero further poverty reduction. This non-linear response reflects a combination of existing income distribution of people below the poverty line and of the diverse livelihood dependencies of poor people. In February 2009 it was decided to extend the poverty cash payments at a level of IDR 300k.

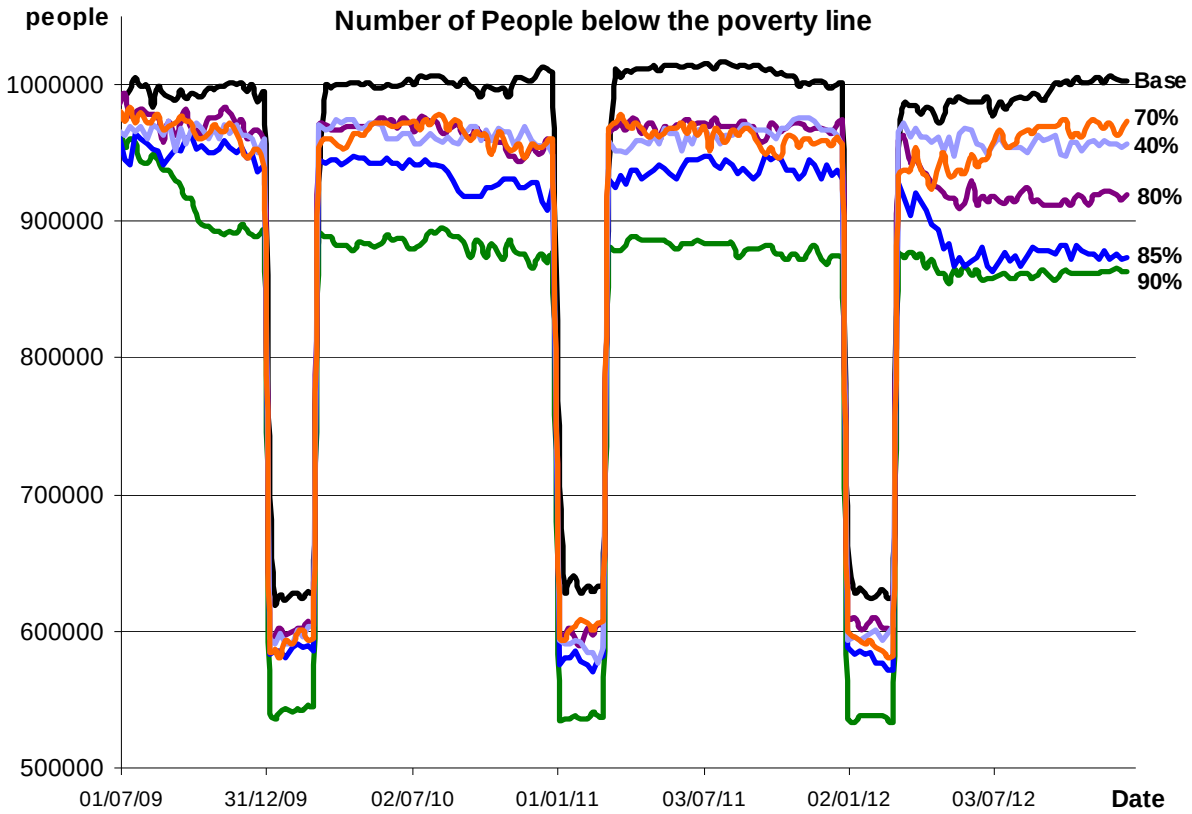

Figure 1: Number of people below the poverty line for different levels of reductions in logging

At the level of district governments, the fuel subsidy discussion raised expectations of stable poverty rates in urban areas and increasing poverty rates in rural areas of East Kalimantan. Therefore, further studies were carried out into logging and mining. Land conversion into oil palm and timber plantations are also included in the model but will not be discussed in this paper. Model results suggest the widespread assumption that increased logging decreases poverty is questionable if poverty is measured as persons below the poverty line. Simulations show the opposite dynamic, with poverty decreasing by about 5% if logging rates decrease by 40%. Figure 2 depicts that in the case of a 90% reduction in logging rates, poverty decreases by more than

14%. Both examples compare benchmark and scenario values for the end of 2012. These results indicate that the logging sector creates employment for a minority in the populations while negative externalities from logging impact on a much larger group.

Furthermore, model results indicate that more mining operations have a minimal impact on poverty reduction, which contradicts current assumptions made by local decision makers. From a dynamic perspective, the simulation reveals that the impact is larger in the beginning as mine site had to be cleared, which involves more local labour. The initial impact of about 6% poverty reduction wears off over the years as the number of skilled labour declines and people immigrate. In addition, erosion decreases fish catches and deforestation decreases non-timber forest products such as honey. Both drive poverty numbers among the rural population up. Hence, long-term outcomes of mining operations turn negative about five to six years after the mining projects are approved.

Skilled labour is an important topic in East Kalimantan and while logging and mining sectors are seen as effective levers in reducing poverty, decision makers point out that most skilled labour has to immigrate. This leads to high population growth, for instance in Kutai Barat the rate is 10% per annum. This increase puts further pressure on natural resources which substantially constrains policy related poverty alleviation. For instance, if quarterly poverty cash payments of $300k were handed out until end of 2012, and taking population growth into account, poverty still increases by 12% when compared to 2006 levels (last official data). This puts policy driven successes into perspective.

3.3. Post modelling phase

The participatory approach utilised at the three levels of governance, central, provincial, the district governments, allowed for initialising and fostering active links between the staff of decision makers and researchers. Training courses were also conducted in agent-based modelling (and CGE modelling), which included staff from various institutions which in turn helped to maintain horizontal and vertical links.

Based on the existing linkages to stakeholder's at all three levels, workshops were conducted to discuss the validity of the model results. The final workshops presented the results such as the ones shown above and policy consequences were discussed. This process revealed that most decision makers implied linear relationships between, for instance public investment and poverty. The model facilitated an ongoing discussion and a process that updated many existing assumptions decision makers made. Several recommendations found their way into the actual decision making process. At the district level, the introduction of a catchment authority for the Mahakam River was discussed to coordinate upstream-downstream effects, such as sedimentation and its impacts on fishery and flooding. Downstream-upstream effects, such as migration due to flooding and land access incentives were also discussed. Two of the six district governments demanded training in using the model for their annual land use planning process.

4. CONCLUSIONS

In retrospect, the participatory approach has proven to be very effective in creating a research impact. Multiple levels of governance was a key issue in triggering vertical coordination. Actively involving stakeholders in the model design allowed for cross-sectoral relevance, which triggered horizontal coordination and contributed to the uptake of the participatory modelling exercise. Intensive and consistent training allowed for sustainable research, which currently leads into five further case studies with agent-based models developed by the central government in collaboration with local governments and local universities.

In synthesis, any applied research seems more likely to have an impact if carried out in a participatory mode. But if a problem is determined by decisions from multiple levels of governance, the participatory process should be broadened and should develop parallel processes to these multiple decision making layers. By taking not just first order impacts but also second and third order impacts into account, such parallel processes seem necessary in many cases. These parallel processes open up an opportunity (or even trigger the inevitable need for) of coordination between vertically organised decisions makers. Understanding systematically the process-related consequences of multi-level governance issues for participatory modelling requires some future research. Particularly, as the research documented in this paper emphasises the relevance of 'model facilitated processes in relation to the actual model and its results.

The research documented in this paper experienced an impact from the actual model results but more relevant, were the outcomes achieved through the participatory model design process and its implicit mechanism to bring decision makers from three levels into a shared workshop situation. While the agent-based model effectively facilitated discussions and thinking about future scenarios the more relevant discussions went beyond model results and articulated the need for better coordinated decisions. This includes plans to initiate a catchment authority for the Mahakam River and to discuss central decisions in future, with provinces and districts to define coordinated action instead of isolated decisions and responses.

5. ACKNOWLEDGMENTS

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