



## **Multi-level Scenarios for Exploring Alternative Futures for Upper Tributary Watersheds in Mainland Southeast Asia**

Author: Lebel, Louis

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Louis Lebel

# Multi-level Scenarios for Exploring Alternative Futures for Upper Tributary Watersheds in Mainland Southeast Asia

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*Nested scenarios at 2 spatial levels were constructed to explore key uncertainties about how livelihoods and landscapes in upper tributary watersheds of montane mainland Southeast Asia might unfold in the coming decades. At the regional level the scenarios highlight the implications of different forms of market and political*

*integration. At the upper tributary level the scenarios highlight changing dependencies on local natural resources and the extent of empowerment of local stakeholders in their management. The scenarios are intended as a starting point for discussions among stakeholders, as a framework for designing and interpreting land use and land cover change simulation studies, and as a tool to help identify resilient livelihood and regional development strategies. The multi-level approach to scenario building introduced here shows considerable promise for mountain regions, as it encourages analyses to be cognizant of broader-scale economic and social changes as well as the uncertainties specific to these upland environments.*

**Keywords:** Scenarios; scale; upper tributary watersheds; livelihoods; landscapes; Mekong region; South-east Asia.

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## Introduction

The landscapes and livelihoods in upper tributary watersheds of montane mainland Southeast Asia are spatially heterogeneous and diverse. Shaped by topography, climate, wars, trade, and variable cultural practices, their futures are highly uncertain. On the one hand, most governments in the region have adopted progressively more preservationist policies for these watersheds, expanding protected area systems and restricting land uses, especially beyond the rice paddies on narrow valley floors (Thomas et al 2002; Lebel 2005b). Agriculture and even human settlements have been declared illegal, and incentives or force have been used to relocate peoples.

On the other hand, the penetration into upland communities of larger market institutions for cash crops, credit, and labor, made possible by improved road and telecommunication infrastructure, has also brought new economic opportunities (Rerkasem et al 1994; Walker 2004; Ducourtieux et al 2006). At the

same time wealth, new social relations, and political reform have brought new influence, rights, and responsibilities to some peoples and places with respect to natural resource management (Laungaramsri 2002; Li 2002; Xu and Wilkes 2004).

The interaction between local and regional sources of uncertainty is having profound impacts on livelihood strategies and wellbeing. Increasingly divergent outcomes are expected with changes in road access, provision of public health, education, and other services, as well as changes in rights to citizenship, land, and movement. Exploration of development alternatives for the uplands, therefore, needs to be framed in ways that acknowledge the real uncertainties at both local and more regional levels, including those which arise from diverging interests. Scenarios are used in many fields to systematically explore uncertainties (Gallopín et al 1997; Peterson et al 2003; van Notten et al 2003; Swart et al 2004; Lebel et al 2005).

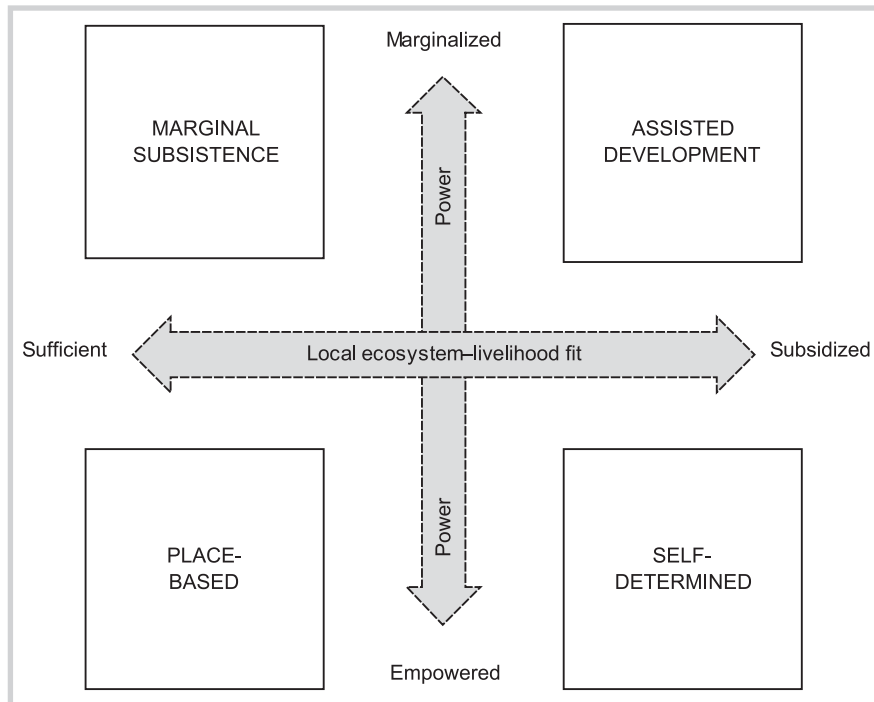
One use of scenarios can be to “test” ideas about medium-term community or agency-based strategies aimed at improving the livelihoods of vulnerable groups such as upland farmers belonging to minority ethnic populations. Scenario-building exercises can also play a role in creating arenas in which stakeholders at different levels can learn about each other’s interests and aspirations as well as some of the biophysical and natural resource constraints to development (Wollenberg et al 2000b). The present article introduces an approach to building and using multi-level scenarios and applies it to upper tributary watersheds in mainland Southeast Asia.

## Multi-level uncertainties

The first step in developing the scenarios was to identify the major environmental and social uncertainties relevant to upper tributary watershed landscapes and livelihoods. Two were identified at each level based on prior analysis of development and environmental change trends by the author (see below). Scenario-building methods are diverse, but all share an emphasis on capturing major uncertainties. Most methods have emerged out of iterative practice and the field remains under-theorized (but see Chermack 2004; Chermack 2005).

### Local (uplands)

In the uplands the quality of ecosystem goods and services relative to how they are used is a crucial factor affecting livelihoods and wellbeing (Thomas 2002; Thomas et al 2002). Some societies are very heavily dependent on renewable local land and water resources, whereas others are increasingly dependent on external inputs, for example, of fertilizers and fossil



**FIGURE 1** Upland scenarios. Four scenarios (boxes) are shown arranged against different combinations of uncertainties at the upper tributary level related to local empowerment (vertical) and resource base of livelihood systems (horizontal).

fuels. These relationships can change rapidly with improved access to credit, technologies, and markets, and capital accumulation (Lebel et al 2003). The extent of empowerment of minority populations through formal representation in political and administrative organizations and through informal networks influential in resource governance, is another important uncertainty, as it can greatly alter the set of entitlements available, including citizenship, land tenure, and off-site employment opportunities (eg Attwater 1997; Hansen 1998; Laungaramsri 2000; Lebel 2005b; Walker 2006). These 2 axes of uncertainty define 4 local-level scenarios (Figure 1).

### Regional

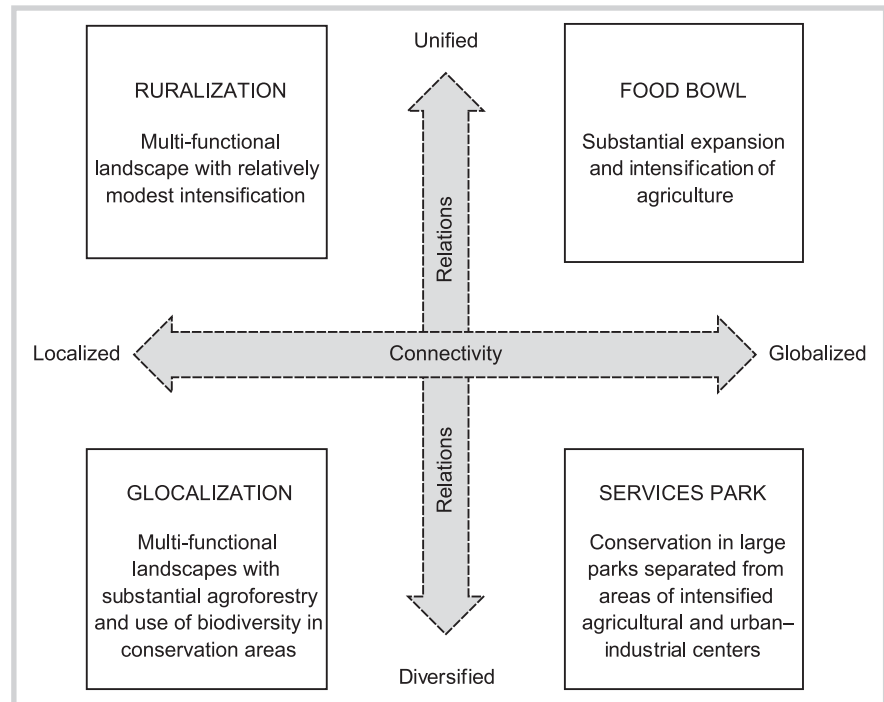
A second set of regional-level scenarios was constructed to capture the great uncertainties about how markets and political structures would interact with local landscapes and livelihoods (Figure 2). These were derived from previous reviews and scenarios of environmental change and socioeconomic trends for the Southeast Asia region (Lebel et al 2002; Lebel 2005a). The first axis, “*localized–glocalized*,” captures the contrasting ideas that production systems could be primarily oriented towards use of local resources, and for local consumption, or they could be largely oriented towards capture of external resources to produce goods for export.

Political systems may likewise vary, from an emphasis on empowering local authorities or communities to transnational corporations. The second axis,

“*unified–diversified*,” is meant to indicate the relative level of economic and political diversification. Economic diversification in the context of mainland Southeast Asia at the turn of the 21st century is inversely related to the level of dependence on agriculture. In a diversified economy, agriculture is still important, but manufacturing and other services employ more people and contribute more to household incomes. In a unified economy, there is heavy emphasis on agricultural and agriculture-related businesses. In political terms, “diversified” implies pluralism, whereas “unified” implies a greater unity and integration of purpose, ideology, and administration.

### Global

At the global level, there are both biophysical and sociopolitical uncertainties of relevance to upper tributary futures. Although we will not give much further attention to global-level scenarios in this paper, we highlight 2 key uncertainties, to acknowledge that for some analyses introducing a global level may also be worthwhile. First, climate change brings with it modest but important uncertainties with respect to rises in mean temperatures, and much greater uncertainty with respect to changes in precipitation patterns that are crucial to prospects for upland development (Lebel et al 2002). Changes in intensity of the hydrological cycle could be a basis for contrasting climate scenarios. Second, international cooperation (and conflict) represents another area of significant uncertainty for mainland Southeast Asia, lying as it does within a geographic



**FIGURE 2** Regional scenarios. Four scenarios (boxes) are shown arranged against different combinations of regional uncertainties relating to social networks for exchange and influence (horizontal) and sectoral development (vertical).

region overshadowed by 2 of the world's largest economic and military powers, India and China (Lebel 2005a).

### Regional storylines

After the main uncertainties to be explored were identified, literature was reviewed, and spatial and time series data were analyzed to strengthen understanding about key processes, interactions, and sequence effects. The storylines here were developed as a set that would span an interesting, and plausible, space of trajectories. They are plausible in the sense that it is possible to find stakeholders who articulate some of the key features of each scenario as either desirable or possible outcomes.

Storylines were refined by identifying other key variables (Table 1) for which the scenarios, originally separated according to just 2 “uncertainties,” would also be likely to differ from each other. In effect these additional assumptions form the core building blocks for writing out storylines under each scenario, so substantial effort was made to create consistent sets of assumptions within any scenario (Table 1). In practice there was some iteration among this table of key assumptions, a graphical timeline that helped in thinking about sequence effects (see Figure 3 below), and a qualitative model for what dominant drivers and feedbacks are present (not shown). Drafts of the storylines, tables and figures were shared and discussed with others working on natural resource management, development, and livelihood issues in the montane mainland Southeast

Asia region for comments, and this expert feedback contributed to improving both consistency *within* and contrasts *among* scenarios.

The aim was not to construct a winner and 3 straw man options, but rather to create a set of scenarios, each with internally consistent but not necessarily all desirable features from the perspective of a particular interest or set of values (see Neumann and Overland 2004). The scenario-building process here was not systematic; it included presentations with discussions in seminar settings, distribution of written materials, and informal working group meetings. Although the methods used would not produce the same scenarios each time, the approach is likely to be much more robust in producing a useful “space” of trajectories to explore, because of the iterations and efforts to build explicit contrasting assumptions.

In this section the 4 regional storylines are described. In the following section, the 4 upland storylines are briefly introduced, emphasizing how they interact with these regional possibilities.

### Food bowl

In this scenario regional economic growth is led by agribusiness industrialization (Figure 2). The region is seen as rich in natural resources, the people as skilled in agriculture, and the potential for rapid and sustained growth over several decades as a distinct possibility—the result of relatively low labor costs (Table 1). The successful completion of bilateral trade agreements between China and other countries in the Mekong

TABLE 1 Key differences in assumptions among the 4 scenarios at the regional level.

Characteristic being compared	Food bowl	Glocalization	Ruralization	Services park
<b>Agricultural trade</b>	High volume, few products at any given time, long distance.	Intermediate volume, very diverse, select products.	Low volume, short distances. Local systems of production, exchange, and consumption.	Intermediate volume, moderately diverse products. Trade dominated by non-agricultural products and services.
<b>Primary sources of ecological knowledge for management</b>	Private consultants and industry scientists.	Mixture of formal research-based and local knowledge.	Emphasis on local knowledge and local research.	Expertise in public agencies. Some joint private–public partnerships.
<b>Investments in water and energy resource infrastructure</b>	Mostly large-scale, irrigation-oriented.	Mostly small and medium-scale, emphasizing diverse local uses.	Low and small-scale only. Renewable energy sources.	Large-scale, with emphasis on energy production and flood management.
<b>Investments in agricultural and forestry research and development</b>	High for biotechnology and related agriculture-related industries. Low to intermediate for others.	High but diverse. Significant attention to rainfed systems, and local value-added processing. Customized design business models.	Intermediate, but strongly focused on appropriate, small-scale technologies with strong pro-rural bias.	Intermediate and focussed. Declining relative to industry and services.
<b>Investments in road/transport and communications infrastructure</b>	Very high for transport. High for communications.	Modest for roads. High for communications.	Low for roads. Modest for communications.	High for transport. Very high for communications.
<b>Vulnerabilities to climate change</b>	High investments in water security and flood proofing needed to cope with changing water regimes being used at maximum levels.	Increased risk of landslips from intense rainfall events and local dry season water shortages. Most land uses resilient to climate change.	Many rainfed systems vulnerable to drought sequences, but much inbuilt social capacity to cope with moderate natural variation.	High investments in flood proofing in lower built-up flood plains. Upper watershed services well protected and resilient to climate change.
<b>Locus of control over natural resources and land use</b>	Primarily large-scale corporate, with and without central state support.	Strongly polycentric and local, with some higher levels for coordination.	Primarily local, with some state-level protection through controls on trade and investment.	Strongly compartmentalized jurisdictions depending on main land use.
<b>Property rights systems for land, forest, and water resources</b>	Predominantly private property vested in firms.	Mixture of private and common property vested in communities and local state authorities.	Predominantly common property vested in communities.	Mixture of private property vested in firms and common property managed by central state authorities.
<b>Ecological feedbacks and surprises</b>	Soil and water pollution problems and crop pest/disease outbreaks from intensification of agricultural systems. Higher rates of biological introductions. Biodiversity losses.	Unexpected positive and negative landscape-level effects from interactions between different land uses with respect to pests, weeds, and diseases.	Outbreaks of newly emerging and older infectious diseases with significant impacts on human health and mortality.	Significantly costly problems with air and water pollution in urban industrial areas, but relatively straightforward management of other areas.

Region begins a new phase of intense competition-driven innovation in agriculture. Successful engagement with the international agricultural commodity markets leads to some manufacturing and services sector growth, but the core of the economy is agriculture-related. Eventually, the region as a whole grows to dominate world food production and also begins to recognize and market itself as the “food bowl of the world.”

As a result of the unhindered flow of capital, commodities, and—eventually—labor for agriculture, individual locations and commodities swing through boom–bust cycles producing highly dynamic agricultural landscapes (Glassman 2001; Rice 2003). High labor mobility becomes an important feature of the region, helping large transnational agri-business firms cope with changes in competitiveness among regions and variability or changes in climate. This includes seasonal migration to and from upper tributary watersheds. Special agro-industrial investment zones become established, including some in upland border regions beginning in 2015. Over time, intensification, precision, and mechanization of agriculture reduce the labor requirements per unit production (Figure 3A). This, however, does not lead to major unemployment because rapid fertility transitions over the previous decades have resulted in ageing populations and a declining overall labor force in many locations.

Over the first 2 decades, large investments in research and development and farmer capacity building are made, which begin to pay off after 2020, with rapid rises in yields, but dependent on high levels of input. Major investments in research and development (Table 1) have created a large network of human capital to redirect at new agricultural challenges as they arise. One of the greatest challenges after 2025 is the need for massive improvements in efficiency of water use, as conflicts over water reach epidemic proportions. Strict regulations and water pricing instruments help drive fast innovations in practices, crop choice, and siting. At the same time, the rising cost of oil in agricultural inputs begins to be felt and there is a shift to lower-energy but still intensified agricultural systems. Local practices and knowledge are replaced by large-scale standardization to meet quality characteristics of markets. By 2030 genetically modified crops dominate the landscape everywhere. Some lost “varieties” are re-created and re-introduced in hybrid form.

Throughout the region, state intervention in agriculture is primarily to facilitate profit-making by agricultural businesses, including smallholders who are treated as entrepreneurs rather than peasants. Ethnic minorities from upper tributary watersheds are seen as flexible, low-cost, and mobile labor rather than security threats. Agreements and enforcement of Intellectual Property Rights become central to commercialization of

new products. This shift is subtle but profound in moving away from decades of urban bias in state policies. The most important business partnerships, however, are not strictly within the region, but between trans-national companies serving the interests of consuming (importing) nations and production-oriented agri-business conglomerates that arise in the region.

### Services park

In comparison to the other scenarios, the services park scenario comes closest to balancing the multiple objectives of economic growth, industrialization, and conservation in what will still be, in 2050, an agriculture-dominated area. The main pattern is that different commercial activities become increasingly segregated spatially (Figure 2).

On the one hand, this scenario is seen as unfolding primarily through tourism that places a high value on landscape esthetics, and hence conservation of forests, wetlands, rivers, and perhaps even highland grasslands. At the same time, this “preservation of places” perspective brings with it the dilemma of increasing resource demands to meet the high level of consumption of large-scale global tourism (Figure 3B). On the other hand, cities are expected to grow, develop, and capture most of the non-tourism related infrastructure budgets. Only profit-making revenue-producing agriculture will be supported by government policies. Subsistence and low-end agriculture will disappear, except as a last resort for a still large but marginalized population.

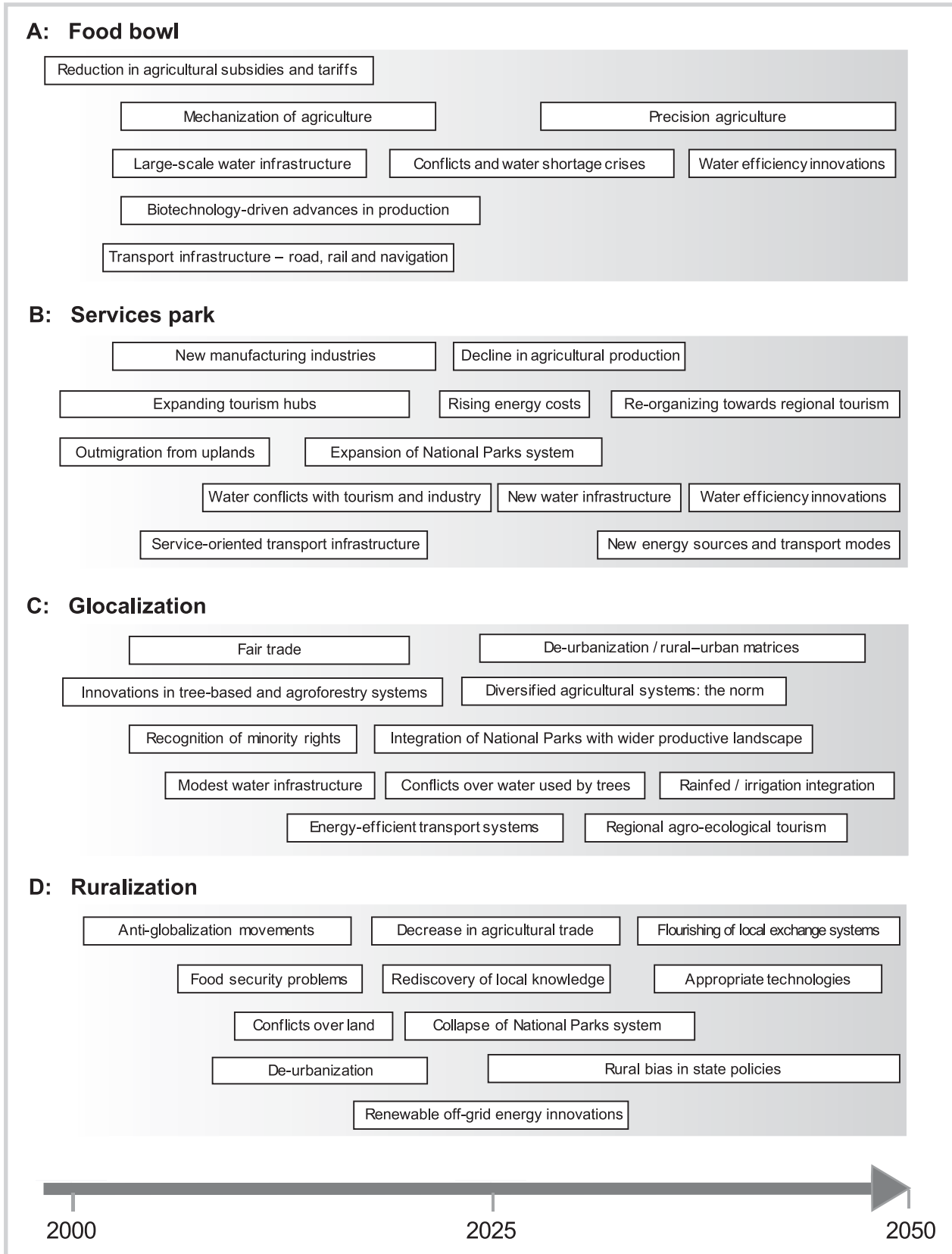
The clear segregation of areas of production and living from areas of nature and recreation will require urbanization trends to continue through 2050. Competition between cities and urban areas will produce divisions of labor, with the wealthiest and most powerful getting stronger, cleaner, and better places to live, while others become part of the low-cost industrial manufacturing belt of Asia. Industrialization will co-evolve with this concentration of labor.

The main impacts on upper tributary watershed communities will be to draw labor away to urban and peri-urban agricultural areas. This will make forest conservation policies in remote locations easier to implement. Populations in some upland areas will decline.

At the regional scale, the continuation of improvements in wellbeing for a large part of the population—if not all—will be dependent on a strong global economy, peace, and cheap energy. The tourism sector, in particular, is sensitive to sharp changes in these variables.

The emphasis on conservation in designated parks will produce some new large parks, some of which will cross over border areas while others will form corridors between major conservation areas. Substantial numbers of upland people will be coerced away from

268 **FIGURE 3** Outline of main event sequences in the four regional-level scenarios for the timeline 2000–2050.



their traditional lands by a combination of the economic pull of urban areas, restrictions on land use and property rights, and force. Apart from land, the other major source of conflicts under this scenario will probably be water: between meeting the environmental flow requirements of conservation and recreation requirements for rivers, and urban-industrial uses, including power generation; and between expanding cities and the declining, but still important agriculture sector.

### **Glocalization**

In the glocalization scenario, significant economic growth occurs, but through exploiting local comparative advantages in agriculture, manufacturing, and tourism rather than through adoption of more uniform technologies and production systems (Figure 1). Engagement with global markets is highly selective and perhaps also filtered through protective state legislation that tries to embed ecological and social externalities within the prices of traded goods (Figure 2).

This scenario could result from a reaction against social injustices and environmental consequences arising from how liberalization of investment and glocalization of trade have unfolded in practice. Fair trade becomes an important principle guiding policy and international cooperation. There is a sharp decrease in long-distance trade for all but specialty and higher-value items. This stimulates innovation and creates, somewhat surprisingly, a massive rise in “boutique” and “super-value-added” products, as trade within the region benefits from the slow-down in global-scale trade. Chinese trading companies grow to dominate the trade of medium-distance commodities across the Mekong Region. Improved information systems allow sharing of knowledge and creation of specialized market chains, making it possible for other aspects of the scenario to unfold. A second wave of portable, handheld information technologies, for example, creates the social connectivity conditions that allow farmers to talk to farmers, and software programmers to other programmers. Government agencies and large corporations lag way behind small private sector entrepreneurs and their networks. Academics in 2040 are still trying to figure out how it all happened.

Sustainability and local wellbeing principles are added to “fair trade” to become the pillars of regional cooperation and collaboration. Although profitability is never as high as in some of the boom industries, returns are viable, and prospects for long-term income stream without excessive labor inputs (always volatile) make investments in the agroforestry sector attractive. Various global environmental institutions that re-emerge after several climatic and other extreme events provide additional incentives for central and regional

government support. The control for which local governments have fought through decentralization creates polycentric and multilayered governance that allows some coordination but still substantial flexibility at local levels. Against claims to the contrary made by big business, these changes do not “retard” economic growth but are responsible for continuing rises in measures of wellbeing, especially among the poorest sectors of society (Figure 3C).

For upper tributary watersheds, more specialized markets and political decentralization create many new opportunities for viable livelihoods and profitable firms in upper tributary watersheds. The agroforestry mosaic scenario unfolds, first in Yunnan province of China, building on expansion of rubber and a history of market development for non-timber products from forests and swiddens. Landscapes are once again viewed as multi-use. Conservation-only protected area systems across the region are replaced by local landscape stewardship councils under the control of farmers experienced in complex agroforestry operations.

### **Ruralization**

This is probably the most radical of the scenarios, given current political and economic trends (Figure 2). The most likely pathway is a progressive lowering of private and public investments in regional infrastructure, either because these funds and loans are being targeted elsewhere (eg Africa) or because the global economy is in prolonged downturn, removing the option of basing regional recoveries on foreign investment and trade (Figure 3D). A deep recession in national economies sees a wave of structural adjustment programs that cut social welfare and rural development programs, leaving upper tributary watersheds to their own devices (Figure 2). For many areas this is not very different from recent experience.

The downturn in foreign investment between 2005 and 2015 leads to rising unemployment in cities, declines in real wages, and a booming informal sector. Rural households are affected just as much as urban ones, because remittances and temporary work in cities no longer exist. Without cash, children are withdrawn from school and the cycle of intensification of agriculture is broken, as there is no money to purchase inputs.

By 2030 a history of 2 decades of increasingly successful and sophisticated local governance over natural resources and planning has led to establishment of watershed networks across the entire region. The dominant paradigm of development is “improving and maintaining wellbeing.” Diversity in goals is seen as normal, and common infrastructure and rules as things that have to be negotiated fairly by people from all walks of life. The backlash against centralized control is so strong that attempts by religious and other groups to



TABLE 2 Plausibility of cross-level interactions in scenarios.

		Upland (local) scenario			
		Assisted development	Self-determined	Place-based	Marginal subsistence
Regional scenario	Food bowl	Plausible	Unlikely	Unlikely	Plausible with poor outcomes
	Services park	Plausible	Plausible	Plausible	Unlikely
	Glocalization	Unlikely	Plausible	Plausible	Unstable, shifts to place-based
	Ruralization	Plausible	Unlikely	Plausible	Plausible

take control over nation-states and urban areas quickly fail. The rising price of oil worldwide further reinforces the emphasis on local control and the basis of existence, making transport on a very modest international infrastructure network limited to occasionally moving people rather than low-value goods.

Throughout the region local populations respond by re-organizing self-help systems based on local and even traditional knowledge, focusing on health and food security. Spirituality increases in response, and multiple religious movements emerge or re-emerge. Markets are still important, but declining road infrastructure and only modest levels of shipping mean that in terms of material products, communities in upper tributary watersheds are as isolated as they were in the 1960s. Information infrastructure, however, continues to be valued for its capacity to share lessons across places. Technological innovations focus on appropriate technologies, but stifled by lack of funds in the first 2 decades finally begin to flower when it is realized that there is no “turning back.”

### Upland storylines and cross-level interactions

How each of these regional scenarios enhances or constrains development in particular upper tributary watersheds depends on the characteristics of those places as well as on how key uncertainties at the upper tributary watershed level unfold. A multi-level scenario analysis opens up the possibility of exploring “discords” among levels, or when a scenario unfolding at one level makes it very hard for a particular scenario to unfold at another level (Table 2).

#### Marginal subsistence

The marginal subsistence scenario is similar to recently experienced conditions in more remote areas (Figure 1). Inhabitants in these areas have little direct say in national land development and conservation policies which impact them; they produce most of their own food, receive little government aid, and draw on wider systems of exchange for only a few special goods. This storyline can arise either from the persistence of neglect, or from the withdrawal of state and private support for development in territories at the periphery.

The marginal subsistence scenario is unlikely to develop under the services park scenario, as such land uses and settlements would be strongly discouraged, given the emphasis on clear separation of land uses and technological modernization (Table 2). This local scenario is also unlikely to persist under a glocalization scenario because of the infusion of market-related opportunities. The most viable outcomes for upper tributary watersheds are likely to be under the ruralization regional scenario, as these policies would be most consistent with relatively un-intensified fallow-field landscapes dominated by small-scale farming (Table 3). The greatest vulnerabilities to upland societies would probably occur under the regional food bowl scenario, as only the least profitable and often poorest agricultural lands would be left and there would be little other assistance.

#### Assisted development

The assisted development scenario is similar to most current experience in the uplands (Figure 1), where state and non-state agencies provide development assistance with the aim of altering land uses and livelihoods in upper tributary watersheds. Local communities are taught, lured, and coerced, and have little political influence beyond their involvement as project “partners.” This storyline can emerge in previously remote areas with better road access, leading to provision of public services and greater activity by authorities.

The assisted development scenario for an upper tributary watershed is plausible under all regional scenarios but less likely under glocalization because of its emphasis on local resources and empowerment (Table 2). As low-lying areas in deltas and main valleys compete closely with urban and industrial towns, based on agricultural commodities and trading services, the landscapes in upper tributary watersheds become more and more integrated with mainstream agriculture in the food bowl scenario as areas of production for more temperate crops and new varieties. With state authorities and non-state organizations playing a large role, local specificities are unlikely to emerge strongly, with the consequence that livelihoods in different locations are more likely to be in direct competition, and favored

**TABLE 3** Implications for landscapes and livelihoods in 4 local scenarios where a corresponding regional scenario is plausible.

Implications	Assisted development	Place-based	Marginal subsistence	Self-determined
<b>Livelihood opportunities for upland farmers</b>	Significant as agricultural laborers or agro-industry wage earners. Health and wealth outcomes depend greatly on degree of corporate and state attention to social justice.	Diverse and numerous opportunities in situ. Some differentiation still likely due to variation in comparative advantages of place and skills of people.	In situ unlimited but very restricted set of opportunities. Primarily subsistence or locally exchanged products and services. Difficult, but not impossible to maintain health, education, and research services in this context.	Many opportunities, most of which are off-site and thus involve seasonal or permanent migration into urbanizing regions.
<b>Landscape ecosystem goods and services</b>	Likelihood of reduced areas of high natural biodiversity, but with substantial human interventions aimed at maintaining or enhancing watershed functions to support agricultural production activities.	Most services and substantial biodiversity likely to be maintained, especially where compatible with mosaic and multi-use landscapes.	Opportunities for significant low impact food systems to emerge but much depends on strength of political institutions to support “innovative” cooperative rather than conventional private sector-based competitive models for rural development.	High-quality conservation areas in uplands but with little economic benefit apart from tourism and transfer payments for maintaining watershed services used by lowlands.

crops and services more likely to converge on more similar configurations (Table 3).

#### Place-based

The place-based scenario reflects the current emphasis of many community-based initiatives on local stakeholder control and responsibility for local resources (Figure 1). It seeks to build on local assets and skills. Upward and downward accountability mechanisms are likely to be crucial to long-term performance on ecological and social justice criteria.

The place-based scenario is unlikely under the regional food bowl scenario because of the lack of control placed with local authorities, states, or communities, but plausible under all others (Table 2). Livelihoods are likely to vary widely among places but to be relatively specialized in the goods and services of particular landscapes (Table 3). With local control and competition in wider markets, comparative advantages will shift along with local capacities and assets as well as the unfolding of regional scenarios.

#### Self-determined

The self-determined scenario is perhaps the most radical of local-level scenarios, given the current context where most upland dwellers are politically marginalized

and lack the assets and skills to take advantage of new information, markets, and technologies (Figure 1). Moves towards self-determination could produce substantial surprises in terms of livelihoods and land uses, including increased mobility and perhaps migration.

The self-determined scenario, however, would be unlikely to emerge in either the food bowl or ruralization regional contexts because of lack of influence over resource access and flows (Table 2). When the self-determined scenario emerges, there are possibilities of both high levels of resource conservation as well as exploitation made possible by substitution with inputs from elsewhere (Table 3). Livelihoods are likely to diversify the most under this scenario, and migration to urban-industrial areas could be significant.

#### Conclusions

Assessing the implications of alternative regional scenarios for upper tributary watersheds can be difficult because of the significant variability and uncertainty in ecological and sociopolitical contexts among and within countries. This challenge was addressed in this paper by developing different sets of scenarios at local and regional levels and then analyzing their interactions. For example, we found that some local development

alternatives were highly unlikely given other regional-level scenarios.

The scenarios described here at both regional and local levels were expert-driven and have only been modestly “worked out.” There are at least 2 ways in which this work could be taken further.

First, the scenarios could be used to help identify and refine alternative livelihood and intervention strategies that are likely to do reasonably well regardless of what happens. A very preliminary exploration of livelihood opportunities under the 4 upland scenarios suggests some major differences (eg Table 3). Additional work could help identify resilient strategies.

Second, the scenarios could be used as a starting point for further rounds of discussions among stakeholders about the assumptions made in alternative futures and trajectories and their likely implications (Wollenberg et al 2000a; Lebel and Bennett 2004). In this case, providing additional information on historical

trends and mapping projected consequences of some modeled relationships, eg on tree cover, may be helpful.

Unlike some scenario-building exercises, the approach espoused in the present article emphasizes learning from contrasts among scenarios (including at different levels) rather than trying to construct our “favorite world.” In this mode it is not necessary for stakeholder groups with different interests to agree on what is the most desirable scenario, but much more modestly, that overall the set spans an interesting space around which to identify and deliberate the plausibility of various assumptions about what is likely to happen before, after, or maybe not at all.

The multi-level approach to scenario development proposed here has exciting potential for exploring development alternatives in situations where key uncertainties of interest vary with scale and there is a need to understand cross-level interactions.

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#### AUTHOR

##### Louis Lebel

Unit for Social and Environmental Research, Faculty of Social Sciences, Chiang Mai University, PO Box 144, Chiang Mai 50202, Thailand.  
louis@sea-user.org

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