A1

ASSESSING SHIFTING CULTIVATION POLICIES

Through the lens of systems thinking

Mai Van Thanh and Tran Duc Vien[*]

Introduction: shifting cultivation in Southeast Asia

Shifting cultivation, also commonly known as 'slash-and-burn' or swidden agriculture, has become a long-standing topic for intensive examination by researchers. This traditional agricultural practice is one of the most important land-use systems in tropical areas (Mertz et al., 2009a; Teegalapalli et al., 2009), and has been a part of the landscape in the uplands of Southeast Asia for centuries (Fox and Vogler, 2005). Shifting cultivation is considered to be a highly appropriate farming system in upland areas where population density is low (Tran, 2007), because in these circumstances fallow periods are long enough to allow the recovery of soil nutrients and vegetation. It also gives swidden farmers a higher quality of life than other common forms of land use, such as wet rice cultivation, because the returns per unit of land labour are much higher (Tran, 2007). Moreover, recent disasters associated with climate change have shown that this traditional land use system can have a role in maintaining and enhancing carbon stocks (Moeliono et al., 2016). Growing population pressures, along with expanding government controls over forest resources in the region, have in many ways compelled swiddeners to shorten the period for which their land can lie fallow. This has resulted in adverse impacts on the environment, including deforestation, accelerated soil erosion, soil-nutrient depletion and biodiversity loss (Gafur et al., 2000). In addition, under a high population density, shifting cultivation is incapable of improving the economic condition of swidden-farming families because returns per unit of land labour are substantially reduced (Sanchez, 1994).

The negative impacts of shifting cultivation on the environment as farmers strive to provide for higher populations and the associated decline of swidden farming into

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an unproductive system have led most governments in Southeast Asia to perceive it as a backward method of cultivation. Consequently, governments throughout the region have tried to ban shifting cultivation. In Malaysia, for example, huge development programmes have been implemented to improve swiddeners' livelihoods when they abandon shifting cultivation (Majid, 1983). In Laos, the government has issued land-use and forestry policies aimed at increasing the country's forest cover while eradicating shifting cultivation and promoting intensive commercial agriculture (Castella et al., 2013). In Vietnam, the government has for many years adopted stringent policies and measures to crack down on swiddening. These include a large-scale programme called 'Fixed Cultivation, Fixed Residence' (it is formally entitled Resolution No. 38/CP), aimed at permanently settling 'shifting fields' and 'shifting people' (McElwee, 2004), and a forestland-allocation policy linking people to specific pieces of land in such a way that shifting cultivation is effectively impossible (Castella et al., 2005).

Extended research throughout Southeast Asia in recent decades has found that shifting cultivation has been rapidly transformed in response to myriad social, economic and political challenges (Rasul and Thapa, 2003; Padoch et al., 2007; Fox et al., 2009; Schmidt-Vogt et al., 2009). Despite the complexity of this transformation process, researchers generally agree that shifting cultivation is declining (van Vliet et al., 2012). Yet even with this trend, shifting cultivation remains important in many forest-frontier areas and will continue to be important throughout at least the current century in areas where alternatives are not yet available (van Vliet et al., 2013). To put figures to this assertion, in the mid-1990s in the Lao PDR, 218,900 hectares of land was under shifting cultivation, involving a total of 124 million people, or about one third of the total population (Pravongviengham, 1998). In the early 1990s in Vietnam, about 50 ethnic groups (out of the country's total of 54 ethnic groups) were practising swidden cultivation, employing 2.8 million people to work 3.5 million hectares in the country's uplands (McElwee, 2004). The government said that about 50% of the 110,000ha of forest lost every year during the 1980s and 1990s was lost because of shifting cultivation (Do, 1994). In 2007, the Ministry of Agriculture and Rural Development noted: '… in many areas villagers continue to illegally cut down the forest for shifting cultivation' (MARD, 2007). The Ministry of Natural Resources and Environment estimated in 2011 that hundreds of thousands of villagers in Vietnam's uplands still engaged in shifting cultivation on an area of more than one million hectares (MONRE, 2011). Recent government data shows that shifting cultivation accounted for 54% of total forest loss in the country in 2012, and 71.6% of total forest loss in the period between 2008 and 2011 (Forest Protection Department, 2013).

The persistence and prevalence of shifting cultivation in the uplands of Southeast Asia clearly indicates the failure of government measures to halt the practice.

Challenges in managing shifting cultivation

The making of decisions in efforts to control shifting cultivation is challenged by the following factors.

First, shifting cultivation is a highly dynamic and complex socio-ecological system. It has socio-political, financial-economic and eco-biophysical dimensions (Cramb et al., 2009; Hett et al., 2012). Policy-makers and planners are therefore often faced with the prospect of policy resistance – a tendency for policy interventions to be delayed, diluted or defeated by responses from the system (Sterman, 2000). In other words, policy-makers and planners often over- or under-estimate the effectiveness of policies and plans, and fail to anticipate the side-effects and unintended consequences of their actions. As a result, shifting cultivation policies don't deliver desired solutions. Second, there is a lack of common understanding and shared vision among stakeholders about how the complex issues of shifting cultivation should be addressed. Much like other natural resource systems, shifting cultivation often involves a diverse array of stakeholders (i.e. shifting cultivators, local authorities, protected-area managers and non-governmental organizations), each of which has different management objectives, agendas and interests (i.e. conservation versus economic development). These different expectations result in unforeseen conflicts among stakeholders that necessitate compromises, collaboration and shared visions, based on a better understanding of each other's requirements.

Third, knowledge and information about shifting cultivation is fragmented. Despite a relatively large number of case studies, especially in Southeast Asia, knowledge of shifting cultivation is still very patchy and many essential elements remain only partially covered, such as exact areas under shifting cultivation, the number of people involved and the consequences of shifting cultivation to livelihoods and the environment (Mertz et al., 2009b). For instance, the World Bank (2007) estimates that there may still be more than 200 million swiddeners in Southeast Asia, but Mertz et al. (2009b), claim the real number is probably much lower than 50 million. Other authors have estimated that there are as many as 400 million swiddeners (Spencer, 1966; Kerkhoff and Sharma, 2006). Shifting cultivators are also often portrayed as a distinct category of farmers in the literature, but rarely appear as such in population censuses or other national and regional classifications (Mertz et al., 2009a). As a result, there is worldwide confusion about how many people are dependent on this traditional form of agriculture (Mertz et al., 2009a).

Finally, the available data and information about shifting cultivation is not consistent. In Vietnam, different government agencies use the term shifting cultivation (*canhtacnuong ray*) to refer to various types of land use. The Ministry of Agriculture and Rural Development – the agency in charge of forest management – uses the term c*anhtacnuong ray* to refer to both terraced, fixed-field areas on which wet rice is grown (a total of 840,000ha) and swidden areas with rotational fields (360,000ha) (MARD, 2007). However, the Ministry of Natural Resources and Environment – the agency in charge of land administration – uses the term *canhtacnuong ray* to refer to swidden land for dry rice (117,322ha) and swidden land for other annual crops (1,154,850ha) (MONRE, 2011). It is therefore difficult for policy-makers and planners to fully utilize available data and information and it is often the case that decisions about shifting cultivation are made on an unsound basis.

Past approaches to decision-making and policy formulation in shifting cultivation have responded to current events or immediate problems, with less concern for how these events or problems transpired and their underlying causes. As a result, they do not deliver desired outcomes. In this chapter, we discuss the benefits of using systems thinking to develop and assess shifting cultivation policies.

In the following sections, we first introduce the 'systems-thinking' approach. Then, by way of a case study, we give an example of the application of this approach in tackling shifting cultivation issues in an upland village in northwest Vietnam. We conclude the chapter with a summary of key findings and highlight the importance of systems thinking to assist policy-makers and planners in effectively managing shifting cultivation.

Systems thinking

Systems thinking is a scientific methodology for understanding and managing complexity. It sees the world as a complex system embedded with dynamic interactions and emergent outcomes. It deals with ambiguity, hidden assumptions and mental models (Sterman, 2000; Maani and Cavana, 2007). Systems thinking helps decision-makers and planners to understand and anticipate the long-term consequences of decisions and actions, polices and strategies. It goes beyond mechanistic processes and policies to acknowledge the underlying role of human drivers of complexity and change and their effects on systems goals and behaviour (Sterman, 2000; Maani and Cavana, 2007).

Systems thinking unravels complexity through four interrelated 'layers', or levels of thinking, as illustrated in Figure A1-1.

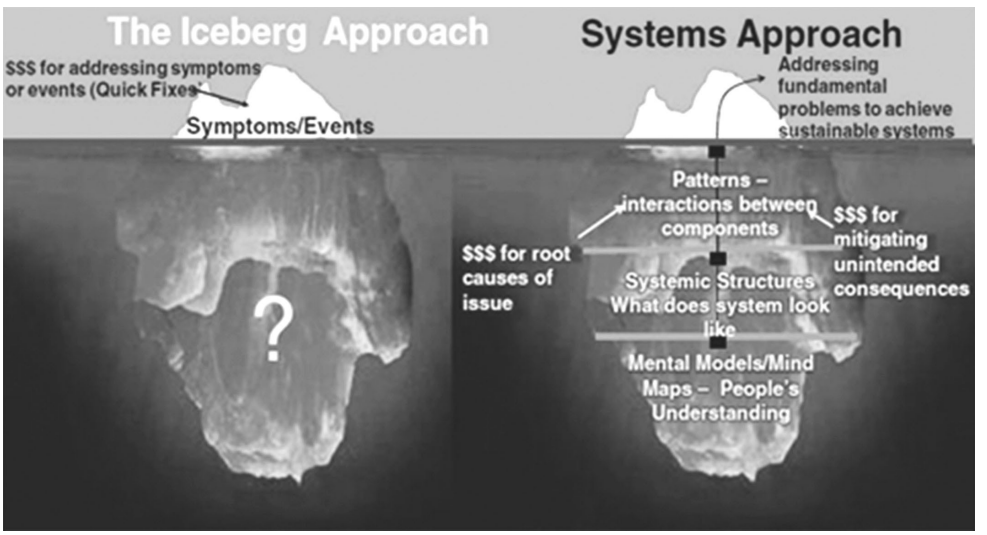

FIGURE A1-1: The iceberg approach versus a systems approach.

Source: Ockie et al. (2013).

The first level, symptoms or events, represents the 'tip of the iceberg'. These are the symptoms of reality; how people understand things by observing or encountering scattered data or information from many different sources. Generally, this information provides answers to simple questions about what happens, where, when, how, and who is involved. This level of information is thus very shallow and only touches the surface of what actually happens. The symptoms or events level represents only a snapshot of reality. However, most people, including managers and policy-makers, are satisfied with focusing their solutions on problems at this level. This is because events are the most visible part of a problem, requiring immediate attention and action, and often receiving quick fixes that lead to 'fire-fighting' or 'band-aid' behaviour.

The second level is one of patterns, where a larger set of scattered data is linked together. This level not only examines the trends or patterns of events over an extended period, but also represents much deeper and more meaningful sources of the reality picture than those at the symptoms and events level.

The third level concerns systemic structures, and represents a much deeper level of thinking. It shows the interactions between the many different factors leading towards an observed outcome. These factors may be economic, social, political or natural. The significance at this level of thinking is to understand how these factors are interacting and to identify the resultant causal relationships.

The fourth level is that of mental models, and is the deepest level of thinking, located at the bottom of the 'iceberg' and rarely coming to the surface. This is the most fundamental level, representing the assumptions, beliefs, values and culture of individuals, organisations, communities and even nations. Hence, mental models are the most powerful force for change. In order to identify systemic and fundamental solutions, policy-makers must understand the mental models held by people and stakeholders that underpin the reasons for their actions and behaviour. Change at this level is the most powerful means of transformation for both organizations and societies (Maani and Cavana, 2007).

Systems thinking provides a wide array of tools, such as causal loop diagrams and system archetypes, that can unfold and reveal the minutiae of dynamic and complex systems. A causal loop diagram is a network of variables that are connected with arrows, showing the causal relationships between them. The variables in the diagram are drawn from key words or phrases that are identified in a problem-articulation phase. Each arrow within a causal loop diagram has either positive '+' or negative '-' polarity. A positive '+' polarity means that two variables move in the same direction, while a negative '-' polarity means that they move in opposite directions. The arrows within a causal loop diagram link pairs of variables together to form reinforcing (R) and balancing (B) feedback loops. Reinforcing loops are positive feedback systems that represent increasing or declining actions, while balancing loops keep everything in equilibrium (Maani and Cavana, 2007). A causal loop diagram may include many combinations of 'R' and 'B' loops, as well as time delays (represented by //) between variables.

Obviously, a causal loop diagram can be quite complex because it is a combination of interplays between R and B loops over time, time delays, and shifts in loop dominance over time. It is therefore necessary to identify core system structures that can explain general system behaviour and the potential for resistance to policy. These core system structures are referred to as 'system archetypes'. System archetypes are generic feedback structures that explain the behaviour of a variety of systems (Senge, 2006). For example, 'fixes that fail' is a system archetype that explains situations where the managerial response to a problem is a quick fix. This fix works in the short-term (balancing effect), but has unintended and often harmful consequences that exacerbate the original problem (a reinforcing effect) and after a delay the system reverts to its original or a worse condition (Senge, 2006). System archetypes also have general management principles that can be employed to change the behaviour of systems in a favourable way. For example, if a system exhibits fixes that fail, the general management principle is to focus on the long-term and avoid short-term quick fixes, using them only to gain time needed to implement long-term solutions.

Applications of systems thinking in managing shifting cultivation

In this section, we demonstrate the utility of systems thinking to address the reality of shifting cultivation management issues by using an upland village called Tat, in Vietnam's northwest, as a case study.

The study area

Tat is one of 16 extremely poor upland villages in Tan Minh commune, Da Bac district, Hoa Binh province (Figure A1-2). The village lies at an elevation of about

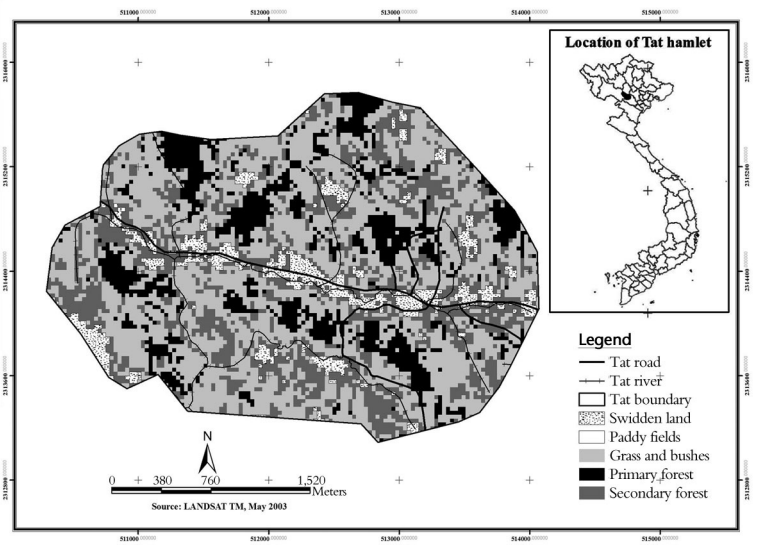

FIGURE A1-2: Location of Tat village and its land uses.

360m above sea level and is surrounded by mountains with slopes ranging from 7 to 45 degrees. Only a few hectares of the valley floor are flat enough for the villagers to grow paddy rice. There are a few areas, mostly at the tops of mountains, where primary forests are found. Secondary forests are found at lower elevations.

Villagers living at Tat are from the Tay ethnic minority group and have been living in the area for many generations, with forest resources as their primary source of livelihood.[1] Most of the villagers' houses are located on either side of a main road that connects the village to other communes.

Prior to the 1950s, forest areas near Tat village were mainly managed by the French colonial administration, as were forests in other upland areas of Vietnam's northwest (Nguyen, 2001). In practice, villagers were free to use the forests to clear swiddens and cut trees for housing. However, these practices changed substantially when the Vietnamese government nationalized all forests after independence in the 1950s. To establish control over the forest, the government established a system of state forest enterprises (Nguyen, 2001). In Da Bac district, where Tat is located, the Tu Ly enterprise controls the forest, and trees suitable for construction timber have all but disappeared following excessive logging in the decades from the 1960s to the 1980s.

By the end of the 1980s, Vietnam's state forests were in crisis (Sikor, 1998), with forest cover in the northwest falling to less than 9% of the land area (Nguyen, 2001). One of the reasons given for this loss was the practice of swidden cultivation. To reverse the trend, the government introduced its forest land allocation policy, under which forest land was distributed to individual households. The policy was implemented in Tat in 1995. However, it paid no respect to villagers' customary land-use practices, such as swiddening. As a consequence, the villagers at Tat ignored the forest land allocation policy and continued to practise shifting cultivation.

At present, villagers at Tat are still subsistence oriented and heavily reliant on crop farming, animal husbandry and forest exploitation for their livelihoods. Almost all households still practise swidden cultivation, even though it is illegal. On average, each household has about four swidden plots, often four to five kilometres away from their home. Some have swiddens as far as 10km from the village, with the journey to reach them on foot taking an entire day. There has recently been a substantial change in the crops grown in their swiddens. The farmers now produce crops not only for their own consumption, but also to sell at markets. In particular, dry rice has diminished as a swidden crop and has been replaced by cash crops such as hybrid corn, canna and ginger.

Canna indica L. [Cannaceae]

High demand for edible Canna bulbs means the vivid flowers of this plant are a common feature of Tat village's swiddens.

Identifying issues

To identify the main issues or variables related to shifting cultivation in the study area, a series of in-depth interviews and group discussions were organized with a wide range of shareholders, including local authorities, community groups and aid agencies. This process produced a set of key variables associated with shifting cultivation, and these were then classified into four categories: environmental, economic, government policy and socio-cultural. The variables, as described by stakeholders, are defined in Table A1-1.

Developing a causal loop diagram

This section involves the mapping of the shifting cultivation system of Tat village and identifying feedback structures by using a causal loop diagram. A preliminary diagram

TABLE A1-1: Variables associated with the shifting cultivation system at Tat village.

Category	*Variable*	*Definition*
Environmental	Soil erosion	Soil is removed naturally by the action of water or wind.
	Adoption of sustainable land use	Types of land use that mitigate soil erosion.
	Forest cover	The physical surface of hills covered by forest.
	Soil fertility	The ability of the soil to support organic life.
	Water availability in Tat stream	The level of water in streams at Tat village.
Government policy	Forestland allocation	The government's policy under which forestland is allocated to households.
	Technical knowledge	Knowledge about cultivation that helps to improve crop productivity.
	Access to markets	The opportunity to sell local products on the market.
	Access to credit	The opportunity for villagers to seek loans from banks.
	Land tenure insecurity	Conditions in which villagers work land but do not hold land-use certificates from the government.
Socio-cultural	Traditional cultivation	The agricultural method of shifting cultivation, which has been practised by villagers for many generations.
Cash crops (economic)	Population growth	An increase in the rate of annual population growth over time.

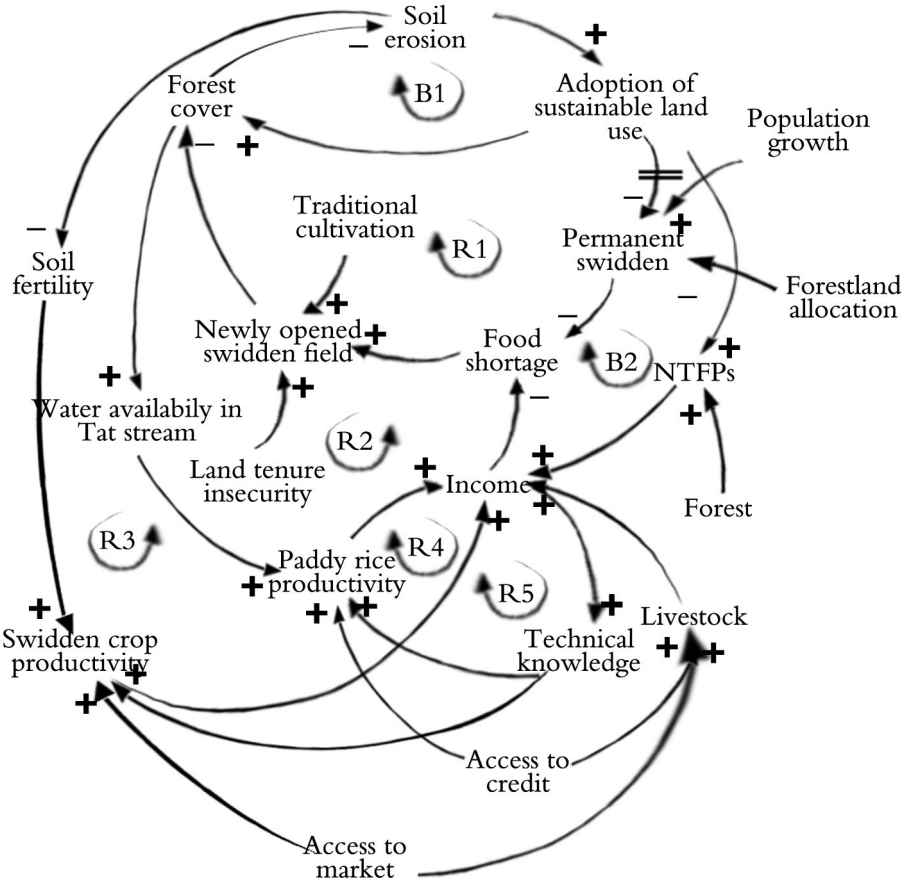

FIGURE A1-3: A casual loop diagram of shifting cultivation in Tat village.

was drawn on the basis of the variables shown in Table A1-1. This diagram was then validated in consultation with experts on shifting cultivation who were also familiar with the study area, to produce the final causal loop diagram (Figure A1-3). The final diagram has seven feedback loops, including five reinforcing loops (R1 to R5) and two balancing loops (B1 and B2). Variables contained in each loop and the key messages conveyed by each loop are presented in Table A1-2. A detailed description of the loops can be found in Mai and To (2015).

Assessing the potential consequences of shifting cultivation policy

In this section, we use the causal loop diagram for shifting cultivation of Tat village to identify groups of feedback loops that fit the structure of common system archetypes. The archetypes thus identified can then be used to explain the potential consequences of shifting cultivation policy currently being implemented in Vietnam's uplands. Further, we can use the management principles of each identified system archetype to suggest improvements to the current policy.

TABLE A1-2: Feedback loops within Figure A1-3.

	Loop	*Variables involved*	*Definition*
Reinforcing	R1	Soil erosion; adoption of sustainable land use; permanent swidden; food shortage; newly-opened swidden field; and forest cover.	Food shortage
	R2	Forest cover; water availability in Tat stream; paddy-rice productivity; income; food shortage; and newly-opened swidden field.	Crop productivity
	R3	Soil erosion; soil fertility; swidden crop productivity; income; food shortage; newly-opened swidden field; and forest cover.	
	R4	Paddy-rice productivity; income; and technical knowledge.	Technical knowledge
	R5	Swidden crop productivity; income; and technical knowledge.	
Balancing	B1	Soil erosion; adoption of sustainable land uses; and forest cover.	Control of soil erosion
	B2	Soil erosion; adoption of sustainable land use; NTFPs; income; food shortage; newly-opened swidden field; and forest cover.	Fallow management

The final causal loop diagram for shifting cultivation in Tat village shows an obvious 'fixes that fail' archetype. It consists of a reinforcing and a balancing loop. The system structure of this archetype and its behaviour are shown in Figures A1-4a and A1-4b.

As shown, massive forest loss in the area around Tat village has been triggering some serious environmental problems, including soil erosion. To eliminate these problems, the 'quick fix' applied by the government and development agencies was to encourage farmers to plant trees and/or introduce sloping agricultural land technologies (represented by loop B1 in Figure A1-3). However, there were unintended consequences, including a shortage of cultivable land because of increased areas taken by tree plantations and sloping agricultural land technology, which resulted in serious food shortages. The villagers had no choice but to open new swiddens in the forest (represented by loop R1 in Figure A1-3). Although the 'quick fix' adopted by the government and development

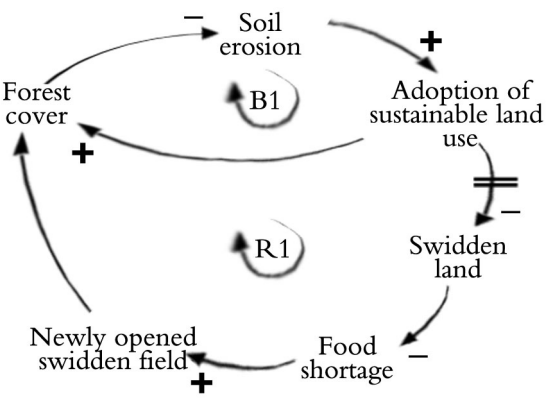

FIGURE A1-4a: Structure of a 'fixes that fail' system archetype for swidden cultivation in Tat.

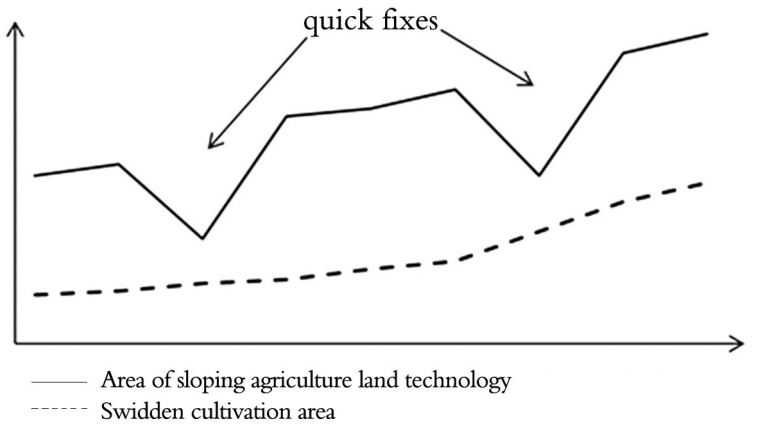

FIGURE A1-4b: Behaviour of a 'fixes that fail' system archetype for swidden cultivation in Tat.

agencies in this case was only a short-term measure, its consequences acted over time to accelerate the expansion of swidden cultivation in the area.

Discussion

The policy principle of effectively controlling shifting cultivation has been endorsed by governments around the world because of the claimed negative impacts of swidden farming on the environment and the belief that it is an unproductive system of agriculture. Despite this official attitude, shifting cultivation is still widespread in the uplands of Southeast Asia, with dynamic expansion or contraction (van Vliet et al., 2013). Researchers have found that inadequate understanding of the dynamic and complex nature of shifting cultivation systems, a lack of collaboration and shared vision among stakeholders and uncertain information are the key reasons why government initiatives to crack down on shifting cultivation have failed.

Using a systems-thinking approach, we constructed a causal loop diagram – a conceptual model that presents a holistic view of a shifting cultivation system. The model visualizes and captures the most important factors (the drivers and inhibitors) and the feedback mechanisms (reinforcing and balancing loops) that constitute current trends and determine the future of shifting cultivation in the study area. The model shows that relationships between the key drivers and inhibitors of shifting cultivation are not linear, but are causal feedback links that attribute the existence and continuation of shifting cultivation to a variety of interdependent factors, categorized here as environmental, economic, arising from government policy and socio-cultural. The model may serve as a platform for dialogue, shared visions and collaboration among stakeholders. This makes it a potentially powerful tool for policy-makers and planners who are seeking to share responsibility for the management of shifting cultivation.

The conceptual model may also serve as a basis for identifying system archetypes, or core system structures. This can help to determine key leverage points in a system at which managers may address the root causes of problems, rather than simply treating the symptoms. In particular, the 'fixes that fail' system archetype illustrated in Figures A1-4a and A1-4b explains the long-term consequences of shifting cultivation policies being implemented in Vietnam's uplands. Specifically, since the early 1960s, the Vietnamese government has made significant efforts to halt shifting cultivation by adopting stringent policies and measures, such as 'fixed cultivation, fixed residence', forest land allocation and the 327 and 661 programmes.[2] However, the implementation of these measures has tended to focus on the promotion of planting trees and/or adopting sloping agricultural land technology and has treated lightly the importance of local livelihoods by neglecting preferred cultivation practices. The conceptual model highlights the risk that an archetypal 'fixes that fail' structure could result from a focus on planting trees and/or sloping agricultural land technology, and that this kind of focus would probably be counter-productive to the achievement of long-term sustainability.

The lessons to be learnt from the 'fixes that fail' system archetype described above is that management strategies should be focused on the long-term, and 'quick fixes' should only be used to buy the time needed to implement long-term solutions to problems. Specifically, to manage shifting cultivation effectively, the government and development agencies should have provided support to improve local livelihoods in order to achieve food security before promoting the planting of trees and/or introduction of sloping agricultural land technology. This could have been done by activating loops R2, R3, R4, R5 and B2 prior to implementing loop R1.

Conclusions

A causal loop diagram, or a conceptual model developed by using a systems-thinking approach, can be used to visualize the complex interrelationships between various parts of shifting cultivation systems. Such diagrams have the potential to serve as useful platforms for dialogue, collaboration and decision-making among social actors involved in the management of shifting cultivation systems. A causal loop diagram may also serve as a sound and valuable foundation upon which to identify core system structures that illustrate how decisions and policies may influence system behaviour. They can thus assist policy-makers and planners by predicting the consequences of management decisions and policies. Furthermore, these diagrams help to identify key leverage points in a system that should be given high priority in the formulation of effective and timely interventions that will effectively manage shifting cultivation.

Conventional reductionist ways of thinking have proven to be totally ineffective in the management of dynamic and complex systems of shifting cultivation. Systems thinking provides a new approach by providing a comprehensive understanding of feedback between and among the many components of such systems. It allows decision-makers to anticipate the long-term consequences of their decisions and

actions as well as predicting the unintended consequences of polices and strategies. It also provides a common language for diverse stakeholders, enabling them to engage in deep dialogues and consensus building. Importantly, a causal loop diagram developed through systems thinking can be used not only to assess the potential consequences of shifting cultivation policies, but also to suggest improvements to them.

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Notes

1. The Tay ethnic group is the largest of Vietnam's 54 ethnic minorities.
2. The 327 and 661 programmes are concerned with forest development and protection. Under these programmes, the government has strongly promoted increased forest cover through the expansion of protected areas and has reforested five million hectares of degraded land.