Companion modeling to understand the expansion of sugarcane in rainfed lowland paddies of upper northeast Thailand

The land-use dynamics problem

• The last three decades have seen the expansion of upland cash crops above the rainfed lowland rice ecosystem across upper northeast Thailand.

• Recently, as rice prices have dropped while sugarcane prices were supported and sugarmills relocated in this region, farmers have been converting low-yielding and drought-prone upper paddies into sugarcane plantations.

• The extent, the driving forces, and the effects of such land-use changes on rice and other subsystems are still poorly understood.

Research objectives

• To understand farmers' individual decision-making processes and related collective decision-making mechanisms determining land-use changes.
• To integrate knowledge on land-use dynamics by developing and assessing a role-playing game associated with a multi-agent system model.

The study site

Some 50 km north of Khon Kaen City, the agricultural system of Nam Phong District has the following characteristics:

• Rainfed lowland rice, sugarcane, and cassava are the main cropping systems distributed over gently undulating landscapes.
• Farm size varies from less than 1 ha to more than 15 ha.
• There is an increased occurrence of farm ponds and importance is growing for livestock rearing, fish farming, and horticultural production.
• A large sugarmill (100,000 tons of cane/year) and two cassava-processing plants are present in the district. Around 10 to 15 sugarcane quota leaders (100-1,200 tons) are operating in each village.
• Some 25% of the local farmers have already converted upper paddies into sugarcane plantations.

Activity diagram for crop allocation to land units

Companion modeling for interactive collective learning

• A synthesis of the existing knowledge about the spatial, technical, and institutional organization of the cropping and farming systems was prepared, and a role-playing game conceived to validate and improve researchers' understanding of the problem.

• The role-playing game was tested with students and used in the Phang Touy sub district administration office (TAO) with 12 different farmers.

• Two sessions were played and recorded:
(1) according to the rules set up by the research team and
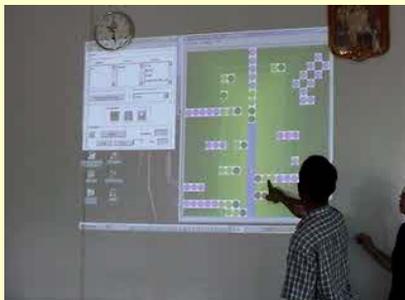(2) after modification of these rules by the players.

• Later, another gaming session took place with a greater diversity of stakeholders.

• Individual interviews with players took place to elucidate their decisions during the gaming sessions to understand how they relate the game to real circumstances, and to facilitate the modeling of decision-making processes.

• A multi-agent model with features similar to those of the role-playing game was built and discussed with farmers. Several scenarios for future land use were collectively identified and simulated.

Results and discussion

• Stable production of glutinous rice for family consumption dominates in the poorly drained depressions. Sugarcane and cassava occupy most of the upland areas, and crop diversity is most extensive in the transition zone.

• Large-scale sugarcane quota leaders influence the crop choice of smaller growers.

• Fewer growers request being quota leaders when the sugarcane price drops.

• The role-playing game raised growers' awareness of the effects of a decrease in sugarcane prices and the need for coping strategies.

Land-use in the transition zone:
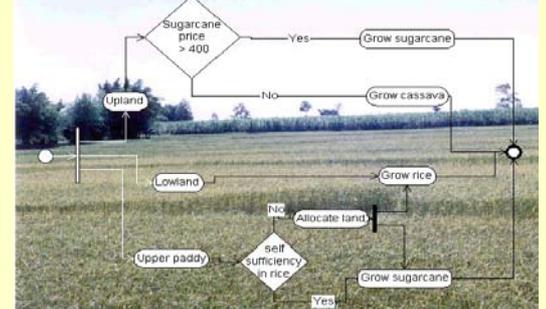**results of three role-playing games**

• "It wakes up the brain!": the role-playing game is taken seriously by the villagers. Most of them play according to real circumstances (field location, crop allocation, common agricultural practices, price negotiation, social influences, etc.). If given the chance, some farmers implement their projects during the game or test new opportunities. Even 3-hour-long gaming sessions were well-accepted.

• Players say they learned how others were thinking and planning their choice of crops.

• The role game was efficient in stimulating discussions and exchange of views (on land use, price negotiation, etc.) among a diversity of stakeholders.

• Players requested changes in the game rules, such as more options to diversify their farm activities or more stakeholders to be added.

• Most farmers were better able to follow a computer simulation with similar features than the game they played before, and some proposed model improvements.
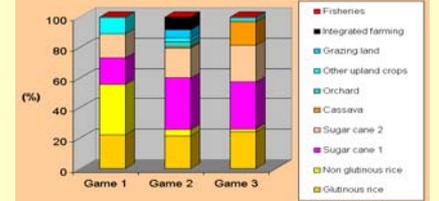
Conclusions and lessons learned

• Most of the conversion from upper paddies to upland crop plantations seems to have already been carried out, and mostly at the expense of nonglutinous rice.

• The current drop in sugarcane prices could stimulate farmers to further diversify their production systems: increased livestock, fish, and horticultural production require improved access to water from farm ponds.

• Because companion modeling takes social relations into account, special attention should be paid to the composition of the group of stakeholders-players.

Authors and institutions

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