Companion modeling to improve irrigation water sharing among rice growers in west-central Bhutan

The water-sharing problem

• At the national level, 20% of farming households see access to irrigation water as a major constraint to agricultural production.

• All irrigation systems are managed according to customary rights. Over the years the efficiency of local norms weakened under the influence of economic development, commercialization, and globalization.

• Villagers of the Lingmuteychu watershed actually fight over water during the rice-transplanting season. Such conflict can bring about social tensions causing society's bonds to break.

• To examine the complexity of resource management among heterogeneous users, their coordination, innovative approaches are needed to facilitate understanding and learning, mediation, and the emergence of management regimes that fulfill the aspirations of stakeholders and yet ensure the sustainability of the resource base.

Research objectives

• To understand stakeholders' decision-making processes in sharing irrigation water at household and community levels.

• To generate scenarios with users to assess the impact of their decisions on water and land use.

• To test the companion modeling approach to improve communication among stakeholders in irrigation water sharing.

Study site

• Lingmuteychu watershed covers 34 km^2 and is drained by the 11-km-long Limti Chu stream (Fig. 1). There are 180 ha of terraced wetland belonging to 162 households of 6 villages.

• Villages follow the norms of "first come, first served". A village situated in the upper catchment has an absolute right to divert all water from the stream.

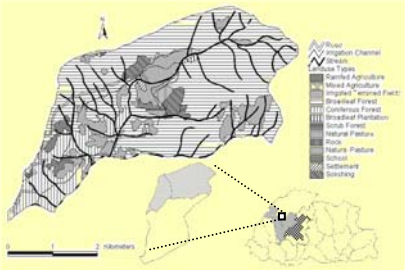

Fig. 1. Map of Lingmuteychu watershed in Punakha District.

• Limbukha and Dompola villages are in conflict over irrigation water: Limbukha shares half of the stream flow with Dompola only after the 10th day of the 5th Lunar month (June or July); before this date, Dompola has no access to water whatsoever.

Companion modeling for collective learning

The study followed a conceptual framework made of three distinct iterative phases (Fig. 2). The diagnostic studies helped to conceptualize a role-playing game (RPG) that was first tested in May 2003. Base on the players' suggestions, a second session of RPG was held in December 2003. The findings of 2 RPG sessions were modeled and simulated in the CORMAS platform.

• A synthesis of existing knowledge on social, economic, agronomic, and institutional aspects related to water sharing issues in Lingmuteychu watershed helped to conceptualize the RPG.

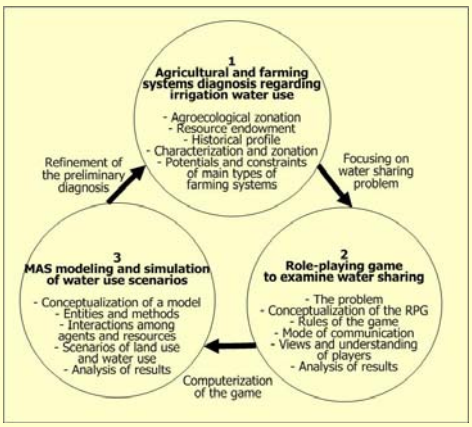

Fig. 2. Schematic representation of the methodological framework used in this study.

• The RPG sessions were played with 6 farmers each from Limbukha and Dompola, and three scenarios were played each time: 2 modes of communication: intra-village and inter-village, and swapping the roles.

• The first RPG session was based on the researchers' understanding of the system and in the second session the players' suggestions were included: exchange of labor for water, reduction in available cash by player, and inclusion of a local development committee as observers.

• All players were individually interviewed after the gaming sessions to assess the RPG and to better understand the reasons behind their actions.

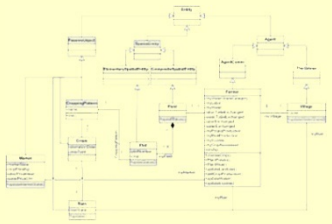

Fig. 3. Class diagram of Limbukha model.

• A multi-agent model was built similar to the RPG to facilitate knowledge integration, to better understand interactions among agents, to explain the effects of their decisions, and to facilitate communication between the 2 communities in conflict (Fig. 3).

• 36 scenarios based on 3 types of social networks, 2 rainfall patterns, and 6 water exchange protocols were simulated to look for the viable ones. These scenarios are yet to be discussed with the stakeholders (Fig. 4).

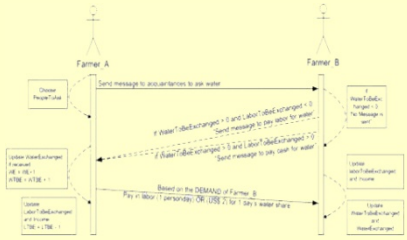

Fig. 4. Example of a protocol for exchanging water.

Results and discussion

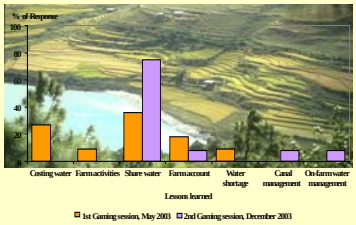

Fig. 5. Lessons learned by players after 2 gaming sessions.

• The RPG adequately represented the real situation and facilitated self-motivating and non-confrontational interactions among the players in a non-threatening mode.

• Interviews of players after RPG sessions clearly indicated that their knowledge and understanding of water sharing increased significantly between the first and second session (Fig. 5).

• The swapped role helped farmers to compare their constraints and opportunities between villages.

• First simulations show that the results are more sensitive to exchange protocols than to rainfall patterns or types of social networks.

• In the collective mode of communication (S6), both villages had a minimum amount of unused water cards and more instances of exchange between villages (Fig. 6).

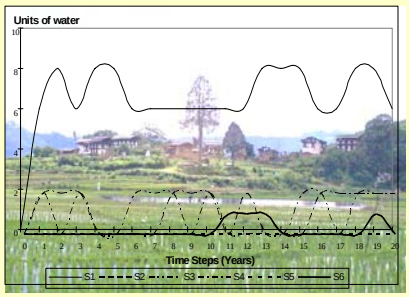

Fig. 6. Number of unused water units in different scenarios generated from Limbukha model.

Lessons learned

• The RPG was efficient to stimulate continuous collective learning, knowledge acquisition, and a shared understanding of the irrigation water sharing problem.

• The research team needs to be seen as one social agent in society and its main role is to facilitate discovery learning, and voluntary change in stakeholder behavior.

• The research process encourages interactive participation among players motivating them to identify appropriate strategies and concrete action plans.

Partners and institutions

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