

Appendix 1.

Workshops

The experimental results presented here come from 12 workshops held during 2012-2013, in which participated (separately) 116 rural smallholders (farmers) and 108 academics from socio-environmental disciplines (graduate and postgraduate students; researchers, and professionals). Between December 2012 and July 2013, we did seven workshops with farmers, and five with academics. In no case did the players of different workshops have the opportunity to communicate with each other before participating. The farmers came from the full range of socioeconomic levels that are present in the mountains of tropical southern Mexico. Six of the workshops with farmers included participants from 12 communities in Sierra de Villaflores (in Chiapas's Sierra Madre); the seventh was given to persons from six communities in Chiapas's Sierra Norte. Participants from the first six workshops were 84 native Spanish speakers who raised cattle, corn, and coffee on 5 to 30 ha. (Therefore, they are considered small and medium producers.) All of the farmers in the seventh workshop were native Tsotsil (Maya) speakers who raised cattle, corn, and coffee on 2 to 5 ha. (They are considered small producers.) In terms of social organization, the native Spanish speakers are organized loosely around the political party in power, whereas the native Tsotsil speakers are from communities organized strongly around a Jesuit mission. Their ages ranged from 20 to 65 years, with a mode of approximately 35 years. In each workshop, participants played "let's make a snake" to order themselves from oldest (the head) to youngest (the tail); its body was then segmented into 4- player teams to reduce age-difference hierarchies within them. The authors and/or their colleagues have maintained close relations of participatory action research with both teams of farmers for over five years.

All five of the workshops with academics were held during short, intensive courses on the evaluation of sustainability and/or complex sociological processes. Ages also ranged from 20 to 65 years, with a mode of approximately 28 years. Socioeconomically, they represented levels from students who were just beginning their master's degrees, to seasoned, internationally renowned Mexican researchers. Professionals with master's degrees predominated. The academics' disciplines included anthropology, sociology, economy, biology, ecology, and environmental engineering oriented toward public and private enterprises. Because of the nature of the investigation, we maintain the anonymity of all workshops and participants. Information is available upon justified request, with proper safeguards.

After the players had listened to Sierra Springs' fixed rules and tried them out in detail on the board, the investigators presented the rules of Session 1 in the form of the following fictional, but plausible, narrative that established a stylized context for the game:

We are in the year 1960. You are four young adults, children of local farmers, and the assembly of local property owners meets with you to assign you tracts of land in an uncolonized, forested part of the community that has the initial forested configuration described in the fixed rules. The assembly assigns a quadrant to each of you, and informs you of the environmental limits and the rules for colonizing sites in riparian borders. In addition, the assembly imposes two social rules that must be followed scrupulously:

- (a) Moral Economy Rule: In this community, we live by the principle of moral economy: each of you may earn as much as you wish (i.e., gain as many points as you wish) from your quadrant and its riparian borders, in any way you wish, as long as you ensure that no one dies for having failed to earn the minimum living (24 points) necessary for survival.
- (b) SixF Rule: Because of environmental limits, at least 16 of the 48 sites in the territory that has been assigned to you must remain under forest management. For the good of the community, two of you must specialize in managed forestry so that the community can be supplied with forest products efficiently, from sites that are not inconveniently dispersed (i.e. two players must place all their F tokens on their quadrants).

If either of these rules is violated, each of you who survive must pay a fine of 1.5 USD, then leave the community to make a life elsewhere. (You become socially dead to the community). The family of each person (i.e., player) who dies will have to pay a fee of 1.5 USD for a cemetery plot. At the end of the game, the game coordinator will collect any fines and fees.

Each table of participants played one game under the above rules; they were allowed to talk freely, but only to their team members. After a 20-minute rest, a second game was announced. They return to the same positions that they occupied during session 1. In preparation for session 2, the time limit was reset to 50 minutes, and the initial, forested condition of the Sierra Springs game board was reestablished.

Session 2 retained the fixed rules conditions. However, the game coordinator began with the following narrative that rescinded Session 1's institutional rules and introduced new ones:

We are in the year 2010. You are four young adults. The environmental limits and land-use restrictions are the same as in 1960. However, the authority of the local assembly has weakened, and the institutional rules ME+SixF of Session 1 are no longer obligatory. To satisfy the domestic and international demand for so called (forest dependent) hydrological services and provision services (livestock), the external actors offer individual monetary incentives to induce farmers to use their land in specific ways. The local authorities meet with you to assign you tracts of land in an uncolonized, forested part of the community that has the initial forested configuration described in the fixed rules. The authorities assign a quadrant to each of you, and inform you of the

environmental limits for colonizing sites in riparian borders. Then, you are informed that

- (a) The ME principle is no longer in effect. If someone dies, her family must pay a fee of 1.5 USD for a cemetery plot. Survivors are no longer expelled from the community. Whether you help others survive or not is now your personal decision, and will be respected by the community. Thus, moral economy is no longer a norm but a free option.
- (b) If you survive (i.e., if you have 24 points at the end of the game), and have established managed forestry on six sites, you will receive a 1.5 USD bonus in payment for hydrological services.
- (c) If you survive, you will receive a bonus of 1.5 USD for each point that you earned in excess of the 24 needed for survival.
- (d) If you meet the requirements for both (b) and (c), you will receive both payments.
- (e) There is a relatively high transaction cost for local actors of interacting with the external actors that provide bonuses. Therefore, each player incurs a cost of 3.0 USD which she must pay upfront to the game coordinator.

The authors took participants' circumstances into consideration when setting the amount of the entry cost at 3 USD. Academics were told one day ahead of time that they would need to pay that amount if they wished to participate. Farmers—who would spend a full workday traveling to the workshop and participating in it—were told at the beginning of the workshop that those who played would receive only 3 USD rather than the 6 USD that they would normally make for a day spent working for a wage. At the request of the leaders of their communities, we gave farmers from the Sierra Norte 3 USD in chocolates rather than in cash. We paid their bonuses in chocolates as well.

To maintain consistency, the first author was the game coordinator in every workshop. Each workshop lasted four and one-half hours: one hour for explaining and demonstrating the game; two and a half for playing the game and collecting data; and one hour for paying bonuses, exchanging information, and reflecting as a group upon the results. Players were free to talk within their teams all the time. Rules were clarified for them upon request

At the end of each game session, the players in each team worked together to record the final configuration of tokens on maps, in orthogonal photographs, and in individual, confidential questionnaires. The authors and their trained collaborators supervised those activities, made photos of board-game outcomes, verified the point totals earned by each player and team, and checked the maps and questionnaires for accuracy.

Immediately after S2, each player filled out a written questionnaire in private (see DATA ANALYSIS in the main text).