# Community harvesting of trees in Tanzania under payments for ecosystem services (PES) schemes

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Lopez MC, Torres S, Naftal B, Kopa A, Julius R, Samweli T, Mwabulambo R, Samweli J, Kingazi G, Mwangi E and Andersson K. 2016. *Community harvesting of trees in Tanzania under payments for ecosystem services (PES) schemes: Results of economic games in selected communities in Tanzania*. Bogor, Indonesia: CIFOR.

ISBN 978-602-387-033-2
DOI: 10.17528/cifor/006135

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We would like to thank all funding partners who supported this research through their contributions to the CGIAR Fund. For a full list of the 'CGIAR Fund' funding partners please see: http://www.cgiar.org/who-we-are/cgiar-fund/fund-donors-2/

# Contents

# Figures and tables

## Figures



## Tables

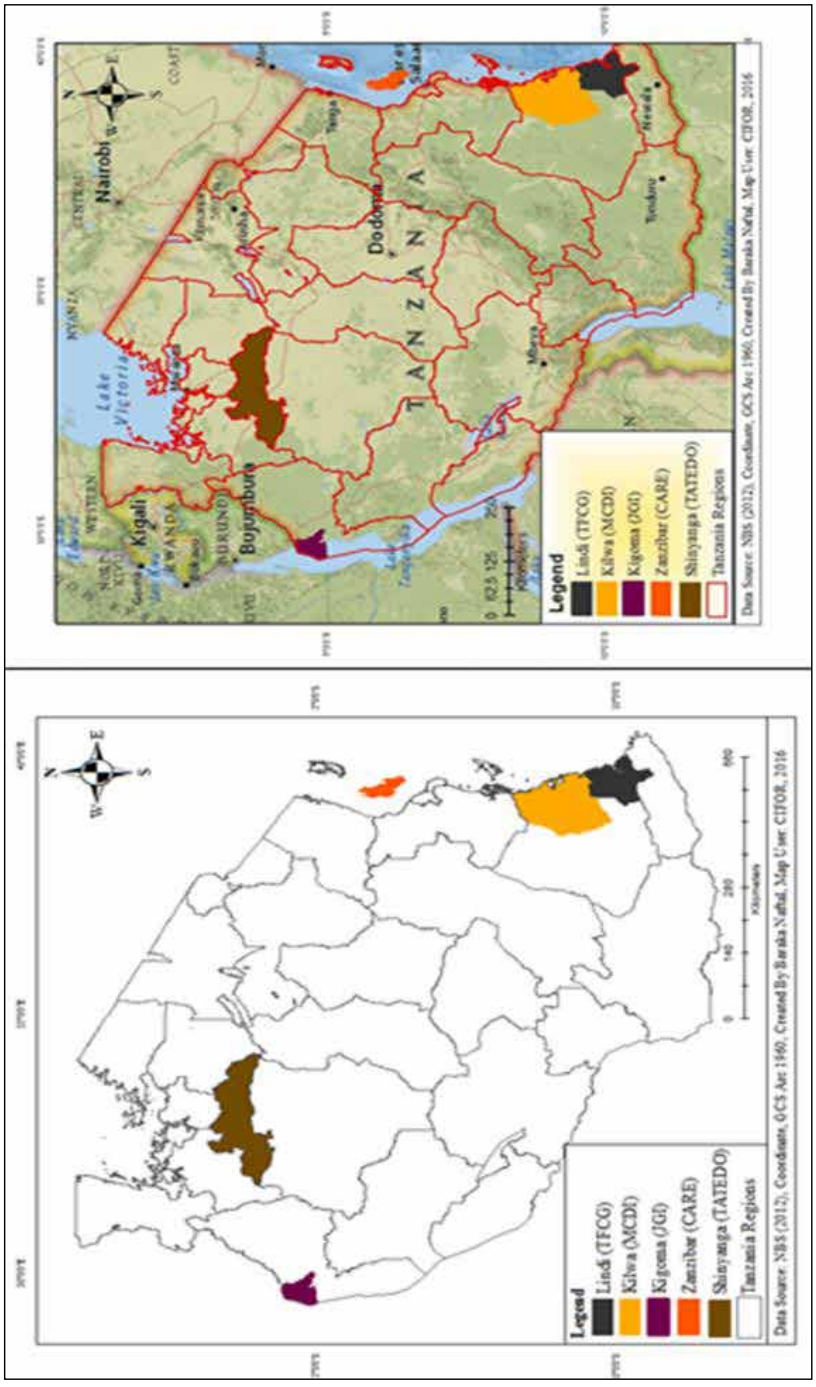
# Acknowledgments

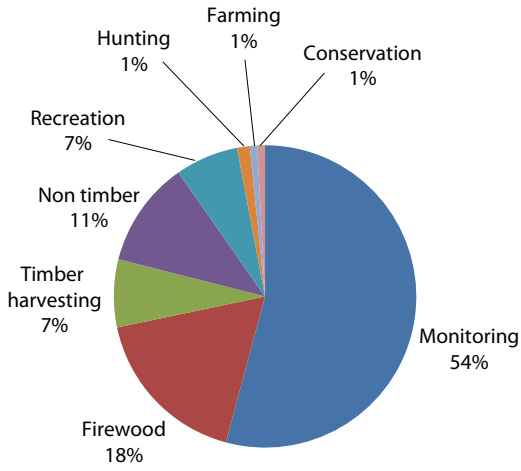
This handbook has been produced with the financial assistance of the European Commission and the UK Department for International Development (DFID). Any views expressed in this publication are those of the authors. They do not necessarily represent the views of CIFOR, the editors, the authors' institutions, the financial sponsors or the reviewers. We would like to thank Alisson Soche Forero and Paula Andrea Zuluaga for their help in the data management process.

# 1 Introduction

Communities all over the world commonly use forests for part of their livelihood and many have organized ways of using their forests and regulating what is harvested when, from where, and by whom. They often also have ways of distributing benefits among their members as well as nonmembers. In many cases, these communities are linked with external actors such as forestry agencies and conservation NGOs who affect how resources are used and managed through the policies/laws they implement and the incentives they offer. This study seeks to understand how people make decisions on the use of the forest and how different policies may affect that use. In particular, we look at the effects of providing a payment to forest users to conserve the forest, often referred to as a "payment for an environmental service". A payment for an environmental service as defined by Wunder (2005) is a transaction where an ecosystem service is being "bought" by a buyer (or multiple buyers) from a service provider or a group of service providers, if the service provider can secure the ecosystem service. In general, the buyers of the ecosystem service are organizations that are external to the communities of forest users. These organizations find different ways to monitor the conservation of the forest and make payments to the communities; these payments can be in cash or in kind, at the individual or group level.

Here we investigate the effects on the forest, and on users' behavior, of receiving a payment to conserve the forest by implementing a set of activities simulating the use of a forest by a forest community. We look at the effectiveness of four alternative ways of providing a payment in four different variations of the activity, and we also created a variation in which no payment was administered. The five variations of the activity that we created were: (1) allowing the community members to communicate among themselves with any payment or external organization involved; (2) having the external organization pay an equal amount directly to each member of the group, where community members were not allowed to communicate among themselves; (3) having the external organization pay an equal amount directly to each member of the group, where community members were allowed to communicate among themselves; (4) having the organization giving the payment to one person selected by the community (leader) after a group discussion, and then that person deciding how to allocate the payment among community members; (5) having the same sort of payment described in (4), but with the majority being women in the group.


Nairobi
Kigali
Bujumbura
Dodoma
TANZANIA
Lake Victoria
Legend
Lindi (TFCG)
Kilwa (MCDI)
Kigoma (JGI)
Zanzibar (CARE)
Shinyanga (TATEDO)
Tanzania Regions
Data Source: NBS (2012), Coordinate, GCS Arc 1960, Created By: Baraka Nathal, Map User: CIFOR, 2016




This project was carried out among rural communities in Tanzania that live near forests and use them in different ways. The communities were: Kikole, Kilago, Kirando, Mbwenkuru, Mchakama, Mkanga 1, Muyuni C, Ngulu, Nyamoli, Ruhokwe, Uroa and Wame. Some of these communities participated in REDD+ projects implemented by NGOs between 2009 and 2014. See Figure 1 for the location of these villages.

For the study, we selected communities that were part of a payment for environmental services (PES) scheme (Kikole, Kilago, Kirando, Mchakama, Mkanga 1, Muyuni C and Ngulu) and communities that were not part of a PES scheme (Mbwenkuru, Nyamoli, Ruhokwe, Uroa and Wame). The communities were also participating in the Center for International Forestry Research (CIFORs) broader research program on the efficiency, effectiveness and sustainability of REDD+. REDD+ is a program that is aimed at providing communities with incentives to use forests in a sustainable way in order to reduce the effects of climate change. When forests are degraded or destroyed, carbon dioxide is emitted and this is thought to lead to increasing temperatures, which may eventually have negative effects on human welfare.

In each village, we held five working sessions (one for each one of the variations mentioned earlier, and explained below); in each of these sessions we invited eight different community members to participate. During each session, we first conducted a brief survey of each participant, then an activity representing the use of a forest, and after the activity we administered another survey. The purpose of the surveys was to gather socioeconomic information about the participants in the activity, as well as some information about the ways they interact with the forest and their perceptions after the activity. This

report contains results from both the surveys and the forest activity in the 12 communities in Tanzania.

This study was carried out in Indonesia, Peru and Tanzania. In this report we report on research conducted in Tanzania and we include data from Peru and Indonesia to give some perspective on the results. As we only had five working sessions in each village we only tested one type of variation in each village. In this brief handbook we do not present results on differences between villages in Tanzania. This will allow us to maintain the anonymity of the results by not mentioning what happened in each group, but we can examine the results aggregated at the country level.

# 2 The participants

In Tanzania, 480 people participated in the study: 245 women and 235 men. The average age of participants was 40 years old, with an average of 7 years of education each. When asked about their economic situation, 28.7 % considered themselves as poor and 56.5% considered their economic situation to be average compared to other people in their village. Most of the participants (91%) owned their home. Below, we present a table (Table 1) with some of this information for each village where we conducted the study.

The participants in this study were forest users or people who were living close to a forest. Approximately 30.4% of the participants claimed that they never visited the forest. The other participants claimed that they went to the forest on average once or twice a month. Among those in this group, 35.4% replied that when they visited the forest, they spent half a day or less in it, while 21.88% spent an hour or less in the forest.

When we asked participants about the different reasons for visiting the forest, the majority mentioned monitoring, followed by firewood and timber

**Table 1. Participant characteristics in each village.**

| Village | Number of participants | Average age | Number of women | Number of men | Average of years of education |
|---|---|---|---|---|---|
| Kikole | 40 | 47.25 | 20 | 20 | 6.05 |
| Kilago | 40 | 40.55 | 22 | 18 | 7.05 |
| Kirando | 40 | 35.85 | 20 | 20 | 6.05 |
| Mbwenkuru | 40 | 46.23 | 21 | 19 | 4.88 |
| Mchakama | 40 | 39.60 | 19 | 21 | 4.80 |
| Mkanga 1 | 40 | 38.45 | 21 | 19 | 6.70 |
| Muyuni C | 40 | 42.18 | 21 | 19 | 9.68 |
| Ngulu | 40 | 36.58 | 20 | 20 | 6.98 |
| Nyamoli | 40 | 42.55 | 20 | 20 | 5.83 |
| Ruhokwe | 40 | 39.93 | 21 | 19 | 5.43 |
| Uroa | 40 | 37.33 | 20 | 20 | 9.60 |
| Wame | 40 | 40.45 | 20 | 20 | 6.45 |
| **Total** | **480** | **40.58** | **245** | **235** | **6.62** |

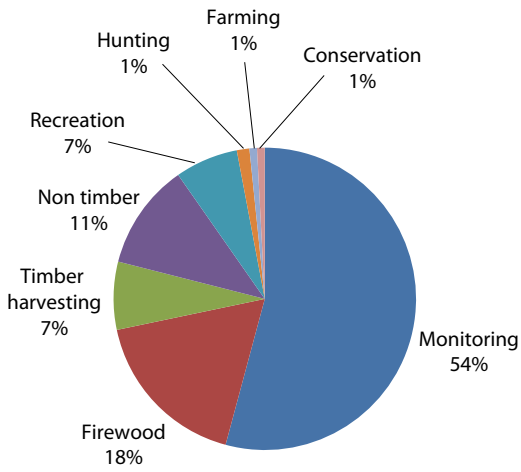



**Figure 1. Participants' responses to the question: why do you go to the forest?**

harvesting, as presented in Figure 1. Survey responses did not inform us what type of monitoring they did, or how it worked. Additional fieldwork needs to be conducted to address these questions.

In total, 90.83% (16.43% agreed; 74.38% very much agreed) of the participants reported that they think it was important to care for nature and protect the natural resources in their village; and 82.7% (34.79% agreed; 47.9% very much agreed) of the participants believed their village could do more to protect their natural resources. Most (80.21%) of the participants believed that compared to other villages around them, the condition of their forest was better than other forests nearby.

As many as 96.25% of the participants believed that cooperation and working together was important (10.4% agreed; 85.8% very much agreed), but more research needs to be done to understand the different ways in which these communities work together. A clear majority of the participants in the activity trust most people in their village (28.5% somewhat agree; 25.8% agree; 28.7% very much agree) and believed that most people in their community trust one another (34.4% somewhat agree; 24% agree; 21.5% very much agree). Figure 2 shows the percentages who agreed or not with the statement "I trust most people in the village".

As part of our survey we asked questions about payments for ecosystem services (PES). More than half (58.3%) of the villages in our study have a PES scheme in their area. Among these villages, 54.3% of the participants knew that people in their village had received payments for conservation activities; and among

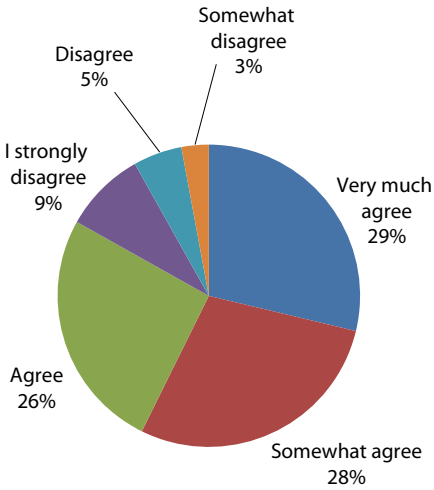



**Figure 2. Participants' responses to: I trust most people in this village.**

those receiving payments, 31.4% reported having received at least one of these payments. Unfortunately in these surveys we did not collect information about the type of payment, the frequency of these payments or the organization providing the payment. We did not ask either about the type of ecosystem service the organization was paying for, or how the payments were shared among community members. Further fieldwork will be required to answer these questions. In the communities where there is no payment scheme implemented, only 11% of the participants had ever heard of such a scheme and only 1% had received at least one payment.

# 3 The activity representing the use of a forest

A team carried out this decision-making activity (commonly called economic games) in Tanzania. This activity portrays a scenario where a group of forest users must decide how to use a common forest. The group consists of eight people sharing a forest containing 80 trees (Figure 3). Each participant was invited to participate in the activity only once and each activity was played for 24 rounds. Each round represents a day spent harvesting wood. During each round, each participant had to choose how many trees (between 0 and 10) he/she wanted to cut from a shared forest containing 80 trees. This decision was made in private, without communicating with other participants in the group.

**Figure 3. Forest In the activity, the forest was represented by blocks of wood. Each block is equivalent to one tree.**

The monitor explained that a participant would get five tokens for each tree he/she cuts from the forest, whereas for each tree left standing in the forest each one of the participants in the group would get one token. At the end of the 24 rounds, the monitor calculated the total number of tokens made by each participant, and the monitor paid each participant TZS 4 for each token earned during the activity.

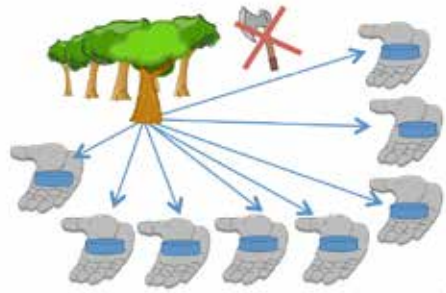
| Individual earnings per tree cut | Group earnings per tree left standing |
|---|---|
|  |  |

**Figure 4. Individual and group earnings in tokens per tree.**

Participants made their decisions in private, and they informed the monitor about his/her decision by filling in a decision card (Figure 5).

**Figure 5. Decision card.**

| Decision card | |
|---|---|
| **Participant number:** | |
| **Round number:** | |
| Please mark with an X the trees you want to cut from 0 to 10. | |
| 0 - 10 | |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

After each round of the activity, the monitor collected the decision cards from the eight participants and publicly announced how many trees were cut from the forest by the group and how many trees were left standing in the group forest. Additionally, he/she announced the earnings participants received from the trees that were not harvested but left standing in the group forest. Then each participant (individually and in private) calculated his/her earnings in tokens for that round based on the tokens earned by cutting trees, plus the tokens earned for the trees left standing in the group forest. All of this information was recorded on a calculation sheet (Table 2) that participants had with them at all times. The monitor and other facilitators were on hand to assist participants in making these calculations as needed. This process was repeated for 24 rounds.

**Table 2. Calculation sheet.**

| Round number | Trees you cut from the forest | Earnings in tokens for the trees you cut (for each tree you will receive 5 tokens) (A*5) | Number of trees cut by the entire group (announced by the moderator) | Earnings in tokens for the trees left in the forest (announced by the moderator) (80-C) | Tokens earned in this round (=B+D) |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |

This basic activity simulates a cooperation dilemma where at the individual level it is in the participant's best interest to cut as many trees as possible, but at the group level it is better to keep the trees standing in the common forest. In other words, there is a tension between what an individual sees as best for him or herself and what is best for the group overall. However, if everybody in the group follows the individual strategy, then in the end, the group would not accumulate as many tokens as they could if they were not cutting trees and they will destroy the group forest. As shown in Table 3, if nobody cuts trees from the forest, then the earnings for each individual from the trees left in the forest are 80 tokens, which means that the total earnings for the group are 80*8=640. This is how a group can earn more tokens and we call this a social optimum. If every participant cuts one tree, then the earnings for each individual are 5 tokens from the tree cut + 72 tokens from the trees left in forest, or 77 tokens per participant. The total earnings for the group in this case are 616 (77*8), which is substantially less than what the group could have earned if everyone had abstained from harvesting trees.

If one individual cuts 10 trees and the rest of the participants do not cut any trees, that individual's earnings are 50 from the trees cut + 70 from the trees left standing in the forest or 120 tokens. In this particular case, the total earnings for the group are 610, (120+70*7). This example shows how for the individual it may be better to cut all of the trees, but by doing that, the individual is affecting the total earnings of the group. In this activity, all participants were faced with the temptation to harvest some trees while other refrained from harvesting any trees at all. The example we just showed yields the highest possible individual earnings (for the individual cutting all 10 trees), but that comes with a cost in earnings to the rest of the group (because the other players in the group are not cutting any trees). In this particular case, we say that this individual is free riding on the effort of others in the group to conserve the forest.

If every participant decides to do the same and to cut all trees they are allowed to cut, then the individual' earnings are 50 tokens, and the total earning made by the group are 400 tokens (50*8). In this case, none of the participants will cooperate, and this will be damaging for the forest and for the individual and group earnings. This situation is known as a Nash equilibrium – a situation in which no participant can benefit from doing something different while the other participants keep doing what they are doing; in this case a participant in the whole group is cutting 80 trees, the only way a participant can benefit in terms of earnings from doing something different (i.e. cutting less trees) is if others cut less tress as well. If everyone follows this strategy, the forest will disappear rapidly and participants will earn very little income from all that harvesting.

The cooperation dilemma manifests itself in this activity by representing the advantages for the group and for the forest of not cutting trees (*the social*

**Table 3. The social dilemma introduced in the activity.**

| Trees cut by individual | Trees cut by seven other players | Earnings for individual by the trees cut | Earnings for the individual from trees left standing in the forest | Total Earnings for individual from trees cut + trees left standing in the forest | Total earnings for the group |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 80 | 80 | 80*8=640 |
| 1 | 7 | 5 | 72 | 77 | 77*8=616 |
| 10 | 0 | 50 | 70 | 120 | 120+70*7=610 |
| 10 | 70 | 50 | 0 | 50 | 50*8=400 |

*optimum*), but showing how difficult it is to get there if you do not trust others and commit to the group. If participants start free riding, then it will easier to get to a situation such as the one in the *Nash equilibrium*.

For the first eight rounds of the activity, participants were making decisions, as we just described. Each participant decides how many trees to cut from the shared forest, without any way to communicate with other group members, or any type of external organization looking or controlling the group's decision-making.

From rounds 9 to 16, we included five different possible variations to the basic activity. Each group participated in only one of these five possible variations (Table 4). As mentioned earlier in every community we did the five variations of the activity only once.

**Table 4. Different variations of the activities from rounds 9-16 (and in parenthesis the name of the variation in subsequent tables).**

| Variation for rounds 9 to 16 | Description |
|---|---|
| Communication (COMM) | Participants were allowed to talk amongst themselves before making decisions in each round. The decisions remained private. |
| Bonus (BONUS) | An organization offers a bonus to the group not to cut trees from the forest. This bonus is offered in every round. But if the organization finds out that the group is cutting trees, then they will not pay the bonus. The organization cannot perfectly monitor whether or not the group is cutting trees, but each tree cut increases the probability that the organization will find out that trees are being cut. If they cut more than 40 trees, the organization will always know they cut trees. The bonus is 160 tokens, and it is distributed equally among all participants. No communication was allowed between participants.. |
| Bonus and communication (BONUS+COMM) | Participants participated in the "bonus" variation described above, but they had the opportunity to communicate for 5 minutes with each other before making any decision. |

| Variation for rounds 9 to 16 | Description |
|---|---|
| Bonus and communication with leader (BONUS+LEADER) | An organization offers a bonus to the group not to cut trees from the forest. This bonus is offered in every round. But if the organization finds out that the group is cutting trees, then they will not pay the bonus. The organization cannot fully monitor whether or not the group is cutting trees, but each tree cut increases the probability the organization will find out that trees are being cut. If they cut more than 40 trees the organization will always know they cut trees. Participants could communicate and had to elect a participant that would be in charge of distributing the bonus of 160 tokens, if the bonus is given. The leader was free to distribute the bonus in any possible way. That distribution is private to the other group members. |
| Bonus and communication with leader and a majority of women in the group. (BONUS+LEADER+MAJORITY) | This variation is the same as "bonus and communication with leader", but the majority of the participants are women. |

In rounds 17–24, all groups went back to participate in the activity under the same conditions as in rounds 1 to 8 regardless of the variation of the activity they were participating in – i.e. with no communication and without any bonus or organization examining what they were doing.

Table 5 illustrates a summary of the different components of the activity across the 24 rounds that were completed in each community. In rounds 1–8 we did not have any type of variation in the activity (pre-variations rounds), in rounds 9–16 we used the five variations explained above (one per group), and finally in rounds 17–24 the groups were not subject to any variation, but they experienced the withdrawal of the variation they had used in rounds 9-16 (i.e. post-variation).

**Table 5. Summary of the 24 rounds of the activity.**

| Rounds 1–8 pre-variations | Rounds 9–16 variations | Rounds 17–24 post-variations |
|---|---|---|
| No communication. No Bonus | COMM | No communication. No Bonus |
| | BONUS | |
| | COMM+BONUS | |
| | BONUS+LEADER | |
| | BONUS+LEADER+MAJORITY | |

Table 6 shows the villages where each variation was conducted, the breakdown of the number of participants per variation and the distribution of men and women.

**Table 6. Summary of participant distribution per village and per variation.**

| Village | Variation | Number of participants | Number of women | Number of men |
|---|---|---|---|---|
| Kikole | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 5 | 3 |
| | COMM | 8 | 3 | 5 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Kilago | BONUS | 8 | 5 | 3 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 5 | 3 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Kirando | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Mbwenkuru | BONUS | 8 | 5 | 3 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Mchakama | BONUS | 8 | 3 | 5 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |

| Village | Variation | Number of participants | Number of women | Number of men |
|---|---|---|---|---|
| Mkanga 1 | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 5 | 3 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Muyuni C | BONUS | 8 | 5 | 3 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Ngulu | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Nyamoli | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Ruhokwe | BONUS | 8 | 5 | 3 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Uroa | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| Wame | BONUS | 8 | 4 | 4 |
| | COMM+BONUS | 8 | 4 | 4 |
| | COMM | 8 | 4 | 4 |
| | BONUS+LEADER | 8 | 2 | 6 |
| | BONUS+LEADER+MAJORITY | 8 | 6 | 2 |
| **Total** | | **480** | **245** | **235** |

# 4 Results

## a) Results rounds 1 to 8

Table 7 and Figure 6 give a first approximation of the results in the first eight rounds of the activity, by comparing what participants did in Tanzania to what others did in Indonesia and Peru. We used the data from Indonesia and Peru as a reference for what participants were doing in Tanzania.

As shown, participants were extracting on average 2.22 trees, thus they were only cutting around 2 trees of the 10 trees that they were allowed to cut, meaning that they were not being selfish or uncooperative; in fact they were very close to what is the optimal for the group earnings, which results from cutting 0 trees. This result is very impressive since participants were not allowed to communicate, they did not have any way to coordinate their actions and they were very cooperative.

Compared to the activities conducted in Peru and Indonesia, participants in Tanzania were cutting significantly fewer trees; in Peru and Indonesia they were cutting 3.95 and 3.80 trees respectively during these first 8 rounds (an average of 3.88). So in Tanzania in rounds 1 to 8 participants cut on average 1.66 less trees than the participants in the other two countries when we look at these two together.

**Table 7. Trees cut in the first eight rounds of the activity in Tanzania, Peru and Indonesia.**

| Round | Average individual extraction in Tanzania | Average individual extraction in Peru | Average individual extraction in Indonesia |
|---|---|---|---|
| 1 | 2.09 | 3.58 | 3.31 |
| 2 | 2.27 | 3.66 | 3.52 |
| 3 | 2.14 | 3.78 | 3.92 |
| 4 | 2.33 | 3.99 | 4.03 |
| 5 | 2.08 | 4.12 | 4.02 |
| 6 | 2.32 | 4.15 | 3.70 |
| 7 | 2.26 | 4.19 | 3.87 |
| 8 | 2.29 | 4.16 | 4.06 |

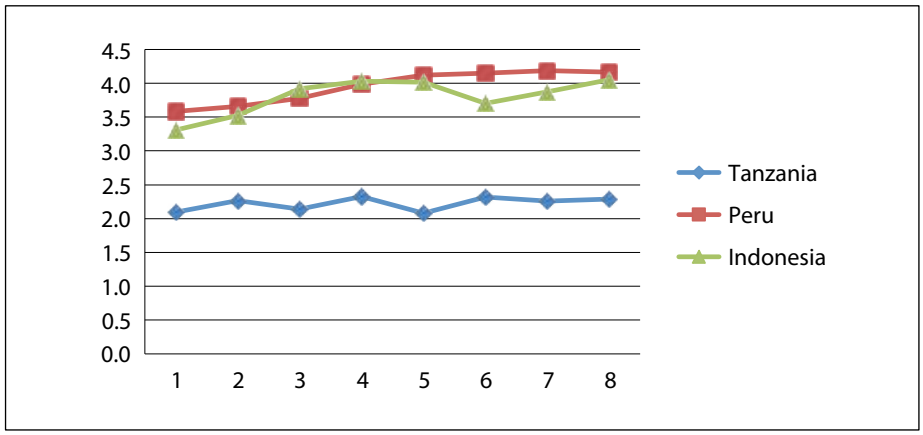



**Figure 6. Average individual extraction in Tanzania in rounds 1 to 8.**

## b) Results rounds 9 to 16

**Table 8. Trees cut in rounds 9–16 of the activity for each one of the variations in Tanzania.**

| Round | BONUS | COMM+ BONUS | COMM | BONUS+ LEADER | BONUS+ LEADER+ MAJORITY |
|---|---|---|---|---|---|
| 9 | 0.59 | 0.73 | 1.48 | 1.11 | 1.92 |
| 10 | 0.89 | 0.77 | 1.55 | 1.51 | 1.41 |
| 11 | 1.20 | 0.85 | 1.90 | 1.49 | 1.63 |
| 12 | 1.14 | 1.02 | 1.76 | 1.44 | 2.30 |
| 13 | 1.33 | 0.81 | 1.67 | 1.64 | 1.59 |
| 14 | 1.08 | 0.94 | 1.54 | 2.05 | 1.53 |
| 15 | 1.47 | 0.94 | 1.40 | 1.93 | 1.67 |
| 16 | 1.56 | 0.93 | 1.49 | 1.90 | 1.41 |

Table 8 and Figure 7 show the individual average extraction during rounds 9 to 16. The extraction levels for all variations were lower than in rounds 1 to 8. However, as Figure 7 clearly shows there is variability among all the variations.

For the variation communication (COMM), the average extraction was 1.60. Participants decreased the number of tress cut in rounds 1 to 8 when they were cutting on average 2.22 trees. This means that communication had a positive effect on reducing the number of trees cut. The effect of communication was more or less the same during all rounds (except for rounds 11 and 12); this suggests that participants reached an agreement on how to manage the forest and

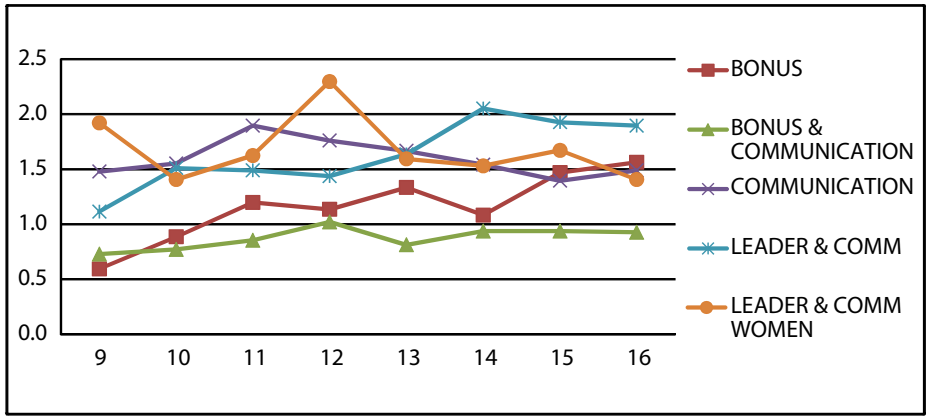



**Figure 7. Average individual extraction in rounds 9–16 in Tanzania.**

they kept the agreement during the eight rounds. This effect of COMM is very interesting since participants did not have any way to enforce any agreement made during the communication period; in fact if somebody did not follow the agreement it would have been difficult to find out who that person was. The positive effects of communication in dilemmas of this type are reported in the literature, but very often the positive effect does not last for so many rounds.

In the BONUS treatment, all participants in the group knew that they may get the bonus provided by the organization, but it was impossible for them to communicate to coordinate their actions to get it (the fewer trees they cut, the bigger the chances of getting the bonus and at the same time the bigger the share they were getting from the trees remaining in the forest). The average extraction was on average 1.16 trees. Thus, this variation was more effective than the COMM variation and much more than what was seeing in rounds 1 to 8. However, as it can be seen in Table 8 and Figure 7, this variation was very good at reducing extraction in the first rounds (round 9 had an average of 0.59 and round 10 had an average of 0.89), but over time it started to be less effective (round 16 had a average of 1.56). In round 16, the average extractions were higher than for the variation COMM in the same round (with an average extraction of 1.49). Again, cooperation started to erode over time; this is not surprising as participants did not have any way to discuss the benefits of the BONUS or to make agreements about how to get it.

The three variations that allow communication and where participants were getting a bonus were: COMM+BONUS, BONUS+LEADER and BONUS+LEADER+MAJORITY. These three variations are relatively easy to compare but they also have differences in terms of implementation and ways of sharing the bonus.

In the COMM+BONUS variation, the external organization providing the bonus was also in charge of distributing the bonus equally among participants. The average extraction was 0.87. The results from this variation are quite remarkable; in fact, this variation led to the least number of trees being cut. This is the variation that led to more cooperation between group members. Also the distribution of the bonus equally to participants by an external organization may have also reduced the extraction levels by participants.

The other two variations, BONUS+LEADER and BONUS+LEADER+MAJORITY got average extractions of 1.63 and 1.68 respectively, which are lower than the average extraction in rounds 1 to 8, similar to the variation COMM, and higher than variations BONUS and COMM+BONUS. The extraction levels in these two variations were low, but when we compared those with the results of the other variations in Tanzania we need to examine these results further.

The results of BONUS+LEADER and BONUS+LEADER+MAJORITY were almost the same, so it seems that having a leader distributing the bonus did not have an impact on the extraction decision in the group. It also means that having more women in the group did not have a noticeable impact on the extraction levels (since that is the main difference between these two variations). The result of these two variations is somewhat striking if we compare it with the results of COMM, in which no bonus was offered. Since participants were getting very similar results to the COMM variation, one could argue that participants in these two variations did not benefit from the bonus payment. The bonus did not seem to be a way of coordinating the participants' actions and the distribution of the bonus by a leader did not influence the extraction levels.

To try to understand this result, let us examine the difference between the BONUS+LEADER and BONUS+LEADER+MAJORITY and COMM+BONUS variations. The main difference is that in the earlier cases an individual selected by the group was in charge of distributing the bonus, whereas in the latter cases, the bonus was distributed by the organization directly. So the main difference concerns who is responsible for distributing the bonus, and the certainty that the bonus will be distributed in an equal way in the COMM+BONUS. But in BONUS+LEADER+MAJORITY and COMM+BONUS variations the group were able to choose their leader, and they were able to communicate about any topic, including how to choose the leader and the ways in which the bonus should be distributed. Is this result – those variations that involve an elected leader appear to lead to less reduction of individual harvests compared to variations without a leader – a result of lack of trust in the leaders the communities chosen? Or is because the group could not verify how the leader was distributing the bonus as that decision was private? Or is that the groups were not familiar with distributing external resources? We do

not have any way to answer these questions with the information we have for now, but we believe these questions will be important in follow-up studies. We did, however, ask several questions at the end of the activity in the survey and participant responses to these questions indicate that some participants were not very happy with the way the bonus was distributed in these two variations.

When we look at the selection of the leader in BONUS+LEADER and BONUS+LEADER+ MAJORITY variations, we notice that 42% of the participants who participated in one of these two variations were leaders at least once in the activity. That means that the position of leader rotated among participants. Out of the participants who were leaders, 57.5% were chosen as leader more than one time. Additionally, we noticed that out of 24 groups that participated in these two variations: eight groups elected the same leader for all eight rounds, and only one group chose a different leader every round, allowing for all participants to get a turn at being a leader. The design of these two variations was done in a way to allow for the groups to implement that rotation mechanism, but only one group used it. The rest of the groups used a variety of ways to choose their leaders.

In 23% of the rounds, participants elected a woman to be the leader of the group. In the groups playing under BONUS+LEADER, 12.5% of the elected leaders were women and in the groups with a BONUS+LEADER+MAJORITY, 33.7% of the elected leaders were female. This means that in the groups with more women, more women were chosen as the leader in the group. However, as noticed earlier, the number of women in a group did not affect the extraction levels.

In 114 (out of 146) rounds where the organization paid the bonus, the bonus was distributed equally amongst the participants by the leader. The leader distributed the bonus, giving more to himself/herself than to the othersin 17 (8.2%) rounds. In 5 rounds (3.4% of rounds) the leader kept the entire bonus to himself/herself. In 13 rounds (7.5% of rounds), the distribution was unequal and the leader gave himself/herself less than the rest of the group in just 2 rounds (1.37% of rounds).

When we compared the results from Tanzania with those from Peru and Indonesia (Table 9), we see that as in rounds 1 to 8, the average extraction in rounds 9 to 16 *was much lower in all variations* and the differences are stark. In the case of COMM+BONUS, for example in Tanzania, groups were extracting on average 0.87 trees whereas they were extracting on average of 2.83 trees in Peru and 2.42 trees in Indonesia.

**Table 9. Trees cut in rounds 9–16 of the activity for each one of the variations in Peru and Indonesia.**

| Country | Round | BONUS | COMM+ BONUS | COMM | BONUS+ LEADER | BONUS+ LEADER+ MAJORITY |
|---|---|---|---|---|---|---|
| Indonesia. | 9 | 2.61 | 2.19 | 4.47 | 3.17 | 1.92 |
| | 10 | 2.58 | 2.42 | 3.64 | 2.09 | 1.41 |
| | 11 | 3.05 | 2.66 | 2.78 | 2.63 | 1.63 |
| | 12 | 3.53 | 2.92 | 2.92 | 2.36 | 2.30 |
| | 13 | 3.72 | 2.17 | 3.38 | 2.14 | 1.59 |
| | 14 | 2.91 | 2.28 | 3.30 | 1.81 | 1.53 |
| | 15 | 3.11 | 2.34 | 3.11 | 3.05 | 1.67 |
| | 16 | 3.14 | 2.36 | 2.70 | 1.50 | 1.41 |
| Peru | 9 | 2.30 | 2.90 | 2.63 | 1.54 | 2.28 |
| | 10 | 2.67 | 2.67 | 2.64 | 1.70 | 2.14 |
| | 11 | 2.48 | 2.92 | 3.09 | 1.75 | 3.22 |
| | 12 | 2.66 | 2.93 | 2.70 | 1.93 | 2.30 |
| | 13 | 2.45 | 2.76 | 2.84 | 1.98 | 3.17 |
| | 14 | 3.17 | 2.86 | 2.94 | 1.89 | 1.69 |
| | 15 | 2.72 | 3.14 | 3.42 | 1.61 | 2.39 |
| | 16 | 3.34 | 2.43 | 2.86 | 2.11 | 2.23 |

The variation that led to fewer trees being cut in Indonesia was BONUS+LEADER+MAJORITY with an average of 1.68. This is the same average found in Tanzania for the same variation. This is the only case where the extraction levels in Tanzania come close to either of the other two countries. With this variation in Peru the extraction level was an average of 2.43 trees. In Peru the variation that led to fewer trees being cut was BONUS+LEADER where the average extraction was 1.81, which is still higher than the average of 1.63 trees extracted in Tanzania for the same variation. In general in Tanzania the extraction levels in rounds 9 to 16 in all variations, even in the ones that did not have a big decrease with respect to the rounds 1 to 8, were very close to the social optimum. The cooperation in general during the activity was very high.

The variation that *led to more cooperation* in Tanzania was not the same as the variation that led to more cooperation in Indonesia or Peru. This result is important when designing institutions to manage forest, showing that variations that work really well in one setting may not be as effective in another setting.

## c) Results rounds 17 to 24

**Table 10. Trees cut in rounds 17–24 of the activity in Tanzania.**

| Round | After BONUS | After COMM+ BONUS | After COMM | After BONUS+ LEADER | After BONUS+ LEADER+ MAJORITY |
|---|---|---|---|---|---|
| 17 | 1.15 | 0.96 | 1.70 | 1.90 | 1.57 |
| 18 | 1.69 | 1.14 | 1.57 | 2.15 | 1.93 |
| 19 | 1.59 | 1.08 | 1.68 | 1.99 | 2.01 |
| 20 | 1.77 | 0.96 | 1.55 | 1.81 | 1.70 |
| 21 | 1.97 | 1.21 | 1.39 | 1.96 | 1.94 |
| 22 | 1.61 | 1.02 | 1.48 | 1.83 | 2.05 |
| 23 | 1.53 | 1.21 | 1.73 | 2.00 | 1.98 |
| 24 | 1.71 | 1.36 | 1.55 | 2.35 | 1.46 |

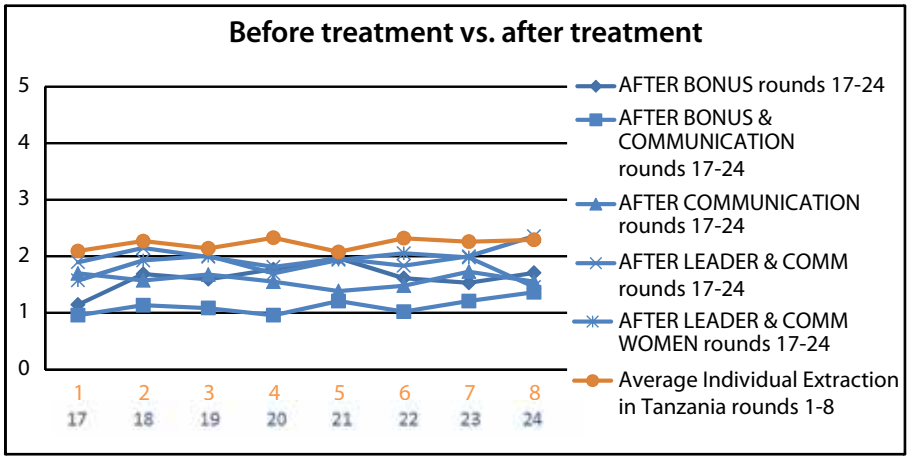



**Figure 8. Comparison of rounds trees cut in rounds 1–8 versus rounds 17–24.**

In Table 10 and Figure 8, we present the results of the activity for rounds 17 to 24. In these rounds, participants were playing the activity with no bonus and no communication, so they went back to the same scenario they had in rounds 1 to 8, but after experiencing the variations of rounds 17 to 24. In all cases, the extraction levels were higher than in rounds 9 to 16, but lower

than the extraction levels in rounds 1 to 8. When we compare the results of the averages in rounds 17 to 24 with the averages of rounds 1 to 8, in all variations the average extractions were smaller (1.63 for BONUS, 1.12 for COMM+BONUS, 1.58 for COMM, 2.00 for BONUS+LEADER and 1.83 for BONUS+LEADER+MAJORITY) compared to 2.22 for the first eight rounds.

The difference with respect to rounds 9 to 16 is not very high. For the COMM variation, the average extraction in rounds 9 to 16 was 1.60 and now it is 1.58, meaning that the extraction diminished a little, even in the absence of communication in rounds 17 to 24. The variation that led to a bigger difference was BONUS, with an average extraction of 1.16 in rounds 9 to 16 and an average of 1.63 in rounds 17 to 24. This shows that all variations had a positive longer term effect on extraction levels compared to the initial rounds (1 to 8), even after the variations were removed from the activity. The participants seem to have learned something from having the variations in place and that effect lasted even after they were removed.

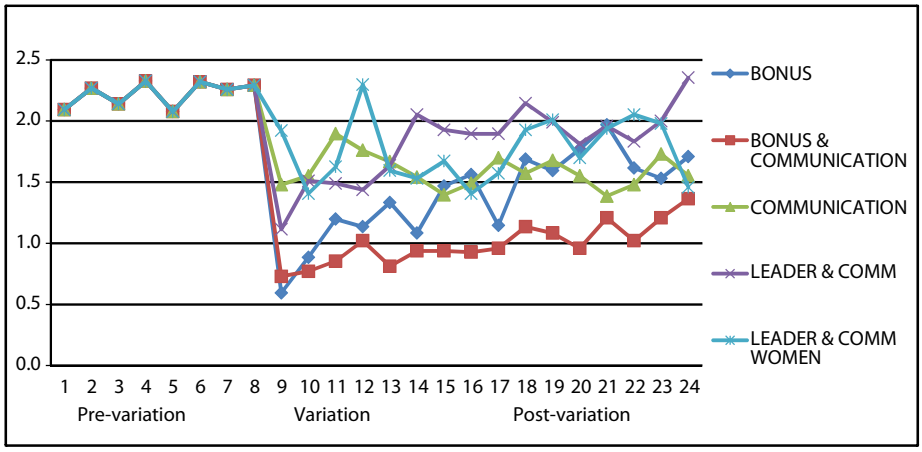



**Figure 9. Average individual extraction in Tanzania from rounds 1–24.**

**Table 11. Trees cut in rounds 17–24 of the activity in Peru and Indonesia.**

| Country | Round | BONUS | COMM+ BONUS | COMM | BONUS+ LEADER | BONUS+ LEADER+ MAJORITY |
|---|---|---|---|---|---|---|
| Indonesia | 17 | 2.23 | 2.73 | 3.03 | 2.81 | 2.47 |
| | 18 | 2.84 | 2.98 | 3.30 | 3.03 | 2.50 |
| | 19 | 3.08 | 3.02 | 3.63 | 3.09 | 2.03 |
| | 20 | 3.06 | 2.84 | 3.31 | 3.41 | 2.23 |
| | 21 | 2.78 | 3.30 | 3.22 | 3.25 | 2.22 |
| | 22 | 2.94 | 3.38 | 3.33 | 3.84 | 1.81 |
| | 23 | 2.77 | 3.00 | 3.31 | 3.34 | 1.77 |
| | 24 | 2.92 | 3.59 | 3.52 | 3.52 | 1.91 |
| Peru | 17 | 2.55 | 2.71 | 2.48 | 2.05 | 3.58 |
| | 18 | 3.42 | 3.21 | 2.75 | 2.29 | 3.45 |
| | 19 | 3.66 | 3.13 | 2.97 | 2.34 | 4.11 |
| | 20 | 3.78 | 3.65 | 2.88 | 2.43 | 4.11 |
| | 21 | 3.20 | 3.21 | 2.84 | 2.11 | 4.25 |
| | 22 | 3.42 | 3.49 | 2.92 | 2.34 | 3.89 |
| | 23 | 3.27 | 3.25 | 2.92 | 2.20 | 4.31 |
| | 24 | 3.83 | 3.63 | 3.03 | 2.70 | 4.44 |

Figure 9 shows a graphical representation of the average individual extraction rates in the different forest activities. As described before, all variations led to less extraction in rounds 9 to 16, compared to rounds 1 to 8. Thus all variations were effective at reducing the number of trees cut, and some variations worked better than others. In rounds 17 to 24, the extraction levels did not increase to the point to where they were in rounds 1 to 8 when no variations where available, but they were a little higher than when the variations were in place, (except for the COMM variation).

Table 11 allows us to compare the results from rounds 16 to 24 in Tanzania with Peru and Indonesia. Again for all variations, the levels of extraction in Tanzania were lower than in Peru and Indonesia. This result is not surprising since that has been the trend in all rounds of the activity.

# 5 Discussion

After we concluded the forest activity, we asked participants questions about the activity. Most participants enjoyed their experience of the game (99.8%) and most (99.2%) reported having learned something new.

We also asked participants who played with one of the bonus options if they thought the distribution of the bonus among the participants was fair and 83.1% of them responded that it was. In addition, we asked them the following question: what do you think of the way that this payment was shared by the participants? As many as 80.99% replied that it was fair and 19% replied it was unfair or unequal. When we disaggregated that answer between participants with a leader (BONUS+LEADER+MAJORITY and COMM+ LEADER) and participants without a leader (BONUS+COMM), we found that when the community was sure that there was equal distribution of the bonus among participants, most of them (92.7%) reported that the way the bonus was shared was fair. For those who had leaders (BONUS+LEADER+MAJORITY and COMM+ LEADER) and most (69.27%) reported that they not know the way the bonus was being distributed, just 30.7% of participants reported the distribution to be unfair and unequal. These two results help explain some of the results we presented earlier – as to why groups that were exposed to variations involving leaders tended to reduce their harvests less than groups without leaders. However, our data does not provide many clues as to why participants perceived the distribution of the bonus to be unfair.

# 6 Conclusion

The average extraction levels in Tanzania were very low in general. In fact they were very close to the social optimum even in rounds when communication and bonus were not available. Moreover, the average extraction levels in Tanzania in all rounds were lower than in Indonesia and Peru. This result is remarkable and shows that participants were cooperating among themselves and conserving forest.

Although in Tanzania the cooperation levels were very high in all variations, and in all cases the extraction levels were lower than in rounds 1 to 8, the extraction levels in variations BONUS+LEADER and BONUS+LEADER+MAJORITY are not as expected. These two variations were not as effective as the COMM+BONUS variation, although these three variations had the bonus and the opportunity to communicate among group members. As we indicated earlier, this is puzzling. Is it because the groups did not trust the leaders they selected? Or is it because leaders were expected to make decisions about the distribution of the bonus in a public way but failed to divulge this information to the participants? We wonder if the results of these two variations would have remained the same if the distribution of the bonus had been made public, or at least if the leader had been asked to show how much he allocated to himself/herself.

The degree of effectiveness of some variations may depend on the context particular to the countries where the activity was done. This may be the reason that we found that the variations that were more effective in Tanzania were not the same as the ones that were found to be most effective in Peru and Indonesia. This implies that variations that work really well in one setting may not be as good in another setting. This is a very important outcome to remember when trying to create new policies to manage natural resources, including forests in different places.

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RESEARCH PROGRAM ON Forests, Trees and Agroforestry

This research was carried out by CIFOR as part of the CGIAR Research Program on Forests, Trees and Agroforestry (CRP-FTA). This collaborative program aims to enhance the management and use of forests, agroforestry and tree genetic resources across the landscape from forests to farms. CIFOR leads CRP-FTA in partnership with Bioversity International, CATIE, CIRAD, the International Center for Tropical Agriculture and the World Agroforestry Centre.

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