1. Introduction

Several million people in the world are engaged in the extraction of gold that uses artisanal mining methods (Spiegel and Veiga, 2005). For most of them, gold extraction is the most attractive or the unique livelihood activity (Siegel and Veiga, 2010). However, the application of conventional practices, mercury amalgamation being the most representative, makes artisanal and small-scale gold mining (ASGM) an activity with a high negative impact on health and the environment. Even though cleaner, more productive, and financially viable technologies are available to miners (Pantoja et al., 2005; Hilson, 2006), mercury amalgamation and other rudimentary techniques continue to be very widely used techniques for gold recovery in ASGM.

Technology choice for the gold recovery process in ASGM can be characterized as a social dilemma. Even though socio-ecological systems involved in ASGM fit the definition of a common-pool resource (Saldarriaga-Isaza et al., 2013), their main social dilemma involves a trade-off in which miners may tend to maximize short-run individual profits by choosing the cheapest and easiest-to-handle technique available, i.e. mercury amalgamation. However, in the long-run, the entire community, which includes the miners, is worse off than with the choice of a cleaner and more productive technology. In this context, the dilemma that artisanal gold miners face is not found in the extraction and availability of this non-renewable resource or in its depletion. Instead, the dilemma concerns the pollution resulting from the gold recovery process, i.e., it is a public-good dilemma.

In order to tackle mercury pollution, there have been interventions in the form of training programs and environmental campaigns. Incentives to access alternative technologies have also been proposed or undertaken in several places. In fact, the United Nations in 2002 launched the Global Mercury Project, which is a capacity-building initiative, created with the aim of "removing barriers to the adoption of cleaner practices of small-scale gold mining" (Spiegel and Veiga, 2005, p. 362). However, interventions must go beyond the presentation of technical solutions to the problems of mining and processing, and attention to economic and social issues should also be paid (Jennings, 2003). For instance, a complementary form of intervention would be the promotion or strengthening of collective action through miners' associations (Kazilimani et al., 2003).

When we use the terms "collective action" or "associative entrepreneurship" in this paper, we refer to the creation of local associations between small-scale gold miners; these associations are meant to acquire more environmentally-friendly technologies, in order to overcome the social dilemma that is present in the gold recovery process. The promotion of associative entrepreneurship has been on the policy agenda of governments and independent agencies working to improve the quality of life of ASGM communities (Saldarriaga-Isaza et al., 2013). This type of association allows not only the improvement of the relationship with the state, but it would also enable miners to accumulate the financial capital required to obtain cleaner and more productive technologies that are beyond the budget of most mining families (Hentschel et al., 2002; Hinton et al., 2003; Hilson and Potter, 2003; Heemskerk and Oliviera, 2004; CDS, 2004; Ghose and Roy, 2007; Spiegel, 2009). This financial capital is difficult to obtain from the financial system, which perceives small-scale mining as a risky activity (Chaparro, 2003). This fact, added to the low tendency of miners to save money for investment (Saldarriaga-Isaza et al., 2013) would partially explain the low rate of adoption of cleaner technologies. Associative entrepreneurship is therefore an option for small-scale miners to increase their financial capital.

In addition to the environmental benefits, alternative technologies would bring greater productivity to miners who employ them in the gold recovery process. Hereafter, the corresponding additional profits will be referred to as "private benefits," in order to differentiate them from the public-good benefits associated with the use of the cleaner technology. Despite the advantages of associative entrepreneurship, aspects such as lack of communication and organization would hinder miners reaching those gains (Hinton et al., 2003). In this sense, it is then necessary to explore the effectiveness of institutions in fostering collective action that promotes the adoption of cleaner technologies. Some of the main institutions that have been proven to have effects on collective action for the sustainable management of common-pool resources and public goods are as follows: external regulation (e.g., Cardenas et al., 2000; Dickinson, 2001), face-to-face communication (e.g., Ledyard, 1995; Ostrom, 2010), and information disclosure (e.g., Ledyard, 1995; Smith, 2010).

In this paper, we analyze the effect of two different institutional arrangements on associative entrepreneurship in ASGM, using a framed field experiment. One of the institutions that we investigate is co-management. This institution is understood as the interaction between internal communication among community members and an external non-coercive party. Moreno-Sánchez and Maldonado (2010) showed in a field experiment with fishermen in Colombia, that co-management may perform better than other institutions, such as using only internal communication among community members, or an external (coercive) regulation.

External coercive regulation in ASGM may be unfeasible, due to widespread informality and lack of operational resources for enforcement (Saldarriaga-Isaza et al., 2013). Thus, considering the difficulties of carrying out external coercive regulation, and the current policy context in which some external organizations are trying to encourage better practices in ASGM, we test the effect that co-management may have on associative entrepreneurship in ASGM and whether the effects of co-management found by Moreno-Sánchez and Maldonado hold in the case of ASGM.

Another institution we are interested in testing is the option that once a better technology is acquired and the public good (lower mercury emissions) is provided, non-contributors may be excluded from the private benefits that the technology providing the public good also generates. In general, the exclusion from the benefits of a public good, of those individuals who fail to meet a predetermined minimum contribution requirement, may lead to increases in contributions to the public good (Swope, 2002; Kocher et al., 2005; Croson et al., 2007; Bchir and Willinger, 2008). This kind of exclusion reduces the individual incentives to free ride, and generates Pareto-efficient outcomes. However, Swope (2002) argued that in environments in which individuals fail to coordinate their contributions, exclusion can decrease both contributions and welfare. Czap et al. (2010), for instance, found that subjects contributed more to the non-excludable compared with the excludable public good, arguing therefore that in their case exclusion of non-contributors crowded out other-oriented preferences.

There are examples of goods that can be non-rival but somehow excludable in their consumption (Swope, 2002; Kocher et al., 2005), e.g., public facilities with controlled access such as parks and museums, or television broadcasts. In our case, we are not interested in exclusion from the positive externalities stemming from the utilization of a cleaner technology. In ASGM this kind of exclusion may actually be unfeasible or too costly. Instead, we focus on exclusion from the private benefits that an artisanal gold miner might obtain from the alternative technology, i.e., greater productivity in the gold recovery process. The cleaner and more productive technology could be used in a centralized processing facility (Hilson, 2006), or in a community-based development project. The exclusion of non-contributors would avoid this group of miners benefiting from the recovery of an increased amount of gold in the ore beneficiation process. However, this exclusion would not prevent these miners from enjoying the benefits stemming from an improved environmental quality and lowered health risk. In such a case, the incentives to free-ride would be linked only to the enjoyment of the benefits of better environmental health and it would be therefore expected that the free-riding rate would decline under this scheme of exclusion.

In order to get the more productive and cleaner technology for gold recovery, miners should contribute to a common fund to raise the minimum financial capital required to buy such technology. Given that there is neither exclusion nor rivalry in the positive externalities derived from the adopted technology for recovery of this mineral, we carry out a framed threshold public-good game (TPGG). In general, public-good games are a useful tool for the analysis of organizational processes that entail dilemmas such as environmental protection or teamwork (Ledyard, 1995; Camerer and Weber, 2013). Participants in our experiments are artisanal and small-scale miners from the Northeastern region of the Department of Antioquia, Colombia. This is a region of particular interest. The mercury emitted and registered into the environment there make this region the world's highest per-capita emitter of mercury resulting from gold mining (Cordy et al., 2011).

The paper is organized as follows. In Section 2 we describe the hypotheses we want to test and the economic experiment that tests it. Then, in Section 3 we describe the experimental protocol and the study site. In Section 4, we present our principal findings and results, which mainly suggest that under co-management, miners can achieve an efficient level of contributions that holds up until the end of the game. However, in the framework of our experiment, we do not find evidence that exclusion may foster collective action in ASGM. Our conclusions, as well as policy recommendations and avenues for further research are presented in Section 5.

2. The experiment

In order to get the more productive and cleaner technology for gold recovery, miners should contribute to a common fund to raise the minimum financial capital required to buy such technology. Given that there is neither exclusion nor rivalry in the positive externalities derived from the adopted technology for recovery of this mineral, we propose to carry out a framed threshold public-good game (TPGG). In general, public-good games are a useful tool for the analysis of organizational processes that entail dilemmas such as environmental protection or teamwork (Ledyard, 1995; Camerer and Weber, 2013).

In a TPGG, a minimum amount of money must be raised (provision point or threshold) for provision of the public good to occur (van de Kragt et al., 1983). Examples of threshold public goods on the large scale are dikes and bridges; at the organizational level, some kind of initial investments in organizing the fundraising have to be made before any voluntary provision of a public good is possible (Schram et al., 2008). In the field, TPPGs have been used before, to analyze contributions for the construction of a bridge in a Vietnamese village (Pham, 2011).

We have found two main approaches in the TPGG literature. There are games that restrict participants to binary (all-or-nothing) contributions (van de Kragt et al., 1983), while in others participants can contribute any desired amount of their endowment (Marks and Croson, 1998, 1999; Cadsby and Maynes, 1999). For the latter case, Cadsby and Maynes (1999) showed that permitting continuous contributions tends to increase the contributions to, and facilitates provision of, the public good.

For our experiment, we consider the results of Cadsby and Maynes (1999) and Cadsby et al. (2008), who consider a continuous TPGG with two institutional factors: a money-back guarantee (refund) and a no-rebate rule applied if the level of contributions exceeds the threshold (T). On the one hand, if someone contributes but T is not reached, his contribution is refunded. In the mining case, if the association cannot be established, every miner can allocate the planned contribution to other things. According to Cadsby and Maynes (1999), this guarantee of getting money back may encourage contributions to, and provision of, the public good. On the other hand, if the total amount of tokens contributed exceeds T, no one is refunded the excess amount. Marks and Croson (1998) found that no-rebate and proportional rebate rules generate similar contributions, which are not statistically different from the Pareto-efficient Nash equilibrium level. However, Marks and Croson (1998) also showed that the no-rebate rule may be preferable to a proportional rebate rule in terms of equity and variability of contributions.

In order to test the effect of our two institutions of interest, (i) co-management and (ii) exclusion from private benefits derived from technology adoption, we use a 2x2 experimental design as presented in Table 1:

Table 1. Summary of experimental design.

		Exclusion from the benefits of greater productivity	
		No	Yes
Co-management	No	*Treatment 1* [T1]	*Treatment 2* [T2]
	Yes	*Treatment 3* [T3]	*Treatment 4* [T4]

Our control treatment, Treatment 1 (T1), is a standard TPGG with continuous contributions. In this treatment there is a money-back guarantee if T is not reached, and no rebate if the level of contributions exceeds the threshold. Taking into consideration the fact that in the gold recovery process associations of miners are unlikely to be seen (Hinton et al., 2003; Saldarriaga-Isaza et al., 2013), with this base case we can test our first hypothesis:

H1: *Sustained collective action would not emerge as a solution to the social dilemma faced by households engaged in ASGM.*

In T1, each of the n members of a group has an initial endowment (E) of which he/she chooses to contribute $c_i \in [0,E]$ to the group account. If the sum of contributions is lower than T, the technology cannot be bought and as a result the contribution is paid back to participants, the public good is not provided, and hence the public and private benefits from the new equipment are not delivered. In this case each participant's payoff (U_i) equals the initial endowment:

$$\text{If } \sum_{i=1}^{n} c_i < T, \text{ then } U_i = E \qquad (1)$$

If the sum of contributions is greater than or equal to T, the technology is acquired with the consequent provision of the public and private benefits from the technology adoption. In this case the individual's payoff is composed of three factors: (i) the individual's earning from the private account that represents his private consumption in the experimental environment, which is given by $E - c_i$; (ii) the reward R, which represents the benefits of an improved environmental quality; and (iii) ρ, representing the private profits from technology adoption. Both R and ρ are not excludable. In this case each participant's payoff is represented as follows:

$$\text{If } \sum_{i=1}^{n} c_i \geq T, \text{ then } U_i = E - c_i + R + \rho \qquad (2)$$

Provided that this game is representing a threshold public-good dilemma, we must assume that $E<T<n.E$. To be incentive compatible and socially efficient, it is necessary that $n.(R+\rho)>T$ (Cadsby et al., 2008). In our experiment we chose the following parameterization: E=25, T=60, n=5, R=16, ρ=8. This choice of the parameters is in line with previous TPPG experiments like Cadsby et al.'s (2008), in which the base step return, $n.(R+\rho)/T$ in this case, has usually been set at 2.

Our second hypothesis is about excluding non-contributors from the private benefits of the alternative technology; thus, we design and implement Treatment 2 (T2) for testing it. Our second hypothesis is as follows:

H2: *The exclusion of those miners who do not contribute to the provision of a cleaner and more productive technology from the private benefits* (*greater productivity*) *derived from the technology that reduces a public bad* (*mercury pollution*), *triggers collective action.*

In T2, an individual may obtain the productivity return (ρ) only if he contributes to the project and the project is actually implemented. Those who do not invest in the project are excluded from these profits, but they still receive the benefit of the positive externality (R). In this treatment the subject receives the payoff:

$$\text{If } \sum_{i=1}^{n} c_i < T, \text{ then } U_i = E \qquad (3)$$

$$\text{If } \sum_{i=1}^{n} c_i \geq T, \text{ then } U_i = E - c_i + R + \rho$$

where for the individual i ρ=8 only if $c_i > 0$, and ρ=0 otherwise; i. e. the parameters are the same as in T1. With this change in the conditions of the experiment, the free-riding equilibrium should change from contributing nothing to contributing one token.[1] Moreover, by comparing T1 and T2, we can discover whether a miner's preference for the technology is due more to its private benefits

[1] The level of minimum contribution in T2 was chosen to be simply above zero. Czap et al. (2010) pointed out that this condition removes strategic considerations from the game. Thus, even if a risk-averse subject attaches a low probability of success for reaching the provision point, he would rationally contribute at least one token.

or, alternatively, if it is social preferences that lead him to contribute to the amelioration of the public good.

In order to test the effect of co-management, we expand T1 to consider another mechanism for the management of this nonrenewable resource. Both the current policy context, in which some external organizations are trying to encourage better practices in ASGM, and Moreno-Sánchez and Maldonado's (2010) results, lead us to our third hypothesis:

H3: *The intervention of a third party* (*co-management*) *is needed to promote a larger and well-established association of miners that allows them to access cleaner and more productive technologies.*

In our co-management treatment (T3) every group had the opportunity to talk for up to five minutes with an external advisor, following Moreno-Sánchez and Maldonado (2010). The task of the advisor was to persuade miners to invest in the new technology, with the aim of reducing the emissions of mercury and avoiding the harmful effects of mercury pollution. This procedure can create a kind of advisor's demand effect, but it is precisely what we wanted. More about the protocol of this treatment is presented in the next section.

Finally, in Treatment 4 we explore the interaction between the two institutional settings described and implemented in T2 and T3. Bowles and Polanía-Reyes's (2012) survey of behavioral experiments shows that interventions aimed at influencing behavior by altering the economic costs or benefits of some targeted activity – i.e., economic incentives – may undermine or trigger social preferences. Therefore, with T4 we want to test whether the effects of co-management are crowded in or crowded out by exclusion from the private benefits stemming from the cleaner technology.

We implement both within- and between-subjects design. The within-subjects design is implemented to analyze the effect of the institutional settings, in which every subject played the game for several periods: eight initial periods of the base case (Stage 1), and a second stage in which subjects played one of four treatments as follows:

- T1: Players continued playing the base case.
- T2: Exclusion treatment.
- T3: Co-management.

- T4: Exclusion and co-management.

This means that participants can be classified in four groups as follows: those who played the base case and the treatment with exclusion of the private benefits from technology adoption (T1-T2), those who played the base case and the treatment with co-management (T1-T3), those who played the base case and the treatment with both co-management and exclusion of private benefits from technology adoption (T1-T4), and those who played T1 over all periods.

3. Procedures

All subjects recruited for this experiment were from the same subject pool: artisanal gold miners from the municipalities of Segovia and Remedios, in the Northeastern region of the Department of Antioquia, Colombia. This has been the region with the greatest production of gold in Colombia (UPME, 2012), and according to Cordy et al. (2011), the world's largest mercury polluter per capita from artisanal gold mining.

The experiment was a multi-period game but the number of periods was not indicated to participants, in order to avoid end-of-game effects. At the end of the game, participants were informed that the game had ended, and thereafter they received instructions on how to collect the payment. At the end of each period, via a piece of paper each participant was privately informed of total group contributions and his payoff according to those contributions. This was done to avoid any bias that might arise from several groups in the same session being able to compare their contributions. The length of the experiment was about two hours.

With the same population, the experiment was run in a classroom and also *in-situ*, i.e. in the mines. For the classroom experiments, players were recruited through a public call with the help of mining leaders and existing miners' associations, flyers distributed in mines and processing plants, and messages that were transmitted from a local radio station. A total of 35 miners responded to this call. The experimental sessions with these participants were run in classrooms of an education center in Segovia, on the 23rd and 24th of November, 2012.

One week later, in order to increase the sample size of our experiment, which was initially set at 50 participants per treatment, we also ran sessions right in some of the mines, which constituted the *in-situ* experiment. For security reasons, only four out of 25 phone calls to mine managers for this opportunity were answered. By the time the experiment was run, illegal armed groups were extorting mine managers by making phone calls. An additional 50 miners were recruited with this strategy, totaling 85 subjects for the complete experiment. In each mine, people were randomly assigned to each of the possible groups that were conformed, and people sat in, according to conditions of the site. In the parametric analysis we included a dummy variable to identify the possible effect of this procedure. Table 2 reports the number of players by treatment.

Table 2. Number of players by treatment.

Treatment	*No.*
Baseline	10
Exclusion	30
Co-management	20
Exclusion & Co-management	25

In each session we randomly formed up to four groups of five members each, according to a number that the participant took from a box. In each five-person group every member knew both the size of the group and who the other members were. This situation is to some extent similar to what may happen in the field where miners not only surely know other people from the mine they exploit, but also those from surrounding mines. In the game, each participant made individual decisions as to the amount of his endowment – expressed in tokens – which he would allocate to a private account and to a group account. Instructions were read aloud by the experimenter in all experimental sessions. All the individual decisions were private and confidential, and were made anonymously. To guarantee the confidentiality of their decisions, players were seated back-to-back. To facilitate and ensure understanding of the game, hypothetical examples were provided. Also, there were three training periods in which participants made decisions that did not affect their final payment. At any time in these training periods, participants were allowed to raise their hand and ask questions regarding the game.

The instructions of our framed experiment adhered to the basic language of the instructions developed by Isaac et al. (1984). These instructions have been commonly utilized in several other experiments about public-good games with a provision point (Croson and Marks, 2000, 2001; Marks and Croson, 1998, 1999; Cadsby et al., 2008). As part of the framework of these instructions, we introduced a statement that described the kind of equipment that has been promoted among miners and processing facilities to phase out mercury, namely continuous mills and methods of gravimetric concentration. These specific technologies are recognized for being cleaner than mercury amalgamation, and more productive than the traditional ball mills currently employed in the gold recovery process (García and Molina, 2011).

The protocol of the co-management treatment (T3) adhered to the instructions of Moreno-Sánchez and Maldonado (2010). In this treatment, the conversation with the external advisor is based on a predesigned guideline, but not a script that the advisor must always read.[2] The advisor, a representative of the Global Mercury Project, was asked to persuade miners to invest in the new technology, with the aim of reducing mercury emissions and avoiding the harmful effects of mercury pollution. After this discussion, the group had five minutes to converse among themselves. The advisor was not allowed to listen to this conversation. After this, group members made their final decisions in private and under strict confidentiality for the first period of the second stage of the game. Additionally, based on Moreno-Sánchez and Maldonado (2010), the external advisor was given one minute to talk with the group for each successive period of the game, and thereafter, the group members had one minute to talk.

Payments to participants in the experiment were done individually and privately. Every participant was identified with a number that was provided on a slip of paper at the beginning of the experiment. To collect his payment, the player had to give back this slip of paper, individually, at the end of the session, receiving in exchange a sealed envelope with his payment. In the game, each token gained by a miner was converted into 72 Colombian pesos. This value was computed bearing in mind participants' average opportunity cost of time and the maximum and minimum amount of tokens each participant could gain in the game. The total payment to each individual could vary between COP$35,000 and COP$60,000.[3]

At the end of each session, and before payment was made, we asked every player to fill out a survey. The answers to these questions were used for interpretation of the results of the experiment. Besides some specific socioeconomic and demographic information such as education and income levels, we also asked questions about perceptions that miners have about the gold recovery process. Additionally, attitudes towards risk, trust, and two personality traits (empathy and self-control)

[2] According to Moreno-Sánchez and Maldonado (2010), this way of communication allows the advisor to express his/her ideas about what kind of strategy is better for the group. These authors argue that such a source of variance may be relevant when thinking about the policy implications of co-management implementation.
[3] The exchange rate at the time of the experiment was approximately 1US$ as equal to 1815 Colombian pesos.

were measured in this survey. Previous studies suggests that these four attributes may affect contributions to public goods (Kocher et al., 2011, 2012; Czap and Czap, 2010; Czap et al., 2010). The attributes were measured as follows:

- *Risk*: Dohmen et al. (2011) and Ding et al. (2010) have found that a simple risk question may predict results of risk measures obtained in economic experiments.[4] We followed Dohmen et al. (2011) and asked participants in our experiment to indicate their willingness to take risks on an eleven point scale, with zero indicating complete unwillingness to take risks, and ten indicating complete willingness to take risks. The question was as follows: "How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?"

- *Trust*: Naef and Schupp (2009) and Ben-Ner and Halldorsson (2010) argue that survey measures of trust are significantly correlated with the measure of trust obtained in a trust game. Considering these results, we asked subjects to answer the statement for measuring trust found in surveys like the General Social Survey: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

- *Self-control* and *empathy*: In the questionnaire, each subject specified his level of agreement regarding several statements taken from the International Personality Item Pool inventory (Goldberg et al., 2006), using a 5-item Likert scale, ranging from the highest of "Completely Agree" (5) to the lowest of "Completely Disagree" (0). The scores for each personality trait are calculated as the mean of these answers.

[4] See, for example, Holt and Laury (2002) for an economic experiment in which risk is measured.

4. Results

Table 3 summarizes the descriptive statistics of socioeconomic and demographic characteristics of participants in the game. Perceptional characteristics and attitudinal variables are included. In general, there are no differences between subjects who participated in the experiments.[5] Therefore, in our tests we assume that participants from both samples – classroom and *in-situ* – are statistically the same or from the same population. These participants were adults with low education, earning between one and two times the national minimum wage, most of them having lived in either Segovia or Remedios for more than twenty years. Despite the fact that a large proportion of miners know methods for gold recovery other than mercury amalgamation, few of them employ such methods. Those who stated a reason for not employing those alternative methods said that it is because they cannot afford the requisite equipment. Furthermore, even though most of the participants stated that training programs for better practices in mining are useful, few of them have taken part in such sessions.

Figure 1 shows average group contributions across treatments. Consistent with previous TPGGs (Croson and Marks, 2000), the oscillating pattern around the efficient Nash equilibrium outcome (60 tokens) is observed in the baseline (see T1 and periods 1 to 8 in T2, T3 and T4). This pattern is less evident when co-management is applied (T3); in fact, from periods 9 to 17 in T3, players try to coordinate their actions at the efficient contribution level of 60 tokens. Regarding exclusion (T2), the oscillating pattern observed in the baseline remains, even when it is combined with co-management (see periods 9 to 17 in Figure 1). We can also discern the differences between these treatments in Figure 2. This figure shows an example of individual contributions in a chosen group of miners that played T3 and another group that played T4.

In order to gain more insights from these results, in the next two subsections we provide tests of the hypotheses above. Firstly, we discuss the provision of the public good in the game and the effect of the mechanisms on contributions. In the analysis of contribution decisions we then do a multivariate analysis in order to understand the decisions of players in this type of game.

[5] In our comparisons we follow the standard procedure of testing the null hypothesis of equality versus a hypothesis of strict inequality. We performed a t-test of difference in means and the Mann-Whitney-Wilcoxon (MWW) Z-test. Both tests coincided with each other in their results. In this paper we only present the results for the MWW test.

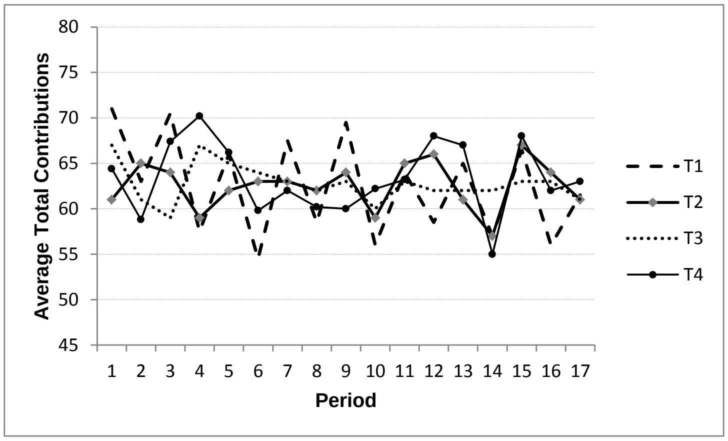

Figure 1. Average group contributions in treatments.

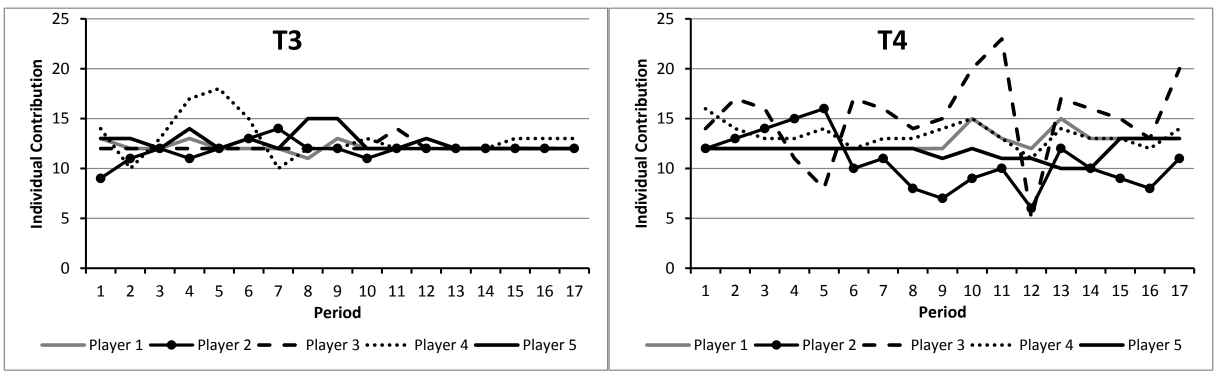

Figure 2. Examples of individual contributions in treatments T3 and T4.

Table 3. Description and test of differences between treatments of socioeconomic and perception variables.

	Pooled data			Mean				Differences					
Variable	**Mean**	**Min**	**Max**	**T1**	**T2**	**T3**	**T4**	**T1-T2**	**T1-T3**	**T1-T4**	**T2-T3**	**T2-T4**	**T3-T4**
Socioeconomic Variables													
Age (years)	32.39 (10.6)	16	58	30.6 (11.2)	31.4 (8.5)	37.6 (12.7)	28.4 (8.5)	n.s.	n.s.	n.s.	*	n.s.	***
Education[a]	3.59 (3.6)	1	7	4.4 (1.8)	2.8 (1.5)	3.92 (1.9)	4 (1.7)	**	n.s.	n.s.	**	**	n.s.
Income[b]	3.42 (3.4)	1	8	3 (2.91)	3.1 (1.38)	3.28 (2)	4 (1.1)	n.s.	n.s.	*	n.s.	**	**
Residence Time in Town (years)	22.6 (13.1)	1	57	23.4 (9.2)	25.7 (11.9)	21.5 (14.7)	19.8 (13.1)	n.s.	n.s.	n.s.	n.s.	*	n.s.
Perception Variables													
Knowledge of alternative methods for gold recovery? (1 yes 0 no) (*Know_new_tech*)	0.76 (0.47)	0	1	0.8 (0.45)	0.73 (0.45)	0.72 (0.46)	0.84 (0.37)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Limitations in access to better equipment? (1 yes 0 no) (*Limitation_in_access)*	0.52 (0.5)	0	1	0.6 (0.55)	0.6 (0.49)	0.52 (0.5)	0.4 (0.5)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Have you operated alternative methods for gold recovery? (1 yes 0 no) (*Have_used_ tech*)	0.4 (0.49)	0	1	0.6 (0.55)	0.4 (0.49)	0.4 (0.5)	0.36 (0.49)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Have you participated in any training session for better practices in ASGM (1 yes 0 no) (*Participation_in_training*)	0.44 (0.5)	0	1	0.4 (0.24)	0.3 (0.09)	0.48 (0.5)	0.52 (0.5)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Is this training useful? (1 yes 0 no) (*Participation_is_useful*)	0.98 (0.15)	0	1	1 (0)	1 (0)	0.92 (0.28)	1 (0)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Have you or anyone you know suffered any mercury-related disease? (1 yes 0 no) (*Health_effects*)	0.53 (0.5)	0	1	0.2 (0.45)	0.63 0.49)	0.52 (0.51)	0.48 (0.51)	*	n.s.	n.s.	n.s.	n.s.	n.s.
Attitudinal variables													
Risk	6.58 (2.72)	0	10	8.8 (1.3)	5.9 (2.36)	6.63 (3.21)	6.88 (2.65)	**	n.s.	n.s.	n.s.	n.s.	n.s.
Can people be trusted? (1 yes 0 no) (*Trust*)	0.39 (0.49)	0	1	0.2 (0.45)	0.37 (0.49)	0.5 (0.51)	0.36 (0.49)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Empathy	3.45 (1.15)	1	5	4.4 (0.5)	3.2 (1.36)	3.99 (0.66)	3.13 (1.1)	**	n.s.	***	**	n.s.	***
Self-control	2.6 (0.9)	1	5	3.5 (0.97)	2.5 (1.1)	2.67 (0.55)	2.48 (0.8)	*	*	*	n.s.	n.s.	n.s.

[a] Education is measured in levels depending on whether primary, secondary, technical or college education had been completed.
[b] Income is measured in levels ranging from half the minimum wage to six times the national minimum wage.
*** significant at 1%, ** significant at 5%, * significant at 10%, n.s. non-significant. Standard deviations in parentheses.

Table 4 summarizes the proportions of successful provisions of the alternative technology and percentage of efficient Nash equilibrium outcomes in the four treatments. In all treatments, and consistent with results of other TPGGs made in the lab (Croson and Marks, 2000), the provision occurs frequently. In Stage 1, the threshold is reached more than 80% of the time, except in the baseline where the provision rate is 57%. In Stage 2, the provision rate falls to about 70%, which can be explained by decreasing contributions, and the Nash equilibrium of 60 tokens is barely reached by groups. In contrast, under the co-management treatment (T3), the public good is provided most of the time and players try to coordinate their actions in order to reach the efficient outcome.

Table 4. Proportion of successful provisions by stage.

Stage	Treatment			
	Baseline	T2	T3	T4
Stage 1	57.14%	85%	82.1%	86.7%
Stage 2	75%	78.9%	92.5%	69%
Difference	17.85%	-6.1%	10.36%	-17.7%
MWW test of the difference	0.45	0.314	1.1	1.08
% of Efficient Nash Equilibria	2.9	3.3	52.5	0

In all treatments, the difference in the provision rates between stages 1 and 2 is not statistically significant (MWW test in Table 4 is not significant). Individual contributions are always close to or around 12; therefore, a test of means may not show the whole effect that each treatment has on the players' decisions. To complement this analysis, in this section we also present an analysis of the standard deviations of contributions. In Tables 5 and 6 we present the results of these analyses.

In general, there is a difference between the contributions made by players in T3 as compared with those made in other treatments. Table 5 shows that average contributions in T3 tend to be closer to the cost-sharing equilibrium (twelve tokens), while average contributions in the other treatments are greater than twelve. Contrary to linear public-good games in which monotonically increasing contributions are preferred over low contributions levels, the goal in a threshold public good is to reach the provision point. Contributions beyond the provision point are not efficient, and are welfare-decreasing for the group (Marks and Croson, 1998). Therefore, for the case of ASGM, we can argue that efforts to achieve long-lasting associative entrepreneurship can be more efficient with an institutional arrangement such as co-management. Moreover, the effect that exclusion has on individual contributions appears to be inconsequential and no different from the baseline. In the latter case, players fail to achieve a long-lasting collective outcome.

Table 5. Average contributions for each treatment and non-parametric test for differences in means.

Treatment	Mean	P-value of the MWW test				
		T1 – T2	T1 – T3	T1 – T4	T2– T4	T3– T4
Baseline (T1)	13.34	0.7173	0.0038***	0.6008	0.4707	0.0735*
Exclusion (T2)	13.52					
Co-management (T3)	12.67					
Exclusion + Co-management (T4)	13.04					

***, **, and * denote statistical significance of the difference at 1%, 5%, and 10%, respectively.

Table 6 shows that the average standard deviation of the contributions per period is significantly lower when co-management occurs, even lower than the case in which exclusion is applied (*p-value*<0.001). Nonetheless, when exclusion and co-management are combined (T4), the standard deviation is much higher than in treatments T2 and T3 (*p-value*<0.001). In fact, results from Tables 5 and 6 suggest that when players can communicate with each other in the group and can count on the support of a third party, decisions are much closer to being optimal: everyone chooses a fair contribution, including original free-riders, and the public good is regularly provided. This result might be partially explained by members of the group who played the role of leaders. In co-management we could observe that one or two individuals in the group tried to point out the features of the social dilemma and suggested a better way of dealing with it: to make fair contributions to buy the technology. Our finding is comparable to Moxnes and van der Heijden's (2003) who showed that the actions of a leader might persuade other members of the group to desist from making investments in a public bad.

We also observe that the aforementioned effect of co-management is undermined when combined with exclusion. This finding is consistent with other studies of behavior in common-pool resource dilemmas. Ostrom (2006), for instance, provides an overview of this literature and shows the critical importance of communication and endogenous rule formation on the sustainable management of these resources, and the adverse effect that coercive rules may have on such management. Moreover, we find that although the threat of being excluded from some of the benefits of the alternative technology does increase mean contributions, such an increase is not significant, either from a statistical viewpoint or for the provision of the technology.

Table 6. Average standard deviations of individual contributions per period for each treatment and non-parametric test for differences in standard deviations.

Treatment	Mean of s.d.	P-value of the MWW test				
		T1 – T2	T1 – T3	T1– T4	T2– T4	T3– T4
Baseline (T1)	2.69	0.0000***	0.0000***	0.2776	0.0000***	0.0000***
Exclusion (T2)	2.04					
Co-management (T3)	1.42					
Exclusion + Co-management (T4)	3.2					

***, **, and * denote statistical significance of the difference at 1%, 5%, and 10%, respectively.

Our results thus indicate that under co-management, subjects can engage in a well-established association that persists for several periods. Under this association not only is the technology acquired and the public good provided, but also each player supports this provision on equal terms. The independent effects that communication among members and the intervention of an external party have on individual contributions cannot be disentangled from these results. Nonetheless, considering Moreno-Sánchez and Maldonado's (2010) result, together with ours, co-management can be thought of as a suitable rule to achieve sustained and successful provision of threshold public goods.

With respect to the exclusion treatment, results from our paper counter findings from other experiments (Swope, 2002; Kocher et al., 2005; Croson et al., 2007; Bchir and Willinger, 2008). Even though the threat of exclusion may initially trigger individual contributions (see Figure 1), such a rise is not sustained and the oscillating pattern observed in the baseline carries on. This effect is observed even when this mechanism is combined with co-management. In other words, although co-management alone leads the miners to manage the production process and their resources better, the pressure generated in the exclusion case would make it difficult for subjects to reach the coordination needed to achieve a sustained and efficient outcome.

We performed a parametric analysis by modeling individual contribution for each period. Given that there are observations of individual contributions for several periods, data are treated as a panel. The estimated model considers the fact that the dependent variable only takes discrete values, and that the individual specific constant terms of the model are randomly distributed across the cross-sectional units, where the sample units are drawn from a population (Greene, 2000).[6]

[6] In other public-good experiments authors such as Carpenter (2007) and Spencer et al. (2009) have estimated two-limit Tobit models because the individual contributions have been assumed as a variable that is double-censored

Hence, we use the Poisson regression with random effects. The Poisson regression assumes that the mean and the variance are the same. Alternatively, the negative binomial model allows for over-dispersion. We estimated both types of model and we observed that the results coincided with each other, which suggests that there is no problem of over-dispersion. Of these two only the estimations of the Poisson model are reported. Additionally, we ran an OLS random-effects regression.

The explanatory variables are socioeconomic and demographic characteristics, perception variables, and attitudinal variables. Dynamic and treatment variables are also included in the behavioral model. The dynamic variables include the total contributions of the other four members of the group in the previous period ($\Sigma_{j\neq i,\ t-1}$), the difference between group contribution and the threshold also in the previous period ($Difference_{t-1}$), interactions among these two variables, and a variable that captures the time trend (*Trend*). The inclusion of the dynamic variables is mainly intended to capture how individual behavior may depend upon past group behavior; i.e., to evaluate whether subjects show reciprocity or altruism across the game (Croson, 2006). Moreover, to test the impact of the different rules on individual contributions we introduce three categorical variables (T2, T3, T4), which take binary values; one if the player was exposed to the treatment, and zero otherwise. The estimation results, which were estimated in STATA™, are presented in Table 7.

From the estimations, Poisson and OLS specifications generate similar results. Consistent with results presented in subsection 4.2, T3 and T4 do not have a statistically significant effect on the level of contributions. Conversely, the threat of exclusion (T2) can raise contributions somewhat, but as we mentioned above, such a gain is not long-lasting. Nonetheless, the main effect of the treatments can be seen in the variability of contributions over time. In Table 8 we present the results of an OLS model with the standard deviations of individual contributions as a dependent variable. In this case, all institutional arrangements, except T4, are statistically significant in downgrading the variability of contributions, that is, in making players agree with each other on what the best level of contributions is. This effect is stronger with co-management (T3).

(from above and below). To consider individual contributions as a censored variable signifies, for instance, that a player would be willing to make contributions greater than allowed, and that those censored values are not observed. However, the conditions of the game actually limit the range of values that this variable can take. Therefore, the censoring assumption does not seem to be plausible inasmuch as the values that the level of individual contributions can take are perfectly observable in the experiment. We also ran a two-limit Tobit model and obtained results that do not match results from Poisson and OLS models. For instance, significant parameter estimates for treatment effects are negative, while trend is positive.

Table 7. Results of specifications of random-effects models.

Variable	Poisson panel model		OLS panel model	
	Coef.	t-value	Coef.	t-value
Trend	-0.009**	-2.43	-0.131***	-2.77
T2	0.069	1.62	1.411***	2.85
T3	0.019	0.44	0.355	0.71
T4	0.033	0.77	0.719	1.41
$\Sigma_{j\neq i,\ t-1}$	-0.019***	-5.72	-0.515***	-11.2
Difference_{t-1}	0.0001	0.03	0.196***	2.89
$\Sigma_{j\neq i,\ t-1}$ * Difference_{t-1}	0.0003***	3.82	0.004***	3.55
Residence Time	0.002	0.9	0.012	1.01
Age	0.001	0.61	0.023	1.3
Income	0.02	1.37	0.199**	2.37
Education	-0.012	-0.78	-0.049	-0.49
Know new tech.	0.106**	2.01	0.92**	2.41
Limitation in access	0.018	0.4	0.393	1.34
Have used tech.	-0.108**	-2.15	-1.064***	-2.93
Participation in training	0.016	0.33	0.22	0.74
Participation is useful	-0.046	-0.25	-0.924	-0.83
Health effects	-0.137***	-3.12	-1.716***	-6.02
Risk	0.012	1.4	0.113**	2.16
Trust	0.054*	1.69	0.715**	2.5
Empathy	-0.006	-0.23	-0.085	-0.51
Self-control	0.025	0.67	0.387	1.48
Mine	0.015	0.26	0.008	0.02
Constant	3.356***	12.01	36.343***	13.78
Observations	85		85	
Wald $Chi^2(k)$	88.58***		356.34***	

*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 3.8. OLS model of treatment effects on standard deviation of c_i.

Variable	Coef.	t-value
T2	-0.327*	-1.83
T3	-1.697***	-7.86
T4	0.106	0.51
Trend	0.084***	5.18
Constant	3.117***	14.63
Wald $Chi^2(k)$		93.95***

*** significant at 1%, ** significant at 5%, * significant at 10%.

With respect to the dynamic variables, the negative sign of *Trend* indicates that individual contributions are decreasing over time, which is consistent with other linear and threshold public-good games (Ledyard, 1995; Croson and Marks, 2000). Moreover, we found that the previous tokens contributed by the other members of the group have an effect on the individual decisions. In linear public-good games, the positive sign of the coefficient of contribution of others has been interpreted as reciprocity, with the negative sign as altruism (Croson, 2006). Thus, the negative sign of the coefficient of this variable ($\Sigma_{j\neq i,t-1}$) in our experiment would indicate altruism instead of reciprocity. However, in this case we must bear in mind that each subject also has the goal of reaching the threshold, so that the technology can be bought and the public good provided. Hence, the positive sign of the interaction term of others' previous contributions ($\Sigma_{j\neq i,t-1}$) and the difference between past total contributions and *T* ($Difference_{t-1}$) suggests that given a difference between Σ_{t-1} and *T*, higher contributions on the part of other players trigger higher allocations of tokens to the group account. In other words, in this game, players reciprocate.

Econometric analysis is also consistent with literature that recounts the circumstance in which someone's level of trust in others positively determines social capital and cooperation, and thus recounts a subject's concern for the provision of the public good (Czap and Czap, 2010; Czap et al., 2010; Kocher et al., 2011).

Some studies have shown that risk-averse individuals might make lower contributions to the public good if they anticipate others' contributions being low. A decision of this kind would compensate for the risk of others not contributing (Kocher et al., 2011). Evidence of this relationship can be found, for instance, in the study by Charness and Villeval (2009). These authors showed that subjects who invest more in a risky asset are more willing to cooperate in a public good-game. Similarly, Sabater-Grande and Georgantzis (2002) and Kocher et al. (2012) found that risk-aversion relates negatively with the frequency of collusive outcomes in social dilemma situations. This positive correlation between risk-seeking and cooperation is, however, unclear from our parametric analysis. The coefficient of this variable is significant in the OLS model (*p-value*<0.005), whereas in the Poisson model it is not significant at all. Our result is consistent with that of Kocher et al. (2011), who did not obtain any significant effect of their measure of risk on contributions in a one-shot public-good game.

Czap and Czap (2010, p. 2035) suggest that the subject's decision to contribute to the provision of a public good would depend on his "ability to walk in the shoes of those who suffer from the problem, i.e. on empathy." In addition to this personality trait, self-control would also be related to contributions to the public good (Czap and Czap, 2010; Czap et al., 2010; Kocher et al., 2012). According to this literature, more impatient subjects may exhibit lower levels of cooperation in the presence of a social dilemma. In our experiment, however, personality traits such as empathy and self-control did not have any effect on the contributions miners made.

Finally, our results suggest that *a priori* knowledge of alternative technologies (*Know_new_tech*) has positive implications for the contributions to the common fund. However, the negative sign of *Have_used_tech* suggests that lack of operation of, or familiarity with, any of this equipment (see Table 3) makes it less likely that miners will contribute to the acquisition of the technology. Lastly, a counterintuitive result that we got from these estimations is that when someone has or knows someone else who has suffered mercury-related diseases (*Health_effects*), his contributions marginally decrease.

5. Conclusion

In this paper we have explored the role of two institutional arrangements on associative entrepreneurship in order to phase out mercury in artisanal and small-scale gold mining, via a framed experiment with miners in Colombia. In this experiment, we have found empirical support for our first hypothesis, which states that sustained collective action does not emerge as a solution to the social dilemma faced by households engaged in ASGM. In the base case, we found that total contributions exceeded the provision point, but this provision was not sustained and exhibited an oscillating pattern.

In contrast, co-management effected collective action in the experiment. We combined communication among members and the intervention of an external party; such a combination led to a rise in the provision rate and a better coordination of players, both factors allowing them to attain an efficient level of individual contributions. This finding supports hypothesis H3: co-management encourages a larger and well-established association of miners that allows them to access cleaner and more productive technologies.

We also tested the effect of exclusion, from private benefits stemming from the alternative technology, on fostering a well-established collective action (H2); experimental results did not support this hypothesis. Despite the fact that this arrangement led to an initial increase in contributions, they fell rapidly followed by the oscillating pattern observed in the baseline. The extent to which the size of the private benefits affects the impact of this institutional arrangement on associative entrepreneurship is a question that is left for future research.

To some extent, miners are aware of the harmful effects of employing mercury in the gold recovery process. Switching to cleaner technologies can, however, be hampered if miners do not develop trust by, for instance, communicating among themselves. Communication and the support from external parties could help miners break out of the vicious cycle in which they are trapped, due to, among other things, mercury utilization. Thus, external intervention can take several forms: training in the operation of new equipment, education programs, and other policies that focus on the access and switch to better practices, and campaigns to foster social capital.

In this study we tested alternative rules in a TPGG. To our knowledge, in the literature this is the first economic experiment done with mining communities, and one of the few TPPGs done in the field. This study opens the door for further field research on a topic that has seen little research published in the economic literature, but which is very important for the economic activity of many miners. This is particularly relevant nowadays, when efforts are taking place to phase out mercury from ASGM, and other sources of mercury pollution worldwide (Qiu, 2013). Rather than thinking of coercive policies, such as a ban on the mercury trade, others could be implemented or at least assessed using, for instance, the methods that experimental economics offers.

Further research is needed to test other mechanisms and institutions that help these mining communities improve their production process and alleviate poverty. For instance, the role of leaders might be essential in persuading other subjects to change behavior in the context of the public-good dilemma (Moxnes and van der Heijden, 2003). Leaders' tendencies to adopt better practices might encourage fellows of his/her social network to do the same. Such tests might be done by using experimental economics.

Other real-life components that could drive decision-making in a public-good dilemma are access to credit, and norms such as how others would treat people who do not contribute, how individuals care about another's income, and the armed conflict that surrounds these communities. Alpizar et al. (2005), for instance, show evidence that the income of others affects one's own subjective well-being and consequently human decision making. There is also experimental evidence that shows that inequality affects decisions in public-good dilemmas (see, e.g., Cardenas et al., 2002). In general, there are many other factors that drive behavior in common-pool resource experiments (see, e.g., Ostrom, 2010). In this sense, there is broad space for future research not only in the analysis of decision-making in artisanal gold mining, but also in the assessment of institutions meant to improve the well-being of these communities.

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APPENDIX A

Instructions Used in the Economic Experiment

The following instructions correspond to the baseline (T1) of our experiment. These instructions are based on the instructions used in the experiments of Marks and Croson (1998, 1999). Adaptation includes framing and translation.

INSTRUCTIONS

BIENVENIDOS! El siguiente ejercicio es una forma diferente y entretenida de participar activamente en un estudio de toma de decisiones. Varias entidades han suministrado fondos para desarrollar esta investigación. La cantidad de dinero que usted gane dependerá de las decisiones que tome así como de las decisiones de los otros participantes; por ello la importancia de prestar mucha atención a estas instrucciones. Al final de la sesión se le estará pagando dinero en efectivo, en privado.

Es importante que usted permanezca en silencio y no observe el trabajo hecho por el resto de personas. Si tiene alguna pregunta o necesita cualquier tipo de ayuda, por favor alce su mano y un asistente irá donde usted. Si usted se comunica de alguna manera con otra persona, se le solicitará dejar la sala y no se le realizará pago alguno. Esperamos y agradecemos su cooperación. Se espera que esta sesión dure aproximadamente dos horas.

Durante esta reunión utilizaremos "fichas" que al final del juego serán convertidas a dinero en efectivo. Cada ficha que usted tenga al final se convertirá a $72. Todas sus decisiones en esta reunión serán completamente anónimas. Para asegurar la confidencialidad de sus decisiones al principio cuando usted entró al salón se le entregó un papelito con un número; este número será su identificación de ahora en adelante. Al final de la reunión, usted nos debe regresar este número y nosotros le entregaremos un sobre con el dinero que usted ganó.

Finalmente, en esta actividad no se pretende evaluar si su decisión es buena o mala, por lo tanto, no hay decisiones correctas o incorrectas.

DESCRIPCIÓN GENERAL

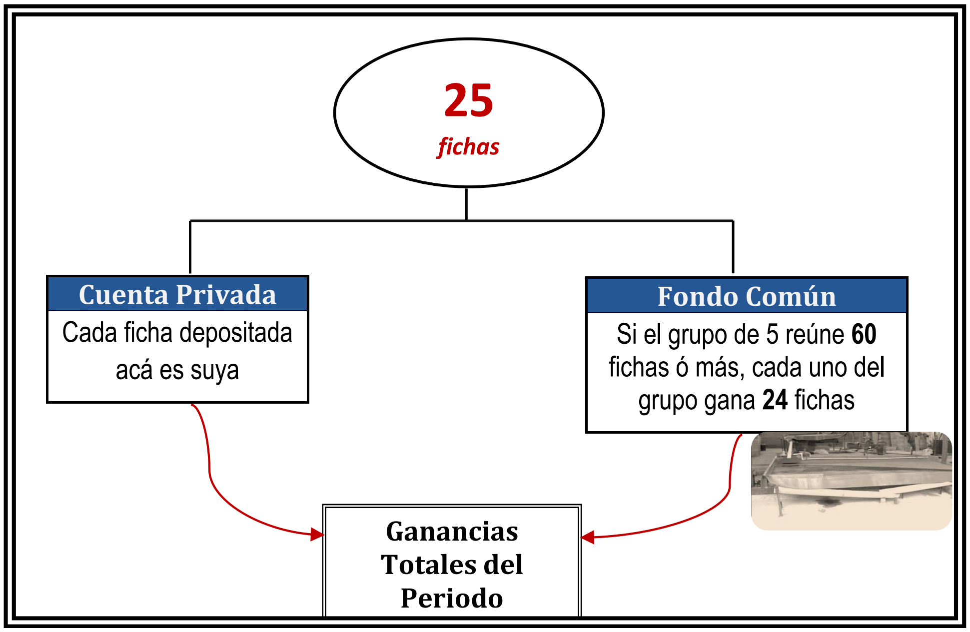
Este ejercicio considera una situación en la que un grupo de personas debe tomar decisiones sobre cómo aprovechar los recursos naturales en la zona del Nordeste antioqueño.

En esta zona, desde varias entidades se viene promoviendo el uso de tecnologías alternativas a fin de disminuir el uso del mercurio y sus efectos sobre el medio ambiente y la salud humana, y mejorar el proceso de beneficio del oro que implique una mayor recuperación del mineral.

En esta reunión usted ha sido ubicado en un grupo de cinco personas. Este juego consistirá de varios periodos de toma de decisiones. En cada periodo, ***cada uno*** de ustedes será dotado con 25 fichas, y debe decidir cómo repartir estas 25 fichas entre dos cuentas.

El primer tipo de cuenta es una **Cuenta Privada**. El segundo tipo de cuenta es una **Cuenta Grupal o fondo común** que pertenece a su grupo y es única para el grupo. Sus ganancias provenientes de la Cuenta Grupal dependen del **total** de fichas que el grupo de 5 personas asigne a la Cuenta Grupal. Cada una de estas cuentas se explica más adelante.

Por favor siga el dibujo puesto en el tablero, parecido al que aparece aquí, a medida que se lea la explicación de cada una de las cuentas.



CUENTA PRIVADA

Cada uno de ustedes posee su propia Cuenta Privada. Cada ficha que usted decida depositar en su Cuenta Privada le es contabilizada como ganancia de esta cuenta. Por ejemplo, si de las 25 fichas usted elige poner 9 en su Cuenta Privada y 16 en la Cuenta Grupal, su ganancia preliminar de la Cuenta Privada serían estas 9 fichas.

CUENTA GRUPAL o FONDO COMÚN

Cada grupo de 5 personas tiene una Cuenta Grupal. En cada periodo, cada miembro del grupo decidirá cuántas fichas asigna a la Cuenta Grupal: todas, una parte, o ninguna ficha. Las fichas que usted no asigne al fondo común irán automáticamente a su cuenta privada.

En el fondo común vamos a recaudar los fondos necesarios para adquirir una tecnología alternativa que permita reducir la contaminación por el uso de mercurio en el proceso de beneficio, y mejorar la recuperación de oro durante el proceso. En este ejercicio esta tecnología está referida a ***molinos continuos*** y ***métodos de concentración gravimétrica***.

Esta tecnología solamente puede ser adquirida si el grupo de 5 personas reúne un total de **60 fichas** en la Cuenta Grupal, en el periodo en juego. Estas 60 fichas representan el costo de la nueva tecnología. Si el grupo logra reunir esas fichas y adquiere la tecnología, a cada integrante se le entregan 24 fichas de esta cuenta, durante el periodo en juego y solamente por ese periodo. Esas ganancias representan la mejora en la calidad ambiental por usar tecnologías que reducen el uso de mercurio, y el obtener una mayor recuperación de oro. Como en la vida real esas ganancias podrían ser disfrutadas por todos sin importar si contribuyen o no a la compra de la tecnología, en este juego decidimos que cada jugador recibirá fichas de la Cuenta Grupal aún si no deposita nada en ella.

Si el grupo reúne más de 60 fichas, la tecnología se adquiere pero las fichas que sobran no son retornadas a los miembros del grupo. Es decir, el grupo no obtiene ganancias adicionales de reunir más de 60 fichas en la Cuenta Grupal.

En caso de que el grupo no logre reunir las 60 fichas, la tecnología no se puede comprar y el grupo no gana nada de la Cuenta Grupal. Las fichas que usted haya asignado a la Cuenta Grupal le son automáticamente puestas en su Cuenta Privada.

Bajo ninguna circunstancia usted está obligado a destinar fichas a la compra de la tecnología alternativa. El dinero asignado a usted (representado en el número de fichas) es suyo y usted es completamente libre de decidir qué hacer con estas fichas. En esta actividad, aún si usted no desea contribuir o lo hace en una pequeña cantidad, en caso de adquirirse la tecnología alternativa usted disfrutará de los beneficios de la Cuenta Grupal durante ese periodo.

CÁLCULO DE SUS GANANCIAS DEL PERIODO

Sus "Ganancias Totales del Periodo" son la suma de sus ganancias de la Cuenta Privada y del Fondo Común. Al final del juego, sus ganancias totales serán la suma de todas las ganancias en cada uno de los periodos. Recuerde que cada una de las fichas que usted posea al final del juego será convertida a $72.

Más adelante mostraremos algunos ejemplos para que todo lo anterior le sea más claro.

LA HOJA DE REPORTE

Usted ha recibido cierta cantidad de **Hojas de Reporte** de color azul que serán usadas durante el juego. Cada una luce como la que aparece a continuación.

HOJA DE REPORTE

Jugador No.: ________ Periodo No.: ________

Sus Decisiones de Asignación

número de fichas a la Cuenta Grupal	________	+	número de fichas a la Cuenta Privada	________	=	25 fichas

En cada periodo usted va a anotar sus asignaciones a la Cuenta Grupal y a la Cuenta Privada, en la parte de la hoja titulada Sus Decisiones de Asignación, teniendo en cuenta que sus asignaciones sumen 25 fichas. Al finalizar, un asistente recogerá la Hoja de Reporte. Las asignaciones hechas al fondo común se sumarán en un computador.

Los resultados del periodo serán reportados a usted en un trozo de papel con la **Información del Periodo**, como el siguiente. Luego de ello deberá tomar la decisión del siguiente periodo.

Jugador No:

INFORMACIÓN DEL PERIODO

Periodo	TOTAL ASIGNACIÓN A LA CUENTA GRUPAL	FICHAS EXTRA	SUS GANANCIAS: Cuenta Grupal	Cuenta Privada	GANANCIAS TOTALES PERIODO

Ejemplo Periodo 1:

HOJA DE REPORTE

Jugador No.: ________ Periodo No.: ____1___

Sus Decisiones de Asignación

número de fichas a la Cuenta Grupal	___13___	+	número de fichas a la Cuenta Privada	___12___	=	25 fichas

Suponga que usted asigna 13 fichas a la Cuenta Grupal y 12 a su Cuenta Privada. Esto queda registrado en la Hoja de Reporte (ver arriba y el tablero). Los resultados del periodo muestran lo siguiente:

Jugador No:

INFORMACIÓN DEL PERIODO

Periodo	TOTAL ASIGNACIÓN A LA CUENTA GRUPAL	FICHAS EXTRA	SUS GANANCIAS: Cuenta Grupal	SUS GANANCIAS: Cuenta Privada	GANANCIAS TOTALES PERIODO
1	40	0	0	25	25

La Asignación a la Cuenta Grupal es 40 fichas. Como el grupo no alcanzó el Requerimiento de la Cuenta Grupal de 60 fichas, no hay fichas extra asignadas a la Cuenta Grupal. En tal caso, la tecnología no es adquirida y las 13 fichas que usted asignó a la Cuenta Grupal automáticamente se van a su Cuenta Privada. Esto significa que el total de 25 fichas quedan en su Cuenta Privada como ganancias, y sus ganancias de la Cuenta Grupal son 0 fichas. Al sumar las ganancias de estas dos cuentas se obtienen las 25 fichas que son la ganancia total del periodo 1.

Conocidos los resultados de este periodo, pasamos al siguiente periodo.

Ejemplo Periodo 2:

Suponga que usted asigna 17 fichas a la Cuenta Grupal y 8 fichas a su Cuenta Privada. Esta información se registra en la Hoja de Reporte.

HOJA DE REPORTE

Jugador No.: ________ Periodo No.: ____2___

Sus Decisiones de Asignación

número de fichas a la Cuenta Grupal ___17___ + número de fichas a la Cuenta Privada ___8___ = 25 fichas

Los resultados del periodo muestran lo siguiente:

Jugador No:

INFORMACIÓN DEL PERIODO

Periodo	TOTAL ASIGNACIÓN A LA CUENTA GRUPAL	FICHAS EXTRA	SUS GANANCIAS: Cuenta Grupal	SUS GANANCIAS: Cuenta Privada	GANANCIAS TOTALES PERIODO
2	69	9	24	8	32

La asignación total de su grupo a la Cuenta Grupal es de 69 fichas, por lo que hay 9 fichas que sobran. Como ganancias usted recibe 24 fichas de la Cuenta Grupal, y 8 fichas de su Cuenta Privada. Sus ganancias totales del periodo suman así 32 fichas.

CUESTIONARIO

En este momento cada uno de ustedes llenará un pequeño cuestionario para asegurar que todos sepan cómo calcular sus ganancias del periodo. Después de completados, los cuestionarios serán recogidos y revisados al frente del salón. Por favor escriba su número de jugador en el cuestionario. El cuestionario luce como la Hoja de Registros de muestra con la que ha estado trabajando. Hay seis periodos de ensayo para los cuales se muestran elecciones hipotéticas de asignación a la Cuenta Grupal y asignación a la Cuenta Privada. Igualmente a usted se le presenta una cierta asignación total a la Cuenta Grupal en cada uno de esos seis periodos. Se le pide además llenar los espacios vacíos en la Hoja de Registros y después responder a varias preguntas.

Si tiene alguna pregunta mientras está trabajando en el cuestionario, por favor levante su mano y un asistente irá donde usted. Cuando finalice, por favor voltee el cuestionario y ubíquelo en la esquina de su escritorio. Un asistente recogerá el cuestionario y lo traerá al frente de la sala para revisarlo. Si hay alguna pregunta en este momento, por favor levante su mano. Si no hay preguntas, por favor inicie el cuestionario en este momento.

HOJA DE CONSENTIEMIENTO INFORMADO

Usted ha recibido una hoja de Consentimiento Informado. Esta hoja es un requisito para las universidades que hacen estudios en donde participan personas. En este formato nosotros informamos a ustedes acerca de la confidencialidad y manejo de la información que recogemos en estas actividades, y ustedes firman si aceptan participar, certificando que fueron informados del proyecto y del manejo de dicha información. La información en este formato es confidencial y nadie podrá tener acceso a ésta, excepto los investigadores de este estudio.

Si está de acuerdo en participar, por favor llene y firme su hoja de Consentimiento Informado este momento.

RESUMEN DE LAS INSTRUCCIONES

En esta página hay un resumen de las instrucciones, que podrá mantener abierta durante la actividad. Esto le permitirá a usted recurrir fácilmente a ella de ser necesario.

Resumen:

- Esta sesión consistirá de varios periodos de toma de decisiones.
- Sus decisiones serán totalmente anónimas.
- Cada periodo, en una **Hoja de Reporte** (azul) usted va a indicar cómo reparte entre la Cuenta Grupal y su Cuenta Privada, las 25 fichas que se le dan. Estas decisiones tienen efectos solamente para el periodo en juego.
- La información de la asignación total a la Cuenta Grupal y sus ganancias del periodo será devuelta a usted en un trozo de papel.
- Su **Cuenta Privada** le garantiza que cada ficha asignada a esta cuenta queda en sus manos.
- Si el número total de fichas asignadas al fondo común es mayor o igual a 60, entonces la tecnología puede adquirirse y cada uno de los miembros del grupo recibe **24 fichas** de la Cuenta Grupal. Si la asignación total de su grupo a la Cuenta Grupal es mayor que las 60 fichas requeridas, las fichas extra no son retornadas a los miembros del grupo.
- Sus "Ganancias Totales del Periodo" son la suma de sus ganancias de su Cuenta Privada y sus ganancias de la Cuenta Grupal.
- Al final de esta sesión se le estará pagando dinero en efectivo, dependiendo del número de fichas que usted posea al final del juego. Cada ficha será convertida a $72.

Acá finalizan las instrucciones. Si en este o en cualquier momento durante el juego tiene alguna duda, por favor levante su mano y un asistente irá donde usted.

Antes de dar inicio al juego realizaremos dos periodos de ensayo. Luego de este ensayo daremos inicio al juego.