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Ostracism and Common Pool Resource Management in a Developing Country: Young Fishers in the Laboratory

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Abstract

This paper investigates how the possibility to ostracise, which is a familiar punishment mechanism to subjects in an experiment, affects harvest in a common pool resource experiment. The experiment was framed as a fishing problem and the subjects were young fishers in Ghana. We find that the introduction of the possibility to ostracise other members of a group at a cost to the remaining members of a group decreased over-fishing significantly in comparison with the situation where ostracism was not possible. The ostracism was based on at least 50-percent voting rule. Moreover, the subjects demonstrated a strong desire to ostracise those who over-fished.

JEL Classification: C92; D72; Q22

KEYWORDS: Common Pool Resource; Experiment; Ostracism; Fishers

1 Introduction

It is well-known that natural resources, such as fish stocks, grazing lands, and forest stocks are generally managed as common pool resources in developing countries. However, common pool resources, if not properly managed, could be over-exploited, a situation referred to as "the tragedy of the commons" in Hardin (1968). Several ways to overcome this problem have been discussed in the literature. For example, Dietz et al. (2003) discussed restriction of access which, according to Hardin (1968), could either occur through privatising an unregulated common pool resource or keeping it as a public property but restricting the right to entry, and/or creating incentives to mitigate overuse of the resource. In many developing countries, including Ghana, formal institutions responsible for regulating the appropriation of environmental resources are generally very weak, hence the drive towards a policy of devolution of responsibility and control over natural resources from government agencies to resource users (Ostrom, 1990; Meinzen et al., 2002).

In most cases, social norms may complement or substitute formal institutions. It is known that rules and social norms impact behaviour and attitude towards the use of natural resources. Although, as argued by Bowles (1998), markets and other economic institutions influence the evolution of human values, the threat of social sanctions may make it rational, from the cost-benefit viewpoint, to abide by norm-guided behaviours (Jon, 1989). This paper therefore investigates the effect of

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ostracism or social exclusion, which is a familiar punishment mechanism to subjects in an experiment, and common in developing countries, in the appropriation of a common pool fishery. As noted by Hoffman and Goldsmith (2004), ostracism is continuously operating in every set of human relations in all cultures.

Evidently, social dilemma experiments in a laboratory setting, without any form of formal or informal institutions, or communication among the members, have generally found over-exploitation at levels close to what is predicted for complete rational self-interestedness (see e.g. Walker et al., 1990; Cardinas, 2003; Casari and Plott, 2003). Recent experimental studies on common pool resources and public goods have focused on the effect of allowing different methods of punishment among members in a group. Ostrom et al. (1992) and Cardenas et al. (2000) found that cooperation and average earnings increase if monetary sanctioning is available in a common pool resource experiment. Similarly, monetary punishment in a public good experiment introduced by Fehr and Gächter (2000), resulted in a significant increase in the contribution to a public good, although it was costly to the punisher.[1] [2]

Although ostracism or social exclusion is a common social sanction in developing countries, only a small number of studies have employed ostracism as a treatment in social dilemma experiments (e.g. Masclet, 2003; Cinyabuguma et al., 2005) to investment its impact on free-rider behaviour. Masclet (2003) designed a linear public good experiment that had two stages in each period and a subject could only be ostracised from the second stage activity in each period. Two treatments were considered: costly ostracism (which was enforceable if at least one member voted for ostracism) to any subject who voted to ostracise, and costless ostracism. It was found that the possibility of exclusion from the second public good experiment increased average contributions to the first public good. Cinyabuguma et al. (2005) introduced ostracism based on at least 50-percent voting in a public good experiment. A cost was imposed on those who voted to ostracise, if and only if the subject who received the votes was ostracised. The ostracised members were then reassigned and given only half of their previous endowment to the same public good experiment. Their results show an almost maximal level of contribution to the public good among the non-excluded members.[3] [4] [5]

This paper reports results from a common pool resource experiment among young fishers in a developing country where ostracism is a familiar punishment mechanism.[6] In particular, we study the impact of ostracism, which is an existing punishment mechanism, on levels of harvest[7]. The

[1] Similar results have been found in other public good experiments on students (e.g. Ostrom et al., 1992; and Bochet et al., 2006). Gächter et al. (2004) found that some definitions of trust have a significant impact on contribution in a public good experiment in Russia. Carpenter et al. (2004) had similar findings in their experiments in Vietnam and Thailand.

[2] Other institutions include e.g. introduction of the possibility of communicating disapproval in a public good experiment as a form of non-monetary punishment (see Masclet et al., 2003). The results of Masclet et al. (2003), for example, indicated a higher level of contribution to the public good after its introduction, but the positive effect on cooperation from the possibility of non-monetary punishment declined over time in their experiment. In a common pool experiment, Ostrom et al. (1992) found that by allowing face-to-face communication within groups, average net yield increased compared to the baseline situation where no communication was allowed.

[3] Interestingly, the effects on net earnings are positive and significant, which is uncommon in public goods experiments with monetary punishment. Masclet (2003) and Soest and Vyrastekova (2004) conducted an experiment with a one-period ostracism from a second activity in that period. In the former case, a public good experiment was followed by a second public good experiment in each period, while in the latter case a common pool resource experiment was followed by a gift exchange.

[4] Baland and Platteau (2000) noted that ostracism will result in cooperation, i.e. adopting the social optimum strategy, if the voting is based on a majority rule and if the decision to ostracise is irrevocable. A similar argument is found in Hirshleifer and Rasmusen (1989) where a prisoner's dilemma game was solved recursively.

[5] Cardenas et al. (2000) found that when people get used to imperfect monitoring, they rapidly move towards self-interested choices.

[6] Murphy and Cardenas (2004) present an excellent introduction on how to conduct a common pool resource experiment. Furthermore, some examples of experiments with subjects who face social dilemmas in resource extraction in their daily lives include Cardenas (2003); Carpenter and Seki (2005); and Gaspart and Seki (2003). There are several studies that compare student with non-student subjects. Other studies that compare the two groups of subjects in public good experiment include Carpenter et al. (2004) and List (2004).

[7] Ostracism as a punishment mechanism exists in all rural communities in Ghana and is usually applied as the last

paper combines the features of the work of Masclet (2003) and Cinyabuguma et al. (2005). To mimic the reality, it is assumed that the ostracism applies to the single activity, i.e. the fishing, and it is permanent. Moreover, the experiment involves real subjects in a developing country where ostracism is a familiar punishment mechanism. The results from our experiment show that without the possibility to ostracise, over-fishing is substantial. When ostracism was introduced, subjects were ostracised although it was costly for the remaining members to ostracise a member. Moreover, as a result of the introduction of ostracism, there was a sharp decline in over-fishing compared to a baseline treatment in which it was not possible to ostracise. The results from our experiment can be viewed in the light of the fact that, in the absence of external sanctions, internalized norms may not be sufficient in regulating resource appropriation. Consequently, for example, a fishing licensing system with decentralised monitoring which makes it possible to withdraw the license upon violation might be a feasible policy tool to regulate over-fishing.

The rest of the paper is organised as follows: In the next section, we introduce our specific experimental design, and the organisation of the experiment is in section 3. The results of the experiment are presented in section 4 and section 5 concludes the paper.

1.1 Experimental design

In our experiment, each group consists of 8 members and the total endowment of time for labour activities in a period is set to 8, which is framed as 8 months in a year to mimic the maximum number of months a fisher could fish within a year.[8] Member $i$can allocate the total time available to him/her to fishing, which is denoted x_i, and other activities, which correspond to $8 - x_i$. We assume that there is no alternative work option for the fishers and this resembles the common situation in most fishing villages in Ghana. Following the literature on common pool resource, we assume that the aggregated production function is "hump-shaped" and this is specified as a two-piece linear production function (e.g. Dasgupta and Heal, 1974; Ostrom et al., 1992; Fischer et al., 2004). The pay-off of the group is presented in equation (1)

$$F(x) = 100 \times \begin{cases} 0.26x & 0 \leq x \leq 24 \\ 11.1 - 0.2x & 24 \leq x \leq 64 \end{cases} \tag{1}$$

The pay-off to member i does not only depend on how many months he/she had fished, but also the total amount of months that the other group members had fished.

$$f_i(x_i, x_{-i}) = 100 \times \begin{cases} 0.26x_i & 0 \leq x \leq 24 \\ 11.1\left(\frac{x_i}{x}\right) - 0.2x_i & 24 \leq x \leq 64 \end{cases} \tag{2}$$

The aggregated social optimum level is 24 months, which corresponds to a symmetric social optimal level of 3 months per year for each member. Without any social sanction, the self-interested fisher will do what is best for him by fishing for more months than the social optimal number of months. Based on equation (E2), we constructed the payoff matrix that was handed out to the subjects in the experiment (see Appendix I). In the pay-off matrix, the columns indicate the number of months a given member fished, while the rows show the total number of months the rest of the members fished. All possible combinations of the earnings from fishing for member i can be read from the matrix. The exchange rate used for the payment in the experiment was 35 Cedis for 1 experimental currency unit.[9] If each member spends the social optimum amount of time of 3 months, the payoff for each equals to 624 Cedis.

resort when any social norm is violated, e.g. stealing, fighting, adultery, etc.

[8] In all fishing communities in Ghana, fishing is strictly prohibited one day per week. The day varies across communities. Moreover, fishing does not normally take place on Sundays since most fishers go to church, mend their nets or attend social gatherings, such as marriage ceremonies and funerals. Thus, on average, a fisher goes fishing about five days in a week and this approximately adds up to 8 months in a year, as in our experiment.

[9] 35 Cedis is the Ghanaian currency equivalent to US$0.036 at the time of the experiment. From personal enquiry at the time of the experiment, the average earning of a fisher within Anyako (the area where the experiment was

The common pool resource experiment is run for 30 periods and we use two different treatments in the experiment, following a similar set up in Cardenas et al. (2000). In both treatments, the first 15 periods consisted of an ordinary common pool resource experiment after which there was a break. After the break, the experiment continued for another 15 periods, and this was known at the beginning of the experiment. Half of the sample continued with the ordinary common pool resource experiment, while ostracism was introduced in the other half. Theoretically, for any common pool resource problem with a large number of potential users, if a member of the group is ostracised, average earnings for the aggregate social optimum number of months will increase for the remaining members of the group. However, in real life fishery, members in a group interact in many ways that enhance mutual benefits. For example, fishermen in Ghana collectively help each other to retrieve lost or entangled nets at sea, haul the fishing boats, carry and dry fishing nets after landing and serve as watchdogs in protecting fishing equipment from theft, which are activities that benefit a larger group. Thus ostracising a member will have a negative effect on the remaining group members in the mentioned contexts. The size of these effects may however vary across the fishers, but we assume in our experiment that these effects, which are expressed as costs, are the same across all the remaining members in the group. To account for this loss, a cost was introduced in the experiment. Moreover, the cost is set such that irrespective of the number of months a fisher fishes, it would always be costly to ostracise a member. The cost was calculated by comparing the payoffs in two different situations. In one situation, all fishers except one fished for the social optimal number of months while the deviating fisher fished for the maximum possible months. This was compared to another situation where the deviating member had been ostracised, and the group only consisted of members fishing at the social optimal level. For example, if all but one member fished at the social optimal number of months, i.e. 3 months, while the remaining subject fishes for 8 months, the payoff to each member fishing 3 months is 54.1. In the situation with 7 subjects, i.e. in a situation where the deviating member has been ostracised, the payoff is 78 each. The difference between the two payoffs is 24, and to make exclusion costly for the remaining members, we added a cost of 3 to make the cost equal to 27, which implies that the net payoff to each of the remaining subjects is 51 (i.e. 78-27).[10] If a cost is imposed on the remaining members, member i's return presented in equation (E2) would then be modified to

$$g_i(x_i, x_{-i}) = 100^* \begin{cases} 0.26x_i - \Omega_j & 0 \leq x \leq 24 \\ 11.1\left(\frac{x_i}{x}\right) - 0.2x_i - \Omega_j & 24 \leq x \leq 64 \end{cases} \tag{3}$$

where Ω_j is the cost of having j members ostracised. Thus, the catch rate per se is not affected, but losses occur for other reasons as discussed above, and this results in a lower net return. In our experiment, each member had the opportunity to vote to ostracise another member from his/her group at the end of each period. Based on at least 50-percent voting, it was decided whether a member was to be ostracised for a life time. In such a case, that member would not earn any money in the subsequent periods of the experiment. This mimics the fact that if a fisher is ostracised from a community, he/she no longer gets any income from the fishing activity and may also find it difficult to secure an alternative viable economic activity. The number of votes required to ostracise a member and the cost of ostracism imposed on the remaining members are presented in Table A2 in Appendix II.

conducted) was about 70,000 Cedis (7.87 USD) per day and the length of a fishing day was on average 6 hours. This was higher than the average earning of 40,233.30 Cedis (4.50 USD) in the experiment. However, the hourly wages are approximately the same between fishing and taking part in the experiment. These levels had been set based on a pilot experiment in May 2004.

[10]Similarly, if the group consists of 7 subjects and a subject is ostracised, the remaining 6 subjects will get an average payoff of 104 if each invests the social optimal level of effort of, in this case, 4 months. To make the exclusion costly, we added 3 to the difference between 104 and 51, thus making the cost of exclusion equal to 56. Following the same procedure, 3 was added to the cost if an additional individual is excluded.

1.2 Organisation of the experiment

The experiment was conducted in Anyako, a fishing community in the Volta region, which is one of ten administrative regions of Ghana. The region is rich in freshwater fish, such as tilapia, but intense fishing activities has led to over-exploitation of many of the species. Anyako is located in the Keta Lagoon basin in the southern part of the Volta region, where occupation possibilities, except for occupations related to fishing, are very limited. Normally, the men in fishing communities in Ghana are involved directly in fishing and maintenance of the boats, and fishing equipment, while the women prepare and sell the catch (Walker, 2002). Although it is generally taboo for women to go fishing in many fishing communities in Ghana, some of them are indirectly involved in fishing by owning fishing boats and nets, which are operated by men on a share-contract basis. Thus, after the variable cost of the fishing expedition is deducted, a proportion of the revenue from the catch, usually a half, goes to the crew and the other half to the owner of the fishing gear. Moreover, some women also give loans to male fishers in order to support their fishing activities. In Ghana, due to a limited budget from government, the state institutions that are responsible for governing common pool resources are generally weak. Consequently, fishing regulations have been decentralised to the communities.[11] A chief fisherman oversees all fishing activities within a fishing community,[12] and this gives him the power to implement traditional fishing laws, resolve fishing-related conflicts and punish violators of the fishing laws. His decisions are made in consultation with his council of elders, which usually consists of the head of each clan within the community. Once the chief fisherman takes a decision, it is binding on all fishers within his community. The fishing laws, which operate at community-level, do not differ much across communities. For example, they include prohibition of fishing on off-fishing days, which is usually one day in a week, and the use of destructive fishing techniques and equipment such as dynamite, cyanide and/or DDT. The punishment for not obeying the laws, which is decided by the chief fisherman, ranges from oral disapproval to life-time ostracism depending on which law is violated. For example, whilst using child labour during school hours may receive oral disapproval, fishing with poisons could receive ostracism as a punishment. Ostracism is employed either as a direct sanction when some traditional fishing law is not obeyed or when a fisherman fails to pay a fine imposed. There are, however, some differences regarding the structure of punishment across communities.

Our sample is from students at the Anyako Secondary School, which is the highest institution for formal education within the area, and is attended by teenagers and young adults from the area. A week before the experiment, a pre-experimental questionnaire was administered to 168 of the first to third year Senior Secondary School students who volunteered to answer the questions. This constituted slightly less than 70% of the 244 students enrolled at the school. All the students had been informed a week before we conducted the pre-experimental questionnaire about this event at a general meeting. One of the purposes of the pre-experimental questionnaire was to identify the sample for the common pool resource experiment, which should only consist of individuals who were currently involved in fishing activities. The respondents were asked a set of background questions, mainly relating to personal characteristics and fishing experience. At the end, the subjects were also asked whether they would be willing to participate in an "economic choice decision", which was to take place a week later. Each subject was given two versions of the questionnaire, one in Ewe[13] and one in English. The questionnaire was developed in English and later translated into Ewe by one translator and another translator did the reverse translation. Afterwards the translators met and discussed any differences that have occurred, and agreed on the final wording. From the 168 subjects who took part in the pre-experimental questionnaire, we randomly selected 128 subjects

[11] In 1997, the fishery sector supported over 1.5 million people in Ghana, which constituted about 8.3% of the total population (Atta-Mills et al., 2004).

[12] The position of a chief of a community is hereditary, but the chief fisherman, who is usually the most skilful fisherman, is elected. Traditionally, he occupies the position until his death.

[13] Ewe is the local language of Anyako. It is one of the nine government-sponsored languages in Ghana and spoken by 13% of the Ghanaian population.

who had some fishing experience. The average age of the students was 18.5 years. We conducted the experiment on a weekday to reduce the potential problem of individuals not showing up. Moreover, in order to encourage the subjects to attend, we asked the headmaster to announce the names of those that had been selected to participate at a gathering of all the students of the school.

On the day of the common pool resource experiment, the identities of the randomly selected subjects were checked against the list of names, and each subject was then given a numbered card outside the room. These numbers assigned them to a pre-marked seat. The numbered cards were also used to assign the subjects to the two treatments (i.e. the baseline and ostracism treatment). Each treatment consisted of eight groups. The venue for the experiment was two halls, one for each treatment group. The subjects took their seats at numbered but otherwise empty desks with enough space between the desks to guarantee privacy when making their decisions. They were informed that they were about to make "economic choice decisions", and that the amount that each subject would earn would depend on their own decisions as well as on the decisions made by the other subjects in their group.

They then received the instructions of the game and the payoff matrix (see Appendix I). Moreover, each subject was given 30 experimental cards, i.e. one card per period, to be handed to the instructor indicating how many months they fished during a specific period, or year as framed in the experiment. All 30 experimental cards were delivered before the experiment began to avoid a re-start effect in period 16, i.e. the break motivated for resting and where we also introduced ostracism treatment for half of the groups. Finally, the subjects were given one record sheet on which they recorded the number of months that all the other members of their group fished. This information was written down on a sheet of paper and handed out by an instructor to each member of a group after each round. This approach was chosen to avoid any effect from a different degree of recall on behaviour. The subjects were then given some time to read the instructions, and thereafter the instructor read the instructions aloud, first in English and then in Ewe to all the subjects. The subjects then answered six exercises in a language of their choice to test their understanding of the payoff matrix. The correct solutions, as well as how to obtain them from the payoff matrix, were explained orally and also written down on the chalkboard. Half of the sample, i.e. 64 subjects, sat in each of the two halls.

In the experiment, we used partner matching but the subject remained anonymous to other members in his/her group. In our case, it is natural to let the subjects remain in the same group to replicate living in a community. The procedure during one period in the experiment was as follows: the subjects first decided on how many months to spend on fishing, which was written down on the experimental cards for that specific period. These cards were then collected by one of the instructors. The contributions and earnings were computed manually, and then written down on a sheet of paper and handed to the members of each group, but no additional information was provided. After the fifteenth period, there was a break, which had been announced before the experiment began, giving the subjects the opportunity to rest and to introduce the ostracism in half of the group. It was stated in the instructions that they were not allowed to talk to each other during the experiment, which also applied during the break, and the instructors were instructed to ensure that during the break the subjects obeyed this rule.

In the ostracism treatment, the subjects were given information about the rules of ostracism at the end of the break. They were informed that they had the opportunity to vote out a member from their group. In order to be able to execute the selection, each subject was given 15 voting cards. Each subject had the opportunity to vote after the information on the total and individual months of fishing was handed out to him or her. The information was provided in the same way as in the non-ostracism treatment during the first 15 periods, and in the baseline treatment after period 15. The voting cards were then collected by one of the instructors, and if a subject refrained from voting, an "X" was entered on the card. Each member was then given a written feedback on the number of votes he/she received in that period after which the experiment continued to the next period. If an individual received the minimum number or more votes required for ostracism, he/she was orally informed by an instructor to leave the room.[14] It was stressed that anyone could refrain from voting if he/she desired to do so. If a subject was voted out, he/she would not continue to take part in the experiment and thus would not have the possibility to earn any money from the subsequent periods of the experiment. The decision to ostracise an individual was based on at least 50-percent voting as presented in Table A2. In total, the experiment lasted for 5 hours, consisting of the first two hours for the ordinary CPR, and then a 15-minute break, and finally two hours and forty-five minutes for the treated section.

All subjects were paid the following day. Their earnings were calculated and the amounts were put in an envelope, which was sealed and the subject's identification number was written on it. The envelopes were then placed on a table in an unused classroom to be collected by the subjects. Each subject entered the room through one door and left through another door. When the subject entered the room, he/she showed his/her numbered identification card from the experiment of the day before, to an instructor who did not assist during the common pool resource experiment. The instructor was sitting at a nearby table ensuring that the right envelope was collected.

1.3 Results

Figure 1 presents the time paths of the average time spent fishing in the two treatments. The figure shows no significant difference between the two treatments during the first fifteen periods. However, after ostracism was introduced, the time spent fishing declined sharply towards the social optimum number of months compared to the baseline treatment. In both treatments, the time spent fishing started from a level slightly above the social optimum of 24 during the first periods and increased over time in the experiment. The over-fishing increased over time and approached the Nash optimum of 6 months.

[Insert Figure 1 about here]

Using a two-tailed Mann-Whitney U-test, we cannot reject the null hypothesis that the average time spent on fishing in the two treatments is the same during the first fifteen periods at 5% significance level. After the introduction of ostracism, the time spent fishing decreased in these groups to a level slightly above the social optimum number of months but statistically lower than the Nash equilibrium, while in the baseline treatment, the time spent fishing continues to slowly increase.[15] During the last fifteen periods, we can reject the null hypotheses that the two treatments are the same at 1% significance level using a two-tailed Mann-Whitney U-test, which indicates that the introduction of ostracism significantly affected the total time spent fishing.

Figure 2 shows the proportion of subjects who voted in the ostracism treatment, and the cumulative proportion of ostracised members. As shown in the figure, when the ostracism was introduced, 61% of the members voted in the first period to exclude another member in their group although exclusion was costly to the remaining members in the subsequent periods. Three subjects were ostracised in the first period, and an additional two subjects during the following 14 periods. It should be noted that the subjects gained some experience with the common pool experiment since they had taken part in the first 15 periods.

[Insert Figure 2 about here]

[14] The pilot experiment indicated that ostracism would most likely to happen in the first period and this would have resulted in letting ostracised subjects sit and wait for 2.5 hours. By keeping the ostracised members waiting, there is a high possibility that they would be tempted to communicate with other subjects in the experiment. As a result, we decided to let the ostracised members leave the hall.

[15] The average was computed as the total effort per group divided by eight even if some member(s) had already been ostracised from the group. This approach is applied to make the results comparable between the baseline and the ostracism treatment. This is because while the individual optimal level of fishing has changed, the total social optimum level of fishing remains the same.

The pattern of the graph showing the proportion of subjects who voted over time reveals some inter-temporal dependency or an autoregressive process. Thus, over time, the proportion of subjects who casted their votes to exclude miscreants from the game decreased because overharvesting diminished as effort levels got closer to the social optimum. This indicates that voting is not random but motivated by the extent of overharvesting. A simple ordinary least square regression analysis, where the proportion of the subjects who voted was regressed on a one period lag is reported in Table 1. From the results, there exists a strong indication that the voting follows a first order autoregressive process. On average, the proportion of votes in a period is approximately one-half the proportion in the previous period.

[Insert Table 1 about here]

Furthermore, we investigate the relationship between the number of votes received and effort applied in the fishery in excess of the group average; and the determinants of the changes in the number of months of fishing in the ostracism treatment. The determinants include: the level of *trust* that the subject has in other students (rated on a 1-5 scale, with 1 being the highest); the number of local associations or clubs that the subject belongs (denoted *membership* in our regression); if the subject in reality fishes less than 21 days in a month (denoted *low fishing intensity* in our regression); whether the subject has ever been caught violating a fishing regulation or not (denoted *violated fishing law* in our regression); and the *gender* of the subject. The descriptive statistics of these variables are presented in Table 2.

[Insert Table 2 about here]

In Table 3, the number of votes received was regressed on *positive deviation from group average,* i.e. the amount of effort the individual applied in the fishing activity in excess of the average effort of his/her group.As expected, positive deviation has a positive and significant effect on votes received. The coefficient indicates that if an individual on the average applied a unit of effort in excess of his/her group average, approximately one individual within his/her group voted against him/her[16]. Note that since the maximum number of votes that a subject could receive in each round is 8 and the minimum is zero, the regression is estimated as a panel Tobit model. The results presented in Table 4 show that in the ostracism treatment, the only significant effect on the change in months of fishing was whether a subject, on average, received a vote or not.

[Insert Table 3 about here]
[Insert Table 4 about here]

1.4 Discussion and conclusion

In this paper we find evidence that the introduction of ostracism affects the amount of time spent on fishing in a common pool resource experiment, which is framed as a fishery problem among young fishers in a fishing community in Ghana. The fishery sector in Ghana is currently characterized by over-fishing, weak formal institutions to regulate harvest, and a decentralized decision-making process where the chief fisherman acts both as the maker of traditional fishing laws and enforcer of the laws.

Our experiment shows that the introduction of the possibility to ostracise a members of a group, based on a simple at least 50-percent voting rule, decreased over-fishing significantly. Although it was costly for non-ostracised members to ostracise a member, ostracism still took place. This finding is in line with work by, for example, Fehr and Gächter (2000) and Cinyabuguma et al. (2005) where subjects punished others although the punishment was at a cost to the punisher. Interestingly, of the

[16]We also estimated the model with a binary dependent variable of whether the individual received a vote or not but the regression had a lower explanatory power relative to the case where the dependent variable is continuous.

5 members who were ostracised, 3 were ostracised in the first period of the ostracism treatment. From the voting pattern in the experiment, by implication, two-thirds of the subjects in our sample would always self-report violation of fishing laws. It is therefore likely that part of the problem related to over-fishing might be due to inadequate punishment of over-fishers, or in reality ostracising a member from the community does not often take place, or ostracised members quickly show remorse and are reaccepted into the community. This may imply that the social ties are stronger than the concern for over-fishing. In addition, in reality there is the chance that an individual who overfish may get away with the crime and as a result may not be ostracised. This may lower the extent of compliance.

From a policy perspective, ostracism in our experiment could be permanent withdrawal of community-based fishing licensing if a fisher violates a fishing law that is endogenously monitored. Fishing licenses exist in many developing countries in Africa and Asia. However, at the heart of the effectiveness of enforcement of fishing regulations with endogenous institutions is the availability of adequate and reliable data on fish stocks and harvest rates, which is taken for granted in our experimental settings.

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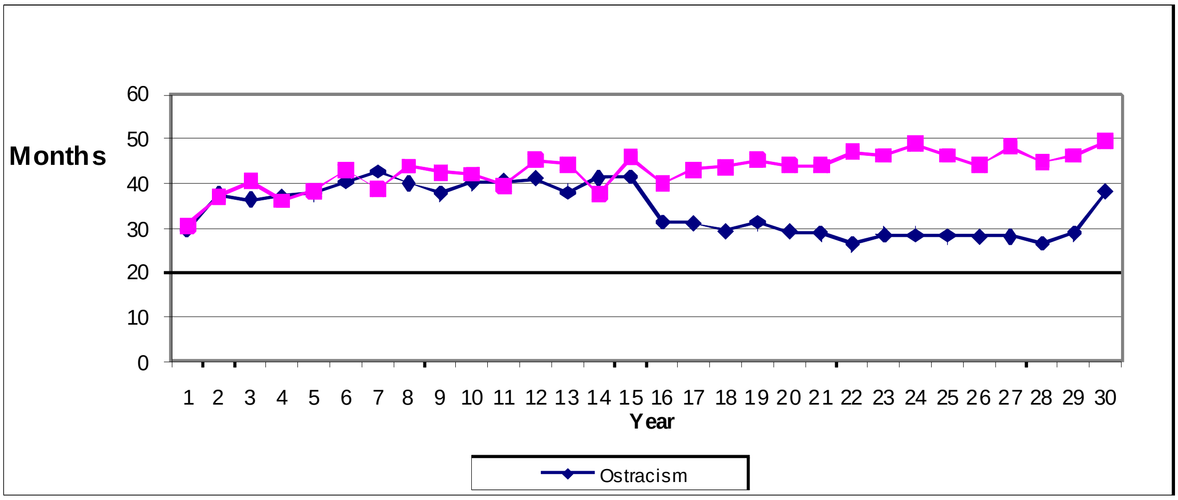
TABLES AND FIGURES

Figure 1: Average Number of Months of Fishing for the Two Treatments (i.e. Ostracism and Baseline)



Note: The social optimum corresponds to 24 months.

Figure 2: Cumulative Proportion of Ostracised Individuals and Proportion of Individuals Voting per Period

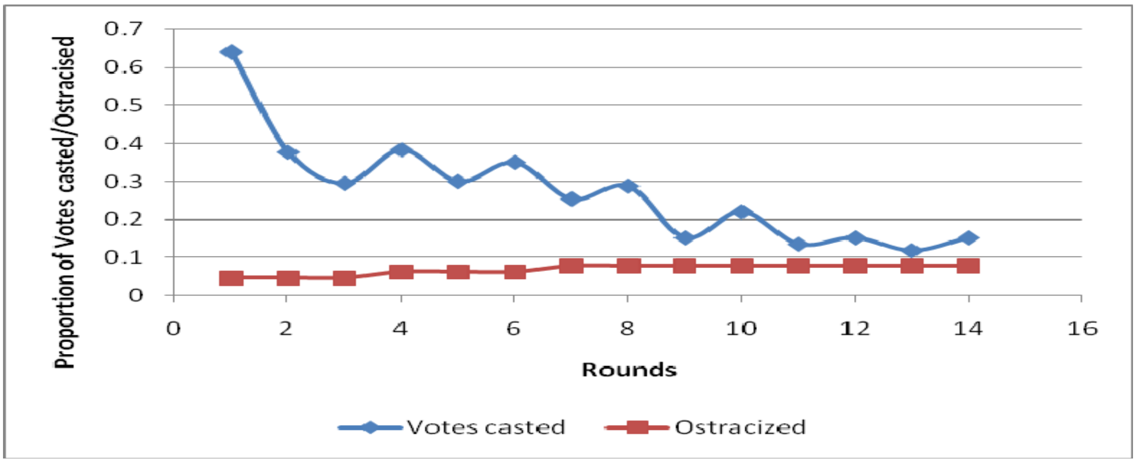


Table 1: Votes casted in round t: Regression Results for Periods 16-30

Variables	Coefficients
Votes casted in round $t-1$	0.51 (0.09)***
Constant	0.09 (0.03)**
Observations	14
R-squared	0.54

Note: The robust standard errors are in parentheses.*,**,*** significant at 10%, 5% and 1% respectively.

Table 2: Descriptive Statistics of Explanatory Variables

Variable	**Description**	**Mean**	**Std. Dev.**
Votes Received		0.24	0.64
Female		0.34	0.47
Membership		2.13	1.26
Low Fishing Intensity	Fished at most 21 days during a month	0.75	0.43
Trust	Trust in other students measured on a scale from 1 to 5	2.95	1.40
Violated Fishing Law	1 if violated fishing law during the last 12 months.	0.27	0.44

Table 3: Determinants of Votes Received: Regression Results for Periods 18-29

Variables	Coefficients
Positive Deviation from Others' Group Average	1.126 (0.082)***
Constant	-2.939 (0.389)**
Observations	715
Number of Subjects	61
Wald Chi2 (8)	190.57***

Note: The standard errors are in parentheses.*,**,*** significant at 10%, 5% and 1% respectively. Group dummies have been included in the regressions to control for group fixed effects.

Table 4: Determinants of Change in Months of Fishing: Regression Results for Periods 18-29

	Model 1	**Model 2**
Average Months of Fishing by Others in Previous Round	-0.139 (0.088)	-0.144 (0.083)
Votes Received	-0.676 (0.82)***	-0.697 (0.090)***
Female		0.014 (0.113)
Membership		- 0.020 (0.053)
Low Fishing Intensity		0.109 (0.107)
Trust		0.010 (0.042)
Violated Fishing Law		-0.186 (0.143)
Constant	0.651 (0.325)**	0.601 (0.341)*
Observations	835	835
Number of Subjects	61	61
R-squared	0.08	0.08

Note: The standard errors are in parentheses.*,**,*** significant at 10%, 5% and 1% respectively. Group dummies have been included in the regressions to control for group fixed effects.

APPENDIX I

INSTRUCTIONS FOR THE EXPERIMENT

Hello, and thank you for coming here today. Please read through these instructions carefully. **DO NOT DISCUSS THE EXPERIMENT WITH OTHERS IN THE ROOM**. If you have any questions, please feel free to raise your hand and an instructor will come and help you. Before the experiment begins, everyone will be given the opportunity to ask questions. Once the experiment has begun, you may still raise your hand if you have a question. Talking with others during the experiment is **NOT** permitted. If you do, you will be asked to leave the room and forfeit all your earnings.

In each round of the experiment, you have the opportunity to earn cash in Experimental Currency Units (ECU). The experiment has two parts with each part consisting of 15 rounds. Once the experiment is over, we will compute your total earnings for both parts. The following day **all of you will be paid in cash.** You will be paid the Cedis equivalent of your experimental earnings at an exchange rate of **1 ECU = 35 Cedis in Cash.** The more you make in ECU, the more you will make in Cedis. We will ensure that none of the other students in the experiment knows how much you earned. You will need your ID to collect your earnings the following day so keep it until you collect the cash.

Introduction

In this experiment you and **seven** others in this room will make a series of decisions on how many months to fish in a year. In any one year, you can fish up to a maximum of 8 months but the quantity of fish you harvest will depend on the number of months the other members of your group harvest from the fishery. In each round, which corresponds to a year of fishing, you will have to decide, and declare, how many months you will spend in the fishery.

The Payoff Table

At the start of the experiment, you will receive a PAYOFF TABLE that should be read the same way as the one attached at the end of these instructions. All participants will have the same payoff table as you. This table contains all the information that you need to make your decision for each year of fishing. The **numbers that are in the table** correspond to the **ECU** that you would earn in each year for a given set of decisions. Each of you must decide the number of MONTHS that you want to spend in the fishery (in the columns from 0 to 8).

To harvest in each round you must write the number of the current round and the number of months you have decided upon (this will be a number between 0 and 8) on an EXPERIMENTAL CARD that the instructor will give to you. There is an example attached at the end of the instructions.

After everyone has made his/her decision, the instructor will collect the EXPERIMENTAL CARDS from all 8 members of the group and will calculate the total number of months that the group decided to spend extracting from the fishery. When the instructor announces the group total, each of you will be able to calculate the ECU that you earned in that round. You will find an example below.

In this experiment, we assume that each individual has a maximum of 8 MONTHS each year to extract fish. On the PAYOFF TABLE, this corresponds to the columns from 0 to 8. Each of you must decide on the number of months, from 0 to 8, that you fish in each year. But to be able to know how much you earned in ECU, you need to know the decisions that the rest of the group made.

Table A1: An Example of How the Payoff Table Works

		My Months In The Fishery								
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Their Months In The Fishery	**19**	49	52	55	58	60	63	64	66	67
	20	47	51	53	56	59	61	62	64	65
	21	46	49	52	54	57	59	60	62	63
	22	45	48	50	53	55	57	58	60	61

1. You decide that "**My Months In The Fishery**" will be 2.
2. The instructor collects all the Decision Cards and gives you a written feedback on the number of months each ID number spent in the fishery and the TOTAL number of months your group spent in the fishery.
3. Assuming that a TOTAL of 22 months were spent in the fishery, you know that "Their months in the fishery" was 20, and your earnings for the round are 53 ECU.

<u>The First Record Sheet</u>

OK, let us look at how the experiment works in each round (i.e. each year). Each participant will receive a FIRST RECORD SHEET like the one attached at the end of these instructions.

Using Example 1 above, let us see how to use this FIRST RECORD SHEET. Suppose that you decided to spend 2 months in the fishery this round. On the EXPERIMENTAL CARD, you should write 2 next to "My months in the fishery." You must also write this number in the first column (A) of the FIRST RECORD SHEET. (You must enter your decision in 3 places: the EXPERIMENTAL CARD that you give to the instructor, the FIRST RECORD SHEET and the SECOND RECORD SHEET both of which you hang onto …).

The instructor will collect the EXPERIMENTAL CARDS from everyone in your group and will calculate the total number of months spent in the fishery by the whole group. The instructor will give everyone in the group written feedback on the number of months that each ID number in your group spent in the fishery and the TOTAL number of months that your group spent in the fishery. Suppose that the total was 22 months. Write 22 in column B of the FIRST RECORD SHEET. To calculate "Their months in the fishery", subtract column A from column B, and record this in column C. In our example, "their months in the fishery" is 20. To calculate your earnings, use the payoff table described earlier. If "my months" equals 2, and "their months" equals 20, then your earnings would be 53 ECU. In this example, you would have written the following on your FIRST RECORD SHEET:

FIRST RECORD SHEET ID: ___________________________________				
	Column A	**Column B**	**Column C**	**Column D**
Round No.	**My Months in the Fishery** (Your Decision)	**Total Group Months in the Fishery** (Given by the Instructor)	**Their Months in the Fishery** (Column B minus Column A)	**My Earnings in this Round (ECU)** (Use your PAYOFF TABLE)
1	2	22	20	53
2				

Second Record Sheet:

It is very important to understand that nobody will know what your decisions were in each year or what you have earned from the experiment because only your ID number will be used throughout. Written feedback on both the **group total** and the months spent in the fishery by each ID number in your group will be given to you at the end of each round by the instructor. Record the **individual months** and the **group total** on the SECOND RECORD SHEET below. The instructor will collect this record sheet at the end of the experiment.

ROUND	**SECOND RECORD SHEET** **ID_________________________________** **INDIVIDUAL NUMBER OF MONTHS (Please Record for each Round)**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Group Total**
1									
2									
3									
4									
5									
. **.** **.**									
30									

If you have any questions about how to earn money in the experiment, please ask before the experiment begins.

Summary of Steps for Harvesting One Round of the Experiment

How it is Done: In each round, you must decide how many months, between 0 and 8, you want to devote in one year in extracting resources from a fishery. Your earnings in each round depend on both your decision and the decisions made by the other members of your group, according to the PAYOFF TABLE.

What you need: To take part, you need a PAYOFF TABLE, FIRST RECORD SHEET, SECOND RECORD SHEET, and EXPERIMENTAL CARDS. You also need an **ID number**. The instructor will provide all of these.

Steps for Each Round

1. Using the **PAYOFF TABLE (given to you),** decide how many months you will spend in the fishery.
2. On the **FIRST RECORD SHEET,** write **your decision** (My Months in the Fishery) in Column A for the current round.
3. On an **EXPERIMENTAL CARD,** write the round number, and your decision (My Months in the Fishery). Make sure it corresponds exactly to what you wrote on the FIRST RECORD SHEET. Hand the experimental card to the instructor.
4. The instructor will collect all the experimental cards and give you written feedback on the **TOTAL GROUP MONTHS** and **INDIVIDUAL MONTHS.**
5. On the **FIRST RECORD SHEET,** write this total in Column B (Total Group Months in the Fishery).
6. On the **FIRST RECORD SHEET,** calculate Column C (Their Months in the Fishery). This equals Column B minus Column A.
7. On the **FIRST RECORD SHEET,** write in Column D the total amount in ECU that you earned in this round. To know how much you earned, use the PAYOFF TABLE and columns A and C (My Months and Their Months).
8. On the **SECOND RECORD SHEET**, write down individual months, which were given by the instructor for each round.
9. Harvest another round (Go back to step 1).

FIRST RECORD SHEET NAME: ______________________________ ID: _______				
	Column A	**Column B**	**Column C**	**Column D**
Round No.	**MY MONTHS IN THE FISHERY** (From your Decision)	**TOTAL GROUP MONTHS IN THE FISHERY** (Given by the Instructor)	**THEIR MONTHS IN THE FISHERY** (Column B minus Column A)	**MY EARNINGS IN THIS ROUND** (Use your PAYOFF TABLE)
1				
2				
3				
…				
30				
			TOTAL	

EXPERIMENTAL CARD	
ID:	
Round Number:	
My Months in the Fishery:	

PAYOFF TABLE

THEIR MONTHS IN THE FISHERY	MY MONTHS IN THE FISHERY 0	1	2	3	4	5	6	7	8
0	0	26	52	78	104,1	130,1	156,1	182,1	208,1
1	0	26	52	78	104,1	130,1	156,1	182,1	208,1
2	0	26	52	78	104,1	130,1	156,1	182,1	208,1
3	0	26	52	78	104,1	130,1	156,1	182,1	208,1
4	0	26	52	78	104,1	130,1	156,1	182,1	208,1
5	0	26	52	78	104,1	130,1	156,1	182,1	208,1
6	0	26	52	78	104,1	130,1	156,1	182,1	208,1
7	0	26	52	78	104,1	130,1	156,1	182,1	208,1
8	0	26	52	78	104,1	130,1	156,1	182,1	208,1
9	0	26	52	78	104,1	130,1	156,1	182,1	208,1
10	0	26	52	78	104,1	130,1	156,1	182,1	208,1
11	0	26	52	78	104,1	130,1	156,1	182,1	208,1
12	0	26	52	78	104,1	130,1	156,1	182,1	208,1
13	0	26	52	78	104,1	130,1	156,1	182,1	208,1
14	0	26	52	78	104,1	130,1	156,1	182,1	208,1
15	0	26	52	78	104,1	130,1	156,1	182,1	208,1
16	0	26	52	78	104,1	130,1	156,1	182,1	208,1
17	0	26	52	78	104,1	130,1	156,1	182,1	193,3
18	0	26	52	78	104,1	130,1	156,1	169,2	179,7
19	0	26	52	78	104,1	130,1	145	157,2	167
20	0	26	52	78	104,1	120,8	134,7	146,1	155,3
21	0	26	52	78	96,7	112,3	125,3	135,9	144,3
22	0	26	52	72,5	89,8	104,4	116,5	126,3	134,1
23	0	26	48,3	67,4	83,5	97	108,2	117,4	124,6
24	0	24,2	44,9	62,6	77,6	90,2	100,6	109	115,6
25	0	22,5	41,8	58,2	72,2	83,8	93,4	101,2	107,2
26	0	20,9	38,8	54,1	67,1	77,9	86,7	93,8	99,3
27	0	19,4	36,1	50,3	62,3	72,3	80,4	86,9	91,8
28	0	18	33,5	46,7	57,8	67	74,5	80,4	84,8
29	0	16,8	31,1	43,4	53,6	62,1	68,9	74,2	78,1
30	0	15,6	28,9	40,2	49,7	57,4	63,6	68,4	71,8
31	0	14,5	26,8	37,2	45,9	53	58,6	62,8	65,8
32	0	13,4	24,8	34,4	42,4	48,8	53,9	57,6	60,1
33	0	12,4	23	31,8	39,1	44,9	49,4	52,6	54,7
34	0	11,5	21,2	29,3	35,9	41,1	45,1	47,9	49,6
35	0	10,6	19,5	26,9	32,9	37,6	41	43,4	44,6
36	0	9,8	18	24,7	30,1	34,2	37,2	39,1	39,9
37	0	9	16,5	22,5	27,4	31	33,5	35	35,5
38	0	8,2	15	20,5	24,8	27,9	30	31	31,2
39	0	7,5	13,7	18,6	22,3	25	26,6	27,3	27,1
40	0	6,8	12,4	16,7	20	22,2	23,4	23,7	23,1
41	0	6,2	11,2	15	17,7	19,5	20,3	20,2	19,3
42	0	5,6	10	13,3	15,6	16,9	17,3	16,9	15,7
43	0	5	8,9	11,7	13,5	14,5	14,5	13,8	12,2
44	0	4,4	7,8	10,1	11,6	12,1	11,8	10,7	8,9
45	0	3,9	6,8	8,7	9,7	9,8	9,2	7,8	5,7
46	0	3,4	5,8	7,3	7,9	7,7	6,7	5	2,6
47	0	2,9	4,8	5,9	6,1	5,6	4,3	2,2	-0,4
48	0	2,4	3,9	4,6	4,4	3,5	1,9	-0,4	-3,3
49	0	2	3,1	3,3	2,8	1,6	-0,3	-2,9	-6,1
50	0	1,5	2,2	2,1	1,3	-0,3	-2,5	-5,3	-8,8
51	0	1,1	1,4	1	-0,2	-2,1	-4,6	-7,7	-11,4
52	0	0,7	0,6	-0,2	-1,7	-3,8	-6,6	-9,9	-13,9
53	0	0,3	-0,1	-1,2	-3	-5,5	-8,5	-12,1	-16,3
54	0	-0,1	-0,8	-2,3	-4,4	-7,1	-10,4	-14,3	-18,6
55	0	-0,4	-1,5	-3,3	-5,7	-8,7	-12,2	-16,3	-20,9
56	0	-0,8	-2,2	-4,3	-6,9	-10,2	-14	-18,3	-23,1

APPENDIX II

Table A2: The Number of Votes Required to be Ostracised and the Cost Imposed on Remaining Members

Number of Subjects Remaining	Number of Votes Required to be Ostracised	Cost from Exclusion on the Remaining Subjects
8	4	0
7	4	27
6	3	56
5	3	76
4	2	114
3	2	169