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Sustainability of common pool resources: A field-experimental approach

Raja Timilsina
Kochi University of Technology

Koji Kotani
School of Economics and Management, Kochi University of Technology
Research Center for Social Design Engineering, Kochi University of Technology

Yoshio Kamijo
School of Economics and Management, Kochi University of Technology
Research Center for Social Design Engineering, Kochi University of Technology

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School of Economics and Management
Research Center for Social Design Engineering
Kochi University of Technology

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Raja Timilsina* Koji Kotani† Yoshio Kamijo‡

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Abstract

Sustainability has become a key issue in managing natural resources together with growing concerns for capitalism, environmental and resource problems. We hypothesize that ongoing modernization of competitive societies, which we call "capitalism," affects human nature and preference in utilizing common pool resources, further endangering the sustainability. To test the hypothesis, this paper designs and implements a dynamic common pool resource game in the two types of Nepalese fields: (i) rural (non-capitalistic) and (ii) urban (capitalistic) areas. We find that a proportion of prosocial people in the urban is lower than that in the rural, and urban people deplete resources more quickly than rural people. The composition of proself and prosocial people in a group and the degree of capitalism (rural vs. urban) are crucial in the sense that an increase of prosocial members in a group and the rural dummy positively affect resource sustainability by approximately $65\,\%$ and by $45\,\%$, respectively. Overall, this paper concludes that when societies move toward more capitalistic environments, sustainability of common pool resources tends to be lost through changes in people's preferences, social norms, customs and assumptions for other people. It implies that people may gradually be losing their coordination abilities for social dilemmas of resource sustainability in capitalistic societies.

Key Words: sustainability, dynamic common pool resource, capitalism, field experiment

*Kochi University of Technology (e-mail: 196018s@gs.kochi-tech.ac.jp).

†Professor, School of Economics and Management, Kochi University of Technology, 2-22 Eikokuji-cho, Kochi-shi, Kochi 780-0844, Japan (e-mail: kotani.koji@kochi-tech.ac.jp).

‡Professor, School of Economics and Management, Kochi University of Technology, 2-22 Eikokuji-cho, Kochi-shi, Kochi 780-0844, Japan (e-mail: kamijo.yoshio@kochi-tech.ac.jp).

Contents

Nomenclature

CPR Common pool resource

NPR Nepalese rupee

SD Standard deviation

SVO Social value orientation

1 Introduction

Capitalism has become a dominant social regime over the last several decades (Piketty, 2014). Economic theory claims that goods and services are "efficiently" produced, allocated and consumed through competitive markets in capitalism, and this efficiency property is a main engine for economic growth (Schumpeter, 1942). However, some issues appear not to work in reality as theory predicts. For instance, intra and intergenerational allocations of environmental goods and natural resources are proven to be inefficient under capitalism illustrated by climate change and depletion of world forests. Therefore, sustainability of natural resources has become a key issue with a growing concern for capitalism.

When natural resources are provided as commons, they are usually called common pool resources (hereafter, CPR). In the CPR allocations, people are known to face a coordination problem of social dilemmas and a sustainability problem of depletion (Gordon, 1954, Hardin, 1968). Ostrom (1990) states that people tend to lose their ability for coordination in social dilemmas unless they are facilitated by communications and monitoring. Interestingly, however, Fruteau et al. (2013) have recently demonstrated that animals such as vervet monkeys overcome social dilemma problems without any intervention. An open question to address in this paper is whether or not humans have coordination abilities to solve the dilemma and to manage CPRs in a sustainable manner.

Economists have long considered the CPR dilemmas using experimental methods. Walker and Gardner (1992) is a pioneering work to study CPRs in experimental settings, and further studies have been conducted by many other researchers. Walker and Gardner (1992), Keser and Gardner (1999), Cardenas and Ostrom (2004) and Janssen et al. (2011) have studied CPR games in laboratory experiments that mimic some environments observed in the field such as probabilistic destruction of commons and strategically asymmetric situations. Cardenas and Ostrom (2004), Velez et al. (2009) and Fehr and Leibbrandt (2011) examine decision-making processes and preferences of actual resource users for CPRs through field experiments. All these studies adopt static or repeated-game settings, and conclude that some external devices such as information provision

as well as other-regarding preferences are key to the solution of CPR dilemmas.

Another group of works considers dynamic evolution of resources in the CPR games. Herr et al. (1997), Mason and Phillips (1997), Bru et al. (2003) and Kimbrough and Vostroknutov (2015) explicitly incorporate resource dynamics in the CPR experiments, and analyze how the dynamic nature of resources makes a difference with static or repeated cases. These studies demonstrate that the regeneration processes of CPRs critically affect the sustainability of resource use. Built upon these studies, Fisher et al. (2004) and Botelho et al. (2014) introduce intergenerational allocation and process uncertainty of resource dynamics, respectively, demonstrating that the one-way nature of intergenerations and process uncertainty deteriorate the sustainability.

Ostrom (2009) has claimed that people can self-organize sustainable resource use in specific socio-ecological environments that enable interpersonal communication, monitoring and leadership across resource users. She suggests an importance of identifying socio-ecological factors to enhance self-organization rather than of imposing top-down rules. Accordingly, there have been several recent works that report how socio-ecological environments influence people's preference and actual behaviors in the field. Ockenfels and Weimann (1999) and Brosig-Koch et al. (2011) study people's cooperative behavior in the Eastern and Western Germany, considering the different economic and social histories. They find that subjects from the Eastern part act more selfishly than that of the Western part. Leibbrandt et al. (2013) show that fishermen in individualistic lake-based fishery are more competitive than those in collective sea-based fishery, suggesting that daily practices with other people in workplace affect human behavior and preference.

Sustainability of natural resources has been claimed to be endangered all over the world, as many countries are moving toward more competitive environments. Since socio-ecological environments are established to affect human nature, it is very crucial to analyze how ongoing modernization of competitive environments, i.e., "capitalism," characterizes human preference, behavior and sustainability of natural resource use. Despite its importance, there have been no works to address these issues and thus this paper tackles how the degree of capitalism in societies affects people's prosociality, behavior and CPR sustainability. To this end, we design and institute dy-

namic CPR experiments in the two types of Nepalese fields, urban (capitalistic) and rural (non-capitalistic) areas. Nepalese fields were chosen as study sites, because the country possesses a wide gap in life style between the rural and the urban and is the most appropriate to control the degree of capitalism in the experiments.

2 Experimental details

2.1 Dynamic CPR games

Resource dynamics is incorporated in the field experiments of a CPR game in such a way that subjects with limited education understand.[1] A group of four subjects is formed where each subject knows the group size, but not the identity of members in a group. Subjects are also informed that group members remain the same with annonymity until the game ends. Suppose that the resource stock at the beginning of every period is denoted by x_t where the subscript indicates time periods of $t = 1, 2, \ldots$, and an initial stock size, x_1, of 120 is given. At the beginning of each period t, subject i is asked to decide his/her individual harvest $y_{i,t}$. The escapement, s_t, is defined to be $s_t = x_t - \sum_{j=1}^{4} y_{j,t}$ where $\sum_{j=1}^{4} y_{j,t}$ is the total group harvest at period t. If $s_t \geq 0$, then the individual payoff is going to be $\pi_{i,t} = y_{i,t}$. If $s_t < 0$, the individual payoff, $\pi_{i,t}$, is assumed to become $y_{i,t} = \frac{x_t}{4}$ for simplicity.[2]

The escapement, s_t, is considered to be a remaining stock at every period t and determines the evolution of resource dynamics. The resource stock dynamics is represented by

$$x_{t+1} = \begin{cases} 1.5 s_t = 1.5 \left(x_t - \sum_{j=1}^{4} y_{j,t} \right) & s_t > 0 \\ 0 & s_t \leq 0. \end{cases}$$

[1] Many subjects do not enter into junior-high or high schools, and their education is lower than those in developed countries.

[2] There may be other ways to split the resource when depletion takes place. However, this is the simplest way to let subjects understand the rule of games in the field based on pilot testing. That is to split the resource equally when depletion occurs.

In this model, the next-period stock x_{t+1} grows up to $50\,\%$ increase of the escapement, and the game continues to the next period if $s_t > 0$. Otherwise, it is terminated.

To reflect a realistic situation in managing resources, we incorporate time discounting in the dynamic CPR games. We use total 20 chips in a box where 19 chips are white and 1 chip is red. The game can move to the next period when a representative of members in each group picks one chip and the chip turns out to be white. If a red chip is picked, the game is terminated for that group. This situation resembles the discount factor of $\rho = 0.95$ in time preference. In summary, our CPR games are terminated when a group depletes the resource, i.e., $s_t \leq 0$, or the red chip is picked by a group representative. With this setup, we are interested to identify how many periods each group can sustain the resource use in the games. The period at which each group terminates the game by the chip or resource depletion is called the "terminal period" in this paper. Since our main interest is to measure sustainability of CPR utilization in a dynamic setting, the terminal period is considered a measurement for the degree of sustainability in this field experiment.

2.2 Experimental procedure

The dynamic CPR field experiments were conducted at two kinds of Nepalese fields. Kathmandu and Pokhara districts are urban, while Chitwan and Parbat districts are rural (figure 1). Kathmandu and Pokhara districts are the first and second largest cities in Nepal, respectively, and the most highly populated areas where a majority of people engage in businesses, service and government sectors. Chitwan and Parbat are rural areas consisting of many small villages and less populated where most people engage in agriculture and forestry for their livelihood. To maintain random assignment of groups, subjects were chosen from different cities and villages within each district with cooperation of local NGOs and offices for each session. With this approach, we avoided the situations where participants in each session know each other since they come from the same village or city.

[Figure 1 about here.]

A total of 528 subjects participated in this experiment.[3] Accordingly, the 67 groups and 65 groups in the urban and rural areas were formed. In each session, $5 \sim 8$ groups were gathered together in one place of the fields, and subjects are asked to fill up pre- and post-questionnaires for collecting socio-demographic information and social preference, and to go through the experiments. On the average, one session took 3 hours. After subjects finish pre-questionnaires, experimenters present the rule of the games. In the presentation, subjects were told that the CPR game will continue to the next period as far as the resource is not depleted, and the red chip is not picked by the group representative. We explain the resource and its dynamics using neutral terminologies. For instance, the resource stock and escapement are expressed as "tokens" and "remaining tokens" in that period, and the "next-period tokens" grow to $50\,\%$ increase of the remaining tokens. We have double-checked whether each subject understands the fundamental rules of our CPR games.[4] There were neither computers nor internet connections in the field. Therefore, everything was managed manually by experimenters and hiring research assistants for each session.

[Table 1 about here.]

Subjects are told that they cannot communicate with each other during the period of experiment and get initial 120 tokens in each group. At the beginning of each period, subjects are first asked to make an individual decision of how many tokens they take. After the individual decisions, they are informed of the group harvest of $\sum_{j=1}^{4} y_{j,t}$ and the remaining tokens. However, they are not informed of members' individual harvests in the same group. Unless the remaining tokens are zero, a representative in each group is randomly selected to pick one chip. When the chip is white, the group moves to the next period with the information of the next-period tokens. To identify social preferences of subjects, we conducted social value orientation (hereafter, SVO) experiments called "Slider Method" in our questionnaires (Murphy et al., 2011). Subjects are paid real money based on the cumulative payoffs of all their decisions in the experiments including SVO and CPR games. Subjects are paid approximately US $\$2$ in the local currency as a show-up fee. At the end

[3] Given time, budget constraints and geographic nature, this is the maximum number of subjects we could collect.

[4] However, when the game continued more than 20 periods, we simply stopped the game due to time and money constraints.

of the session, experimental rupees were converted to real Nepalese rupee (hereafter, NPR) at the rate of 1 experimental token $=$ NPR 2, with each subject earning a minimum of NPR 300 and a maximum of NPR 3000 for an average of NPR 500 which is equivalent to approximately $\$5$. Finally, the experimental design is summarized in table 1.

This CPR game in the field experiments attempts to capture key factors of resource sustainability in the simplest ways, reflecting some fundamental natures of renewable resource in a real world. More specifically, they are (i) strategic uncertainty with annonymity, (ii) dynamic evolution of resources and (iii) time preference. The game can be considered a resource utilization problem of multiple players in an infinite horizon, and possesses the following predictions of Nash equilibrium and Pareto optimality. The Markov perfect Nash equilibrium is that each subject harvests the resource up to exhaustion at an initial period. Pareto optimal allocation is that each subject waits without any harvesting until the last period at which he/she supposes "the game is over." Say, the last period is $n \gg 0$. At last period n, each subject should harvest all at once after the resource grows large enough.[5]

3 Experimental results

We report a series of the questionnaires and experimental results, focusing on the rural and urban settings with 65 and 67 groups of 260 and 268 subjects, respectively. Table 2 provides the summary statistics of subjects' socio-demographic information and experimental results. In the rural, $38\,\%$ of the participants are male with an average age of 34.5 years, while the urban consists of $58\,\%$ male with an average age of 24.5 years. This reflects the fact that many young males in the rural areas migrate to the urban areas or even to foreign countries for employment. With respect to education, more than $50\,\%$ of subjects in the urban have undergraduate degree in universities (16 years of schooling as the median in table 2), while subjects in the rural possess 10 years of schooling as the median. Regarding occupation, $90\,\%$ and $27\,\%$ of subjects in the

[5]This becomes Pareto optimal because the regeneration of the renewable resource ($= 1.5$) is higher than the discount factor ($= 0.95$) in the experiment.

rural and the urban engage in agriculture, respectively, implying that more than $60\,\%$ of urban subjects work in non-agricultural sectors such as such as business, service and government sectors. Household income is higher in the urban than in the rural. Overall, the summary statistics of socio-demographic information in table 2 reflect the fact that urban areas are more capitalistic, providing non-agricultural employment and opportunities such as education. On the other hand, in the rural areas, people are less educated and engage in agriculture and forestry.

[Table 2 about here.]

Table 2 reveals subjects' social value orientations between the rural and the urban. First, a significant difference in social value orientation can be seen in the summary statistics of the "SVO" variable, showing that $76\,\%$ of subjects in the rural are prosocial, while only $39\,\%$ of subjects are prosocial in the urban. Accordingly, this difference directly affects the group composition of members based on SVOs between the rural and the urban. In the rural, an average number (median) of prosocial members in a group is 3.03 (3), but it (median) is 1.57 (1) in the urban. Since one group consists of 4 people, this difference may affect how rural and urban groups harvest the resources in a different way. This SVO result seems to show that as the degree of capitalism in societies increases, people tends to be more proself. Based on the SVO theory, urban subjects put more weights on their own gains, whereas they do not care about others in a group. The SVO variable should be a strong predictor for sustainability of our dynamic CPR games.

Table 2 also provides the summary statistics of the terminal periods across the treatments. The most striking features rest on the measures of central locations (mean and median) and variability (standard deviation) between the rural and the urban. The average (median) terminal period is 7.63 (6.00) in the rural, while 2.24 (1.00) in the urban, implying that more than $50\,\%$ of groups in the urban exhaust the resource at an initial period and never proceed to the 2nd period. On other other hand, most groups in the rural successfully continue the CPR game more than 6 periods, and one group even reaches 20 periods of continuation. For the "longest" group, we asked the group members to stop the game due to time and budget limitations. The standard deviation in the rural ($= 5.56$) is much higher than that in the urban ($= 2.19$), and the total harvest per group in the rural

tends to be much higher than that in the urban (table 2). These statistical findings are in line with the fact that the rural groups continue the game much longer than the urban groups.

[Table 3 about here.]

Table 3 summarizes the frequency distributions of the terminal periods across urban and rural areas. Table 3 also shows frequencies of game termination by picking red chis as "red-chip termination." As can be seen in table 3, red-chip terminations in the rural are more often than those in the urban. More specifically, the percentage of red-chip in the rural is $33\,\%$, while it is $15\,\%$ in the urban. This is quite consistent with the facts that rural groups continue the game longer and probabilities of red-chip termination increases with longer periods of the game. In fact, there is only one red-chip incidence among 43 terminations for "Terminal period 1" of the urban in table 3, implying that many urban groups (42 urban groups) terminate the game by exhausting the resources in the 1st period. On the other hand, the rural groups could have continued the game much longer if there is no red-chip termination rule. Therefore, we believe that a significant gap of the terminal periods between the rural and the urban shall exist, irrespective of the red-chip termination rule.

Figure 2 shows the corresponding histograms where the vertical axis is the frequency and the horizontal axis is the terminal period. Consistently with the summary statistics of the terminal periods in table 2, we see that the distribution in the rural is more widely spread than that in the urban, and the two frequency distributions are very different each other. In particular, the highest spike of the frequency distribution in the urban is found in period 1, confirming that more than $50\,\%$ of urban groups exhaust the resources at an initial period. At the post-questionnaires, we have included a question "how did you want to play?" A considerable portion of urban subjects answered to that question as follows: "I really wanted to continue the game longer, but I could not think that other members in the group are motivated in the same way, or I could not trust other members." In fact, this type of answers among urban subjects reaches $51\,\%$. It appears that many urban subjects recognize some potential benefits by continuing the game longer. However, they did not actually restrain their harvests for continuation even at an initial period in the game, because they are worried that others would harvest to outright exhaustion.

[Figure 2 about here.]

To statistically confirm the difference of frequency distributions between the rural and the urban, we have run a Mann-Whitney test. The result shows that the frequency distributions differ each other at 1 percent statistical significance. Provided that the statistical difference of the terminal periods, we characterize resource sustainability in the dynamic CPR games by running regression of the terminal periods. We specify the terminal periods as a dependent variable and rural vs. urban treatments, SVO and socio-demographic information as independent variables. Since the terminal periods take positive integers, we have chosen Poisson regression in our analysis. The Poisson regression allows us to test statistical significances of the independent variables and compute the marginal change of the terminal periods when an independent variable alters, holding other independent variables fixed (Wooldridge, 2008).

The Poisson regression model can be specified as

$$Y_j = \beta_0 + \beta_1 X_j + \beta_2 R_j + \boldsymbol{\beta}_3 \mathbf{Z}_j + \epsilon_j \tag{1}$$

where j is an index for groups from 1 to 528, Y_j is a variable of the terminal period for group j, X_j is a number of prosocial members in group j, R_j is a regional dummy variable taking 1 in the rural, otherwise 0, and $\mathbf{Z}_j$ is a vector of other socio-demographic independent variables that may be assumed to characterize the terminal periods Y_j. Finally, ϵ_j is an error term. The parameter β_i for $i = 0, 1, 2$ is a set of coefficients for intercepts, X_j and R_j. The $\boldsymbol{\beta}_3$ is a vector of coefficients for other independent variables $\mathbf{Z}_j$. Recall that our main focus is on the estimated coefficients of β_1 and β_2. We hypothesize that these coefficients are statistically and economically significant with positive sign.

[Table 4 about here.]

Table 4 reports the estimated coefficients and their respective standard errors with statistical significance in the regression. Model 1 in table 4 contains the number of prosocial members in

a group and the regional dummy as independent variables. The result reveals that both independent variables exhibit statistical significance of 1 percent and positively affect the terminal periods. More specifically, the expected terminal period increases by $68\,\%$ with an increase of prosocial members in a group, holding other factors fixed. In the same way, the expected terminal period in the rural is interpreted to be about $45\,\%$ higher than in the urban, holding other factors fixed.[6] These marginal effects are considered economically significant, illustrating the strong impacts of members' social value orientations and the regional dummy variable. Since the regional dummy variable in our analysis represents the degree of capitalism, the result can be interpreted that resource sustainability tends to be lost as societies become more capitalistic.

For roubustness check, we run Poission regression by including other variables as shown in model 2 of table 4. The independent variables in model 2 are average income, a number of males, average education and average age in a group. As can be seen from the result in model 2, the qualitative results in model 2 do not change with model 1. Rather, the economic significance of the estimated coefficient for the regional dummy increases in model 2, while it almost remains the same for the number of prosocial members in a group. That is, the estimated coefficients on the number of prosocial members in a group and the regional dummy are still statistically and economically significant in model 2. The expected terminal period is interpreted to increase by $65\,\%$ with an increase of prosocial members in a group. Likewise, the expected terminal period in the rural is estimated to be about $63\,\%$ higher than in the urban. We have tried some alternative specifications of the Poisson regression. However, the results with respect to the number of prosocial members in a group and the regional dummy have not changed significantly. We confirm that these two variables remain statistically and economically significant, irrespective of the specifications in the models. The result reflects the fact that the SVO and the degree of capitalism (regional dummy) are key determinants for resource sustainability.

The SVO is a good proxy for people's social preferences, and our result on the SVO is intuitive

[6]The marginal effect of the regional dummy ($\approx 45\,\%$) comes from a simple formula introduced in Wooldridge (2008). The estimated coefficient of the regional dummy is $\hat{\beta}_2 = 0.37$ (see table 4). Then, the marginal effect of the regional dummy variable can be approximated with the following formula: $\exp(.37) - 1 \approx 0.448 \approx 45\,\%$.

in the sense that more prosocial subjects in a group lead to higher resource sustainability. On the other hand, our result on the regional dummy leads to a following question: What does the regional dummy truly capture in the regression? We define ongoing modernization of competitive societies as capitalism in this paper. The urban areas such as Kathmandu in the field experiment are considered capitalistic societies, rapidly developing in a competitive fashion. On the contrary, the rural areas such as Chitwan district are still agrarian and traditional societies. Note that the gap between the rural and the urban in Nepal is huge, compared to the situations in developed countries.

People in the urban areas are required to compete with other people for survival in business, service and government sectors through utilizing their skills and education. In the rural, most people still engage in agriculture and natural resource management based on indigenous knowledge and traditional practices. For instance, *Mela pat* and *Parma* are well known to be voluntary and cooperative farming practices that prevail as rural Nepalese culture, exchanging hard labor among rural farmers without any reward. Such voluntary cooperation is considered quite common for many activities in rural areas, since rural people are still vulnerable to natural uncertainty and calamities, and cannot sustain their life for survival without mutual cooperation. Such daily-life style and culture in Nepal form rural people's preference, customs, norms, assumptions for other people to sustainably manage resources. In contrast, recall that more than half of urban subjects answer in questionnaire surveys "I really wanted to continue the game longer, but I was not sure whether other members in a group think in the same way, or I could not trust other members."

In summary, the difference in daily practices of cooperation and competition for survival or for earning incomes between the rural and the urban appears to nurture people's desire, custom, social norm for resource use, assumptions about other people and so on in collective CPR settings. The regional dummy is conjectured to capture such important factors other than the SVOs. Following the previous arguments that social environment affects people's preference and behavior (North, 1990, Henrich et al., 2005, Dawkins, 2006, Richardson and Boyd, 2008, Wilson et al., 2009, Henrich et al., 2010, Leibbrandt et al., 2013), our field experiment can be considered the first attempt

to demonstrate that both the SVO and the degree of capitalism (regional dummy) are important for resource sustainability. A general message drawn from the analysis is that resource sustainability shall be more endangered through changes in people's preferences, social norms, customs and assumptions for other people, as societies develop in capitalistic ways. This also implies that people may be losing their coordination abilities for solving social dilemmas of resource sustainability in capitalistic societies.

4 Conclusion

This experiment has analyzed resource sustainability in a dynamic setting with respect to the degree of capitalisms and social preferences. We find that a proportion of prosocial people in the urban is lower than that in the rural, and urban people deplete resources more quickly than rural people. The composition of proself and prosocial people in a group and the degree of capitalism (rural vs. urban) are identified to be keys in the sense that an increase of prosocial members in a group and the rural dummy raise resource sustainability by approximately $65\,\%$ and by $45\,\%$, respectively. Overall, this paper concludes that when societies move toward more capitalistic environments, sustainability of common pool resources tends to be lost through changes in people's preferences, social norms, customs and assumptions for other people. More simply, people may be losing their coordination abilities for social dilemmas of resource sustainability in capitalistic societies.

Finally, we note some limitations of our study. We initially thought that different types of dynamic CPR games with various settings would have been applied in the field. Unfortunately, however, we realize that such complex CPR games do not work in Nepalese fields. In the future research, however, the qualitative results in this paper should be established by trying different types of dynamic CPR games including further investigation of social norms and other aspects of behavioral issues. These caveats notwithstanding, it is our belief that this field experiment is an important first step to characterize resource sustainability in relation to the degree of capitalism

and social preference. Our results clearly suggest that new institutions or devices are necessary for urban people to sustainably manage CPRs. Whereas there are many researches that examine social dilemmas of resource use in repeated settings, there are few researches in dynamic settings. Since sustainability has been claimed to be a global concern, future research should address social dilemmas by focusing more on both dynamic nature of common pool resource and its sustainability.

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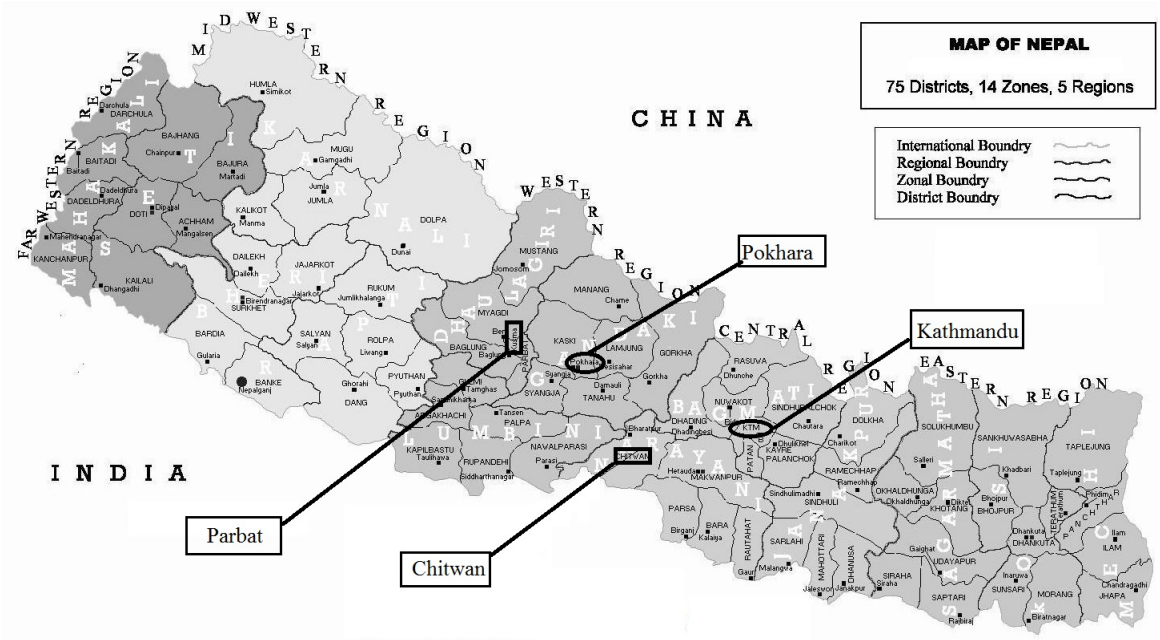
List of Figures

Figure 1: The locations of fields: Kathmandu and Pokhara as urban areas and Parbat and Chitwan as rural areas



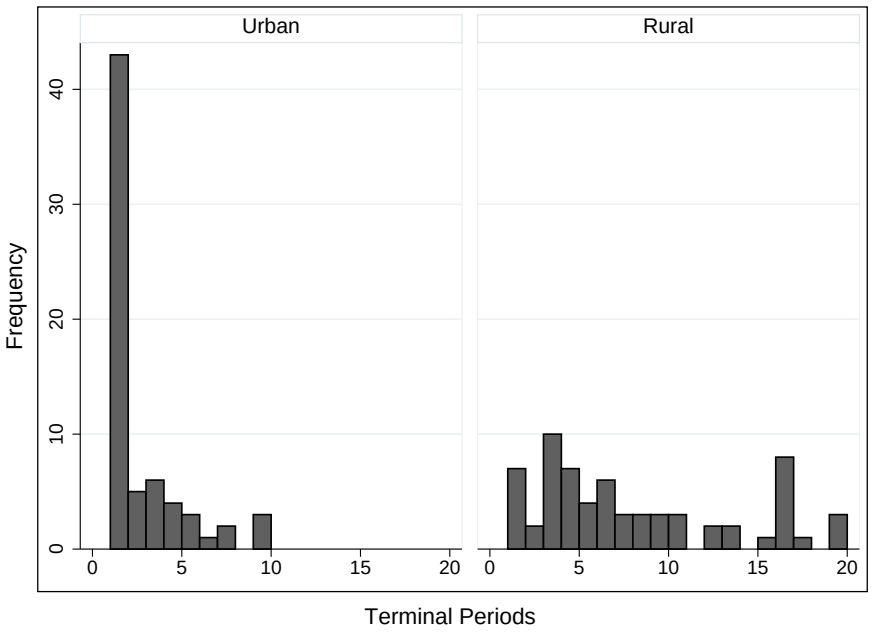


Figure 2: Terminal periods of each regions

List of Tables

Factors	Experimental designs
Treatments	Urban and Rural areas
Game	Dynamic CPR
Subjects	Urban people and rural people
Location	Urban (Kathmandu and Pokhara)
	Rural (Chitwan and Parbhat)
Education of subjects	from university to elementary-school level
Group	4 subjects in a group
Time per session	Approximately 180 minutes

Table 1: Summary of the experimental design

Table 2: Summary statistics:

Variables	Rural (65 groups, 260 subjects)					Urban (67 groups, 268 subjects)				
	Mean	SD[1]	Median	Min	Max	Mean	SD	Median	Min	Max
Age[2]	2.27	1.09	2.00	0.00	5.00	1.62	1.25	1.00	0.00	5.00
Gender[3]	0.38	0.49	0.00	0.00	1.00	0.58	0.49	1.00	0.00	1.00
Education[4]	9.58	3.40	10	1.00	16.00	13.07	3.57	16.00	1.00	16.00
Employment[5]	0.90	0.27	1.00	0.00	1.00	0.63	0.48	1.00	0.00	1.00
Income[6]	4.20	2.10	5.00	1.00	6.00	4.80	2.02	6.00	1.00	6.00
SVO[7]	0.76	0.43	1.00	0.00	1.00	0.39	0.49	0.00	0.00	1.00
Pro-social people in a group	3.03	0.93	3.00	1.00	4.00	1.57	1.08	1.00	1.00	4.00
Terminal periods	7.63	5.56	6.00	1.00	20.00	2.24	2.19	1.00	1.00	10.00
Total harvest per group	143.14	443.54	47.50	12.00	3270.00	36.23	16.62	30.00	13.00	140.00

[1] The "SD" stands for standard deviation.

[2] Age is a categorical variable of $\{0, 1, 2, 3, 4, 5\}$ where 0 is under 20, 1 between 20 and 30, 2 between 30 and 40, 3 between 40 and 50, 4 between 50 and 60. Finally, 5 is above 60 years old.

[3] A dummy variable that takes 1 when the subject is male, otherwise 0.

[4] Education represents years of schooling.

[5] Employment is a dummy variable that takes 1 when a subject is stably employed or engage in agriculture/forestry as a main occupation. Otherwise 0.

[6] It is a categorical variable of annual income measured by US dollar $\{1, 2, 3, 4, 5, 6\}$: 1. $0 \sim 300$, 2. $300 \sim 600$, 3. $600 \sim 900$, 4. $900 \sim 1200$, 5. $1200 \sim 1500$ and 6. more than 600.

[7] The "SVO" represents a dummy variable taking 1 (0) when a subject is prosocial (proself) based on SVO games.

Table 3: Terminal periods across the rural and urban areas

Terminal periods	Frequency	Red-chip termination	Percentage of red-chip termination
Urban areas			
1	43	1	2 %
2	5	2	40 %
3	6	2	50 %
4	4	2	50 %
5	3	2	67 %
6	1	0	0 %
7	2	0	0 %
8	0	0	0 %
9	2	0	0 %
10	1	0	0 %
Urban subtotal	67	10	15 %
Rural areas			
1	7	0	0 %
2	2	1	50 %
3	10	3	30 %
4	7	0	0 %
5	4	3	75 %
6	6	2	33 %
7	3	1	33 %
8	3	2	67 %
9	3	3	100 %
10	3	2	67 %
11	0	0	0 %
12	2	2	100 %
13	2	2	100 %
14	0	0	0 %
15	1	0	0 %
16	8	0	0 %
17	1	1	100 %
18	0	0	0 %
19	2	0	0 %
20	2	0	0 %
Rural subtotal	65	22	33 %

Table 4: Poisson regression for the terminal periods in the dynamic CPR games

	Model 1	Model 2
Number of prosocial members in a group	0.68***	0.65***
	(0.041)	(0.044)
Regional dummy	0.37***	0.49***
		(0.108)
Average income in a group		−0.29
		(0.042)
Number of males in a group		0.077**
		(0.039)
Average education in a group		−0.0045
		(0.021)
Average age in a group		−0.077
		(0.070)
Constant	−0.55***	−0.37
	(0.13)	(0.44)
Wald χ^2	333.08***	530.86***
Pseudo R^2	0.46	0.46

Numbers in parentheses are robust standard errors
***significant at the 1 percent level, **significant at the 5 percent level and *significant at the 10 percent level.