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SOCIAL DESIGN AND SUSTAINABILITY OF ENVIRONMENTAL RESOURCES: LEARNING FROM THE FIELD EXPERIMENTS.

by

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I would

like to dedicate this to

future generation.

SOCIAL DESIGN AND SUSTAINABILITY OF ENVIRONMENTAL RESOURCES: LEARNING FROM THE FIELD EXPERIMENTS.

ABSTRACT

Sustainability has become a key issue in managing natural resources together with growing concern for capitalism, environment and resource problems. The paradigms of the economy, society, and natural environment are going through fundamental changes and human society is in the midst of great transition. The major agents of this transition could be from a market and institution like democracy. Therefore, one of the solutions for natural resource management could be through economic-incentive, in other words, market-based policy instrument. Market-based instruments, such as tradable permits are considered to capture feature of free-market environmentalism if they are well designed and implemented. A marketable permits system (MPS) has been deemed effective in laboratory experiments, however, little is known about how the MPS works in the field.

As a first step, we evaluate the MPS efficiency of forest conservation by conducting framed field experiments in Nepal. Forestland demands are elicited from farmers, with which the experiments are carried out. The novelty lies in instituting a uniform price auction (UPA) under trader settings and in identifying the MPS efficiency for forest conservation in the field of developing nations. The results suggest that farmers with limited education understand UPA rules, reveal their forestland valuations and that the MPS is effective with $80\,\%$ of efficiency. However, there are certain limitations with the free market as it creates externalities.

Second, the market is better when no waste is created, but, it is not the case with

current capitalism that is ongoing in the societies. It appears to be an important issue to find out externalities produced by the market and how market competition shapes peoples' behavior and preference. Many literature in the past have shown that economic environment and institutions affect people behavior and preferences. Therefore, we want to see how current ongoing modernization of competitive societies, which we refer to as "capitalism," might affect human nature to utilize natural resources that are provided in commons.

To test our hypothesis, we design and implement a set of dynamic common pool resource games and experiments in the following two types of Nepalese areas: (i) rural (non-capitalistic) and (ii) urban (capitalistic) areas. We find that a proportion of prosocial individuals in urban areas are lower than that in rural areas, and urban residents deplete resources more quickly than rural residents. The composition of proself and prosocial individuals in a group and the degree of capitalism are crucial in that an increase in prosocial members in a group and the rural dummy positively affect resource sustainability by $65\,\%$ and $63\,\%$, respectively. Overall, this paper shows that for some class of social problems market yields better performance, while on the other hand, when societies move toward more capitalistic environments, the sustainability of common pool resources tends to decrease with the changes in individual preferences, social norms, customs and views to others through human interactions.

Third, to further analyze peoples' real behavior we again conduct field experiments of the social value orientation and the generative behavior checklist in the two fields of Nepalese societies: (1) urban and (2) rural areas. Generativity as concern, and commitment to the next generation, is one important factor for sustainable development of a society. Generativity emerges through both prosocial and proself behaviors characterized by social preference, and is now hypothesized to decrease in some modern societies

called “generativity crisis.” However, little is known about how ongoing modernization of competitive societies, i.e., capitalism, and social preferences affect generativity. The analysis finds that prosociality and the rural-specific effect are the two major factors that positively affect people’s generativity, while a larger proportion of prosocial people are found in rural areas than in urban areas

Finally, our results imply that individuals may be losing their coordination abilities while facing social dilemmas, therefore social design is necessary to ensure sustainability of human society. We are in need of new social institution or design that can govern and guide us to cooperate and coordinate.

Key Words: common pool resources, marketable permits system, field experiments, forest management, social dilemma, sustainability

ACKNOWLEDGEMENTS

गुरुर्ब्रह्मा गुरुर्विष्णुर्गुरुर्देवो महेश्वरः ।
गुरुरेव परं ब्रह्म तस्मै श्रीगुरवे नमः ॥१॥

In Sanskrit language "Guru" means teacher, and it says that Guru is verily the representative of Brahma, Vishnu and Shiva (creator, protector, and destroyer). He creates, and sustains knowledge, and then destroys the weeds of ignorance. I would like to express my deep gratitude to my supervisor Prof. Koji Kotani for being my "Guru" and more than anything else this thesis has been shaped by those rigorous thought-provoking discussion with him. My utmost gratitude goes to him for his sincerity, consistent guidance, and encouragement. I feel highly privileged to be supervised under him. He has been my inspiration as I hurdle all the obstacles for the completion of this thesis which I cannot overlook. In addition, without any exclusion, I was lost stochastically in an unbounded economics research and it could not be possible without great foundation, consultations, and encouragement specially provided by Prof. Tatsuyoshi Saijo, Prof. Yoshio Kamijo, Prof. Yoshinori Nakagawa, and Prof. Makoto Kakinaka. I owe my deepest gratitude to all the SSP faculty members, administration office, of the University, for their untiring effort in encouraging, managing and pursuing professional help when ever necessary.

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Chapter 1

Introduction

Market based instrument have been considered by many resource economists over the past decades because they believe that it encourages behaviour through market signaling rather than through directive methods (Field and Conrad, 1975). Some communities have been successful to manage environmental resources while other fails, these phenomena deserves our attention. Common pool resource management has been playing a great role in solving many issues such as disaster mitigation and sustaining livelihood through providing employment and other supports. Concurrently with solving issues, CPRs also have deeper relationship between group dynamics, communities collective stake for resources, social norms, and enforcement mechanism.

With the process of industrialization and urbanization traditional resources management system has been gradually declining and it is breaking humans ties with natural resources and ecosystem, that has challenged us to search for new theoretical framework and institutional design. There are many other factors that could be responsible for these shift such as external regulation, change in rights and obligation, population growth, change in economy and foreign aids. The disintegration of the collective stake as well as unfair welfare distribution process might have been responsible for discontinuation of various process and practice of CPRs.

There are two distinct issues associated with human or nature provided CPRs such as irrigation system, groundwater basins or fisheries, i.e., appropriation and provision problems. These both problems account for demand and supply side of common pool resources. The problem of appropriation starts with the efficiently managing externalities and technological issues. Secondly, provision problems begin with behavioral incentives and individual social preference for managing appropriation activities within existing CPRs. Given these circumstances, natural resource management requires research to focus on a local context to develop and understand new social institution. Therefore, in these three essays, my focus is on the reorientation of the market-based mechanism such as MPS in rural Nepal for the management of community-based forestry. Next, we are trying to understand the existing difference in societies for an appropriation of CPRs with ongoing capitalism in the society. With the similar interest, while contemporary urban societies are losing skills and capabilities to properly appropriate CPRs we are also interested to know the intergenerational linkage in two different societies.

1.1 Overview of voluntary forestry management system:

Community forestry is a voluntary forestry management system in which the CFUG members contribute labor to organize some collective activities of forest protection and management, such as meeting, harvesting, weeding, thinning, pruning and guarding. In return, they are allowed to harvest non-timber products. Harvesting non-timber products is highly labor-intensive. Poor households do not usually possess land and cattle (Adhikari et al., 2004). Thus, firewood is the only non-timber product they are motivated to harvest. Unfortunately, however, it is reported that such poor households cannot sufficiently allocate their own labor for harvesting firewood because they are swamped with daily agricultural labor works and do not have enough money to hire additional external labor (Adhikari et al., 2007). Relatively high-income or middle-income households within the CFUG usually possess land and cattle so that they are motivated to harvest a variety of non-timber products such as leaf litter, fodder and thatching materials (Adhikari et al., 2007). Since they are not struggling with their daily life compared to poor households, they can allocate their own time to harvest such non-timber products or can even hire additional external labor. Therefore, poor households do not utilize the opportunities of CFUG, while middle-income or high-income households utilize them more efficiently (Adhikari et al., 2004, 2007).

In summary, community forestry management as a participatory system had been considered a viable solution to forestland preservation. However, it have resulted in undesirable outcomes for poor households due to the aforementioned problems. Previous literature has supported this finding, and the community forestry management system is claimed to be inefficient in its process because poor households are deprived of the appropriation of resources and the benefits of sharing (e.g., Campbell et al., 2001; Adhikari et al., 2004, 2007). Consequently, this system has not necessarily helped poor people in Nepal, but has often worked to their disadvantage (Graner, 1997; Adhikari et al., 2007). Gautam (1987) argues that the indigenous forest management is more equitable and effective in conserving nature's integrity than community forestry because the latter fails to achieve an equitable cost-benefit sharing arrangement for society. The consequences of such a failure have led to inefficiencies and have opened the door to the inceptions of feasible and alternative institutional setups for new forest management to enhance the access of poorer households to the forest.

The MPS could be a solution when applied to forestland management, as it gives a right to the people to utilize forest products without clear-cutting timbers. This approach can provide equal rights to all individuals, and by holding the permits, each individual can commercially utilize forestland under some controlled regulations. To implement the MPS, local farmers are required to enter into a time contract to attain an arranged number of permits for forestland use, in which they can carry out agro-forestry farming. Initial permits can be allocated equally without socio-economic discrimination and, thus, the MPS can address inequitable distributions of resources through the allocation of initial rights.

1.2 Global debate on sustainability:

One of the most important issues faced today is to what extent the interest of future generation's needs are to be addressed, while a sustainable society have to satisfy current generation's needs without jeopardizing the prospect of future generations (Howard, 2000; Masini, 2013; Tonn, 2009, 2017). The sustainability of natural resources is claimed to be endangered worldwide, as many countries are now moving toward more competitive environments. Therefore, it is important to analyze how socio-ecological environments are established to affect human nature with respect to ongoing modernization of competitive environments, i.e., "capitalism," . Despite the ongoing global debate, no works have addressed these issues. In the second essay of the thesis, we focus on discussion how the degree of capitalism in societies characterizes individual prosociality, behaviors and CPR sustainability.

To this end, we design and implement a set of dynamic CPR games and experiments in the two types of Nepalese areas, urban (capitalistic) and rural (non-capitalistic) areas. Nepalese areas are studied, because Nepal is characterized by relatively uniform ethnic, religious and cultural demographics, but has wide disparities between rural and urban areas with respect to daily life practices. The features of Nepal allow us to control for degrees of capitalism in our field experiments without experiencing confounding factors.

1.3 Concern and commitment towards current and next generations:

One important element for sustainable development of a society depends upon concern and commitment that members of society have for the current and next generations, Erikson (1963) defined it as generativity . Higher generativity of the current generation induces people to educate and benefit the next generation and even the next (Erikson, 1963; Volckmann, 2014). Generations overlap in societies as it transit over time in a way that some members in one generation survive and remain as members in the next generations (Gaspar and Lauren, 2013). Unfortunately, the current generation has behaved in more selfish ways than ever, compromising generativity and intergenerational sustainability by incurring costs for the current and next generation, i.e., "generativity crisis" (Sasaki, 2004; Fisher et al., 2004; Milinski et al., 2006; Pratt et al., 2013; Molnar and Vass, 2013; Jia et al., 2015; Lefebvre and Lefebvre, 2016). Therefore, the third essay in this thesis features future generations thinking or generativity. When societies are changing in favor of the current generations it becomes an urgent issue and addressing the generativity in relation to intergenerational sustainability deserves higher attention.

Chapter 2

Evaluating the potential of marketable permits in a framed field experiment: Forest conservation in Nepal

2.1 Introduction

Economists have long considered a marketable permits system (MPS) to be potentially effective for preservation of environments and natural resources due to the decentralized nature and the price signals of market exchanges (Shogren, 2005).[1] The most important advantage economists claim for the MPS is that it can achieve environmental objectives with the least cost to the society, i.e., efficiency (Field and Field, 2006). Given this positive view of the MPS, extensive studies have been conducted to test theories and examine the performance (Ledyard and Szakaly-Moore, 1994). However, little is still known about how the MPS achieves the efficiencies in the real-world conditions of the field, especially in the context of managing the natural resources of developing nations. Therefore, this research addresses the efficiency of the MPS and to provide an important test for its proposed institution in a framed field experiment.[2]

Many studies on MPS experiments have been conducted to verify the performance in controlled laboratory settings with various environments and treatments. There are two important dimensions of the experimental designs: (i) the market institution for

[1]In this paper, the MPS is interchangeably referred to as "tradable property rights" or "transferable development rights."

[2]We categorize our experiment as a "framed field experiment" following Harrison and List (2004) and List (2011).

permit trading, either a double auction (DA) or a uniform price auction (UPA), and (ii) the trader or non-trader settings. The first dimension is concerned with the organization of the price determination mechanism in the permit market. The DA mechanism is a real-time trading institution where agents can submit bids to buy and offers to sell for permits or can accept the best bid and offer made by other agents at any time during trading periods of several minutes.[3] Therefore, the DA gives more flexibility to agents in terms of trading strategy.

In comparison, the UPA is simpler because all of the permit trades are made with a uniform price.[4] First, each agent is asked to submit his or her "bids to buy," representing the price she is willing to pay for each unit of additional permits, as well as "offers to sell," representing the price with which she is willing to sell each unit of permits she has. After all the agents submit bids to buy and offers to sell, a central authority collects and ranks all of the bids to buy from high to low (the demand curve), all of the offers to sell from low to high (the supply curve) and determines the intersection of the demand and supply curves. Specifically, the intersection occurs at the last unit in which the bid to buy exceeds the offer to sell, and the uniform price is the average between the two. The UPA has also been established to achieve high efficiencies and stable price dynamics (Smith et al., 1982; Cason and Plott, 1996).

The second dimension is concerned with whether each agent in a permit market can be both a seller and a buyer or each agent can be only one of these during trading periods. If he (she) can be both, we call the environment a "trader setting," and if he (she) cannot, the environment is a "non-trader setting" (Ledyard and Szakaly-Moore, 1994). Regarding application of the MPS, the trader setting is known to be closer to

[3]Refer to Davis and Holt (1992) for the details of the DAs.

[4]A UPA is also known as a call market. See Davis and Holt (1992) for further reference.

real-world conditions. However, a considerable portion of experimental works employ non-trader settings as it simplifies the experimental procedures and reduces the decision complexity for agents.

A majority of previous works have used the DA for experimental studies of the MPS. In particular, works by Plott (1983); Cason et al. (2003) and Kilkenny (2000) have employed the institution under non-trader settings. They report that the average efficiencies observed in the experiments are approximately $98\,\%$ and that the DA promises greater flexibility and relief from administrative burdens than other schemes, even though instability in the permit's prices is observed. These MPS results are consistent with the high efficiencies achieved under non-trader settings in other DA studies under general settings such as Williams (1980) and Plott and Gray (1990).

Another group of studies, such as Ledyard and Szakaly-Moore (1994); Godby (1997); Muller et al. (2002) and Cason and Gangadharan (2006), also have used the DA but under trader settings. The results of these experiments indicate that the observed efficiencies exhibit higher variations and can be lower on average than the DA experiments under non-trader settings, ranging between $60\,\%$ and $98\,\%$. Furthermore, these works report that the observed prices of permits could be unstable. In summary, the DA under trader settings is more likely to generate lower efficiencies and less stable price dynamics than those under non-trader settings. Some economists argue that agents have more opportunities for speculative trades under trader settings and that this may be the reason for the results (Ledyard and Szakaly-Moore, 1994).

Cason and Plott (1996) have conducted an experiment with the UPA under non-trader settings. The work confirms that the UPA is very efficient in the MPS and induces true revelation of abatement costs for pollution through the bids to buy and offers to sell in the experiments. It is also found that the price dynamics are stable because the UPA is relatively simple and does not offer agents the opportunities of speculative trades in the permit market. In summary, most of the research that has examined the performance of MPS mechanisms has been conducted in controlled laboratory conditions with induced value frameworks, irrespective of market institutions and of trader or non-trader settings (Muller and Mestelman, 1998; Cason, 2010).

Some MPS markets are operated in the real world, especially in developed countries such as the European union emissions trading scheme, and several empirical studies were conducted to estimate their effectiveness (Ellerman and Montero, 1998; Montero, 1999; OECD, 2000; Newell et al., 2005; Ellerman and Montero, 2007; Ellerman et al., 2010; Hahn and Stavins, 2011). However, these empirical studies have not addressed or cannot identify how the market has achieved overall efficiency, i.e., market surplus achieved under the MPS through permit trading. This is due to the fact that each agent or firm in the market never reveals his private information of abatement costs to others, otherwise there is no way for authorities to know the abatement costs. Therefore, there has been no MPS research to explicitly report and compare the efficiency and applicability in the field with those in laboratories.[5] Furthermore, no previous works evaluate the applicability of the MPS in the field of developing countries where depletion of natural resources such as forests is a more serious concern (FAO Forest Department, 2010, 2015).

Given this paucity, our research question becomes "how does the MPS perform and achieve the overall efficiency in the field of developing nations?" To answer this question, we conduct a framed field experiment of the MPS based on local farmers' valuation for forests and evaluate the overall efficiency and performance of the MPS as applied to forest conservation in the field of Nepal. The setup of our field experiment is in contrast

[5]Levitt and List (2007) claim that the comparison between fields and laboratory experiments is important for bridging the gap.

to the laboratory setting with induced value frameworks. More specifically, we have designed a novel setup of framed field experiments that is feasible in developing nations and can be understood by the "real" subjects. We chose Shaktikhor in Nepal as a site because the livelihoods of farmers highly depend on the forest and the farmers can naturally report their valuations of forestry. First, we conducted a survey through which we elicited valuations of local farmers for each unit of forestland, i.e., deriving the demand and supply for forestland as well as for permits.[6] Second, MPS experiments were carried out with the UPA under trader settings based on the aggregate demand and supply derived in the first stage. These experiments allow for observations of efficiencies, price dynamics and revelation of valuations through bids to buy and offers to sell and enable us to analyze the overall performance of the UPA in the real field.

Subjects in this field experiment were local forest users and farmers who have elementary education. Many of them cannot make some arithmetic calculations, such as a series of summations and subtractions, but they can understand which number is larger when given two different numbers. Thus, they can compare and trade their forest products in their daily life. With these facts in mind, we chose the UPA as a market institution because it is simpler and more intuitive for local farmers regarding how they incur the loss or to reap the benefit from the permit trades, compared to the real-time trading of the DA. We chose a trader setting for our experimental design to reflect the real-life condition of the MPS when applied to natural resource management. Due to the aforementioned arguments, an additional novelty in this research lies in designing a field experiment with real subjects of a developing country in comparison with a standard laboratory experiment of WEIRD subjects as claimed in Henrich et al. (2010b).[7]

[6]The permits are entitlements for the owners to utilize a single unit of forestland for commercial purposes in a legal way. More detailed explanation for the definition of permits will be given in later sections.

[7]Henrich et al. (2010b) claim that although behavioral scientists publish many re-

The results suggest that the MPS is effective with high efficiency of $80\,\%$ in the field. In this success, the institution of the UPA is identified as a key element because (i) farmers with elementary educations could understand and follow the rules of trading and (ii) they are induced to reveal their valuations of forestland through their bids to buy and offers to sell. To our knowledge, this study is the first to design and employ a UPA institution under trader settings as well as to establish successful MPS performance in the real-life conditions of developing nations. Overall, the MPS could be an effective policy option for natural resources management, even for those with less administrative expertise, limited educations and fewer resources to implement.

2.1.1 Overview of Community forestry in Nepal

Nepal is a landlocked country in South Asia that shares its northern border with the People's Republic of China and its borders to the south, east, and west with the Republic of India. The total area of the country is $147\,181\,\mathrm{km}^2$, $80\,\%$ of which is covered by hills and mountains and the land use of the country is divided as follows: forests $29\,\%$, shrubs $11\,\%$, grassland $12\,\%$, cultivated land $30\,\%$. The rest is categorized as others such rocky mountain $18\,\%$ (FAO Forest Department, 2010, 2015). The total population of the country is approximately 30 million, SI80% of which depend upon subsistence farming (Central Bureau of Statistics, 2011). The forestry sector is very critical from socio-cultural and economic points of view as farms, forests and livestock are interrelated components of Nepal's farming systems (Gilmour and Fisher, 1991; Mahat et al., 1986). The forest management system has undergone a structural shift away from privatization

search papers of human behavior with samples of population from western, educated, industrialized, rich and democratic (WEIRD) societies as a "standard" approach, such WEIRD sample is something we should not consider as "standard." They argue the necessity of implementing behavioral experiments with less-standard samples.

and nationalization toward voluntary participation systems (Gilmour and Fisher, 1991).

Prior to 1957, the forest management had been based on the indigenous practices of local villagers who utilized the forest to meet their daily demands of fuel, fodder, poles, and timber. The Private Forest Nationalization Act of 1957 nationalized the entire forest-land which prevented people from utilizing forests to avoid deforestation (Gilmour et al., 1989). Since 1978, a local institution "Community Forestry User Group" (hereafter, CFUG) has managed the local forests as "community forest." Inequality and poverty are the major problems in this transitional phase, along with political instability, absence of social reforms and imprudent utilization of resources (Gilmour et al., 1989).

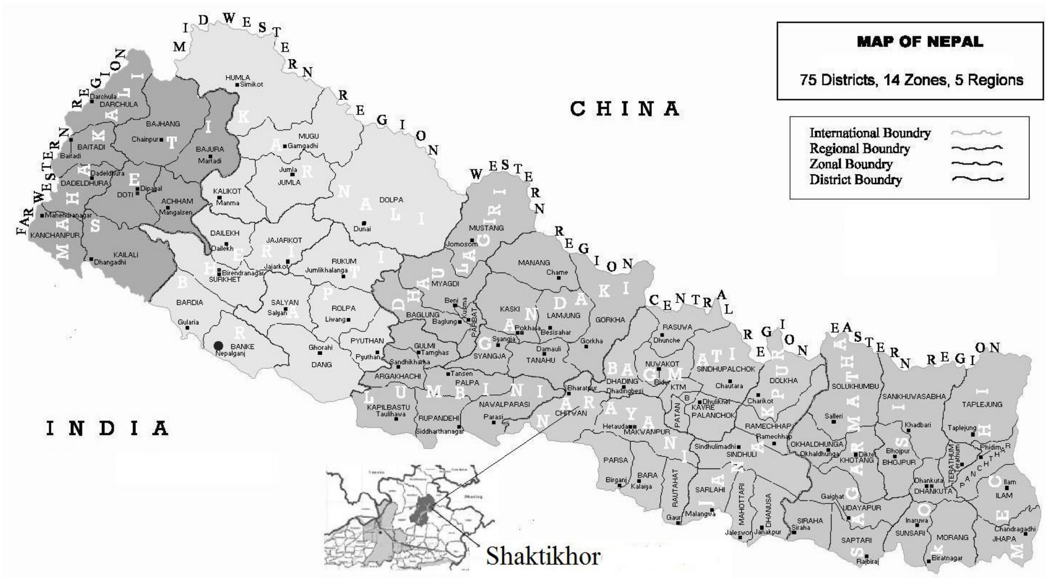
Community forestry is a voluntary forestry management system in which the CFUG members contribute labor to organizing some collective activities of forest protection and management, such as meeting, harvesting, weeding, thinning, pruning and guarding. In return, they are allowed to harvest non-timber products. Harvesting non-timber products is highly labor-intensive. Poor households do not usually possess land and cattle (Adhikari et al., 2004). Thus, firewood is the only non-timber product they are motivated to harvest. Unfortunately, however, it is reported that such poor households cannot sufficiently allocate their own labor for harvesting firewood because they are swamped with daily agricultural labor works and do not have enough money to hire additional external labor (Adhikari et al., 2007). Relatively high-income or middle-income households within the CFUG usually possess land and cattle so that they are motivated to harvest a variety of non-timber products such as leaf litter, fodder and thatching materials (Adhikari et al., 2007). Since they are not struggling with their daily life compared to poor households, they can allocate their own time to harvest such non-timber products or can even hire additional external labor. Therefore, poor households do not utilize the opportunities of CFUG, while middle-income or high-income households utilize them more efficiently (Adhikari et al., 2004, 2007).

In summary, community forestry management as a participatory system had been considered a viable solution to forestland preservation. However, it have resulted in undesirable outcomes for poor households due to the aforementioned problems. Previous literature has supported this finding, and the community forestry management system is claimed to be inefficient in its process because poor households are deprived of the appropriation of resources and the benefits of sharing (e.g., Campbell et al., 2001; Adhikari et al., 2004, 2007). Consequently, this system has not necessarily helped poor people in Nepal, but has often worked to their disadvantage (Graner, 1997; Adhikari et al., 2007). Gautam (1987) argues that the indigenous forest management is more equitable and effective in conserving nature's integrity than community forestry because the latter fails to achieve an equitable cost-benefit sharing arrangement for society. The consequences of such a failure have led to inefficiencies and have opened the door to the inceptions of feasible and alternative institutional setups for new forest management to enhance the access of poorer households to the forest.

The MPS could be a solution when applied to forestland management, as it gives a right to the people to utilize forest products without clear-cutting timbers. This approach can provide equal rights to all individuals, and by holding the permits, each individual can commercially utilize forestland under some controlled regulations. To implement the MPS, local farmers are required to enter into a time contract to attain an arranged number of permits for forestland use, in which they can carry out agro-forestry farming. Initial permits can be allocated equally without socio-economic discrimination and, thus, the MPS can address inequitable distributions of resources through the allocation of initial rights.

The Shaktikhor village development committee is located in Chitwan district of the

Figure 2.1: The location of Shaktikhor, Chitwan in Nepal



southern part of Nepal, where we implemented our field experiments (See figure 2.1). Chitwan district is rich in natural flora and fauna and is highly committed to species diversity. The word *Chitwan* itself means *Heart of the Forest* in the Nepali language. The Shaktikhor village comprises a unique blend of diversified indigenous ethnic groups, such as "Chepang," who reside in approximately 1000 households that are involved in agriculture and forestry.[8] All of the hill forests at the study site are surrounded by agricultural lands and have to fulfill the primary demands of rural households.

Subsistence farming in that region is based on a triangular relationship among the farms, the cattle and the forests (Adhikari et al., 2004). Forestland is essential for these people as it yields grass fodder for feeding livestock, leaf litter for composting, fuelwood for cooking and heating, timber and poles for constructing houses. Most of the households' daily routines are based on farming and harvesting of forest products to ful-

[8]The "Chepang" is an indigenous ethnic group that inhabits Shaktikhor. They traditionally practice slash-and-burn agriculture or simple hoe-based horticulture, along with hunting and gathering in the forests.

fill their primary needs. The literacy rate in Shaktikhor village is approximately 65 %, implying that most of the population has only an elementary-level education (Central Bureau of Statistics, 2011). In fact, many subjects could only perform simple calculation. However, they have a sense of valuing forestland and trading forest products based on their daily experiences.

2.2 Experimental designs

This section provides an overview for the design of our framed field experiments. First, we describe a study site, a feature of the subjects' pool and how we elicited the economic valuations (hereafter, EVs) of local farmers for each unit of forestland. We next highlight how the information about EVs was utilized in the MPS with the UPA for the conservation of forests in Shaktikhor, Nepal. Finally, we explain the procedure and the general sequence of experiments. The field experiment was conducted at the community hall, which was especially constructed for the "Tourism for Rural Poverty Alleviation Program" by the Chitwan hill guides group. Subjects were randomly chosen from five different villages in Shaktikhor, Nepal. A total of 40 subjects participated in the experiment.[9] They were farmers and CFUG members. We conducted four sessions, each of which involved 10 subjects from different villages and consisted of 10 experimental periods. Each session lasted 3 hours on average. The summary of our experimental design is given in table 2.1. In the first stage, each subject had to go through a survey interview for the elicitation of EVs for each unit of commercial forestland he

[9]Given the time & money constraints and geographic settings for our field experiments, this is the maximum number of subjects we could collect. For instance, we randomly picked forest users from different villages to avoid a situation where subjects in a session know each other. It takes more than 5-7 hours to go from one village to another village on foot where roads are not paved. Likewise, one subject needed to come to the city hall for our field experiments by walking of 5 hours on average.

(she) demands.

To fulfill this objective, we have asked each respondent about the maximum price he (she) is willing to pay (WTP) for each unit of forestland, realizing the net benefit he (she) could gain if the given unit is of commercial forest (See the row "Economic Value (EV)" in table 2.2).[10] If a person obtains a commercial forest unit, he (she) can utilize the forest to harvest timber and non-timber products for commercial purposes following the regulations of Nepalese government. Nevertheless, irrespective of the ownership of commercial forests, the respondents have an obligation to participate in community forestry management as described in the previous section.[11] Thus, the economic valuations we asked from respondents in this survey represent the net benefit of obtaining a unit of land as commercial forests.

For some respondents, the economic valuations for a unit of commercial forests could be low, because they may possess non-farming jobs or do not have enough resources to fully utilize forests. For others, the economic valuations could be high, because they have some expertise in generating forest products with their management practices and expect to have the large net benefits. In summary, through a series of these WTP questions, we elicited the demand of each individual or household until his or her WTPs for commercial forests arrived at zero or a negative value. For instance,

[10] Every subject in this framed field experiment possesses hands-on experiences in practicing forest management, because people's life in these areas is highly dependent upon forests. When we elicited the WTP per unit of commercial forest, we asked subjects to answer the WTP focusing only on the net "economic" value (EV) they can gain. This question was easily answered by the subjects in our survey.

[11] We acknowledge that monitoring and enforcement for obligations or regulations in managing community forestry are crucial issues for MPS, and there exist several works that focus on this issue (Murphy and Stranlund, 2006, 2007, 2008). However, note that monitoring and enforcement are out of our scope in this paper. This is because our field experiment becomes too complex for subjects if we try to include that aspect in the experimental design.

Figure 2.2: Elicited demands for forestland and the supply of permits across each session

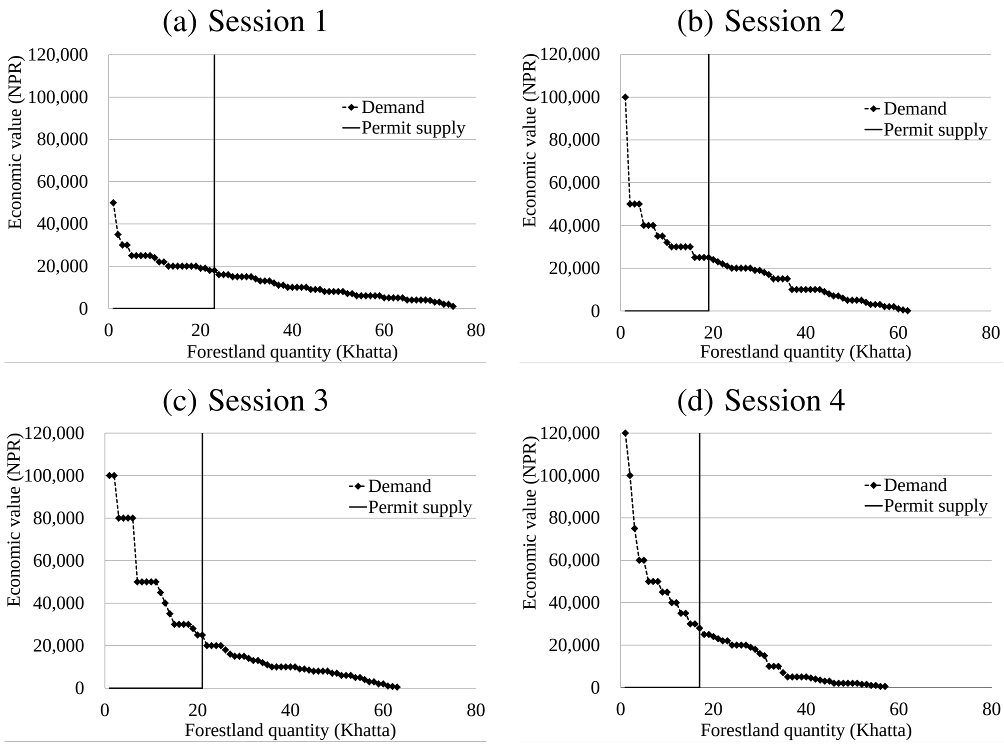


table 2.2 exhibits a schedule of WTPs elicited from one respondent, with the reporting of a zero WTP or negative value arriving at the 11th unit of forestland.[12] The respondents are very knowledgeable, experienced in forestry practices and have been trading forest commodities in their everyday life. This satisfies the sufficient conditions for employing an open-ended question format (See, e.g., Cummings et al., 1986; Mitchell and Carson, 1988). Fortunately, we have found that respondents did not have any difficulties in reporting WTP values in the survey.

After the collection of EVs, we derived the aggregate demand of forestland for each session as shown in figure 2.2. This figure consists of four subfigures, each of which corresponds to the demand in each session. For instance, figure 2.2(c) shows

[12]Some respondents reported zero WTP for units of forestland less than 10, such as 8 or 5 units. In such cases, the EV cells for the units corresponding to zero WTP are trimmed accordingly.

the downward-sloping derived demand for commercial forestland in session 3. This is derived by pooling and ranking the collected EVs of session 3 from high to low where aggregate farmers' demand (or WTPs) become zero at the 64th unit of forestland. Figures 2.2(a) to 2.2(d) are derived in the same way and demonstrate that their demands are qualitatively similar in the sense that they are downward-sloping to the same degree and becomes zero around the 60th unit of forestland.

We subsequently determined the capped level of commercial forestland provided by the permits in the MPS. For this calculation, we referred to previous studies suggesting that about 62 % of a total forestland of 3.5 million hectares has been handed to the CFUG for preservation where only non-timber products can be harvested mainly for non-commercial purposes, and it is expected to be preserved up to 70 % (Regmi, 2000). In this scenario of gradually transferring accessible forestland to the community for preservation, we assume that 70 % of forestland is conserved under current CFUG schemes, while the rest of 30 % is managed and utilized by the MPS. To mimic this scenario, 30 % of the total demand was allocated to subjects as marketable permits in the field experiments. Given the conditions, the initial permit endowments were randomly allocated to all subjects such that the total capped level was allotted to preserve 70 % of forestland. Table 2.2 shows that the subject has demanded 10 units of forestland and is entitled to have 3 permits. In this way, the aggregate supply of permits was derived for each session. For example, in session 3, 22 units were determined as the aggregate supply, which is 30 % of the total demand of 63 units (See figure 2.2(c)).[13]

Utilizing the information from the EVs of forestland, we can derive the demand and

[13] We admit that there might be a better way to determine an initial allocation of permits. However, when each subject reported his or her EVs, he (she) did not know in advance what types of experiments would proceed. Therefore, the way we have conducted the initial allocation does not affect both the reporting behaviors of the subjects and the results that follow.

supply of permits in the UPA. As mentioned earlier, we employ the UPA under trader settings. This means that each subject is required to submit his or her bids to buy and offers to sell all at once in a single trading period. Specifically, each subject is asked to submit his or her bids to buy, representing how much he (she) is willing to pay for each additional unit of permits, as well as his or her offers to sell, representing the price with which he is willing to sell for each unit of permits he (she) possesses. For instance, consider a subject who is endowed with 3 permits and who faces an EV schedule in table 2.2. In this case, he must submit 7 distinct bids to buy, each of which corresponds to the potential purchase of the permits for the 4th, 5th, $\ldots$, 10th units of forestland, and 3 distinct offers to sell, each of which corresponds to the potential sale of the permits for the 1st, 2nd and 3rd units he (she) currently possesses.

If subjects are rational, the subjects' bids to buy and offers to sell should theoretically be very close to the EVs (Cason and Plott, 1996). In the experimental instructions by the Nepali language, we clearly stated that if a bid to buy (an offer to sell) is higher (lower) than the corresponding EV, then it may incur a loss. However, we did not repeatedly tell them so. Additionally, such irrational behaviors are permitted, although some previous research does prohibit such irrationality. This decision is motivated by the fact that we sought to clarify whether the MPS under trader settings could be efficient for farmers under the most primitive setting in Nepal.

Suppose that subjects are sufficiently rational and that they reveal their EVs through bids to buy and offers to sell as predicted by economic theory. We can derive the aggregate demand and supply for permits in each session by ranking the bids to buy from high to low and the offers to sell from low to high. When the derived demand and supply are plotted together, it yields an equilibrium volume of trade and an equilibrium price as the intersection of the two curves. Figure 2.3, which consists of four subfigures, shows the

Factors	Experimental designs
Subjects	Local farmers and members of CFUG
Location	Shaktihore village development committee
Education level of subjects	Illiterate or elementary level
Session and experimental periods	4 session, each consists of 10 periods
Market institution	Uniform price auction
Time per session	Approximately 180 minutes

Table 2.1: Summary of experimental design

Figure 2.3: Theoretical equilibrium of permit demand and supply in each session

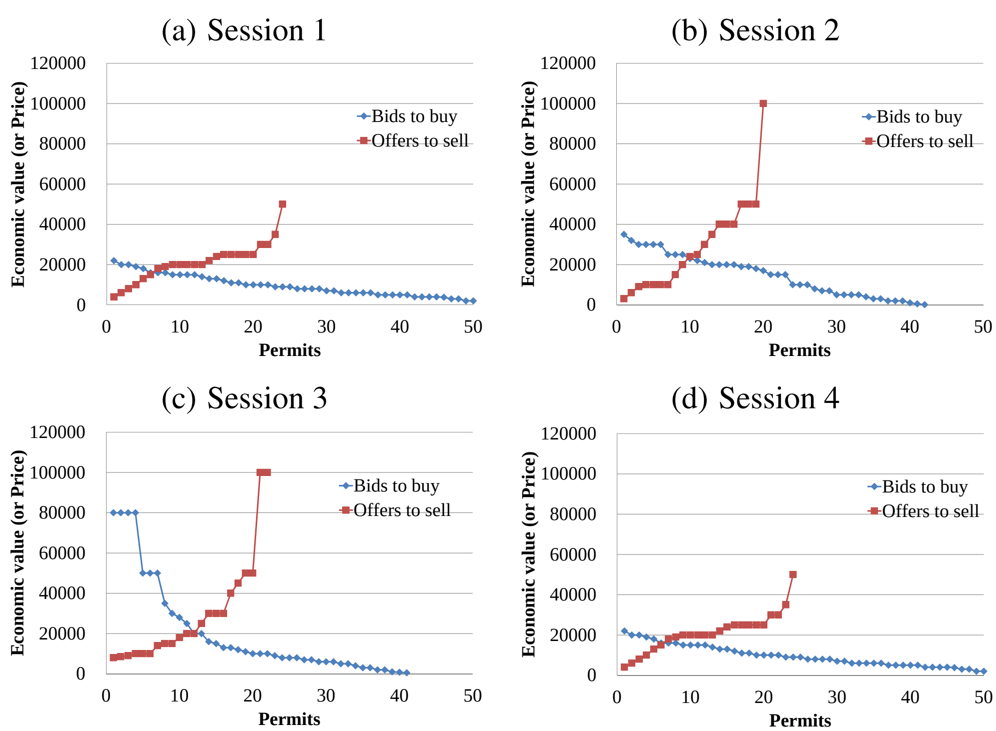


Table 2.2: A farmer's elicited economic valuation in the forestland information sheet

Round	10									
Uniform price (NPR)	18500									
Commercial forest land (unit)	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	1st
Economic value (NPR)	10 000	13 000	15 000	16 000	18 000	21 000	25 000	30 000	38 000	45 000
Offer to sell (NPR)	-	-	-	-	-	-	-	55 000	70 000	75 000
Bid to buy (NPR)	8000	10 000	12 000	14 500	16 000	19 000	21 000	-	-	-
Payoff (NPR)	122 000									

derived demand and supply for permits in each session. Figures 2.3(a) to 2.3(d) correspond to sessions 1, 2, 3 and 4, respectively. These four figures show that the demand and supply for permits are slightly different across sessions, but the qualitative nature of the markets appears to be close.

While there were neither computers nor internet connections in the field, everything was managed manually by hiring research assistants for each session. Following the general rule of the UPA, each subject does not know about the EVs of other subjects, and the volumes of trade that occurred, and the corresponding payoffs of others. Subjects were not allowed to communicate with each other during the period of trading and were paid real money based on the cumulative payoffs of their decisions over 10 periods. Given the aforementioned conditions, each subject was required to determine his or her bids to buy and offers to sell at the same time in a single period. After the announcement of the uniform price, they identified whether they would become buyers or sellers and their payoffs for that period.

Suppose that a subject has the EVs for forestland as shown in table 2.2 and is endowed with 3 units of initial permits. In this case, a subject is asked to submit 3 distinct offers to sell and 7 distinct bids to buy. If the uniform price is announced as $18\,500$, this subject buys two additional permits by paying $18\,500$ for each, because his bids to buy for the corresponding units are higher than the price ($21\,000$ and $19\,000$ for the 4th and 5th, respectively). In that trade, he must pay $37\,000$ ($= 2 \times 18\,500$) and will come into possession of five permits, which gives him a gross benefit of $159\,000$ (the summation of EVs from 1st and 5th units). His payoff in that period is the difference between the two, that is, $122\,000$ ($= 159\,000 - 37\,000$). The further details of the rules and of the auction mechanism of the UPA employed in this study are summarized in the appendix.

Many subjects do not have good math skills. Therefore, the calculations of the payoffs were double-checked by research assistants. However, each subject appeared to understand the types of situations in which he (she) incurred losses or obtained more benefits from trading. We instructed subjects to trade in a way that they seek to obtain more benefits from trading. This explanation was selected because many subjects have only limited educations but do have a sense of trading for forest products in a local market. Typically, our participants were paid the equivalent of almost US $\$2$ in the local currency as a show-up fee. At the end of the session, experimental rupees were converted to real NPR at the rate of 1000 experimental rupees $=$ NPR 1, with each subject earning a minimum of NPR 500 and a maximum of NPR 2000 for an average of NPR 800 which is equivalent to approximately $\$12$. This is a high stake for typical farmers in that region, as their daily earnings range from $\$4$ to $\$7$.

2.3 Experimental results

This section provides the details of the experimental results. The first subsection gives an overview of the demand for forestland by the farmers of Shaktikhor and the derived demand and supply of marketable permits. The second subsection reports the overall efficiency gains from the trading. The third subsection shows the observed equilibrium price behaviors and the associated volumes of trades. The final subsection addresses the trading behavior of individuals regarding their strategies for "bids to buy" and "offers to sell."

2.3.1 Elicitation of economic valuation for forestland

The demand and supply of marketable permits in each session are derived, based upon the demand for forestland elicited by the survey. Figure 2.2, consisting of four subfigures, shows the aggregate demand for forestland elicited from 10 subjects in each session. Figures 2.2(a) to 2.2(d) correspond to the aggregate demands in sessions 1, 2, 3 and 4, respectively. From a comparison of the four figures, we can see that they are not so different qualitatively and that the total aggregate demand in a session is approximately 60 *Khatta.*[14] Furthermore, the intersection of the supply and demand occurs around NPR $20\,000$ in each session. This value could be considered an equilibrium price of permits in the MPS.

The derived demand and supply curves are in figure 2.3, which consists of four subfigures, each exhibiting the demand and supply for the permits in each session. As mentioned earlier, the demand and supply for permits, respectively, represent the "bids to buy," as arranged from highest to lowest and the "offers to sell," as arranged from lowest to highest, assuming that the subjects are rational (See figures 2.3(a) to 2.3(d)). When subjects are rational, they should submit their bids to buy and offers to sell that are close to their own EVs. Therefore, we should be able to observe the similar demand and supply for permits in the experimental results as derived in figure 2.3 for each session.

The initial endowments of sessions 1, 2, 3 and 4 are 24, 20, 22 and 18 permits, respectively. The trades of 6, 9, 12 and 8 should occur with the equilibrium prices, or equivalently, the uniform prices of NPR $16\,000$, NPR $22\,500$, NPR $20\,000$ and NPR $25\,000$ in sessions 1, 2, 3 and 4, respectively. Accordingly, the market surplus is identified as the area surrounded by the derived demand and supply on the domain between 0 and the equilibrium price. The information about the market in each session is summarized in table 2.3. Note again that subjects' actual bids to buy and offers to sell would deviate from the EVs derived in figure 2.3 if they do not understand the rule of the MPS with the UPA or if they are irrational. In this case, losses of market surplus (or efficiency

[14]One unit of "*Khatta*" in the Nepali language is equivalent to approximately $500\,\mathrm{m}^2$ of land.

losses) would be realized.

The equilibrium prices derived in figure 2.3 appear to be plausible, reflecting the current incomes and the price levels of the villagers in Shaktikhor, Nepal. These derived markets exhibit across 4 sessions an average equilibrium price of around NPR 22 000 per Khatta of forestland, where arable land price is approximately NPR 100 000 per Khatta.[15] The crop intensity in Nepal is known to be higher in the mid-hills geographic areas such as Shaktikhor, our field site. For instance, 4 to 5 types of crops are cultivated in the arable land of Shaktikhor over a year and it can sustain the lives of a family of 4 to 5 members for approximately 3-4 months (See Chhetri, 2011). In such cases, forest products can function only as complementary goods to the crops produced in such arable land. Hence, forestry products are not considered the main products for the lives of villagers, rather the complements to agriculture or a living itself. This observation is consistent with the fact that the price of forestland is a quarter of the arable land price. Thus, the elicited demand from the local farmers at Shaktikhor, Nepal, is very plausible.

[15]The heterogeneous group of farmers from the five different villages and the community forestry user group determined this equilibrium price with a small variation of the equilibrium price: a minimum of NPR 16 000 and a maximum of NPR 25 000 (See figure 2.3).

Session	1	2	3	4
Total demand for commercial forest	75	62	63	57
Total permits supply	24	20	22	18
Efficient equilibrium price (NPR)	16 000	22 500	20 000	25 000
Efficient trade volume	6	9	12	8

Table 2.3: Summary of market information per session

2.3.2 Market efficiency, price dynamics and trade volume

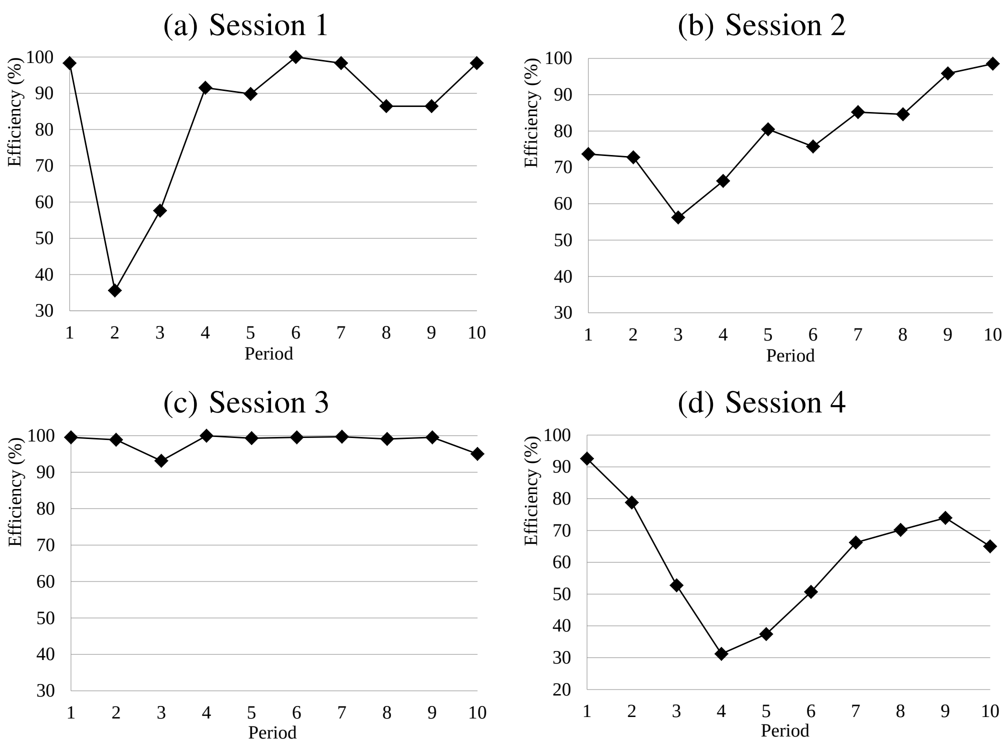
Efficiency

The maximum possible surplus (hereafter, theoretical surplus) is the triangular area between the supply and demand curves to the left of their intersection (See figure 2.3). The efficiencies were measured as a ratio between the surplus obtained from a single experimental period's market and the theoretical surplus. If the surplus that was obtained from the market in a single trading period is equivalent to the theoretical surplus, then $100\,\%$ efficiency gain is considered to be achieved, or equivalently, if the permit trading in a single experimental period yields the maximum surplus from exchanges.

Figure 2.4, which consists of four subfigures, shows the efficiency gains from permit trading by subjects across 10 periods in each session. The least efficiency gain is observed in session 4 (See figure 2.4(d) and the $30\,\%$ efficiency of period 4) and the highest efficiency gain is observed in session 3 (See figure 2.4(c) and the $100\,\%$ efficiency in some periods). However, in total, the efficiency levels observed during the periods have heterogeneous patterns across sessions that range between $60\,\%$ and $90\,\%$, regardless of exceptions (See figure 2.4). By pooling all of the observed efficiency gains over the 10 periods in each session, the average efficiency is calculated to be 80%, with a corresponding standard deviation 20%.

As mentioned earlier, a certain degree of variation in the efficiency gains is observed across the sessions (See figure 2.4). The degree of the efficiency gains from trading is known to be sensitive to the structure of demand and supply as well as to the characteristics of subject pools. Although the derived supply and demand for permits in each session are not so different qualitatively, some hidden heterogeneous factors may have contributed to the variation of efficiency gains in our field experiment. In fact, we admit

Figure 2.4: Observed efficiency gains over the periods across each session



that a small portion of subjects appeared to be confused with the rule of trading at the initial stage in some sessions, especially, during session 4. In that session, we observed that such confusion led to very irrational bidding and offering strategies and contributed to the loss of efficiency gains.[16] However, as additional periods passed, we also have found that such confusion gradually disappeared in most cases of sessions 1, 2 and 3.

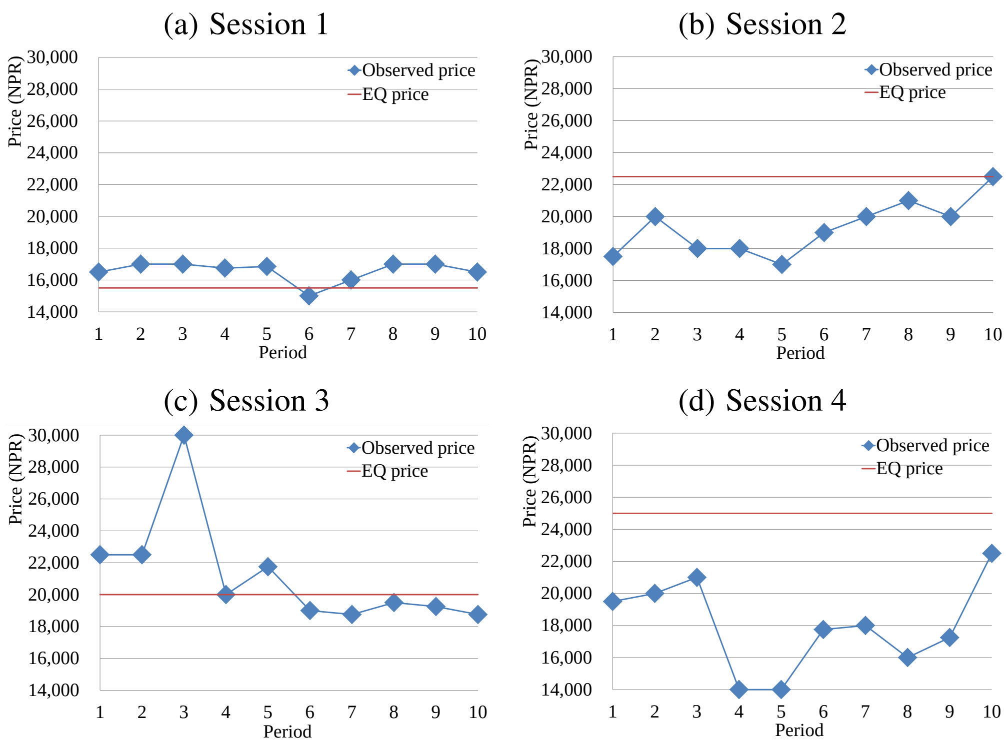
In summary, the UPA under trader settings in our experiments has shown high efficiency of $80\,\%$ on average. In comparison to the prior laboratory experiments on the UPA and the DA, the statistics and observed efficiencies reported earlier are consistent with previous works (Cason and Plott, 1996). For instance, Cason and Plott (1996) report an efficiency gain of $90.9\,\%$ using more educated subjects and a UPA under a non-trader setting. Because our experiment was conducted in the field with less educated subjects under a trader setting, the $10\,\%$ decline of efficiency observed in our experiment could be considered legitimate. Overall, we would say that the observed efficiencies are high enough that the MPS is effective in the real-life conditions of the field.

Market prices and trade volume

Figure 2.5, which consists of four subfigures, depicts the evolution of the observed prices in the UPA market over the periods of each session. In figure 2.5, a solid line represents the level of theoretical equilibrium prices (hereafter, TEP) and a solid diamond marker represents the observed uniform price per period for each session. Overall, the results suggest that the UPA generated observed equilibrium prices that are not so far from the TEP and can be considered close to it except for session 4 (see and compare

[16]In session 4, we could not observe that efficiencies rise over periods. This is due to the fact that a few subjects seem not to have consistent strategies for bids to buy and offers to sell throughout that session.

Figure 2.5: Observed movement of prices over the periods across each session



figures 2.5(a) to 2.5(d)).

Most of the observed prices range between NPR 15 000 and NPR 25 000. The greatest deviation between the TEP and the observed price is visible in session 4. As mentioned earlier, we realize that in that session, some subjects did not follow the usual trading or consistent strategies under the UPA as argued by Smith and Williams (1982) and Cason and Plott (1996) because of the confusion they had at the initial stages, and this may be the main reason for the large discrepancy between the TEP and the observed prices of that session.

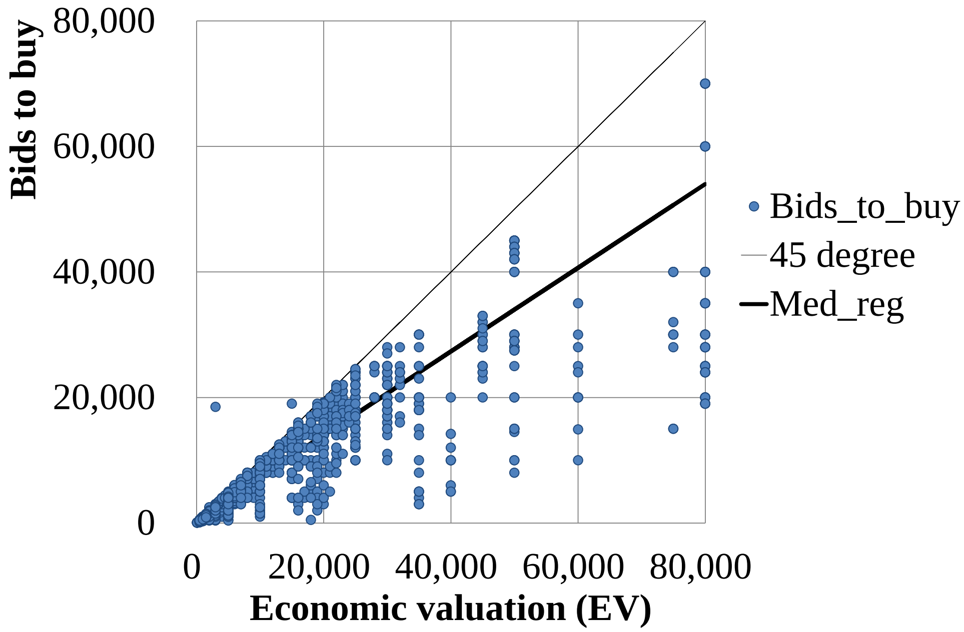
Table 2.4 presents the average units of permits traded across the sessions and the theoretical trade volume. The results show that an average of 70 % of the theoretical trade volume was realized. The average number of permits traded remained less than the predicted trade volume across the sessions (See table 2.4). This result is quite consistent with past literature on the UPA in the sense that the volume of trades that occurs in experiments tends to be less than the theoretical volume of trades. This information regarding the actual trade volume indicates that substantial trades have occurred although they are not always identical to the predicted trade volume. This result could be argued in relation to endowment effects, which will be detailed later.

2.3.3 Demand revelation

This subsection reports how the subjects revealed their demands for forestland through bids to buy and offers to sell and considers whether there is a qualitative difference between the two in our MPS experiments. This analysis is important because efficiency gains are more likely to rise when subjects are induced to reveal their true valuations for forestland through market exchange. Economic theory predicts that a UPA will tend to induce demand revelation at a margin if a subject behaves optimally, which means that he (she) should submit his or her "bids to buy" and "offer to sell" near the EVs (See Cason and Plott, 1996).

In figures 2.6 and 2.7, a circle mark represents each observed bid to buy and offer to sell, the straight line represents a 45 degree slope, and a thick line represents the median regression line estimated with the data which will be explained later. In these figures, we can observe that bidding and offering behaviors are positively correlated with the EVs, and a persistent tendency to submit "bids to buy" below the EVs and "offers to sell" above the EVs. This means that many circle marks exist below the 45 degree line for bids to buy and above it for offers to sell (See figures 2.6 and 2.7). We can also confirm that this behavioral pattern applies to many participants by looking at each individual data. To clarify the positive correlation between the actual behaviors of subjects and

Figure 2.6: Bids to buy



their EVs, we obtain an slope estimate by running the median regression, in which the observed bids and offers are taken as dependent variables and the corresponding EV values are the independent variable. Note that if this regression is close to the 45 degree line, it means that the subjects are induced to reveal their true values through their bids to buy and offers to sell.

The regression is specified as follows:

$$bid_i = \beta_0 + \beta_1 v_i + \varepsilon \tag{2.1}$$

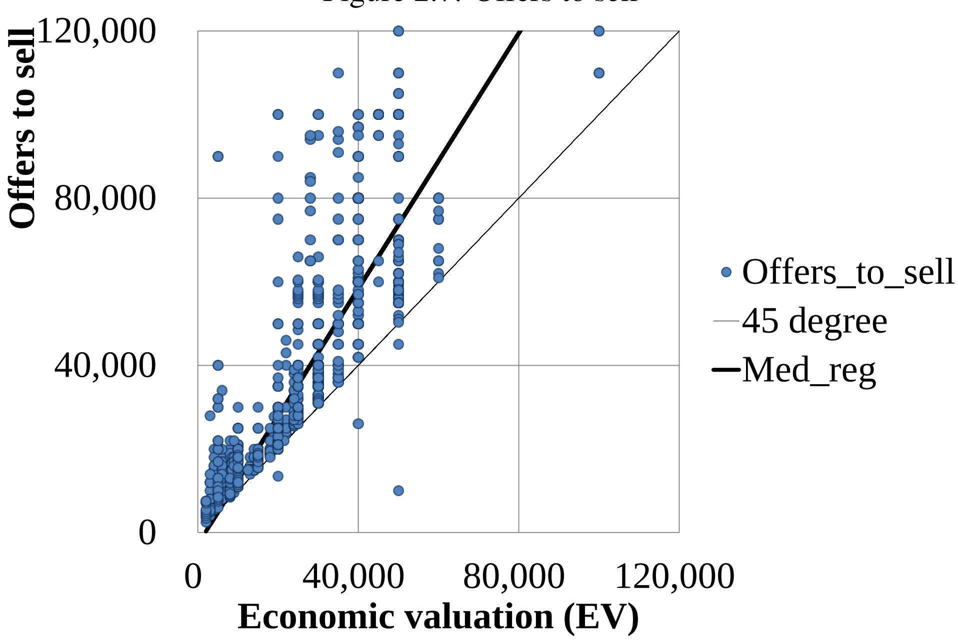
$$offer_i = \beta_0 + \beta_1 v_i + \varepsilon \tag{2.2}$$

where bid_i is an observed bid to buy, and $offer_i$ is an offer to sell as revealed by subject i during the experiments, v_i is the corresponding EV for the unit of forestland, β_0 and β_1 are the parameters and ε is defined as the stochastic error term. Note that if the estimates in the above median regressions produce a zero intercept and a slope of 1, then the subjects are considered to have $100\,\%$ demand revelation.

Session	1	2	3	4
Efficient trade volume	6	9	12	8
Average trade volume	4.7	6.6	9.1	4.5
Median	5	6.5	9	4.5
Mode	5	6	9	5
Standard deviation	1.05	1.34	0.56	1.5

Table 2.4: Observed trade volume per session

Figure 2.7: Offers to sell



Then, the estimates for each of the bids to buy and offers to sell are obtained as follows:

$$\widehat{bid}_i = \underset{(90.99)}{666.67} + \underset{(0.0042)}{0.67}\, v_i, \quad \text{Pseduo } R^2 = 0.57, \quad T = 1740,$$

$$\widehat{offer}_i = \underset{(753{,}89)}{-753.89} + \underset{(0.020)}{1.53}\, v_i, \quad \text{Pseduo } R^2 = 0.23, \quad T = 840.$$

The numbers in the parentheses are the respective standard errors. The estimation from this model shows that both of the slope estimates β_1 are positive and statistically significant, although the magnitudes are different from the regressions for bids to buy and offers to sell. With respect to the estimates of the intercepts, we can clearly see that the bids to buy regression has a positive intercept value, while the offers to sell regression has a negative intercept value. Based on these regression results, it seems that the demand revelation through bids to buy and offers to sell has not been perfectly rendered in our experiment, but the bids to buy and offers to sell are positively correlated with the corresponding EVs to a certain extent of statistical significance. Therefore, we say that a UPA induces at least a partial demand revelation to such an extent that efficiency gains become approximately $80\,\%$ on average.

The reasons for the difference of regression results between the bids to buy and the offers to sell associated with the partial demand revelation could be attributed to several factors. At this point, we conjecture that endowment effects may be potentially present in our experiment. Note that our experiments were conducted in the field and asked subjects to think of the “real” good of forestland, which is different from the controlled laboratory experiment reported in the literature. Most of prior works employ a neutral terminology to describe marketable permits by expressing them as coupons and pollution as production. In contrast, we have used the term “forest” directly throughout the experiments because of our intent to explore the efficiencies of the MPS for real forest management practices.

In our experimental environment, endowment effects can induce the subjects to over-report their offers to sell for each permit in relation to the corresponding EVs (See figure 2.7. Almost all of offers to sell are located above the 45 degree line and the degree of over-reporting is very large). The previous works of Knetsch and Sinden (1987) and Kahneman et al. (1990) have established that if subjects are endowed with real goods, then substantially fewer trades have occurred in comparison to the trades theoretically predicted in the absence of endowment effects. The endowment effects might have reduced the gains from trade in our experiments. Fortunately, the results demonstrate that efficiency losses from the effects are not so significant, and that our UPA institution could be considered efficient in the field even in the presence of endowment effects.

Overall, the market performances observed in our experiment, with the UPA institution under trader settings with real subjects, are quite consistent with the result of Cason and Plott (1996), although some endowment effects were observed in our cases. These data indicate that the UPA institution's market performances, even under trader settings in the field, do not significantly fall shorter than the results under non-trader settings in laboratory experiments. Finally, we claim that the market allocation of permits through the UPA can be efficient and socially desirable with an appropriate scheme of the initial allocation and can improve equitable welfare distribution along with the preservation of forestland resources.

2.3.4 Discussion

Our results can potentially provide some implication not only to forest conservation in Nepal but also to other cases. Currently, the implementation of the REDD+ program has been reviewed in Nepal and in many other parts of the countries to stop worldwide rapid deforestation (Sukhdev et al., 2012; FAO Forest Department, 2015). This program is an effort to create a financial value for the carbon stored in forests, offering incentives for people in developing countries to reduce emissions from forestland and to invest in low-carbon paths to sustainable development. The REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

The MPS induces forest users who are innovative and productive to buy and hold more forestland and the REDD+ program is considered an additional source of benefits for such productive forest users. However, this does not mean that less productive forest users suffer. The existence of the REDD+ program together with the MPS shall strongly motivate forest users to be more productive, implying that overall efficiency gain achieved under the MPS can be larger based on our experimental results. In such a situation, less productive users should be able to sell the land with higher prices and gain more benefit as well, leading to more overall efficiency. In this sense, the REDD+ program can reinforce the effectiveness of the MPS for forest management. Therefore, evaluating the potential efficiencies of the MPS for forest management through field experiments in other parts of the world shall be more important and our results could be considered a benchmark for the future research.

By analogy, the MPS of our field experiments could be related to other land use issues such as potential conflicts between development and conservation of farmland, preserving country-side amenity, protection of natural environment and so on. Due to heavy pressures from urban sprawl and rise in agricultural demand, many countries face potential depletion of wilderness and natural environment. For example, USA, European countries, say, Germany, Switzerland, and Netherlands, Asian countries, Indonesia and Philippines as well as South American countries, Brazil and Costa Rica, face the similar type of problems. Starting in the 1970s, the transferable development rights (hereafter, TDR, or equally the MPS) have been implemented to address the land use problems in more than one hundred locations of USA, while most countries have not adopted the TDR yet (Renard, 2007; Pruetz and Standridge, 2009; Corkindaie, 2013). To the best of our knowledge, the TDR efficiencies have not been addressed empirically in the field, and such evaluation is going to be important for further application of TDRs. Our research implies that the efficiencies of TDR applied to many types of land use in these countries can be evaluated through field experiments, and it is likely that high efficiencies in TDR field experiments are observed.

2.4 Conclusion

This framed field experiment was designed to develop the MPS under cap and trade schemes for the management of forestland at Shaktikhor, Nepal. This attempt was made to fill the gap in the literature in that the performance of the MPS applied to real resource management in the context of a developing nation has not been yet explored. Therefore, this paper has reported the efficiencies and potentials of the MPS by the field experiments with some novel features: (i) implementation of the UPA under trader settings in the field and (ii) representative simulation of economic decisions made by the local farmers with elicited demand for forestland. Equilibrium prices per *Khatta* forestland development were derived through the observed trades in field experiments, using the elicited demand and supply relationships of permits involving 40 farmers.

The experimental results show that the MPS was effective with high efficiency of $80\,\%$ in the real-life conditions of the field. The UPA is considered to be a key element for this result because the UPA could perform with simple market information, and farmers with elementary educations could understand and follow the rules of trading.

Consequently, they were induced to reveal their valuations of forestland through bids to buy and offers to sell, such that the overall experimental outcome lies closer to theoretically efficient markets, although endowment effects and some irrational behaviors are observed. In addition, the UPA has shown stable price dynamics for the market as substantial trades have occurred in the MPS for forestland development. Furthermore, this result shows a good scope for the MPS and potential to be an effective policy option for the practice of natural resources management with less administrative burden.

Another important point to mention is that through the markets elicited across the four sessions of experimentation, an average equilibrium price was estimated at NPR 22 000 per *Khatta* of forestland. The prime factors that contribute to this price of forestland are distinctive valuations among the people and their dependency on forest resources; hence, they can comprehend its costs and benefits based on their daily life experiences in forest. Again, recall that these values are elicited from the local farmers of the Shaktikhor village development committee, Nepal, and it is highly plausible considering their present conditions for price levels, living standards and commercial land prices, as mentioned earlier.

The MPS itself does not always guarantee an efficient market to emerge through simply asking people to trade marketable permits. This study could be considered an illustration of how the MPS is a flexible and cost-effective market instrument that could potentially play a vital role in addressing real world natural resource problems. Here, we admit that the inception of marketable permits for forest conservation in rural parts of Nepal is a very difficult task in reality. However, our field experiments have shown that even local farmers can achieve high efficiency gains under UPA institutions, which may be considered an important first step toward realistic application of the MPS to natural resource conservation. As an implication of our results, the farmers who highly value forestland resources will benefit from buying permits and those who put a low value will benefit by selling the permits. Hence, the issues of social injustice and the unfair welfare distribution of forest resources to rural households of a country like Nepal can be solved. Finally, a governing body should be very vigilant about changes in the scope and motivations of trading to keep trades free from market speculation.

For the future research, there are several possible research topics emanating from this work. It appears that endowment effects play important roles in our field experiments. However, we did not vary the distributions of permits as a control and thus could not identify how initial endowments of permits to subjects affect the overall performance. We conjecture that endowment effects play more significant roles in the field than in the laboratory. Another possible direction of the future research is evaluation of efficiencies in transferable development rights (TDRs) for preservation of wilderness and so on as mentioned in discussion section. There are several places where TDRs have been implemented, however, the TDR efficiencies have never been evaluated in the field experiments. This shall be an important research for further applications of the TDRs.

In summary, this paper has employed the UPA institution under trader settings in the real-life conditions of a developing nation, involving local farmers with elementary educations, which itself could be considered a pioneering work in the sphere of experimental research.

2.5 Appendix

Illustration of experiment design:

In one session, 10 numbers of periods are conducted and in each period subjects earn ”experimental money” by trading ”Permits” however, subjects did not know before how many periods they are going to trade until the end of the experiment. Subject’s earnings in each period are determined as follows: Payoff = Net benefit (EV, here after) from forestland + Sale proceeds from selling permits - Amount spent on buying permits.

Why permits are required?

Permits are necessary for farmers to utilize forestland in a way they wish, enjoying forest product and resources, otherwise they have bear the cost of forestland maintenance by employing labor and time, in other words they have to bear obligation of forestland protection. However, people having the permits are not allowed to do clear cutting, but they can solely enjoy EV of the forestland that they receive as endowment. If anybody wants to have further forestland to develop and utilize he has to buy permits and those who does not want to utilize forestland that can simply sell their permits to others and receive the permits price and maintain rest of his unit of community forestland as obligation. Subjects have a chance to trade ”permits” in each period following the compliance rule:

“Permits”= 30% of the total land demand

“Obligation”= 70% of the total land demand Total forest land demanded 100% = Permits + Obligation

Everyone starts with different number of ”permits” as they have different demand for forestland in every session and they can adjust their own holding of ”permits” by buying and selling them in a market that will operate. If subject, sell the permits, their cash increases by the sales amount, and if subject buy permits, their cash decreases by the sale amount. Later, we explain the rules for buying and selling permits.

Why subject might want to buy permits?

Remember as mentioned above permits will allow subjects to develop or utilize forestland in a way he wish. See table 2.2, this subject has 10 units (1st to 10th) of forestland demand as per his given EV. He currently hold 3 permits, 1st, 2nd and 3rd units which he can solely enjoy and the remaining 7 units, (4th to 10th) he is supposed to maintain is as an obligation. Therefore, total forestland demand is 10 units (7 units obligation + 3 units permit). For instance EV of fourth unit is 22000 so if subject can buy a coupon for less than 22000, this might be a good idea since he is getting forestland in cheaper value. More specifically, if you subject buy permits for 21000, he get surplus of 1000 = (22000 - 21000) because of the lower value of that unit by some other people. In this case, subject will maintain 6 units of forestland and can develop 4 units of forestland with 4 permits that he receives. Note that the same logic applies when subject wants to buy an additional permit to increase surplus from each of 5th, 6th and 10th units of forestland.

Why might subject want to sell permits?

Continuing the illustration based on the previous example, suppose that subject currently hold 3 permits with corresponding EV. The EV of 1st unit is 35,000 but if he can sell a permit of the 1st unit for more than 35000, this might be a good idea since these sales revenues exceed his value of this 1st unit. For example, if he sell a coupon of the 1st 2nd and 3rd unit for higher then his value, even he incur the additional 3 units of forestland as obligation, but still get a higher value for his permits which would increase his surplus. In this case, he will take 10 units of forestland and will hold no permits.

Trading rules of coupons

The authority requires that, in each period, subject must submit bids to buy price at which subject want to buy each additional unit of permit that he will obtain and an offer to sell price at which he would sell each additional unit of permit that he has. In other words, refer table 2.2, this subject has 3 permits, then he has to submit 3 distinct offers to sell at which he would sell for each permit he hold, and also have to submit 7 distinct bids to buy at which he would buy for each permit he might obtain. Therefore, the general rule for submitting offers to sell and bids to buy is written as follows:

The number of offers to sell + the number of bids to buy = total permit demand for forestland

One session consists of 10 participants and 10 periods. After the offers and bids from all participants are collected, the authority ranks all bids to buy from highest to lowest and offers to sell from lowest to highest.

For example, imagine that aggregate demand by 10 participants for forestland permits in one session is 43 units where 13 units of permits are supply, 30 units of permits are demand. Each subject submits distinct offers to sell and bids to buy. Then the authority will receive 13 distinct offers to sell and 30 distinct bids to buy

Finally, the authority will create a ranking for these offers and bids as shown in table 2.8. Here, units of permits are traded in order from left to right as long as the bids to buy exceed or equal the matching offers to sell. In the example of table, the highest 12 bids to buy and the lowest 12 offers to sell are accepted as trades.

The uniform market price, which is paid by all buyers and is received by all sellers, is determined as the average of the bid to buy and offer to sell of the last unit traded. In this example, the last unit traded is 12th unit of permit and therefore, the uniform market price is 20000= (20000+20000) /2 and all units traded in this market are bought and sold at this price. After the authority announces this uniform price, trade occur and pay off is calculated as mentioned earlier.

Figure 2.8: Ranking of offers to sell and bids to buy to determine uniform price

Permit	Bid to buy	Offer to sell
1	80000	8000
2	80000	8500
3	80000	9000
4	80000	10000
5	50000	10000
6	50000	10000
7	50000	14000
8	35000	15000
9	30000	15000
10	28000	18000
11	25000	20000
12	20000	20000
13	20000	25000
14	16000	
15	15000	
16	13000	
17	13000	
18	12000	
19	11000	
20	10000	
21	10000	
22	10000	
23	9000	
24	8000	
25	8000	
26	8000	
27	7000	
28	7000	
29	6000	
30	6000	

Chapter 3

Sustainability of common pool resources

3.1 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 efficient property serves as the main engine of economic growth (Schumpeter, 1942). However, some of these principles do not appear to function in reality as theory predicts. For instance, intra- and inter-generational allocations of environmental goods and natural resources are claimed to be inefficient under capitalistic conditions as illustrated by climate change trends and the depletion of the world's forests. Thus, resource sustainability has become a key issue of a growing concern in relation to capitalism.

When natural resources are provided as commons, they are typically referred to as common pool resources (hereafter, CPRs). In the CPR allocations, individuals are known to face a coordination problem of social dilemmas and a sustainability problem of depletion (Gordon, 1954; Hardin, 1968). Ostrom (Ostrom, 1990) states that individuals tend to lose their ability for coordination in social dilemmas unless they are facilitated through communications and monitoring. Interestingly, however, Fruteau et al. (Fruteau et al., 2013) have shown that animals such as vervet monkeys overcome social dilemmas without any intervention. It thus remains an open question whether or not humans have coordination abilities to solve the dilemma to sustainably manage CPRs.

Economists have long examined the CPR dilemmas via experimental methods. Walker and Gardner's paper is a pioneering work in the examination of CPRs in experimental settings (Walker and Gardner, 1992). Additional studies have examined CPR games through laboratory experiments that mimic some environments observed in the field (e.g., the probabilistic destruction of the commons and various strategic situations) (Keser and Gardner, 1999; Cardenas, 2011; Janssen et al., 2011). Decision-making processes and preferences of actual resource users for CPRs have been examined through field experiments (Cardenas and Ostrom, 2004; Velez et al., 2009; Cardenas, 2011; Fehr and Leibbrandt, 2011). All of these field studies have been conducted in static or repeated-game settings, and show that some external devices such as information provisions and other-regarding preferences are essentials to CPR solutions. Another group of works explicitly incorporates resource dynamics in the CPR experiments and analyzes how the dynamic nature of resources affects the outcomes compared with static or repeated cases (Herr et al., 1997; Mason and Phillips, 1997; Bru et al., 2003; Kimbrough and Vostroknutov, 2015). These studies have demonstrated that the regeneration processes of CPRs critically affect the sustainability of resource use. From these works, other studies have introduced inter-generational allocation and process uncertainties of resource dynamics, showing that the one-way nature of inter-generations and process uncertainties compromise sustainability (Fisher et al., 2004; Botelho et al., 2014). More recent works have theoretically analyzed the dynamics of public resources and people's cooperation in spatial public goods game (Wakano et al., 2009; Xia et al., 2012; Zhu et al., 2014; Chen et al., 2015, 2016). These works suggest that reputation, mobility and neighborhood environments are important determinants for solving social dilemmas in a dynamic spatial environment.

Ostrom discusses that individuals can organize sustainable resource use in specific socio-ecological environments that enable interpersonal communication and monitoring (Ostrom, 2009). This points to the importance of identifying dynamic socio-ecological factors to enhance self-organization through analyzing collective human behaviors rather than imposing top-down rules. Accordingly, several recent works have reported how socio-ecological environments, societal network and reciprocity influence cooperation among individuals in a evolutionary perspective (Perc and Szolnoki, 2010; Wang et al., 2013, 2015). Individual cooperative behaviors in the eastern and western Germany have been studied in consideration of the different social histories of these regions (Ockenfels and Weimann, 1999; Brosig-Koch et al., 2011). Authors find that subjects from the eastern region act more selfishly than those of the western region. Fishermen of individualistic lake-based fisheries are more competitive than those in collective sea-based fisheries, suggesting that daily practices with others in workplaces affect human behaviors and preferences (Leibbrandt et al., 2013).

The sustainability of natural resources is claimed to be endangered worldwide, as many countries are now moving toward more competitive environments. As socio-ecological environments are established to affect human nature, it is necessary to analyze how the ongoing modernization of competitive environments, i.e., "capitalism," affects natural resource use. Despite their importance, no works have addressed these issues and thus this paper seeks to discuss how the degree of capitalism in societies characterizes individual prosociality, behaviors and CPR sustainability in the fields. To this end, we design and implement a set of dynamic CPR games and experiments in the two types of Nepalese areas, urban (capitalistic) and rural (non-capitalistic) areas. Nepalese areas are studied, because Nepal is characterized by relatively uniform ethnic, religious and cultural demographics, but has wide disparities between rural and urban areas with respect to daily life practices. The features of Nepal allow us to control for degrees of capitalism in our field experiments without experiencing confounding factors.

3.2 Methods and materials

The field experiments of the CPR game incorporate resource dynamics in such a way that subjects with limited education understand. A group of 4 subjects is formed. Each subject is informed of the group size but not of the identities of the group members. Subjects are also told that the group members would remain the same. The resource stock at the beginning of each period is denoted by x_t, where the subscript denotes 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 determine his/her individual harvest $y_{i,t}$. The escapement, s_t, is defined as $s_t = x_t - \sum_{j=1}^{4} y_{j,t}$ where $\sum_{j=1}^{4} y_{j,t}$ is the group harvest at period t. When $s_t \geq 0$, then the individual payoff is $\pi_{i,t} = y_{i,t}$. When $s_t < 0$, the individual payoff, $\pi_{i,t}$, is $y_{i,t} = \frac{x_t}{4}$ for simplicity. The escapement, s_t, is considered to be a remaining stock for each period t and determines the evolution of resource dynamics. The resource stock dynamics are specified as

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

In this model, the next-period stock x_{t+1} grows up to a $50\,\%$ increase in the escapement, and the game continues to the next period when $s_t > 0$ (the remaining stock is strictly positive). Otherwise, resource depletion results and the CPR game is terminated.

To simulate realistic conditions, we incorporate time discounting in the 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 each group picks one chip and the chip is white. If a red chip is selected, the game is terminated for that group. This situation resembles the discount factor of $\rho = 0.95$ in terms of time preferences. In summary, our CPR games are terminated when a group depletes the resource, i.e., $s_t \leq 0$, or when the red chip is selected by a group representative. With this setup, we are interested in identifying how many periods each group can sustain resource use in the games. The period at which each group terminates the game via resource depletion or chip selection is referred to as the "terminal period." This is a measurement of the degree of sustainability.

This CPR game is designed to capture key factors of resource sustainability, reflecting some fundamental features of CPR utilization in the real world: (i) strategic uncertainty with anonymity, (ii) dynamic evolution of resources and (iii) time preferences of resource users. The game is framed within a resource utilization problem of multiple players on an infinite horizon, and it uses the following predictions of Nash equilibrium and Pareto optimality. One symmetric Markov perfect Nash equilibrium (potentially the simplest and played most frequently) states that each subject harvests the resource to exhaustion at an initial period. Pareto optimal allocation occurs when each subject in a group allows the resource to grow, and the group harvests the entire resource at once at the terminal period of budget and time constraints. The subjects are told that they may be asked to stop playing the game due to the "terminal period of budget and time constraints" if the game continues for too long.

The dynamic CPR field experiments were conducted in two types of Nepalese regions. The Kathmandu and Pokhara districts are urban, and the Chitwan and Parbat districts are rural (figure 3.1). The Kathmandu and Pokhara districts are the first and second largest cities in Nepal, respectively, and these are the most highly populated areas in the country where most residents work in business, service and government sectors. The Chitwan and Parbat districts are rural areas consisting of small villages that are less densely populated where most residents work in the agriculture or forestry sectors. To ensure the random assignment of groups, subjects were selected from different cities and villages in cooperation with local NGOs and offices for each session. In using this approach, we avoided recruiting participants who knew one another.

Figure 3.1: The locations of fields: Kathmandu and Pokhara as urban areas and Parbat and Chitwan as rural areas

A total of 528 subjects participated in this experiment, which is the maximum number of subjects that we could recruit under our time and budget constraints. As each group includes 4 subjects in the CPR game, the 67 groups and 65 groups of 268 and 260 subjects for the urban and rural areas were formed, respectively. In each session, $5 \sim 8$ groups convened in one place, and subjects were not allowed to communicate with one another. On average, each session of the CPR games and questionnaires lasted 3 hours. The subjects are told that the CPR game begins with an initial group token (initial resource stock) of 120 for each group, and that the next period would be reached as long as the resource is not depleted by the group members and as long as the red chip is not selected by the group representative. We described the resource and its dynamics using neutral terminology. The resource stock and escapement are expressed as “tokens” and "remaining tokens" for that given period, and the "next-period tokens" grow by $50\,\%$ for the remaining tokens. We did not have access to computers or an internet connection in the field. The sessions were thus managed manually by experimenters and research assistants for each session.

At the start of each period, subjects were given the information on the group tokens and were asked to make an individual decision on how many tokens they would take. After the individual decisions were made, the participants were informed of the group harvest and of the remaining tokens. However, they were not informed of group members' individual harvests. Unless no tokens were left, a representative of each group was randomly chosen to select one chip from a box with 19 white chips and 1 red chip. When a white chip was selected, the group moved to the next period. After completing the CPR games, we administered questionnaires on socio-demographic information and the social value orientation (SVO) game (adopting the "Slider Method") for identifying subjects' social preferences (Murphy et al., 2011). Subjects were paid real money based on the cumulative payoffs of their decisions made during the experiments including the SVO and CPR games in addition to a show-up fee in the local currency valued at US $\$2$. Experimental rupees were converted to the Nepalese rupee (hereafter, NPR) at a rate of 1 experimental token $= 2$ NPRs. On average, NPR 500 was paid to the participants, which is nearly equivalent to $\$5$.

3.3 Results

We report a series of the questionnaire and experimental results with a focus on the rural and urban conditions with 65 and 67 groups of 260 and 268 subjects, respectively. Table 3.1 presents the summary statistics on the subjects' socio-demographic information and on the experimental results. For the rural cohort, $38\,\%$ of the participants are male with an average age of 34.5 years, while the urban cohort includes $58\,\%$ men with an average age of 24.5 years. This result is attributed to the fact that many young men in the rural areas migrate to the urban areas or even to foreign countries for employment.

With respect to education, more than $50\,\%$ of the subjects in the urban areas have a university undergraduate degree (16 years of schooling as the median in table 3.1), while the subjects in the rural areas possess 10 years of schooling as the median value. In regards to occupations, $90\,\%$ and $6\,\%$ of subjects in the rural and urban areas work in agriculture, respectively, implying that more than $90\,\%$ of the urban subjects work in non-agricultural sectors such as the business, service and government sectors. Accordingly, household income is higher in the urban areas than in the rural areas. Overall, the summary statistics of socio-demographic information presented in Table 3.1 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, individuals are less educated and tend to engage in agriculture and forestry.

Table 3.1 presents the subjects' social value orientations (hereafter, SVOs) between the rural and urban areas where the SVO game was conducted to categorize subjects into a prosocial or proself group. First, a significant difference in SVOs is shown in the table, demonstrating that $76\,\%$ of the subjects in the rural areas are prosocial, while only $39\,\%$ of prosocial subjects are found in the urban areas. This difference affects the group composition of members based on SVOs between the rural and urban areas. In the rural areas, the average (median) number of prosocial members in a group is 3.03 (3), and it is 1.57 (1) for the urban areas. As one group includes 4 subjects, this is expected to affect how rural and urban groups harvest the resources. This SVO result shows that individuals are less prosocial in capitalistic areas, placing more emphasis on their own gains.

Table 3.1: 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
Agriculture[5]	0.90	0.27	1.00	0.00	1.00	0.05	0.22	0.00	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
Prosocial 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
Individual harvest (payoff)[8]	143.14	443.54	47.50	12.00	3270.00	36.23	16.62	30.00	13.00	140.00
Prosocial individual harvest (payoff)[9]	174.49	505.67	53.00	12.00	3270.00	40.36	21.56	30.00	13.00	129.00

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

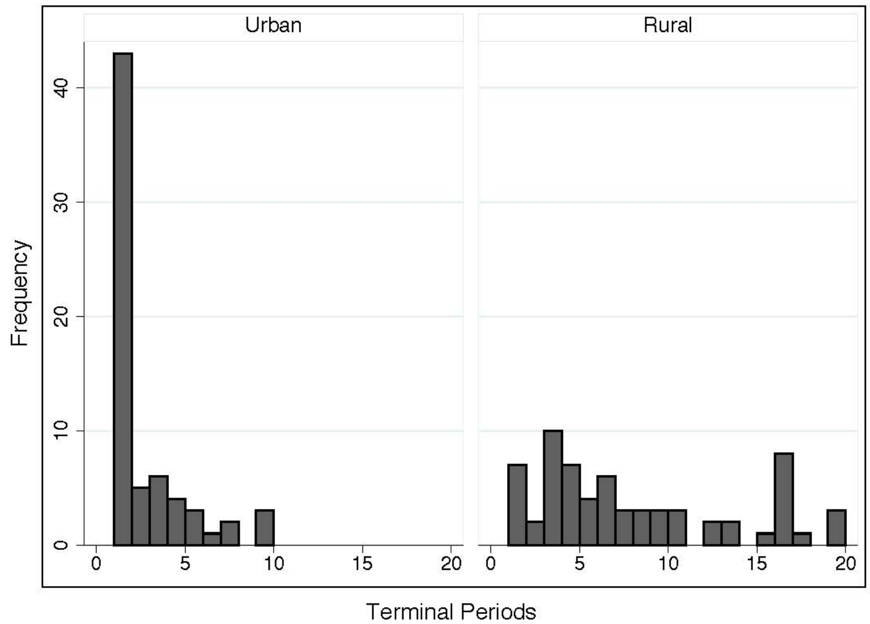
[6] It is a categorical variable of annual income measured by US dollar $\{1, 2, 3, 4, 5, 6\}$: 1. $0 \sim 300$, 2. $300 \sim 600$, 3. $600 \sim 900$, 4. $900 \sim 1200$, 5. $1200 \sim 1500$ and 6. more than 1500.

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

[8] Individual harvest (payoff) indicates the total harvest (payoff) a subject had from the dynamic CPR game.

[9] Prosocial individual harvest (payoff) indicates the total harvest (payoff) a "prosocial" subject had from the dynamic CPR game.

Figure 3.2: Distribution of terminal periods between rural and urban areas



With respect to the terminal periods, the important results can be found for the measures of central locations and variability between the rural and urban areas. The median (average) terminal period is 6.00 (7.63) for the rural areas, while it is 1.00 (2.24) for the urban areas, implying that more than $50\,\%$ of groups in the urban areas exhaust the resource or select a red chip at an initial period and never proceed to the 2nd period. On the other hand, most groups in the rural areas successfully continue the CPR game to more than 6 periods, and one group even reaches 20 periods of continuation. For the group achieving the "longest" play period, we asked the group members to stop the game due to time and budget constraints. The standard deviation for the rural areas ($= 5.56$) is much higher than that in the urban areas ($= 2.19$) (Table 3.1). These statistical findings are in line with the fact that the rural groups play the game for much longer than the urban groups.

Further, Table 3.1 shows the summary statistics of individual harvests (payoffs). The median (average) harvest is 47.50 (143.14) for the rural areas, while it is only 30 (36.23)

Table 3.2: Terminal periods across the rural and urban areas.

Terminal periods	Frequency	Red chip	% of red chip
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 %

for the urban areas. This is a clear evidence that urban subjects not only fail in sustaining the resources, but also end up having lower payoffs. Next, Table 3.1 also shows the summary statistics of "prosocial" individual harvests (payoffs) (Total harvests (payoffs) prosocial subjects had, and see Table 3.1 for the detailed definition). Interestingly, the median is 53 (174.49) for the rural areas, while it is only 30 (40.36) for the urban areas. This implies that prosocial subjects in the urban areas do not differ from general "urban" subjects with respect to harvests, but prosocial subjects in the rural areas perform better than general "rural" subjects.

Table 3.2 summarizes the frequency distributions of the terminal periods and of game termination via "red chip" selection. Red-chip terminations are more common for the rural areas than for the urban areas, with the overall percentage of red chips selected in the rural and urban areas amounting to $33\,\%$ and $15\,\%$, respectively. This is consistent with the fact that the probability of red-chip termination increases with longer periods of play for the rural groups. In fact, only one red chip is selected among all 43 terminations at "terminal period 1" for the urban groups as shown in Table 3.2, implying that many urban groups (42 urban groups) terminate the game by exhausting the resources at the 1st period. On the other hand, the rural groups could have continued the game for much longer if there were no red-chip termination rule. Therefore, we believe that the significant gap in terminal periods between the rural and urban areas would exist irrespective of the red-chip termination rule.

Fig 3.2 shows the corresponding frequency distributions where the vertical axis denotes the frequency and the horizontal axis denotes the terminal period. The distribution for the rural areas is broader than that for the urban areas, and the two frequency distributions are different from one another. In particular, the highest spike in the frequency distribution for the urban areas occurs in period 1, confirming that more than $50\,\%$ of urban groups terminate the game at an initial period. For the post-questionnaires, we include the following question: "how did you want to play?" A considerable number of urban subjects answered to this question as follows: "I really wanted to play the game for longer, but I was not sure whether the other group members were motivated to do the same." This type of answer was given by $51\,\%$ of the urban subjects. It appears that many urban subjects recognize some potential benefits of playing the game for longer. However, they did not actually restrain their harvests for continuation even at an initial period due to their concerns about other members. To confirm the difference in frequency distributions between the rural and urban areas, we conducted a Mann-Whitney test. The result shows that the frequency distributions differ from one another at a $1\,\%$ level of statistical significance.

We characterize resource sustainability in the dynamic CPR games by running regression of the terminal periods where the rural dummy, SVO and socio-demographic information are taken as independent variables. As the terminal periods take positive integers, a Poisson regression is employed in our analysis. The Poisson regression model can be specified as:

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

where j is a group index from $1, \ldots, n$, Y_j is the explanatory variable (terminal periods) for group j, X_j is a number of prosocial members in group j, R_j is a regional dummy variable taking 1 if the region of group j is 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 an intercept, X_j and R_j, respectively. The $\boldsymbol{\beta}_3$ is a vector of coefficients for other independent variables $\mathbf{Z}_j$. We are interested in estimating the coefficients of β_1 and β_2, but we cannot interpret them as they are given. The marginal effect of the number of prosocial members in a group can be approximated by $100 \cdot \beta_1$ which is interpreted as the percentage change. The marginal effect of the regional dummy (percentage change) is derived from a formula of $\exp(\beta_2) - 1$ (See, e.g., Wooldridge (Wooldridge, 2008)).

Table 3.3 reports the estimated coefficients and their respective standard errors with statistical significance. Model 1 includes the number of prosocial members in a group and the regional dummy as independent variables. The results reveal that both independent variables exhibit a statistical significance of $1\,\%$ 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. The expected terminal period for the rural areas is interpreted to be approximately $45\,\%$ higher than that for the urban areas, holding other factors fixed. As mentioned earlier, the marginal effect of the regional dummy variable can be approximated by the following formula: $\exp(.37) - 1 \approx 0.448 \approx 45\,\%$. These marginal effects are considered to be economically significant, illustrating the strong effects of member prosociality and of the regional dummy. As the regional dummy used in our analysis is considered to represent the degree of capitalism, we conclude that resource sustainability tends to be compromised as societies become more capitalistic.

For the robustness check, we run another Poisson regression by including other independent variables of individual characteristics as shown in model 2 of Table 3.3, the average income, the number of males, the average education level and the average age for each group in both areas. The main results of model 2 do not differ from those of model 1. Rather, the economic significance of the estimated coefficient for the regional dummy increases, while it almost remains the same for the number of prosocial members in a group. The estimated coefficients for the number of prosocial members in a group and the regional dummy are still statistically and economically significant. The

Table 3.3: Poisson regression for the terminal periods in the dynamic CPR games

	Model 1	Model 2
# of prosocial members in a group	0.68***	0.65***
	(0.041)	(0.044)
Regional dummy	0.37***	0.49***
		(0.108)
Av. income in a group		−0.29
		(0.042)
# of males in a group		0.077**
		(0.039)
Av. education in a group		−0.0045
		(0.021)
Av. 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.

expected terminal period is interpreted to increase by $65\,\%$ with an increase in prosocial members in a group. Likewise, the expected terminal period for the rural areas is estimated to be roughly $63\,\%$ higher than that for the urban areas (The marginal effect of a regional dummy= $\exp(0.49) - 1 \approx 0.63$).

It is also observed that average income, average education and average age have no significant effects. An exception is that the number of males in a group that shows a positive effect with statistical significance of $5\,\%$. However, the magnitude is $7.70\,\%$, which could be considered small in comparison to the regional effect and social preferences. This result may derive from gender inequality in the society as Nepal is a highly male-dominated society. Past literature has also revealed that women are less cooperative with outgroup members than men (Croson and Gneezy, 2009). We attempted to create alternative specifications for the Poisson regression. However, the results with respect to the number of prosocial members in a group and the regional dummy do not change significantly. We confirm that these two variables remain statistically and economically significant, irrespective of the specifications used in the models. The SVO and the degree of capitalism (regional dummy) are key determinants of resource sustainability.

The SVO is a good proxy for individual social preferences, and our SVO results are intuitive in the sense that more prosocial subjects in a group lead to better resource sustainability outcomes. On the other hand, our results for the regional dummy raise the following question. What does the regional dummy truly capture in the regression? In this paper, we define capitalism as the ongoing modernization of competitive societies. Urban areas examined in the field experiment (e.g., Kathmandu) are considered to be capitalistic societies, rapidly developing in a competitive fashion. By contrast, rural areas such as the Chitwan district are still home to agrarian and traditional societies.

Urban areas such as Kathmandu have attracted a large number of migrants from other areas of Nepal. Individuals migrate to urban areas because they imagine that better opportunities for safety, education and employment are provided in these areas. In reality, however, urban areas in Nepal have become denser, and individuals are required to compete with others for survival in business, service and government sectors by utilizing their skills and education. In many cases, individuals do not know who their neighbors are with their busy lives. Simply put, life in current Nepalese urban areas does not require individuals to interact or to cooperate with neighbors and others on a daily basis. Recall that more than half of urban subjects answered in our questionnaire surveys “I really wanted to play the game for longer, but I was not sure whether the other group members were motivated to do the same.” This trend represents the general assumptions urban subjects possess about how other people behave.

In the rural areas, most individuals still engage in agriculture and in natural resource management based on indigenous knowledge and traditional practices where cooperation and sharing are quite common among individuals. For instance, *Mela pat* and *Parma* are well known as voluntary and cooperative farming practices that prevail in rural Nepalese culture. Individuals exchange or offer farming and forestry services without monetary rewards. Such forms of voluntary cooperation remain common of Nepalese rural areas, as rural residents are vulnerable to natural uncertainties and calamities, and cannot sustain their lives without mutual cooperation. We suspect that such regular human network linkage through daily interaction in Nepal shape rural individuals’ preferences, customs, norms, assumptions about others through for sustainably managing resources.

In our dynamic CPR games, each subject in a group does not know the identity of other group members, and cannot infer how other members behave. That is, each subject needs to decide what to do under the poor information environment. In such a case, it is claimed that people follow what they have experienced, learned and observed from others in their daily life, and their behaviors shall be dominated by not only individual preferences (SVOs) but also conformity for proper actions that people have developed (Henrich and McElreath, 2003; Cardenas and Ostrom, 2004). In particular, it is our belief that the individual decisions and outcomes in the 1st period of the dynamic CPR games shall be influenced by such conformity. From the 2nd period onward, each subject confirms and/or adapts her actions to updated conformity, following the observations in the previous periods. The conformity people possess based on their daily life appears to be very different between urban and rural areas, reflecting a huge discrepancy of 1st-period outcomes and the strong effect captured by the regional dummy in the regression analyses.

In summary, the differences in daily practices of cooperation and competition for survival or for earning incomes between the rural and urban areas appear to affect individuals' preferences, customs, social norms on resource use, assumptions about others, etc in collective CPR settings. The regional dummy is considered to capture important factors other than the SVO. Following the previous arguments that social environments affect individual preferences and behaviors (North, 1990; Henrich et al., 2005; Dawkins, 2006; Wilson et al., 2009; Henrich et al., 2010a; Leibbrandt et al., 2013), our field experiment serves as a first attempt to demonstrate that both the SVO and other factors captured by the degree of capitalism (regional dummy) are important for resource sustainability. This analysis shows that resource sustainability will be compromised by changes in human nature through interactions between individuals, as societies develop in capitalistic ways. This implies that individuals may be losing their coordination abilities to solve social dilemmas of resource sustainability in capitalistic societies.

3.4 Conclusion

This experiment has analyzed resource sustainability in a dynamic setting with respect to the degree of capitalism and social preferences. We find that the proportion of prosocial individuals in the urban areas is lower than that in the rural areas, and urban residents deplete resources more quickly than rural residents. The composition of proself and prosocial individuals in a group and the degree of capitalism (rural vs. urban) are identified as two central factors, such that an increase in prosocial members in a group or the regional change from the urban to the rural improve resource sustainability by approximately $65\,\%$ and by $63\,\%$, respectively. Overall, this paper shows that when societies evolve into more capitalistic environments, the sustainability of common pool resources tends to be lost via changes in individual preferences, social norms, customs and assumptions about others through the ways of human interactions. That is, individuals may be losing their coordination abilities in managing social dilemmas of resource sustainability in capitalistic societies.

We note some limitations of our study. This research does not fully address the details of rural-specific effects on the sustainability of common pool resources. In reality, rural-specific effects might not only compose of the ways of human interactions or human network but in a daily life there could be other factors, such that it hold strong social capital or conformity among them. In the future, we should collect more detailed data about human interactions and other possible factors that may represent the differences between rural and urban areas. If such rich data are successfully collected, new methodologies such as social network methods can be utilized to analyze network effects in resource utilization. It is also very important to ensure external validity of our findings by conducting further experiments in the future. Shahrier et al. Shahrier et al. (2016) show that a larger proportion of prosocial people are found in rural areas than urban areas in Bangladesh, which is consistent with our result. We expect that the same type of qualitative results with our CPR experiments shall be confirmed in different countries and contexts.

Chapter 4

Generativity between rural and urban societies in a developing country

4.1 Introduction

Generativity, concern and commitment for the current and next generations, is one important element for sustainable development of a society, since higher generativity of the current generation induces people to educate and benefit the next generation and even the next (Erikson, 1963; Volckmann, 2014). Generativity is expressed through the daily practices and human interactions such as charity, mentoring, nursing, volunteering, teaching, religious movement and political activities for the next generation (McAdams and de St. Aubin, 1992). In reality, societies transition over time with "overlapping generations" in the sense that some members in one generation survive and remain as members in the next generations (Gaspar and Lauren, 2013). Unfortunately, it is claimed that the current generation has behaved in more selfish ways than ever, compromising generativity and intergenerational sustainability by incurring costs for the current and next generation, i.e., "generativity crisis" (Sasaki, 2004; Fisher et al., 2004; Milinski et al., 2006; Pratt et al., 2013; Molnar and Vass, 2013; Jia et al., 2015; Lefebvre and Lefebvre, 2016). Thus, future generations thinking or generativity becomes an urgent issue when societies are changing in favor of the current generations. Given this state of affairs, this paper addresses the generativity in relation to intergenerational sustainability in rural and urban areas in developing countries.[1]

[1] We have taken the context of one country, Nepal, because it is a good proxy for representing ongoing phenomena of rapid urbanization and diminishing social connectivity in a developing world.

One of the most important issues faced today is to what extent the interest of future generation need to be addressed, while a sustainable society have to satisfy current generation needs without jeopardizing the prospect of future generations (Howard, 2000; Masini, 2013; Tonn, 2009, 2017). In fact, much of the literature in the past have considered these issues philosophically to provide institutional proposals and theoretical framework (Inayatullah, 1997; Pino, 2007; Balazs and Gaspar, 2010; Chen et al., 2016; Tonn, 2017; Seo, 2017). The strongest predictors for measuring people's concern for others is individual social preference (Van Lange et al., 2007b, 2011; Sutterlin et al., 2013; Hauser et al., 2014; Timilsina et al., 2017). However, there have been no studies that established relationship between individual social preference and generativity. Therefore, the key question is how generativity is affected when a society is changing quickly.

Generativity has been studied by many researchers, and the generative behavior checklist (GBC) is established to be one of the most reliable and internally consistent measures (McAdams and de St. Aubin, 1992; McAdams et al., 1993; McAdams and de St. Aubin, 1995). Most studies have sought to characterize the GBC as parts of innate human psychology, focusing on parenting, degree of well-being, life satisfaction and societal concerns (Peterson and Stewart, 1993; Morfei et al., 2004; Huta and Zuroff, 2007; Newton et al., 2014). In particular, Hart et al. (2001) have empirically characterized generativity and found that it has a positive association with social involvement related to parenting in both white and black Americans. Similarly, Hofer et al. (2008) have confirmed that the psychological mechanisms of the generativity model are consistently applicable even in a cross-country comparison. In conclusion, these studies have demonstrated that the GBC can explain behaviors and preferences of social involvement in relation to people's innate psychology, concerns and actual social behaviors.

Economists and behavioral scientists have considered that the socioeconomic environment influences people's social preferences and actual behaviors (Henrich et al., 2005, 2010b; Van Lange et al., 2007b; Leibbrandt et al., 2013). Schotter and Sopher (2003) and Hauser et al. (2014) have shown that the current generation can neither make sustainable decisions in an intergenerational setting, nor take the balance of costs and benefits for future generation when facing excessive competitive economic environment. Henrich et al. (2005, 2010b) and Leibbrandt et al. (2013) have demonstrated that people's social behaviors and preferences are affected by the degree of market integration in societies and workplace environment, respectively. Similarly, Ockenfels and Weimann (1999) and Brosig-Koch et al. (2011) have analyzed people's cooperative and solidarity behaviors in the eastern and western Germany, demonstrating that subjects from the eastern part act more selfishly than those from the western parts. They conclude that social histories and socioeconomic environment play important roles in shaping people's social preferences and behaviors. In summary, the psychologists have addressed how generativity is associated with people's innate psychology and actual behaviors, while the economists and behavioral scientists find how social preference and behaviors are affected by economic environment.

Cultures gradually propagate through various ways such as success-bias transmission in societies and even affect human preferences and behaviors (Henrich et al., 2005; Dawkins, 2006; Richardson and Boyd, 2008; Wilson et al., 2009). Likewise, generativity is hypothesized to be affected by cultures, as it is manifested through both prosocial and proself behaviors originating from people's social preferences (Kotre, 1984; McAdams, 1985). Since societies are becoming more competitive and modernized in the globalized market economy under capitalism, it is expected that such changes in societies as part of cultures affect not only preferences but also generativity. However, no previous researches address how generativity is evolving with economic development of societies and a change in preferences. In this research, we consider ongoing modernization of competitive societies as part of culture and address how generativity changes with such modernization and social preferences. To this end, we conduct field experiments of the social value orientation (SVO) and the generative behavior checklist (GBC) in the two fields of Nepalese societies: (1) urban and (2) rural areas.

4.2 Methods and materials

We implemented field experiments and questionnaire surveys in the rural and urban areas, and employed different approaches of random sampling, because they possess distinct economic and socio-demographic characteristics. Kathmandu and Pokhara are chosen as urban areas that are the first and second largest urban societies in Nepal (figure 4.1). In the urban areas, we administered field experiments and surveys with 268 subjects. These cities are highly populated where most people engage in business, service and government sectors. To maintain random sampling of subjects, a occupation-based randomization procedure was taken. First, we identify a proportion of each occupational category in total population of the urban areas by referring to governmental and international non-governmental reports such as Central Bureau of Statistics (2011) and UNDP (2014). After that, we randomly select a number of organizations or companies for each category. Based on their compliance, we select individuals from these organizations in the way that subjects do not know one another in the same session. Our field experiments and surveys have been carried out in the city and community halls of the urban areas.

In the rural areas, we conducted field experiments and surveys with 260 subjects. Chitwan and Prabat are chosen as rural areas (figure 4.1). These districts consist of

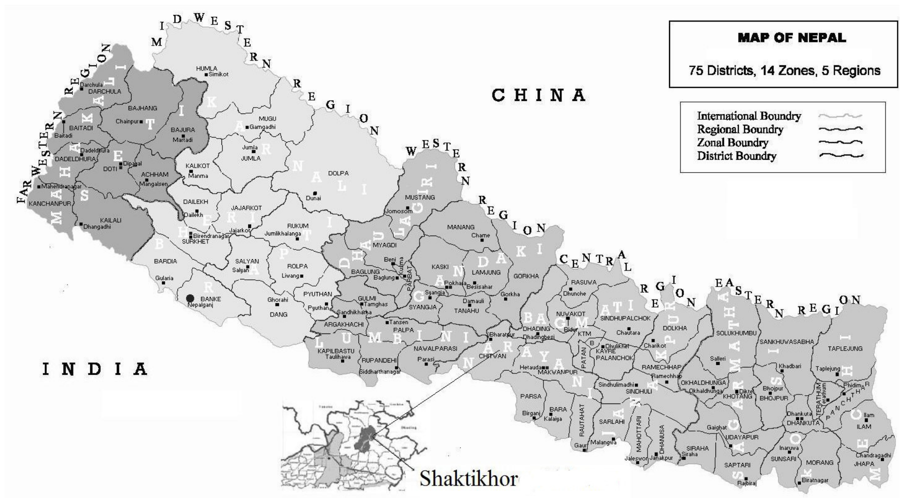


Figure 4.1: The Map of Nepal

many small villages and are known as the least populated areas where most people engage in agriculture and forestry for their livelihood. In rural areas, we conducted a household-level randomization procedure. First, we designate the number of samples for the selected villages based on the total number of households provided by each village development committee office. After that, we select the household number and randomly invite one household by sending them invitation letters. Our monetary incentives and the conditions in invitation letters enabled to collect an enough number of subjects. The field experiments and surveys were conducted in the schools of the rural areas.

The SVO of the "slider method" has been conducted to identify subjects' social preferences as prosocial or proself in urban and rural areas (Murphy et al., 2011). Figure 4.2 shows six items of the slider measure that gives numbers to represent outcomes for oneself and the other in a pair of two persons where the other is unknown to the subject. Subjects are asked to make a choice among the nine options for each item. Each subject chooses her allocation by marking a line at the point that defines her most preferred distribution between oneself and the other. The mean allocation for oneself $\overline{A}_s$ and the mean allocation for the other $\overline{A}_o$ are computed from all six items (see figure 4.2). Then, 50 is subtracted from $\overline{A}_s$, and $\overline{A}_o$ to shift the base of the resulting angle to the center of the circle $(50, 50)$. The index of a subject's SVO is given by SVO $= \arctan \frac{(\overline{A}_o)-50}{(\overline{A}_s)-50}$. Depending on the values generated from the test, social preferences are categorized as follows: 1. altruist: SVO $> 57.15°$, 2. prosocial: $22.45° <$ SVO $< 57.15°$, 3. individualist: $-12.04° <$ SVO $< 22.45°$ and 4. competitive types: SVO $< -12.04°$.

The SVO framework assumes that people have different motivations and goals for evaluating resource allocations between oneself and others. Also, the SVOs or social preferences are established to be stable for a long time (see, e.g., Van Lange et al., 2007b; Brosig-Koch et al., 2011). Responses that are yielded from six primary items give complete categories of social preferences. A major reason for using six primary slider measures by Murphy et al. (2011) is due to its simplicity and easy to implement in the fields of Nepal. It is very intuitive for participants to understand even with a limited level of education. As is done in psychology research, we further simplify the four categories of social preferences into two categories of prosocial and proself types; "altruist" and "prosocial" types are categorized as prosocial subjects, while "individualistic" and "competitive" types are categorized as "proself" subjects (see Murphy et al., 2011).

The GBC developed by McAdams and de St. Aubin (1992) checks the frequencies of generative behaviors each individual has taken in the past. Specifically, the GBC asks how many times a person has performed for 50 different behaviors, among which the only 40 behaviors are suggestive of "generativity."[2] The examples are "taught somebody a skill," "read a story to a child," "served as a role model for a young person" and

[2]GBC is good proxy of behavioral expression for real behaviour and it is also easy for people to answer even in remote rural areas of Nepal. The remaining 10 behaviors in the GBC questionnaire that are not counted for generativity are "fillers."

Figure 4.2: Social value orientation measure by the slider method

Instructions

In this task you have been randomly paired with another person, whom we will refer to as the **other**. This other person is someone you do not know and will remain mutually anonymous. All of your choices are completely confidential. You will be making a series of decisions about allocating resources between you and this other person. For each of the following questions, please indicate the distribution you prefer most by **marking the respective position along the midline**. You can only make one mark for each question.

Your decisions will yield money for both yourself and the other person. In the example below, a person has chosen to distribute money so that he/she receives 50 dollars, while the anonymous other person receives 40 dollars.

There are no right or wrong answers, this is all about personal preferences. After you have made your decision, **write the resulting distribution of money on the spaces on the right**. As you can see, your choices will influence both the amount of money you receive as well as the amount of money the other receives.

Example:

You receive	30	35	40	45	50	55	60	65	70
Other receives	80	70	60	50	40	30	20	10	0

You 50

Other 40

a

1

You receive	85	85	85	85	85	85	85	85	85
Other receives	85	76	68	59	50	41	33	24	15

You ______

Other ______

2

You receive	85	87	89	91	93	94	96	98	100
Other receives	15	19	24	28	33	37	41	46	50

You ______

Other ______

3

You receive	50	54	59	63	68	72	76	81	85
Other receives	100	98	96	94	93	91	89	87	85

You ______

Other ______

4

You receive	50	54	59	63	68	72	76	81	85
Other receives	100	89	79	68	58	47	36	26	15

You ______

Other ______

5

You receive	100	94	88	81	75	69	63	56	50
Other receives	50	56	63	69	75	81	88	94	100

You ______

Other ______

6

You receive	100	98	96	94	93	91	89	87	85
Other receives	50	54	59	63	68	72	76	81	85

You ______

Other ______

"made something for somebody and then gave it to them." Subjects need to write "0" if they have not performed a specific generative behavior, "1" if they have performed the behavior once and "2" if they have performed the behavior more than once for the last one year. Scores on the 40 generative behaviors were summed for each subject to compute a total generativity score.

Considering the opportunity costs of time and to attract subjects to the experimental sites, motivate them seriously to participate in the surveys and games, we have implemented the questionnaire surveys and the SVO game with monetary payments. In each session, we have collected 20 to 40 subjects in a site, provide experimental instructions to subjects, and the experimenter (the first author) orally made presentations to confirm subjects' understanding. We also used six research assistants and helped subjects. After eliciting subjects' SVOs, we conducted questionnaire surveys to collect individual socio-demographic information.

Subjects are paid on the basis of their earnings from the SVO game. After each subject has made his/her decisions, they write the resulting distribution of money on the spaces provided on the right-hand side as shown in figure 4.2. The total amount of points subject allocated for oneself and for the other are calculated from all six items as shown in figure 4.2. Depending on the points generated from the game, the points are converted into real money with an experimental exchange rate. In our experiment, we use 10 points equivalent to 1 NPR. At the end, we randomly matched one subject with another to make pairs for calculating the total payoff of each subject and make payments. One session took 40 to 60 minutes, and the average payment was NPR 200 (approximately USD 2.10) with a show-up fee of NPR 100 (USD 1.05).

This study finally analyzes the association of generativity with people's social preferences and the locations of two different areas. A dummy variable for controlling the urban and rural areas in the analysis is intended to represent different degree of modernization (equivalently, the degree of capitalism) in societies. To characterize which social preference and society lead to higher levels of generativity, nonparametric statistical and regression analyses are employed. The Mann-Whitney test is used to identify the distributional difference of generativity across the two areas and their social preferences. The regression model estimates the marginal impact on generativity when a key predictor, such as SVOs and an area dummy, increases, holding other factors fixed. The set of independent variables includes SVOs, area dummy, household income, age, education, gender and employment.[3] Table 3.1 summarizes the definition of the variables in the analysis.

4.3 Results

Tables 4.1 and 4.2 summarize the statistics of subjects' socio-demographic information and generativity, respectively. Table 4.1 shows that $38\,\%$ of the subjects are male in the rural, while $58\,\%$ of the subjects are male in the urban. With respect to education, more than $50\,\%$ of subjects in the urban have an undergraduate degree in universities (16 years of schooling as the median in table 3.1). On the other hand, subjects in the rural possess 10 years of schooling as the median. Regarding occupation, $90\,\%$ and $6\,\%$ of subjects in the rural and the urban engage in agriculture, respectively. It implies that the urban areas in our field do not depend on agriculture anymore, but rural areas are still agriculture-based societies. Reflecting this difference of dependency on agriculture,

[3] Individual social preferences are established to remain the same for a long time (Van Lange et al., 2007b; Brosig-Koch et al., 2011), while the GBC is a behavior checklist for the actions that subjects have taken over the last one year. Therefore, taking SVOs as an independent variable in the regression of generativity does not cause any erogeneity problem or reverse causality.

household income is higher in the urban than in the rural (table 4.1). Overall, the summary statistics of socio-demographic information in table 4.1 are in line with our initial expectations that urban societies are more advanced and modernized (or urbanized) in many aspects. On the other hand, in the rural areas, people mainly engage in agriculture and forestry.

Table 3.1 shows subjects' SVOs to be prosocial or proself between the rural and the urban. The major difference can be seen in the "SVO" variable, exhibiting that $76\,\%$ of subjects in the rural are prosocial, while only $39\,\%$ of subjects are prosocial in the urban. Specifically, 197 out of 260 rural subjects are prosocial in the rural, while 105 out of 263 urban subjects are prosocial in the urban (table 4.2). The chi-square test for independence between subjects prosociality and area rejects the null hypothesis at $1\,\%$ level of significance (p = 0.000), it implies that prosociality among people is different between the rural and urban areas, and prosocial (proself) people are dominant in the rural (urban) areas. This SVO result appears to suggest that people tend to be more proself as societies are more modernized and developed.

Table 4.2 presents the summary statistics of subjects' generativity. Interestingly, mean and median of generativity are different between rural and urban areas. The median (mean) of generativity in the rural is 42.00 (42.05), while that in the urban is 38.00 (37.91). It implies that the both the mean and median of generativity in the rural are higher than those in the urban. We further categorize subjects generativity by SVOs in each area, for instance, the median generativity of prosocial subjects in the rural is 43.00 (the mean is 43.05) which is higher than that in the urban i.e., 41.00 and (40.23). The median (mean) generativity for proself people in the rural is 34.00 (37.41), while that for subjects in the urban is 37.00 (36.41). Put simply, prosocials in the rural, prosocials in the urban, proselves in the urban and proselves in the rural are the descending orders

Table 4.1: Summary statistics of subjects' socio-demographic information and SVOs

Variables	Rural (260 subjects)					Urban (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 / Agriculture[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

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

[2] The variable of age is defined as categorical variable of 0; 1; 2; 3; 4; 5 where 0 is under 20 and 5 is above 60 and rest is with interval of 10 years.

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

[4] The variable of education is defined as years of schooling.

[5] The variable of employment/agriculture is defined as 1 if engage in agriculture or have an employment.

[6] The variable of income is defined as categorical of 1; 2; 3; 4; 5; 6 with an interval of $250, where 6 represents as earning more than $1800 per year.

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

Table 4.2: Generativity across regions and prosociality

	N	Mean	Median	SD[1]	Min	Max
Urban	268	37.91	38.00	13.34	2.00	72.00
Prosocial	105	40.23	41.00	13.35	6.00	72.00
Proself	163	36.41	37.00	13.17	2.00	67.00
Rural	260	42.05	42.00	12.63	5.00	72.00
Prosocial	197	43.53	43.00	12.32	8.00	72.00
Proself	63	37.41	34.00	12.57	5.00	65.00
Prosocial	302	42.39	42.00	12.76	8.00	72.00
Proself	226	36.69	37.00	12.99	2.00	67.00
Overall	528	39.95	40.00	13.15	2.00	72.00

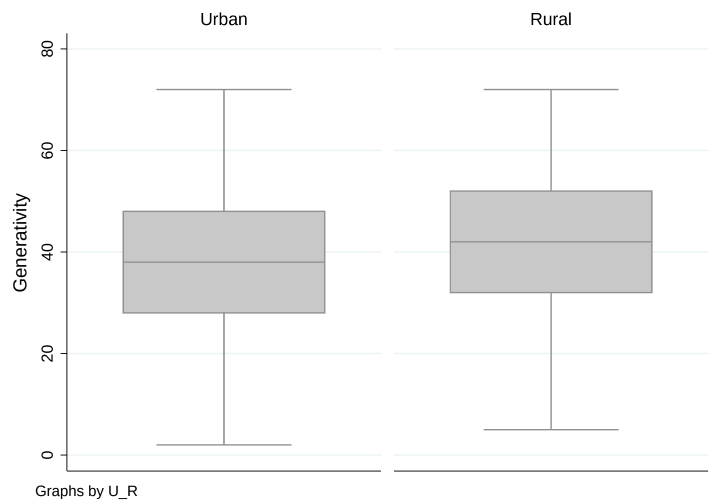
[1] The “SD” stands for standard deviation.

of groups with respect to the central tendencies of generativity. These tendencies can be confirmed from figures 4.3(a) and 4.3(b) from the associated box plots, demonstrating that the medians of generativity scores are different between urban and rural areas as well as across people’s social preferences (prosocial and proself) in these two areas. Overall, table 4.2, figures 4.3(a) and 4.3(b) suggest that prosociality and the urban vs. the rural areas are the keys to characterize generativity.

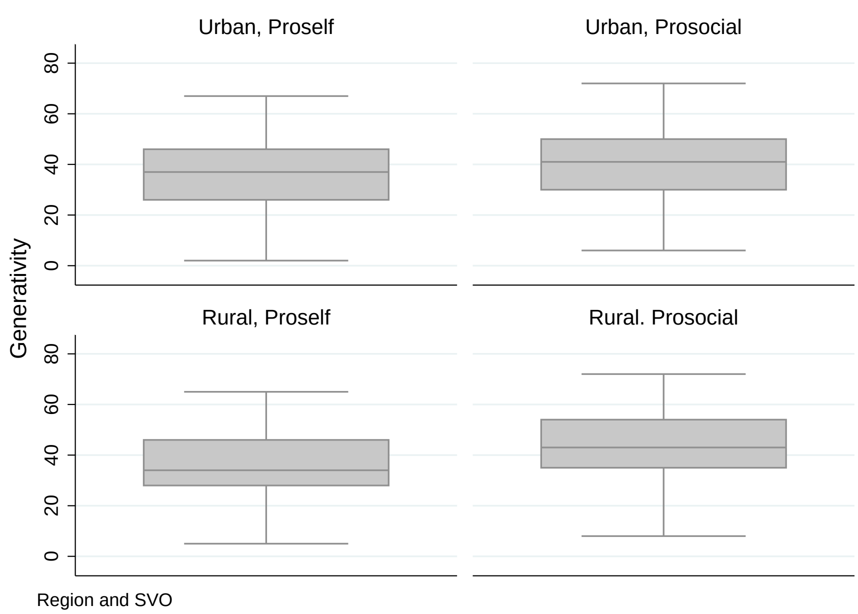
To check whether the distributions of generativity differ from one another by areas and SVOs, we run a Mann-Whitney tests. The null hypothesis is that the generativity distributions are the same across two areas and SVOs (See figures 4.4(a) to 4.4(c) for the frequency distributions of generativity). We have confirmed that all of the following pairs reject the null hypothesis: (1) the rural vs. the urban ($z = 3.404$) test statistic, (2)

Figure 4.3: Boxplot of generativity across urban and rural areas along with people's social preferences

(a) Urban Vs Rural



(b) Urban: Proself Vs Prosocial



the prosocial vs. the proself (z = 4.890), (3) the prosocial in the rural vs. the proself in the rural (z = 3.322), (4) the prosocial in the urban vs. the proself in the urban (z = 2.300), (5) the prosocial in the urban vs. the proself in the rural (z = 4.978) and (6) the prosocial in the rural vs. the prosocial in the urban (z = 1.896). These results of Mann-Whitney tests statistically confirm that generativity may be affected by prosociality and areas between the rural and urban. Given the statistical significance of the generativity across areas and SVOs, we further characterize generativity by running regression model, taking the generativity as a dependent variable and the area dummy between the rural and the urban, SVOs and other socio-demographic information as independent variables.[4]

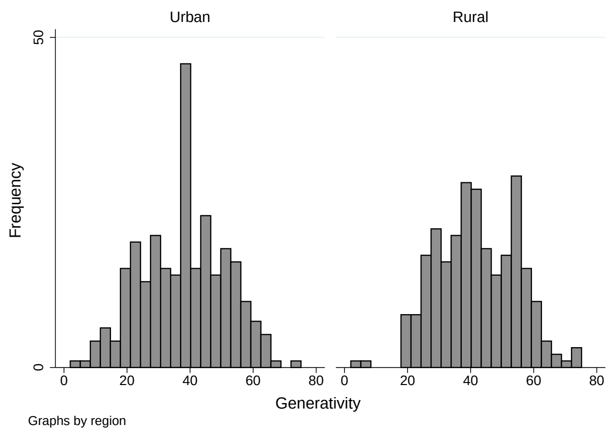
Table 4.3 reports the estimated coefficients and their respective standard errors with statistical significance in the regression of generativity. Model 1 in table 4.3 contains SVOs and the area dummy of the rural as independent variables. The result reveals that both variables exhibit statistical significance of 5 % and 1 %, respectively, and positively affect the generativity. To further confirm the robustness of our result, we add socio-demographic variables such as gender, education, age, employment, number of household members, income level in model 2 of table 4.3. We find that the SVOs and the area dummy remains statistically significant with the same sign and magnitude, and education is statistically significant to positively influence generativity at 5 % level. However, the magnitude of education is rather small compared with that of the SVOs and area dummy. There are no significant associations of gender, employment, income and age in model 2.

In model 3 with adding age squared, both age and its squared variables are significant with positive and negative signs at 10 % level, respectively. This result implies

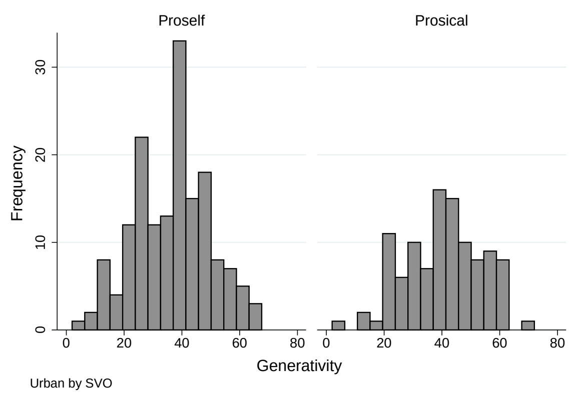
[4]These results of Mann-Whitney tests are statistically significant at 1 % and 5 % level.

Figure 4.4: Histogram of generativity across urban and rural areas along with people's social preferences

(a) Urban vs. Rural



(b) Urban: Proself vs. Prosocial



(c) Rural: Proself vs. Prosocial

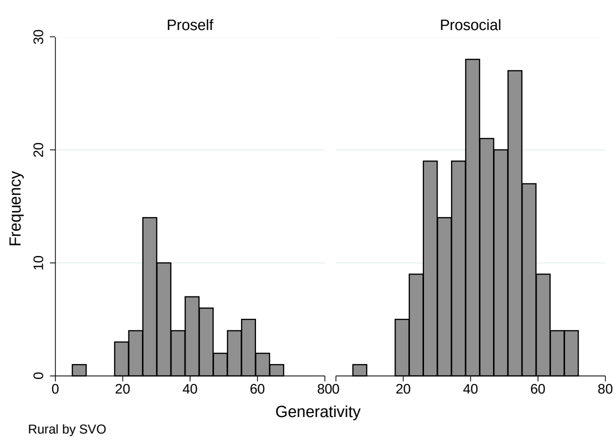


Table 4.3: Regression analysis of generativity

	Model 1	Model 2	Model 3
Constant	36.026***	33.378***	31.730***
	(0.937)	(3.061)	(3.207)
SVOs[1] (Prosocial = 1 & Proself = 0)	4.810***	4.889***	4.773***
	(1.226)	(1.227)	(1.232)
Area dummy[2] (Rural = 1 & Urban = 0)	2.383**	3.294**	3.129**
	(1.208)	(1.415)	(1.410)
Gender		−1.845	−1.445
		(1.164)	(1.182)
Education		0.419**	0.391**
		(0.171)	(0.171)
Employment		0.414	−0.380
		(1.641)	(1.662)
No of household members		−0.387	−0.282
		(0.598)	(0.592)
Income		−0.343	−0.270
		(0.272)	(0.274)
Age		−0.039	2.718*
		(0.556)	(1.586)
Age squared			−0.630*
			(0.328)
Observations	528	528	528
R^2	0.053	0.071	0.077

[1] The SVO represents a dummy variable of individual social value orientations that takes 1 when the individual is prosocial. Otherwise zero.

[2] The area dummy takes 1 when the subject resides in the rural area, otherwise, 0.

The variables other than the SVO and area dummy follow the descriptions in table 3.1.

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.

that generativity reaches its peak in midlife and starts to decline with old age. This is consistent with McAdams et al. (1993); Newton et al. (2014) and Schoklitsch and Baumann (2012) demonstrating that this single-peaked nature in generativity is due to health or physical weakness. Considering the consistent results across models 1, 2 and 3, it appears that SVOs and the area dummy are strong predictors for generativity. More specifically, in model 3, the generativity increases by 4.77 with a change in SVOs from being in the proself to being in the prosocial, and the generativity increases by 3.13 if the individual resides in the rural as compared with residing in the urban. Education is statistically significant in model 3, however, the magnitude remains small.

In summary, our results find that there are more prosocial people in the rural areas; prosocial and rural people possess higher generativity. This suggests that as societies become more modernized and competitive in a capitalistic way, people tend to be less concerned about others and even future generations. The strongest predictors for sustainability is individual social preference (Van Lange et al., 2007a,b, 2011; Hauser et al., 2014). In reality, generativity is expressed through the daily practices and human interactions such as charity, mentoring, nursing, volunteering, teaching, religious movement and political activities that guide current and the next generation (McAdams and de St. Aubin, 1992). It appears that there are two channels to affect generativity. One channel is a direct effect of modernization on generativity which comes from the difference between the rural and the urban areas. The second channel is an indirect effect of modernization on generativity, that is, modernization of societies induces people to be more proself, and generativity decreases through such a change in social preference. Since the magnitudes of the impacts from both SVOs and area dummy are higher, generativity crisis in urban areas may be well explained by these two factors.

4.4 Discussion

There are differences between urban and rural areas in many aspects such as environment, customs technologies, physical space and architectures that influence social interactions among people. Urban areas are high in population density and on a daily basis people come across numerous strangers and colleagues, however, in many cases their social-tie may be weak and there is less intimacy among themselves to act in concert (Timilsina et al., 2017; Shahrier et al., 2016). To make matters worse, they may get even suspicious at strangers and compete with colleagues. These phenomena are not so different from basic city life in Katmandu.

On the contrary, rural areas are nature-dependent and develop on the basis of natural vegetation and fauna available, people mostly live in agriculture-based lifestyle. In rural societies, both cultural learning and vocational training also come from families, relatives, and neighbors because they live in agriculture-based life and the transfer of skills and knowledge is made through close interactions in the local human network. In such a situation, young people mimic and learn standard behaviors and belief from local communities, in particular from older people in previous generations. Such transmission can also be considered conformist biases that they accumulate from their previous generations and neighbors (See, e.g., Henrich and McElreath, 2003; Sasaki, 2004).

We conjecture that such human network of intergenerational linkage and interactions in rural areas corresponds to a rural-specific effect on generativity. It appears that rural life in Nepal induces people to interact with neighbors and others on a daily basis, while urban life does not. Urban settlements have advanced civic amenities, opportunities for education, facilities for transport, and businesses. These standards of living do not induce people to be interdependent or even interact with neighbors. In terms of employment, there is always a division of labor and job specialization with many employment opportunities that lead to higher occupational mobility. With these realities, it is our belief that the difference of how people interact with others affects social preferences and behaviors, leading to a change in generativity with modernization (Huddart-Kennedy et al., 2009; Timilsina et al., 2017; Shahrier et al., 2016, 2017).

Urban areas are different in terms of their functionality and classified according to land use and density of population, but this can vary from developed countries to developing countries (McDonnell and MacGregor-Fors, 2016). Asia and Africa are going to have the world's largest and fastest growing cities in the future and the most of these growths will occur in emerging and developing countries (Wigginton et al., 2016). Such a growth might help to lift hundreds of millions of people out of poverty, but leave behind huge social and economic cost to the future generations (Henderson et al., 2016). There are several social, behavioral and economic challenges that need to be overcome for improving urban settlements and achieve future sustainability. An individual's lifestyle and decisions on how they live their life directly affects society, such as whether to unplug cell phone or use public transport to work, or to install solar panel on a roof for energy is highly depended upon people's concern for others or in other words individual social preference (Van Lange et al., 2007a, 2011).

This study shows one of the adverse consequences of unprecedented urbanization on generativity and prosociality. Many cities that are growing in emerging and developing countries are now in a critical pathway of change. Our results suggest that we should prioritize and create a policy that can redefine economic, social and psychological aspects of individuals towards sustainable societies. Otherwise, such unprecedented modernization shall simply compromise pro-sustainability through a decrease in generativity and prosociality of individuals.

4.5 Conclusion

This paper has explored how generativity is changing along with social preference and the degree of capitalism in the society. To this end, we implemented a social value orientation (SVO) experiment and surveys of generative checklist questionnaires in two fields of Nepal: (i) urban and (ii) rural areas. The results show that mainly individual generativity might have been positively affected by two channels, i.e, prosociality, and rural-specific effect. Since we have found a higher proportion of prosocial people in rural areas than in urban areas, we proposed that as societies are getting more modernized and developed in a capitalistic way, generativity shall be further compromised through changes in social preference and economic environments.

Our research shows the evidence that economic environments affect people's preferences and even behaviors that are important for intergenerational sustainability. We conjecture that the difference of daily life between rural and urban areas influences how people interact with others including families, relatives, neighbors, and strangers. Rural areas might have induced people to interact with others and we consider such interactions could be the main factor for higher generativity. On the other hand, in urban areas, social network and the degree of interactions may be weak, although more people happen to meet or come across one another. We believe that such difference of human interactions or network between urban and rural areas is a key to explain generativity.

Greater attention seems to be required particularly in urban areas to induce people to have a more generative expression in their daily life through institutional change or some social device. We need to develop an extended public conversation about the responsibilities of the current generation to the future in urban areas. The educational institution should play vital role to focus more on intergenerational linkage through its teaching pedagogy and curriculums. The problem of generativity does not only revolve in the sphere of one family or parent-child relation but it covers a wider aspects of society. Thus, further emphasis should be given on how intergenerational sensibility can be strengthen in a society as moving forward.

Finally, we note some limitation of our study. The study of generativity can be highly abstract and this research does not fully address the details of rural-specific effects. In reality, rural-specific effects may be decomposed in not only the ways of human interactions in daily life but also other factors, further data collection and analysis is required to compare among the youth by focusing on current young generation. In the future, we should collect more detailed data of human interactions, intergenerational transfer, attitudes of rural and urban youth toward previous generation or elderly and other possible factors that may represent the differences between rural and urban areas. If such rich data are successfully collected, new methodologies such as social network methods can be utilized (Kim et al., 2015). We did not conduct such analysis and data collection because the main purpose of this research is to establish the relation between generativity and modernization of societies as a first priority. These caveats notwithstanding, it is our belief that this research is considered an important step when societies are changing to be more modernized and intergenerational sustainability is claimed to be a pressing issue.

Chapter 5

Conclusion

Firstly, results from the experiment based on market-based instrument, marketable permit system (MPS) show that it can be a possible solution in developing countries for managing natural resources. However, one should be cautious as numerous important questions are still left open for e.g., regulatory environment, distribution of forestland, quality of timber and location. Many such technical issues need to be analyzed. Despite such technical issues and other uncertainties, we have shown an experimental evidence on how introducing the market-based mechanism could be the good fit for natural resource management when the externalities from the market can be minimized. It is our belief that the scope of the marketable permit system (MPS) has been broadened with the implications of our experiments regarding the resource-use exclusion of forestland resources, and this research counters the myth that market-based instruments work only for industrialized nations. In fact, the MPS would work well in developing countries and this field experiment can be considered as an important step toward applying the MPS to various resource problems in both developed and developing nations.

Second, during economic transition in a country when the market becomes very much competitive activities that are morally and ethically objectionable such as child labor, corruption, higher executive pay, commercialization of education, and earning manipulation likely to happen (Shleifer, 2004). In other words, we can say in such situation people might lose the ability to cooperate and the majority might want to freeride. Therefore, in our second study, we conduct an economic experiment of dynamic common pool resource to characterize modern cities of developing world to confirm if they have abilities to perform collective action successfully in a sustainable way. Cities are going to grow in Asia and Africa in the future and rural locals are considered to be successful in efficiently managing village-level natural resources, however, the question remains, if modern cities can maintain sustainability. Therefore, through a field experiment on commons, we have shown that there is disintegration among people with ongoing modernization in the society. Market erase sociality and it induces people to express with more relativity. People could not manage commons in highly advanced and modernized societies, peoples' daily practice and social learning play an important role in people's action in a society. 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.

Third, we have shown one of the adverse consequences of unprecedented urbanization on generativity and prosociality. Many cities that are growing in emerging and developing countries are now in a critical pathway of change. It has been clear that economic environments affect people's preferences and even behaviors that are important for intergenerational sustainability. Therefore, our hypothesis that due to the difference of daily life between rural and urban areas, it affects people's interaction with others including families, relatives, neighbors, and strangers. Rural areas are considered to have higher interaction with others and considered to have higher generativity and concern for others. On the other hand, in urban areas, social network and the degree of interactions may be weak, although more people happen to meet or come across each other. Urban people are not induced by city life to be dependent on other or to have higher sociability, due to which, there are differences in human interactions between urban and rural that highly affects generativity.

These work clearly suggests us that new institutions or devices are necessary in place to manage CPRs in a sustainable way or to maintain future sustainability.

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