Chapter 10
Property Rights and Natural Resource Management in Developing Countries

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Abstract As forestland and grazing land grow scarcer and rural poverty persists in developing countries, sustainable natural resource management (NRM) for income generation and poverty reduction is imperative. Although securing property rights on forestlands is fundamental for sustainable resource management, the conditions under which one institution outperforms the others in the efficiency of forest management have not yet reached a consensus. In contrast, forest management under common property regimes (e.g., community forest management) is commonly adopted in developing countries in Asia and Africa. As argued by Ostrom, community forest management is effective in protecting forest resources, but it may fail to provide proper incentives for intensive forest management activities. This paper argues that the community management system performs efficiently for non-timber forests, whereas a mixed management system of private and common ownership is a desirable institution for timber forest management in developing countries. This empirical research conducted a randomized experiment in Ethiopia and confirmed that the mixed management system significantly stimulated intensive forest management activities, such as pruning, guarding, and watering.

10.1 Introduction

With the growing scarcity of forestland and grazing land and the persistence of rural poverty in developing countries, it has become imperative to achieve sustainable natural resource management (NRM) for both income generation and poverty reduction (Palmer et al. 2020). Although securing property rights over forestlands is fundamental for sustainable resource management (Arnot et al. 2011; Feder and Feeny 1991), a consensus has not yet been reached on the conditions under which one institution outperforms others in the efficiency of forest management. The debate

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continues on whether private or common ownership improves forest management sustainability.

Forest management under common property regimes ('community forest management') has been adopted in developing countries across Asia and Africa (Agrawal and Chhatre 2006; Ferraro and Agrawal 2021). Ostrom (1990), Baland and Platteau (1996), and Hayami and Godo (2005) argue that community forest management is effective in protecting forest resources because of the community's strong ability to prevent the excessive extraction of common-pool resources. More precisely, compared with private forest management, community forest management has the advantage of protecting forest resources because the total protection cost can be shared among community members through rotational monitoring. Rustagi et al. (2010) and Kosfeld and Rustagi (2015) suggest that monitoring cooperation among community members persists primarily because of the costly norm enforcement in the community. Further, Sakurai et al. (2004) have confirmed that community forests are less expensive to protect than private forests, especially in the case of small private forests, which require full-time monitoring.

Especially in developing countries, the reduction of protection costs is critically important for forest conservation because the risk of illegal logging and theft is typically high due to the greater demand for forest products (e.g., timber, firewood, feed grasses, medicinal plants, honey, mushroom, and spices). Several empirical studies have been conducted in various regions to identify the impact of community forest management on forest protection (Christensen et al. 2021; Eisenbarth et al. 2021). One of the prominent early studies was conducted in Nepal by Edmonds (2002). This study found that the extraction of forest resources reduced after the use rights of forests was transferred from the state to the local community. Further, Takahashi and Todo (2012) utilized satellite imagery to estimate changes in forest areas and showed that the introduction of community forest management successfully conserved forests in Ethiopia. However, empirical evidence on the effectiveness of community management has been mixed (Arts and De Koning 2017; Baynes et al. 2015; Slough et al. 2021). For example, after using the propensity score matching method to control for endogeneity, Takahashi and Otsuka (2016) found that forest quality declined more in community forests than in privately-owned forests in Ethiopia. Similarly, Kijima et al. (2000) also reported that private forest management is more efficient than community forest management in Japan because of differences in the motivation for tree management. Thus, the conditions under which one institution outperforms the others in forest management efficiency are unclear.

Another shortcoming of the existing literature on community forest management is that most previous studies have primarily focused on forest protection or the prevention of excessive resource extraction. Comparatively, less attention has been devoted to investigating how to promote investments in reforestation. Professor Keijiro Otsuka has argued that to rehabilitate timber forests, it is essential to conduct intensive management or silvicultural operations, such as planting, weeding, thinning, pruning, singling, and watering (Otsuka et al. 2015; Otsuka and Place 2001). In this regard, community forest management may fail to provide the appropriate incentives for intensive forest management. In most cases, as the benefits from common

forests are more or less equally shared among community members (Balana et al. 2010), the individual incentives for intensive tree management are likely to be diluted under community forest management because of the free-rider problem. Hence, political interventions may be desirable to facilitate the rehabilitation of community timber forests to provide the necessary incentives for tree management.

In the second section of this chapter, referring to the work of Professor Otsuka, I discuss the optimal management institutions for timber and non-timber forests and the potential of mixed management systems for timber forest rehabilitation. The third section reports the findings of an experimental study conducted in Ethiopia that investigated the impact of mixed management systems on forest management efforts, followed by the conclusion.

10.2 Optimal Management Institutions and Mixed Management System

10.2.1 Optimal Management Institutions of Timber and Non-timber Forests

Otsuka et al. (2015) have pointed out that forests can be divided into timber and non-timber (Table 10.1). Usually, non-timber forest resources regrow without much care; thus, the marginal returns to management efforts are low. In contrast, intensive management is mandatory to maximize profits from timber products. Accordingly, timber and non-timber forests have high and low management intensity characteristics, respectively.

Their study further classified timber and non-timber forests into two types, depending on the protection cost of forest areas. The protection cost tends to be low in areas where forest resources are abundant, or the demand for forest resources is low. The former is typical of sparsely populated areas in developing countries, whereas the latter is typical of developed countries. By contrast, protection costs increase when there is a higher demand for forest products. As argued, it is essential to provide sufficient protection to forest areas where there is a risk of illegal logging or the theft of forest products, which is often the case in many developing countries.

Table 10.1 Characteristics of timber and non-timber forests and optimal institutions

Forest type	Management intensity	Protection cost	Optimal institution
Non-timber	Low	Low	Any
	Low	High	Community management
Timber	High	Low	Private management
	High	High	Mixed private-community management

Note Referring to Tables 1 and 2 of Otsuka et al. (2015)

Based on the above discussion, forests can be divided into four categories, according to the intensity of their management intensity and the protection costs. If the forest type is a non-timber forest with low protection costs (e.g., non-timber forests in sparsely populated areas), institutions do not matter because these forests neither require management nor protection efforts for rehabilitation. However, in the case of non-timber forests where the cost of protection is high (e.g., non-timber forests in densely populated areas in developing countries), the most important aspect of forest management is protection. In this context, community forest management is particularly efficient because of the advantages of substantially reduced protection costs, as suggested by Ostrom and others. In contrast, community forest management may not be an optimal institution for timber forests due to a lack of incentives for intensive management. Instead, suppose the protection cost is low due to the low demand for forest products, as in developed countries. In that case, private management is likely to be efficient.

The critical issue that remains is identifying the appropriate institution for timber forests, where the cost of protection is high. This point is particularly important for developing countries because most timber forests in these regions are classified in this last category. Community forest management of timber forests with high protection costs is not expected to increase the management efforts because of incentive issues, while private management is also inefficient because landholders have to pay high protection costs. Therefore, neither private nor community management may be optimal for timber forests in developing countries. Thus, Professor Otsuka proposed a mixed management system of private and common ownership (hereafter, the 'mixed management system') as a potential solution (Otsuka et al. 2015; Otsuka and Place 2001).

10.2.2 Mixed Management System of Private and Common Ownership

The mixed management system is characterized by: (1) the communal protection of trees and other resources and (2) the individual management of these resources. Such a system can be realized by granting communal use rights for forestland and individual ownership rights for trees to the community members. In this system, as the ownership of forestland is given to the community, collective activities unrelated to tree management, such as collecting non-timber forest products (fodder grasses, honey, medicinal plants, mushrooms, and spices), are likely to be carried out by the community. Therefore, the community enforcement of protection activities (i.e., rotational monitoring) can work the same way as traditional community forest management, resulting in lower protection costs under the mixed management system.

Additionally, the mixed system fully motivates individual members to carry out intensive tree management because individual tree rights holders can accrue all the

benefits from their owned trees. The benefits are not only limited to income from the extracted timber trees but also include the by-products of intensive management, such as thinned trees and pruned branches.

Another advantage of such a mixed management system is that it may reduce the risk of forest conversion, particularly in the case of forests under private management. If the expected benefit from forest conversion is greater than the profit from forestland, individual landholders are likely to convert forestland to agricultural land, resulting in accelerated deforestation. On the contrary, as land ownership under the mixed management system is granted to the community rather than individual tree rights holders, community land cannot be converted without the community's agreement. As a result of this transaction cost of obtaining community agreements for land conversion, the risk of deforestation by land conversion is lower in the mixed management system than in the private management system.

Overall, a mixed management system fully utilizes communities' capacity to protect trees and other natural resources and the motivation of individual community members.

10.3 Impact of Mixed Management System on Tree Management

Mixed management systems, in which forestland is owned by the community and trees are owned by individual members, may be an efficient approach to enhance the rehabilitation of forests in developing countries. However, until recently, no studies have empirically investigated the effects of mixed management systems on forest management. In 2018, through a collaboration between four universities (Kobe University, Mekelle University, Norwegian University of Life Sciences, and Waseda University), a team of researchers, including Professor Otsuka, conducted a randomized controlled trial (RCT) in Ethiopia to empirically investigate the impact of the mixed management system on NRM. This section describes the general situation regarding deforestation in Ethiopia and then explains the description and results of the experiment conducted by Takahashi et al. (2020).

10.3.1 Deforestation in Ethiopia

Deforestation and land degradation (i.e., vegetation cover loss, soil erosion, and nutrient depletion) have been major environmental issues in Ethiopia for some time now. According to the Food and Agriculture Organization of the United Nations (FAO 2022), approximately 10% of the country's forestland has been lost within two decades. Like in other developing countries, the harvesting of forest products has been the primary driver of deforestation in Ethiopia (Takahashi and Todo 2012;

Yahya et al. 2020). More precisely, given the high demand for timber forest products (i.e., thinned trees, pruned branches, and timber trees) and non-timber forest products (i.e., feed grasses, honey, medicinal plants, mushrooms, and spices), there is a strong incentive to conduct extraction activities in these forest areas, thus increasing the pressure on them.

The Tigray region of northern Ethiopia has a similar deforestation issue. To prevent deforestation and rehabilitate vegetation in Tigray, the local government implemented a restriction policy that strictly prohibited access to communal forests and grazing lands and the use of common-pool resources. The restriction policy came into effect in 1991, and since then, 13% of the total land in Tigray has been reserved for rehabilitation (Holden and Tilahun 2020). Although the duration of the restriction for land rehabilitation was not formally set, the restricted communal lands were closed for 5–15 years.

After land rehabilitation, some of the restricted communal lands were distributed to groups of landless youths within the community (hereafter referred to as 'youth groups'). Each youth group had approximately ten members who were allowed to utilize the allocated communal lands for livelihood activities, such as forestry, apiculture, horticulture, mining, and livestock rearing. In addition, members of the youth group conducted collective activities unrelated to tree management, such as collecting feed grasses in the allocated community land. Like community forest management in other developing countries, the benefits from allocated communal land were equally shared among the group members. Furthermore, to protect the forest resources within the allocated communal land, members of these youth groups usually carried out monitoring activities on a rotational basis. According to Holden and Tilahun (2020), the youth groups followed the sustainable NRM principles suggested by Ostrom (1999, 2010). Thus, the communal lands allocated to these groups may be defined as forest areas under community forest management.

10.3.2 Experimental Design and Data Collection

To identify the impact of the mixed management system, an RCT was conducted in Tigray, targeting 68 youth groups (a total of 728 members) that received communal lands from the allocation (Takahashi et al. 2020). The experimental intervention was implemented between May and June 2018, and a questionnaire survey was conducted before the intervention and one year after it. Among the 68 youth groups, 26 groups were randomly selected as the treatment group that had an opportunity to manage their community forestland under the mixed management system. The remaining 42 groups, defined as the control group, continued their conventional community management activities (i.e., conducting livelihood activities using common-pool resources and collecting non-timber forest products).

To implement the mixed management system, the members of the 26 treatment groups were granted individual tree rights that allowed them to extract their owned trees at any time. Furthermore, tree rights holders could continue holding their

tree rights by planting new tree seedlings in the same location, which increased their incentive to engage in sustainable forest management. In this experimental setting, while the ownership of individual trees was transferred from the youth group to the individual members of each treatment group, ownership of the entire land continued to be common property for both the treatment and control groups. Therefore, community agreements remained essential for land-use change. Moreover, it was fundamentally important to secure the tree rights; otherwise, short-term resource extraction would become a rational choice. Hence, the study provided a paper document indicating that the local authorities (i.e., Bureau of Agriculture and Natural Resources) had permanently granted tree rights to the individual members of the treatment groups.

In this study, 172 members in the treatment groups agreed to receive individual tree rights, with an average of 81 trees per member in the allocated forestland. However, 25 members (12.7%) of the treatment group declined the offer of tree rights. This was mostly because they perceived that group rights were preferable. Although the balancing test confirmed no significant difference in the management efforts and extracted volume of forest products between the treatment and control groups before the intervention, there was still a concern about selection bias by the non-accepters within the treatment group. An instrumental variable (IV) method and an intention-to-treat model to estimate the treatment effects were applied to address this. In this essay, I only show the results of the IV estimation, indicating how the provision of individual tree rights affected management effort (i.e., the number of working days spent on tree management) and the volume of extracted timber and non-timber forest products.

10.3.3 Estimation Results

The estimation results for the number of working days based on the IV method are shown in Fig. 10.1, which shows the impact of tree rights on the number of working days and the extracted volume, respectively. The values on the vertical axis of the figure are the log differences in the outcomes of interest, which is the rate of change in each indicator before and after the provision of tree rights.

The results show that the number of working days for three types of management activities—guarding, watering, and pruning—significantly increased after the provision of tree rights. The coefficient shows that the impact on guarding is particularly large, increasing the number of working days by 105%. Before the experiment, each youth group member allocated an average of 19 days per year to guard, equivalent to 190 days per year at the group level. Thus, the estimation results suggest that after providing tree rights, the treatment youth group engaged in guarding activities throughout the year. This increase may reflect an increase in the value of the forest resources in the mixed management area.

Further, the results show that the provision of tree rights significantly increased the number of working days for watering by 66%, while there was no significant

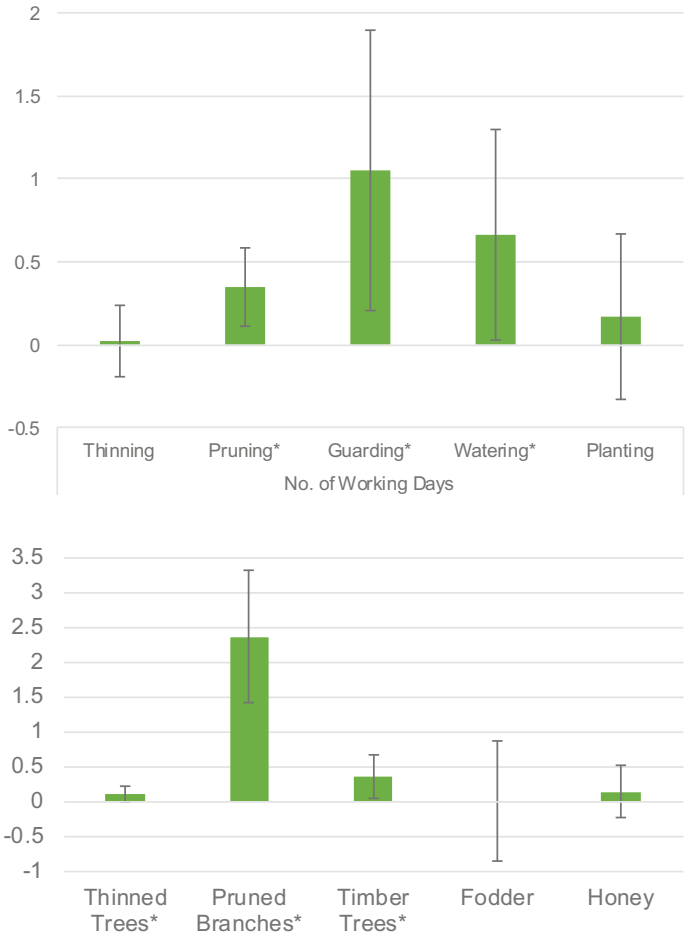

Fig. 10.1 The impact of tree rights on the number of working days and the extracted volume

difference in planting activity. One potential reason for these results is that members of the treatment groups may be more motivated to take care of their allocated trees rather than plant new tree seedlings. In the long-term, individual tree rights holders have an incentive to conduct planting activities because of the motivation to maximize their profits from forest resources. However, if a sufficient number of trees are allocated to the right holders, they may prefer to increase profits from the allocated trees by carrying out short-term management activities, such as watering, rather than planting new seedlings. Because this study only examines the short-term impact of tree rights provision due to data constraints, we may observe a significant increase in labor input to take care of planted trees.

The results of the extracted volume shown in Fig. 10.1 indicate that tree rights holders extracted more timber resources related to tree management (i.e., thinned

trees, pruned branches, and timber trees). These results are expected. As tree rights holders can obtain all the benefits from the allocated trees, there is a greater incentive to harvest the timber resources. Although the extracted volume of timber trees increased after introducing tree rights, such an increase does not necessarily mean that the tree rights provision caused excessive extraction of forest resources or forest degradation. To regenerate forest ecosystems, selective extraction of timber trees is an important forest management activity (Karsenty and Gourlet-Fleury 2006; Langmaier and Lapin 2020). In fact, the average volume of timber extracted after the intervention was only 6 kg in the treatment group.

In contrast, the extracted volume for non-timber forest products, such as fodder and honey, did not change after the provision of tree rights. Before this experiment, both groups (treatment and control) engaged in resource extraction activities unrelated to tree management, such as collecting feed grasses and honey. In this experiment, land ownership in the treatment group remained a common property even after the intervention, and thus, it is reasonable to assume that members of the treatment groups continuously had an incentive to conduct conventional non-timber resource extraction activities. None of the communities investigated in this study changed their conventional activities after the provision of tree rights. Thus, we believe that tree rights only increased the volume of timber resources extracted.

10.4 Conclusion

In this chapter, by referring to Professor Otsuka's previous work, I have attempted to describe the optimal property institutions for NRM, specifically in the case of timber forest management in developing countries. It is fundamentally important to select appropriate institutions for each type of forest, considering the factors of management intensity and protection costs. In the context of timber forests in developing countries, while both management and protection efforts are essential for rehabilitating forest resources, private and community forest management can only stimulate either of these efforts individually.

A mixed private and community management system has been proposed as a novel potential solution to this challenge. In fact, the findings from a randomized experiment in Ethiopia confirm that the introduction of the mixed management system can successfully stimulate intensive forest management. This is evidenced by the increased number of workdays allocated to pruning, guarding, and watering activities. Further, the extracted volumes of forest products related to tree management, such as thinned trees, pruned branches, and timber trees, increased after introducing the new system, whereas the extraction of non-timber products did not change through the intervention.

These arguments and findings provide useful information for sustainable forest management. Currently, many development organizations focus primarily on protecting forest resources by simply introducing community forest management,

which cannot intensively manage forest resources. In contrast to this, the practical advantage of a mixed management system is its adaptability to varying situations in developing countries. As a substantial portion of forests is already under de facto common property regimes (Agrawal et al. 2008), a mixed management system can be introduced by granting individualized property rights for timber trees on community forest lands. Although more empirical investigations are required to examine the effects of mixed management systems, this system has the potential to be an alternative approach to achieving sustainable forest management in developing countries.

Recollections of Professor Keijiro Otsuka

I am honored to participate in the Festschrift honoring Professor Keijiro Otsuka for his tremendous lifetime achievements. I have known Professor Otsuka since 2013 when he served as a member of the review committee for my doctoral dissertation. After receiving my Ph.D., I was very fortunate to have the opportunity to work with him as a postdoctoral researcher at GRIPS for a year and a half. So far, I have written three papers with him on NRM and had the opportunity to go on a field survey in Ethiopia. Through my experience in research with Professor Otsuka, I have truly learned a lot about the attitude one should take toward research, the importance of field observations, and social contribution through research. I would like to take what I have learned from Professor Otsuka and pass it on to the next generation.

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