Impacts of modernization policy on the management of commons forests in Japan: A statistical analysis of individual data

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(Abstract)

After World War II, Japan's policy makers believed that common forests were underutilized because of their legal status and organization method under customary *iriai*-type ownership and that modern ownership in the form of group ownership, such as forest producers' cooperatives, or as individual, separate ownership, would improve the situation. Thus, the Commons Forests Modernization Act of 1966 was enacted, following successive modernization policies since the Meiji Restoration in 1868. We evaluated the impacts of the past modernization policies on the management of commons forests by statistically comparing the performance of modernized and non-modernized forests based on the 2000 Forestry Census. The performance measures for comparison included planting, weeding, thinning, and harvesting activities among others. We found less modernized, customary holdings are more active in tending activities such as weeding and thinning, while modernized holdings may have an advantage in timber sales.

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1. Introduction

1.1 Background

Commons property management constitutes a significant portion of forest management worldwide. Twenty one percent of private forests and seven percent of public forests of the world are managed by communities and indigenous people. (FAO, 2010, p.122-126) In the past, Japanese governments have tried to intervene in commons (*iriai*-type) forests for different purposes. This study examines how the past policy intervention including the most recent one, since the 1960s, encouraging forest commons to obtain more modern legal status such as cooperatives or individual ownership and organize themselves differently, have affected forest management by those forest commons.

There were preceding efforts changing Japanese common forest into more modern types of entities. After the Meiji Restoration in 1868, the newly established Japanese government relied on revenue from land taxation for its financial needs, before the industrialization of Japan. The government divided the country's territory into taxable private lands and government lands that represented important assets for the government. Among private lands, forests managed by "hamlets" constituted a considerable portion. In the 1880s, the government decided to consolidate these hamlets into municipalities such as towns and villages with public administrations that could provide services such as education, public works, and agricultural development. This move created inducements for newly established municipalities to take over forests originally owned by traditional hamlets. This could be one reason why "Public (Hamlet) Forest Reorganization and Unification Project" was promoted from 1910 to 1939 (Handa, 1988; p.212).

After World War II, Japan's recovery from destruction and its subsequent industrial development presented policy makers with a new challenge, namely, the disadvantaged position of the agricultural and forestry sector compared with Japan's fast-growing industrial sector. Policy makers believed that commons forests were underutilized, due to their legal status under customary *iriai*-type ownership; and that modern ownership, in the form of group ownership such as forest producers' cooperatives, or as individual, separate ownership, would improve the situation. In fact, under *iriai*-rules, important decisions, such as sales and termination of their rights, have to be made based on consensus; majority-based decision making is legally impossible on such crucial issues. The plantation ratio of *iriai*-type commons forests, 28.8 %, was in fact lower than that of private owners' forests, 35.5 %, by 6.7 points. (Ministry of Agriculture and Forestry, Department of Survey and Statistics, 1962; p.16)

After several years of research by and discussion among governmental bureaucrats and experts, the Commons Forests Modernization Act of 1966 was enacted. (Hereafter, we call this Act "the 1966 Act" or "the Act"). The Act stipulates that "the prefectural staff may handle the complicated registration procedures, and the registration tax shall be exempted or reduced" (Handa, 1988).

In Japan, since the enactment of the Act, around 30 to 40% of commons forests, 1.6 million ha as of the year 1960, in terms of area have been placed under modern types of ownership such as individual private ownership, forest producers' cooperatives, joint ownership, or other types, such as non-profit associations (Takahashi, Matsushita, and de Jong, 2017). The enactment of the Act and the ensuing policy support in Japan are major and unique state interventions in commons-type ownership in industrialized countries. It is worth analyzing and evaluating this major policy intervention.

The 1966 Act was initially conceived as a means of increasing the size of non-industrial private forest ownership by providing additional forest lands to individual owners, as well as establishing cooperative forestry operations managed by villagers. It is often said that, in reality, many forest producers' cooperatives that are supposed to be modern legal entities without customary relationships retain many of their traditional characteristics such as contributions to community expenses or restrictions on membership.

The consequences of modernization policy are thought to be two-sided. On one hand, the modernization policy led to the establishment of forest producers' cooperatives and individual ownership, which may be theoretically more suited to the for-profit production of forest products. On the other hand, under the increasing tendency of decline in forestry activities in Japan until today, such an arrangement, in many cases, has not resulted in the vigorous for-profit forestry activities anticipated and includes burdens such as corporate tax payments and management tasks for owners. A large scale survey of the effects of the modernization has not been conducted yet, however.

We can find several examples of commons forests that have not been modernized, and relatively well managed by commoners (Kasahara, 2000; Kobayashi, 2013). Several scholars are critical about the modernization policy (Kasahara, 1996 ; Noguchi, 2014). They claim the modernization policy is not effective in improving forest management practices. We try to evaluate effects of the past modernization policy, relying on large-scale census data.

1.2 Use of commons forests in Japan

The pattern of utilization of commons forests by commoners has changed

drastically from the past. Historically, hamlet residents used commons forests to gather wood for fuel, to make charcoal, and to use materials as fodder, fertilizer, and building or tool materials mainly for household consumption. In the early modern era of Japan, the Edo period (1603-1867), each hamlet or groups of hamlets used certain tracts of forests under a regime of customary rights before land ownership had been established, since the modern concept of sole land ownership was not recognized at that time. After the modernization era began following the Meiji Restoration in 1868, the central government assigned the official ownership of commons forests to some hamlets, to members of hamlets, or to the central government itself. On the other hand, the Civil Code of 1896 recognized the customary right of commoners to use commons forests, even when they came under the possession of other people or entities. During the industrialization period of Japan in the later 19th century to the beginning of the 20th century, commoners started planting trees for timber harvesting in the future since timber prices were rising due to the expansion of markets. In later years, reliance on commons forests for the purpose of gathering fertilizer or fuel wood decreased because commoners started purchasing chemical fertilizer or fossil fuel from merchants.

The 1960 World Agriculture and Forestry Census Survey shows the status of commons forests after almost 100 years of industrialization of Japanese society. Among 109,909 commons forests identified in the survey, 19.9% (21,920 entities) produced forest products, such as timber and fuel wood from February 1959 through January 1960 (hereafter, we call this period the Year). A total of 11,046 entities (10.1% of all the commons forests) produced timber, 13,145 entities (12% of them) produced fuel wood or charcoal wood during the Year. Among the 21,920 commons forests that produced timber products, 4,901 entities (4.5% of the forests) distributed the products to their members, while the remaining entities accumulated the cash proceeds in the accounts of their communities or distributed the cash proceeds. The above description indicates that by the end of the 1950s, the majority of commons forests were not being used for the daily household consumption of the members. This trend has continued to today.

1.3 Literature

Previous literature on the commons has examined policy interventions by the state. Dietz et al. (2002; p.13) summarized the observation prevalent by the mid-1980s that transitions from governance as common property of local communities to state governance had led to a deterioration of the resources involved in Africa, Latin America, and Asia. Berkes (2002; pp.298-300) classified types of cross-scale interaction for the purpose of strengthening local-level institutions and identified five such forms, i.e.,

"state legitimization of local institutions," "enabling legislation," "cultural and political revitalization," "capacity building," and "institution building." In this paper, Berkes pointed out that commons researchers "lack[ed] theory and guiding principles" (p.300) in the field of institutional linkages and referred to an opinion stating that "commons literature tend[ed] to concentrate on local-level institutions to the exclusion of the outside world that impacts them and shapes them" (p.300). Anthony and Campbell (2011) identified the state's facilitation role in the commons, or in regard to general collective goods, as an extension to the theory proposed in *Governing the Commons* by Elinor Ostrom. Anthony and Campbell (2011) listed four facilitation roles, such as threat of government regulation, provision of tangible resources, conferring legitimacy, and transformation of perception, in addition to direct state participation and consultation. Tedder (2010) called for more practical guidance for state intervention and devised an intervention framework that includes the following three elements: 1) an institution failure model, 2) a state intervention typology, and 3) a set of intervention properties. The state intervention typology includes the following five types: obstructionist, absent, facilitating, coordinating, and prescriptive. Tedder also emphasized the lack of research on the role of the state within the commons literature (p.7).

Another line of research deals with the situations where the state relinquishes control over commons forests in transition economies. Premrl et. al. (2015) discuss the restitution of forests in Slovenia, and Tran and Sikor (2006) analyze the devolution of forest lands in Vietnam. Both groups of researchers identified problems with these governmental policies.

In one of developed countries, Japan, Takahashi, Matsushita and de Jong (2017) examined what factors have influenced modernization processes by a state, and found the ease of consensus building among commoners, the cohesiveness, and past labor investment affected modernization processes positively.

The literature in the above clearly demonstrates that there are needs for further research on state intervention because of its importance in policies for commons, and that this line of research still remains at the level of creating typologies, requiring having more knowledge on effects of state intervention.

2. Method

We evaluated the impacts of the modernization policy on the management of commons forests by comparing the performance of modernized and non-modernized

forests based on the 2000 Forestry Census. The performance measures for comparison included planting, weeding, thinning, and harvesting activities and timber sales performance. As the published reports on the 2000 Forestry Census did not provide details regarding customary holdings, we used the individual data of the Census and identified 32,908 non-family, group holdings with a minimum size of 10 ha and a total forest area of 1.04 million ha, out of which customary holdings constituted 0.12 million ha and non-customary holding 0.92 million ha. We compared modernized and non-modernized "group" holdings because we cannot identify modernized individual, family ownership among individual, family ownership in our data set. Both the number of holdings and forest area under customary holdings decreased over the past 40 years. One reason for this is the above-mentioned policy for modernization of rights of commons forests.

We present herein three alternative hypotheses of how modernization has affected forest management.

a) Positive influence. Modernized commons forests may enjoy enhanced management owing to various reasons such as improved decision-making mechanisms, intensified attention from local prefectural governments after modernization, or originally active tendencies of modernized forest commons, which enabled them to implement legal modernization.
b) Neutral influence. Modernized commons forests are not so different from non-modernized forests in terms of their management practices because, even though modernized forests went through legal modernization, substantial modernization in the areas of their decision-making and other managerial aspects may not have occurred, in reality. Therefore, we may not be able to identify any substantial differences between modernized and non-modernized forests.
c) Negative influence. Modernization may have destroyed traditional *iriai* forest management schemes and practices. Therefore, contrary to policy intentions, modernized forest commons may be less active in terms of forest management practices.

We first estimated ordinary least square and Tobit regression models including modernization indicators as independent variables for the purpose of examining overall tendencies. Next, we investigated cross tabulations among key variables to see how the data was distributed to find information that may evade regression-type analyses.

3. Results

Forestry holdings under various titles such as shrines and temples, co-ownership, various organizations and cooperatives, property wards, amalgamated cities, towns, villages, and hamlets were selected for the following regression-type analyses. These holdings are more likely to represent former *iriai*-type ownership. Forest holdings that had plantation areas were selected so we could examine forestry-related activities, as modern Japanese forestry almost always involves plantation areas. In addition, samples with abnormal data were sorted out. As a result, among 32,908 non-family forestry operations, 19,690 were selected. We obtained descriptive statistics for these operations, as shown in Table 1.

Table 1: Descriptive statistics for the selected forestry operations (N=19690)

No.	Description	Average	S.D.	Minimum	Maximu
v1	New plantating area/ Total plantation area	0.0064	0.0621	0	1
v2	Weeding area / Total plantation are	0.0665	0.1875	0	1
v3	Thinning area / Total plantation area	0.0402	0.1362	0	1
v4	Harvesting area / Total plantation area	0.0018	0.0281	0	1
v5	Timber sales volume of standing trees (m^3) / Total holding area (ha)	0.4773	8.3846	0	466.7
v6	Total plantation area / Total holding area	0.6501	0.3551	0.0005	1
v7	Age 11-30 years plantation / Total plantation area	0.3626	0.3947	0	1
v8	Age 31-40 years plantation / Total plantation area	0.3204	0.3683	0	1
v9	Age 41+ years plantation / Total plantation area	0.2495	0.3541	0	1
v10	Total holding area (ha)	74.7284	393.5792	10	29649
v11	Number of right holders (2000)	66.1592	279.9854	0	19812
v12	One can obtain right*	0.1029	0.3038	0	1
v13	One can obtain right with conditions*	0.1675	0.3734	0	1
v14	One cannot obtain right*	0.2112	0.4082	0	1
v15	One loses right when he/she leaves the hamlet*	0.3340	0.4717	0	1
v16	One does not lose right when he/she leaves the hamlet*	0.1475	0.3547	0	1
v17	Modernized titles (registered as cooperatives, organizations or property wards)*	0.3301	0.4703	0	1
v18	Customary common holdings*	0.4816	0.4997	0	1

* Dummy variables. If "yes", the value is one.

This table shows how much forest lands were modernized. Around 52 % of this sample were modernized in terms of rules governing forest holdings (V18=0.4816, 1-0.4816=0.5184). In terms of their titles, 33% of this sample were (V17=0.3301) modernized. It was found that, in total, certain forestry activities were not active in the year 2000. Only 0.64% of the total plantation areas were replanted (in Japan, after the year 2000, it has been very likely that tree planting takes place in previously planted areas, not in bare lands or natural forests). Only 0.18% of the total plantation areas were harvested. On the other hand, certain forest tending activities are occurring. Of the total plantation areas, 6.65% and 4.02% received weeding and thinning treatment, respectively.

Correlation coefficients were calculated among the variables. We present the correlations among variables in Table 2.

Table 2: Correlation matrix among variables (N=19690)

Correlation coefficient

p-value for H_0:Rho=0

	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14	v15	v16	v17	v18
	New planting	Weeding	Thinning	Harvesting	Timber sales	Plantation ratio	11-30 plantation	31-40 plantation	41+ plantation	Holding area	Right holder no.(2000)	Can obtain right	Can obtain right conditionally	Cannot obtain right	Lose right	Dose not lose right	Modernzation title	Customary
v1	1.0000	0.1657	0.0007	0.0846	0.0111	-0.0647	-0.0581	-0.0645	-0.0545	-0.0054	0.0097	-0.0059	-0.0024	-0.0016	0.0003	-0.0099	0.0026	-0.0067
New planting		<.0001	0.9232	<.0001	0.1182	<.0001	<.0001	<.0001	<.0001	0.4524	0.1726	0.4073	0.7318	0.8221	0.9672	0.1663	0.7108	0.3453
v2	0.1657	1.0000	0.1088	0.0375	-0.0017	-0.1158	0.0412	-0.0977	-0.1250	-0.0112	0.0161	0.0117	0.0370	0.0051	0.0440	-0.0037	0.0195	0.0389
Weeding	<.0001		<.0001	<.0001	0.8082	<.0001	<.0001	<.0001	<.0001	0.1177	0.0235	0.1005	<.0001	0.4753	<.0001	0.6073	0.0063	<.0001
v3	0.0007	0.1088	1.0000	0.0427	0.0484	-0.0023	0.0612	0.0086	-0.0707	-0.0084	-0.0020	-0.0037	0.0129	0.0121	0.0204	-0.0027	0.0316	0.0173
Thinning	0.9232	<.0001		<.0001	<.0001	0.7461	<.0001	0.2253	<.0001	0.2410	0.7804	0.6042	0.0705	0.0889	0.0043	0.7026	<.0001	0.0153
v4	0.0846	0.0375	0.0427	1.0000	0.0607	-0.0293	-0.0107	-0.0184	0.0046	0.0031	-0.0035	-0.0071	-0.0004	0.0012	-0.0094	0.0073	-0.0048	-0.0037
Harvesting	<.0001	<.0001	<.0001		<.0001	<.0001	0.1348	0.0100	0.5210	0.6630	0.6266	0.3165	0.9515	0.8623	0.1890	0.3056	0.5044	0.6080
v5	0.0111	-0.0017	0.0484	0.0607	1.0000	0.0200	-0.0191	0.0060	0.0121	-0.0029	0.0043	-0.0095	-0.0012	-0.0109	-0.0094	-0.0095	0.0135	-0.0155
Timber sales	0.1182	0.8082	<.0001	<.0001		0.0051	0.0073	0.4013	0.0901	0.6854	0.5501	0.1838	0.8624	0.1280	0.1890	0.1849	0.0583	0.0292
v6	-0.0647	-0.1158	-0.0023	-0.0293	0.0200	1.0000	-0.0807	0.0712	0.0722	-0.0801	-0.0036	-0.0475	-0.0707	-0.0438	-0.0862	-0.0508	0.0510	-0.1175
Plantation ratio	<.0001	<.0001	0.7461	<.0001	0.0051		<.0001	<.0001	<.0001	<.0001	0.6170	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
v7	-0.0581	0.0412	0.0612	-0.0107	-0.0191	-0.0807	1.0000	-0.5208	-0.4850	0.0074	-0.0340	-0.0089	-0.0194	-0.0197	-0.0221	-0.0213	0.0332	-0.0360
11-30 plantation	<.0001	<.0001	<.0001	0.1348	0.0073	<.0001		<.0001	<.0001	0.2993	<.0001	0.2138	0.0066	0.0057	0.0020	0.0028	<.0001	<.0001
v8	-0.0645	-0.0977	0.0086	-0.0184	0.0060	0.0712	-0.5208	1.0000	-0.3470	-0.0083	-0.0098	-0.0055	0.0041	0.0131	-0.0053	0.0217	0.0067	0.0104
31-40 plantation	<.0001	<.0001	0.2253	0.0100	0.4013	<.0001	<.0001		<.0001	0.2462	0.1688	0.4421	0.5666	0.0671	0.4555	0.0023	0.3440	0.1452
v9	-0.0545	-0.1250	-0.0707	0.0046	0.0121	0.0722	-0.4850	-0.3470	1.0000	0.0004	0.0378	0.0145	0.0187	0.0042	0.0250	0.0037	-0.0578	0.0262
41+ plantation	<.0001	<.0001	<.0001	0.5210	0.0901	<.0001	<.0001	<.0001		0.9610	<.0001	0.0420	0.0086	0.5588	0.0004	0.6082	<.0001	0.0002
v10	-0.0054	-0.0112	-0.0084	0.0031	-0.0029	-0.0801	0.0074	-0.0083	0.0004	1.0000	0.0950	0.0175	0.0353	-0.0144	0.0284	-0.0022	0.0923	0.0252
Holding area	0.4524	0.1177	0.2410	0.6630	0.6854	<.0001	0.2993	0.2462	0.9610		<.0001	0.0142	<.0001	0.0431	<.0001	0.7532	<.0001	0.0004
v11	0.0097	0.0161	-0.0020	-0.0035	0.0043	-0.0036	-0.0340	-0.0098	0.0378	0.0950	1.0000	0.2310	0.1016	0.0353	0.2601	-0.0005	0.1297	0.2452
Right holder no.(2000)	0.1726	0.0235	0.7804	0.6266	0.5501	0.6170	<.0001	0.1688	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001	0.9454	<.0001	<.0001
v12	-0.0059	0.0117	-0.0037	-0.0071	-0.0095	-0.0475	-0.0089	-0.0055	0.0145	0.0175	0.2310	1.0000	-0.1519	-0.1753	0.3758	-0.0047	0.0171	0.3514
Can obtain right	0.4073	0.1005	0.6042	0.3165	0.1838	<.0001	0.2138	0.4421	0.0420	0.0142	<.0001		<.0001	<.0001	<.0001	0.5122	0.0162	<.0001
v13	-0.0024	0.0370	0.0129	-0.0004	-0.0012	-0.0707	-0.0194	0.0041	0.0187	0.0353	0.1016	-0.1519	1.0000	-0.2321	0.4187	0.0988	0.0037	0.4653
Can obtain right conditionally	0.7318	<.0001	0.0705	0.9515	0.8624	<.0001	0.0066	0.5666	0.0086	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001	0.6089	<.0001
v14	-0.0016	0.0051	0.0121	0.0012	-0.0109	-0.0438	-0.0197	0.0131	0.0042	-0.0144	0.0353	-0.1753	-0.2321	1.0000	0.2368	0.4415	-0.0254	0.5369
Cannot obtain right	0.8221	0.4753	0.0889	0.8623	0.1280	<.0001	0.0057	0.0671	0.5588	0.0431	<.0001	<.0001	<.0001		<.0001	<.0001	0.0004	<.0001
v15	0.0003	0.0440	0.0204	-0.0094	-0.0094	-0.0862	-0.0221	-0.0053	0.0250	0.0284	0.2601	0.3758	0.4187	0.2368	1.0000	-0.2946	0.0389	0.7348
Lose right	0.9672	<.0001	0.0043	0.1890	0.1890	<.0001	0.0020	0.4555	0.0004	<.0001	<.0001	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001
v16	-0.0099	-0.0037	-0.0027	0.0073	-0.0095	-0.0508	-0.0213	0.0217	0.0037	-0.0022	-0.0005	-0.0047	0.0988	0.4415	-0.2946	1.0000	-0.0624	0.4317
Dose not lose right	0.1663	0.6073	0.7026	0.3056	0.1849	<.0001	0.0028	0.0023	0.6082	0.7532	0.9454	0.5122	<.0001	<.0001	<.0001		<.0001	<.0001
v17	0.0026	0.0195	0.0316	-0.0048	0.0135	0.0510	0.0332	0.0067	-0.0578	0.0923	0.1297	0.0171	0.0037	-0.0254	0.0389	-0.0624	1.0000	-0.0076
Modernzation title	0.7108	0.0063	<.0001	0.5044	0.0583	<.0001	<.0001	0.3440	<.0001	<.0001	<.0001	0.0162	0.6089	0.0004	<.0001	<.0001		0.2862
v18	-0.0067	0.0389	0.0173	-0.0037	-0.0155	-0.1175	-0.0360	0.0104	0.0262	0.0252	0.2452	0.3514	0.4653	0.5369	0.7348	0.4317	-0.0076	1.0000
Customary	0.3453	<.0001	0.0153	0.6080	0.0292	<.0001	<.0001	0.1452	0.0002	0.0004	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.2862	

Note: The p-values under 1% significance levels are indicated by pink-colored cells.

Some indicators representing forest management activities such as thinning and timber sales (from v1 to v5) were correlated with customary ownership indicators (from v12 to v16, and v18) and forest modernization (v17).

We conducted regression analyses using performance measures such as new tree planting areas (v1), weeding areas (v2), thinning areas (v3), and harvesting areas (v4) per total plantation areas, as well as timber sales volumes of standing trees (v5) per total holding areas (v10) as dependent variables, while using holding areas (v10), plantation ratios (v6), and indicators of modernization as independent variables. The variables representing holding areas and plantation ratios were included because they are known to influence modernization decisions (Takahashi, Matsushita, and de Jong, 2017). We tested the above-mentioned hypotheses regarding whether modernization has affected forestry activities or not, and if so, positively or negatively. The indicators of non-modernization and modernization include the fact that the forest lands were NOT managed under customary rules (v18) and certain titles, more types of modern titles (v17), under which forest lands are registered (those titles include cooperatives, organizations, and property wards).

Tables 3 and 4 present, respectively, the results of OLS and Tobit regression analyses, using the “Customary” dummy variable as a non-modernization indicator.

Table 3: OLS regression (Customary) analyses results (N=19690)

	New planting		Weeding		Thinning		Harvesting		Timber sales	
	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value
Intercept	0.01498	14.02 ***	0.10179	31.69 ***	0.03835	16.32 ***	0.00349	7.21 ***	0.30613	2.12 *
Holding area	-1.64E-06	-1.45	-9.99E-06	-2.95 **	-3.07E-06	-1.24	6.276E-08	0.12	-2.31E-05	-0.15
Plantation ratio	-0.01175	-9.35 ***	-0.06042	-16.01 ***	-0.000374	-0.14	-0.00237	-4.17 ***	0.4321	2.54 *
Customary	-0.00178	-2.00 *	0.00977	3.65 ***	0.00474	2.42 *	-0.000405	-1.00	-0.22431	-1.86
F test probability	<.0001		<.0001		0.0595		0.0005		0.01	
Adjusted R squared	0.0043		0.0143		0.0002		0.0008		0.0004	

* 5%, ** 1%, *** 0.1% significance levels

Table 4: Tobit regression (Customary) analyses results (N=19690)

	New planting		Weeding		Thinning		Harvesting		Timber sales	
	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value
Intercept	-0.7488	-25.76 ***	-0.2623	-23.97 ***	-0.4480	-36.55 ***	-0.7660	-17.86 ***	-141.1642	-23.81 ***
Holding area	0.0000	4.51 ***	0.0000	3.13 ***	0.0000	5.24 ***	0.0000	4.19 ***	0.0078	5.01 ***
Plantation ratio	-0.0755	-3.71 ***	-0.1094	-9.35 ***	0.0830	7.07 ***	-0.0118	-0.51	9.9571	2.65 *
Customary	0.0077	0.53	0.0904	10.87 ***	0.0836	10.33 ***	-0.0149	-0.92	-1.2508	-0.48
Log likelihood	-2822.1		-9742.2		-7757.5		-1279.8		-4773.378	
Pseudo R squared	0.006		0.0125		0.0107		0.0063		0.0029	

* 5%, ** 1%, *** 0.1% significance levels

These results indicate customary holdings are more active in weeding and thinning since “Customary” variable have statistically significant, positive coefficients

in “Weeding” and “Thinning” models. “Customary” variable has statistically not-significant coefficient for “New planting”, “Harvesting” and “Timber sales” models in OLS and Tobit analyses.

Next, Tables 5 and 6 present, respectively, the results of OLS and Tobit regression analyses, using the “Modern titles” dummy variable as a modernization indicator.

Table 5: OLS regression (Modern titles) analyses results (N=19690)

	New planting		Weeding		Thinning		Harvesting		Timber sales	
	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value
Intercept	0.01368	14.14 ***	0.10453	35.95 ***	0.03855	18.13 ***	0.00331	7.55 ***	0.113	0.86
Holding area	-1.78E-06	-1.57	-1.107E-05	-3.26 **	-4.08E-06	-1.64	7.799E-08	0.15	-5.398E-05	-0.35
Plantation ratio	-0.01153	-9.22 ***	-0.06287	-16.74 ***	-0.00189	-0.69	-0.00229	-4.05 ***	0.45108	2.67 **
Modern titles	0.00093	0.98	0.01104	3.89 ***	0.00954	4.6 ***	-0.0002017	-0.47	0.22741	1.78
F test probability	<.0001		<.0001		<.0001		0.0007		0.0115	
Adjusted R squared	0.0042		0.0144		0.001		0.0007		0.0004	

* 5%, ** 1%, *** 0.1% significance levels

Table 6: Tobit regression (Modern titles) analyses results (N=19690)

	New planting		Weeding		Thinning		Harvesting		Timber sales	
	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value	Estimated	t-value
Intercept	-0.7914	-26.86 ***	-0.2407	-24.11 ***	-0.4341	-38.02 ***	-0.8015	-18.21 ***	-148.7656	-24.64 ***
Holding area	0.0000	3.56 ***	0.0000	1.90	0.0000	3.84 ***	0.0000	3.86 ***	0.0068	4.37 ***
Plantation ratio	-0.0876	-4.27 ***	-0.1307	-11.19 ***	0.0623	5.33 ***	-0.0144	-0.62	8.8194	2.34 *
Modern titles	0.1338	8.75 ***	0.1082	12.51 ***	0.1179	14.1 ***	0.0710	4.2 ***	19.9024	7.39 ***
Log likelihood	-2781.3		-9722.8		-7709.9		-1271.1		-4744.6	
Pseudo R squared	0.0204		0.0145		0.0168		0.0131		0.0089	

* 5%, ** 1%, *** 0.1% significance levels

The above-mentioned models with “Modern titles” indicate forest holdings with “Modern titles” are more likely to engage in many of forestry activities: new planting, weeding, thinning, and harvesting.

For the purpose of gaining wider perspectives, we present comparative cross-tabulation tables controlling holding sizes, organization titles, regions, and regional groups according to their advances in terms of modernization, for all samples, including corporations and holdings without plantation. We may be able to know more about complicated patterns which may evade regression-type analyses presented in the above.

Table 7 is a cross-tabulation table comparing customary (non-modernized) and non-customary (modernized) holdings in terms of forest management performances. In this table, we controlled the size of forest land holdings. We ranked all the holdings depending on their holding areas, from the smallest to the largest, and divided them

into four categories: 0–25%, 25–50%, 50–75%, and 75–100%.

Table 7: Comparison table of forest holdings based on controlling size

	size	N	Plantation ratio	New planting	Weeding	Thinning	Harvesting	Timber sales
Customary	0–25%	2772	52.2%	0.4%	8.7%	5.9%	0.1%	0.35
	25–50%	3023	51.4%	0.4%	6.6%	4.7%	0.1%	0.35
	50–75%	3409	46.4%	0.6%	5.8%	4.4%	0.4%	0.29
	75-100%	2867	33.2%	0.3%	3.7%	2.7%	0.1%	0.19
Non-customary	0–25%	5513	50.4%	0.5%	6.9%	4.0%	0.2%	1.34
	25–50%	5172	47.0%	0.5%	6.4%	4.0%	0.2%	0.53
	50–75%	4792	44.6%	0.7%	6.5%	4.0%	0.4%	0.30
	75-100%	5360	44.8%	0.3%	3.8%	2.0%	0.2%	0.26
	(All)	32908						
Diff. Custom-Non-custo	0–25%		1.8%	-0.1%	1.8%	1.9%	-0.1%	-0.99
	25–50%		4.4%	-0.1%	0.2%	0.7%	-0.1%	-0.18
	50–75%		1.7%	-0.1%	-0.7%	0.4%	0.0%	-0.01
	75-100%		-11.6%	0.0%	-0.1%	0.6%	-0.1%	-0.08

Diff. indicates non-modernized minus modernized holdings. Negative figures in Diff. are indicated by red-colored cells. New planting, Weeding, Thinning, and Harvesting are the ratios of areas receiving such treatments to the total plantation areas. Timber sales are the sales volumes (in cubic meters) sold as standing trees (not as harvested logs) per a hectare of holding areas during the year 2000. Size indicates into which size category holdings fall.

Tables 8, 9, and 10 present similar analyses based on controlling organization titles, regions, and regional groups according to their advances in terms of modernization, respectively.

Table 8: Comparison table of forest holdings based on controlling organization titles

	organization titles	N	Plantation ratio	New planting	Weeding	Thinning	Harvesting	Timber sales
Customary	Corporations	43	32.0%	0.3%	8.6%	9.2%	4.4%	0.12
	Shrines & Temples	540	42.3%	0.3%	4.2%	2.9%	0.1%	0.12
	Co-ownership	2684	35.4%	0.3%	4.8%	3.5%	0.4%	0.22
	Organizations & Cooperatives	2318	44.5%	0.4%	5.3%	4.0%	0.1%	0.23
	Property wards	1270	32.4%	0.3%	3.8%	2.6%	0.1%	0.19
Non-customary	Corporations	4934	35.7%	0.6%	7.0%	3.1%	0.6%	0.28
	Shrines & Temples	1547	46.9%	0.2%	5.6%	3.0%	0.4%	0.07
	Co-ownership	8090	41.8%	0.3%	4.2%	3.1%	0.2%	0.54
	Organizations & Cooperatives	3763	42.1%	0.5%	5.9%	4.0%	0.1%	0.54
	Property wards	464	49.1%	0.4%	3.7%	2.2%	0.2%	0.17
	(All)	25653						
Diff. Custom-Non-custo	Corporations		-3.7%	-0.3%	1.6%	6.1%	3.8%	-0.15
	Shrines & Temples		-4.7%	0.1%	-1.3%	-0.1%	-0.3%	0.05
	Co-ownership		-6.4%	0.0%	0.6%	0.4%	0.1%	-0.32
	Organizations & Cooperatives		2.4%	-0.1%	-0.6%	-0.1%	0.0%	-0.31
	Property wards		-16.7%	-0.1%	0.1%	0.4%	-0.2%	0.02

Diff. indicates non-modernized minus modernized holdings. Negative figures in Diff. are indicated by red-colored cells.

Table 9: Comparison table of forest holdings based on controlling regions

	region	N	Plantation ratio	New planting	Weeding	Thinning	Harvesting	Timber sales
Customary	Hokkaido	21	31.8%	0.0%	3.5%	0.6%	2.3%	0.34
	Tohoku	2166	37.4%	0.3%	5.7%	3.7%	0.3%	0.45
	Hokuriku	935	20.1%	0.3%	7.3%	2.1%	0.0%	0.03
	Kanto/Tozan	1548	45.4%	0.2%	2.6%	2.0%	0.0%	0.08
	Tokai	1213	46.4%	0.3%	4.6%	4.6%	0.3%	0.23
	Kinki	2336	29.0%	0.4%	4.1%	3.6%	0.1%	0.12
	Chugoku	1735	34.9%	0.7%	5.8%	2.5%	0.1%	0.57
	Shikoku	378	62.5%	0.1%	2.1%	4.6%	0.1%	0.26
	Kyusyu	1710	49.6%	0.4%	6.8%	4.6%	0.2%	0.19
	Okinawa	29	0.3%	0.0%	0.0%	0.0%	0.0%	0.00
Non-customary	Hokkaido	1512	28.4%	0.6%	5.3%	2.7%	0.2%	0.15
	Tohoku	5023	56.7%	0.3%	3.8%	2.2%	0.2%	0.35
	Hokuriku	891	35.6%	0.1%	4.1%	1.4%	0.1%	0.04
	Kanto/Tozan	3466	41.5%	0.3%	4.0%	1.8%	0.2%	0.23
	Tokai	1943	47.6%	0.2%	3.7%	3.1%	0.4%	0.26
	Kinki	2010	48.0%	0.1%	4.8%	2.3%	0.2%	0.17
	Chugoku	2237	53.4%	0.2%	3.2%	1.3%	0.0%	0.12
	Shikoku	1215	70.3%	0.2%	3.3%	2.7%	0.2%	0.17
	Kyusyu	2493	65.6%	0.3%	3.7%	2.4%	0.2%	1.24
	Okinawa	47	10.8%	0.6%	4.0%	0.0%	0.0%	0.05
	(All)	32908						
Diff. Custom-Non-custom	Hokkaido		3.4%	-0.6%	-1.8%	-2.1%	2.1%	0.18
	Tohoku		-19.4%	0.0%	1.9%	1.6%	0.1%	0.10
	Hokuriku		-15.5%	0.1%	3.3%	0.8%	-0.1%	-0.02
	Kanto/Tozan		3.9%	-0.1%	-1.4%	0.2%	-0.2%	-0.14
	Tokai		-1.2%	0.1%	0.9%	1.4%	-0.1%	-0.03
	Kinki		-19.0%	0.3%	-0.7%	1.3%	-0.1%	-0.05
	Chugoku		-18.5%	0.5%	2.6%	1.2%	0.0%	0.45
	Shikoku		-7.7%	0.0%	-1.2%	1.9%	-0.1%	0.09
	Kyusyu		-16.0%	0.2%	3.2%	2.2%	0.0%	-1.05
	Okinawa		-10.6%	-0.6%	-4.0%	0.0%	0.0%	-0.05

Diff. indicates non-modernized minus modernized holdings. Negative figures in Diff. are indicated by red-colored cells.

Table 10: Comparison table of forest holdings based on controlling regional groups according to their advances in terms of modernization

	regional types by modernization	N	Plantation ratio	New planting	Weeding	Thinning	Harvesting	Timber sales
Customary	Advanced	4442	39.1%	0.3%	4.5%	3.3%	0.1%	0.53
	Middle	5073	33.5%	0.4%	5.2%	3.3%	0.2%	0.60
	Remaining	2506	43.3%	0.2%	3.9%	3.5%	0.1%	0.67
	Hokkaido, Okinawa	50	5.6%	0.0%	3.3%	0.5%	2.2%	1.02
Non-customary	Advanced	7064	58.2%	0.2%	3.3%	2.2%	0.2%	0.91
	Middle	6002	54.7%	0.2%	3.5%	1.9%	0.2%	0.40
	Remaining	6212	42.0%	0.2%	4.6%	2.2%	0.3%	0.57
	Hokkaido, Okinawa	1559	28.1%	0.6%	5.3%	2.7%	0.2%	0.54
	(All)	32908						
Diff. Custom-Non-custom	Advanced		0.0%	0.0%	-0.2%	0.0%	-0.1%	-0.32
	Middle		0.0%	0.0%	-0.2%	0.1%	0.0%	-0.02
	Remaining		0.0%	0.0%	-0.3%	0.6%	-0.1%	0.05
	Hokkaido, Okinawa		-0.2%	-0.2%	-1.3%	-0.7%	0.1%	-0.09

Diff. indicates non-modernized minus modernized holdings. Negative figures in Diff. are indicated by red-colored cells.

Even though we could not find clear-cut results from these cross tabulations, we identified several general patterns. First, non-modernized (customary) commons forests were thinned more actively than their modernized counterparts were. A majority of the non-modernized minus modernized values (Diff.) for thinning are positive. Second, timber sales were better in modernized commons forests than in non-modernized ones

4. Discussion and Conclusion

We obtained apparently contradictory results regarding the effects of modernization. That is, less modernized forest ("Customary") holdings measured with their rules are more active in forest tending; modernization measured with modern-type legal titles ("Modern titles") are also active in forest tending as well as harvesting. We interpret this contradiction as an indication that legal titles are not a good indicator of modernization in reality. In fact, "Customary" dummy and "Modern title" dummy are not correlated. Table 2 shows the correlation coefficients between these two variables (v18 and v17) is only -0.0076 (p-value=0.2862). Therefore, by interpreting "Customary" as a "real" indicator of modernization, we conclude less modernized customary holdings are more likely to practice better forest tending.

On the other hand, by controlling sizes, organization titles, regions, and regional advancement in modernization, we identified a potential advantage for modernized forest commons, i.e., timber sales activity. We also confirmed a potential advantage for non-modernized forest commons, i.e., thinning activity, also in these analyses.

We tentatively conclude that the modernization policy has mixed results regarding forest management. In some areas of forest management, possibly areas related to harvesting, the policy was successful, whereas in other areas, possibly such as thinning, it was not as successful. These results suggest several hints for formulating policies affecting forest commons in Japan and other countries in the future.

Here are several caveats. In Japan, during the 1990s and 2000s, forestry activities were stagnating owing to their persistent low productivity and economic downturn. These unfavorable conditions may have influenced the above-mentioned results. Overall, economic conditions may have exerted depressing effects on forest commons. Second, we only considered moneymaking forestry activities and excluded recreational or spiritual aspects of forest management. In fact, many forest commons in Japan are related to shrines or temples. Consideration of these other aspects may shed a different light on the modernization policy. As mentioned above, the current study did not investigate individual ownership created out of forest commons because of data limitation. Inclusion of individual ownership in our analysis is also necessary for comprehensive evaluation of the modernization policy.

We hope to investigate this issue further by conducting regression-type analyses that are more sophisticated, as such analyses could provide answers with statistical hypothesis testing. For such analyses, the current study will give guidance in formulating models.

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