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How did policy intervention work out for commons forests in Japan?
An analysis of time-series prefectural data

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SUMMARY

Since the inauguration of the Commons Forests Modernization Act of 1966, the Japanese government has promoted the so-called “modernization of commons forests,” i.e., the creation of modern (group or individual) property ownership out of Iriai-type (customary users’ rights) forest management schemes in Japan, which were estimated to constitute about 8% of all forests in Japan. Over this period, the creation of modern property ownership has slowed down, but by the year 2010, 36.5% of Iriai commons forests in terms of area in Japan had been “modernized.” This paper examines the factors that are correlated with the creation of modern property ownership in 45 prefectures in Japan and evaluates the consequences of this policy. It is found that the size of commons forest groups and the ratio of plantation forests in each prefecture are negatively correlated with the creation of modern property ownership; strength of unity among members (e.g., allocation of rights to branch and returning households, etc.) is positively correlated with the creation of modern property ownership; strength of Iriai-type management (e.g., loss of rights after leaving the village, etc.) is positively correlated with the creation of group ownership; and that past labor contribution is positively correlated with the creation of individual ownership. A close examination reveals that the economy of scale in the creation of modern ownership turns into a diseconomy of scale at around 301 households. The possibility that Iriai-type characteristics remain in forests under modernized ownership is identified. Possible policy interventions should be targeted towards certain types of commons forests, depending on the strength of Iriai characteristics, with policy instruments modified for each type. Labor contributions by members of commons forests groups could lead to a transformation to individual ownership.

Key words: commons, modernization, privatization, cooperative, *Iriai*

INTRODUCTION

Commons property management constitutes a large portion of forest management worldwide. In the past, Japanese governments have tried to intervene in commons forests for different purposes. After the Meiji Restoration in 1868, the newly established Japanese government relied on revenue from land taxation for its financial needs. 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 "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 apparently 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. The plantation ratio of Iriai-type commons forests was in fact lower than that of private owners' forests.

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 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 in terms of area have been placed under modern types of ownership such as individual private ownership, forest producers' cooperatives, or other types, such as non-profit associations. 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.

Previous literature on the commons has examined policy interventions by the state. Dietz, Dolshak, Ostrom, and Stern (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).

As shown in the above review, state intervention is relatively under-researched in the field of commons study, empirical research at the wider scale being especially scarce. In this paper, we examine how the state's policy interventions influenced Iriai-type commons forests by replacing customary rights with modern property ownership. The Act and related governmental policies represent "institution building" since the central government and prefectural governments promoted modern legal entities such as producers' cooperatives, agricultural producers' cooperatives (*Nougyouseisann Houjin*), and other types of corporations. On the other hand, the Act and related policies promote individual privatization if group members choose to do so. It is of special interest to observe and analyze this natural experiment, in which for more than 50 years the state implemented a legal intervention policy in Japan, a highly industrialized country.

METHODS

We assembled two groups of variables: 1) dependent variables indicating what percentage of commons forests in each of 45 prefectures in Japan had been modernized; and 2) explanatory variables that might have influenced modernization, mainly variables representing the initial conditions of commons forests in each prefecture.³

First, we defined dependent variables representing the following three measures: percentages of areas of Iriai forests modernized; Iriai forests turned over to consolidated, group ownership such as cooperatives or corporations; and Iriai forests turned over to separated, individual ownership, all carried out under the Act. Government statistics report the numbers and areas of Iriai forests modernized under the Act for each prefecture. Among Japan's 47 prefectures, northernmost Hokkaido and Okinawa do not have figures on Iriai forests since Japanese government does not recognize them. The statistics provide time-series data for the remaining 45 prefectures. The percentages of modernized Iriai forests were calculated by dividing the areas of Iriai forests modernized by the areas of Iriai forests identified in 1960, six years before the enactment of the Act.⁴

Next, we hypothesized that the original conditions of Iriai forests could influence

³ The descriptive statistics for variables related to initial conditions are given in Exhibit 1.

⁴ In this study, the areas of Iriai forests are defined as areas identified in the 1960 World Agriculture and Forestry Statistics Survey as customary common holdings.

the development of modernization. The following twelve hypotheses are examined in this paper.

H1 (No. of households): The average number of households for each Iriai group might be negatively correlated with the development of modernization. Due to coordination costs involved in achieving consensus among a large group, larger Iriai groups would have difficulty in advancing modernization. The figures are calculated by dividing the number of Iriai-right holders by the number of Iriai groups in each prefecture in 1960.

H2 (Percentage of “larger than village”): The percentage of groups larger than the corresponding agricultural village (hamlet) might be negatively correlated with the development of modernization, for the same reason outlined in H1.

H3 (Does not permit new members): The percentage of groups not permitting new members might be positively correlated with the development of modernization, because such practices could mean the group has a certain level of cohesion that could promote smooth consensus-building among its members.

H4 (Permits branch and returning households): The percentage of groups allowing the formation of branch households of current members, or old members coming back from another area to rejoin the group, might be positively correlated with the development of modernization, for the same reason outlined in H3.

The following four hypotheses make the assumption that traditional Iriai-type schemes, paradoxically, encourage modernization in the form of group ownership such as forestry producers’ cooperatives under the Act, since many cases of modernization practices merely represent the preservation of traditional Iriai-ownership. These forest producers’ cooperatives are sometimes called “Iriai-type” forest producers’ cooperatives (*Iriai-teki seisanshinrinkumiai*).

H5 (Permits new residents): The percentage of groups permitting new residents to join the group if they obtain a status as an official resident might be positively correlated with the development of group modernization, because this has been a traditional Iriai practice.

H6 (Tradable shares): The percentage of groups permitting someone who has bought shares in commons forests to join the group might be negatively correlated

with the development of modernization in the form of consolidated, group ownership, since such a practice indicates that the commoditization of forest lands is occurring in the community and that consensus building might be difficult under such conditions (McKean, 1992; pp.261-262). On the contrary, the percentage might be positively or negatively correlated (indeterminate) with the development of modernization in the form of separate, individual ownership, since the commoditization of forest lands has a degree of natural affinity with individual ownership, while making consensus building more difficult.

H7 (House-moving to outside loses rights): The percentage of groups in which people leaving from the community lose their rights and cannot receive any compensation might be positively correlated with development in the form of group ownership, because this type of rule indicates that the traditional Iriai scheme is so respected that consensus in establishing group ownership will be relatively easy to reach (McKean, 1992; p.258).

H8 (House-moving to outside retains rights): The percentage of groups allowing departing members to maintain their rights over commons forests might be negatively correlated with development in the form of group ownership, because this type of rule indicates that the traditional Iriai scheme is so weakened that consensus building would be difficult (McKean, 1992; p.258).

H9 (Group management percentage): The percentage of groups that own a certain portion of commons forests that is managed under the direct control of the group, rather than being separately managed by individual members, might be positively correlated with development, since the usage as a group would enhance the unity of the group as well as consensus building.

H10 (Plantation ratio): The percentage of planted areas in commons forests in 1960 might be correlated positively with development, since past investments encourage members to recoup by engaging more actively in the management of forests.

H11 (Labor investment): The percentage of groups, members of which have themselves worked in the forests, might be positively correlated with development, for the same reason outlined in H10.

H12 (Obligatory labor investment): The percentage of groups that use obligatory

labor of their members for forest management might be correlated positively with development, for the same reason mentioned in H10. In addition, the fact that a group demands that its members work for forest management indicates that the cohesiveness of the group is relatively strong, which also encourages smooth consensus building.

These hypotheses are examined by calculating the correlation coefficients corresponding to their respective explanatory variables. Table 1 summarizes the hypotheses introduced above.

Table 1 Summary of hypotheses

Initial conditions (Explanatory variables)	Modernization	Group modernization
1. No. of households	-	
2. Percentage of "larger than village"	-	
3. Does not permit new members	+	
4. Permits branch and coming back households	+	
5. Permits residents		+
6. Tradable shares		-
7. House-moving to outside loses right		+
8. House-moving to outside retains right		-
9. Group management percentage	+	
10. Plantation ratio	+	
11. Labor investment	+	
12. Obligatory labor investment	+	

RESULTS

First, we examine the overall picture of modernization. Table 2 shows the trends of numbers and areas of commons forests modernized under the Act. Declining patterns of both the numbers and areas of modernization can be clearly seen from the table. During the nine years of period 0 ranging from 1967 to 1975, 2.7% of commons forests by number and 18.4% of them by area were modernized under the Act. During the 10-year period from 2001 to 2010, 0.2% of commons forests by number and 0.9% of them by area were modernized under the Act. By the year 2010, 6.0% of commons forests in terms of number and 36.5% in terms of area had been modernized, with more than 60% of them in terms of area remaining within the traditional Iriai-type scheme.

Table 2. Numbers and areas of Iriai commons forests modernized under the Act

		Number of approved modernization projects	Percentage	Cumulative percentage	Approved modernization projects in area (ha)	Percentage	Cumulative percentage
1967–1975	(Period 0)	2,997	2.7%	2.7%	290,345	18.4%	18.4%
1976–1980	Period 1	1,396	1.3%	4.0%	125,002	8.0%	26.3%
1981–1985	Period 2	1,037	0.9%	4.9%	74,041	4.7%	31.0%
1986–1990	Period 3	559	0.5%	5.4%	37,951	2.4%	33.5%
1991–1995	Period 4	283	0.3%	5.7%	19,866	1.3%	34.7%
1996–2000	Period 5	186	0.2%	5.8%	13,300	0.8%	35.6%
2001–2005	Period 6	121	0.1%	6.0%	8,312	0.5%	36.1%
2006–2010	Period 7	76	0.1%	6.0%	6,518	0.4%	36.5%

Period 0 is for 9 years while other periods are for 5 years.

In the following correlation analysis, Period 0 is for 7 years.

In this table, the data for Hokkaido prefecture are included.

Table 3 shows the composition of group and individual modernization for each period. At the beginning of modernization, group modernization is a dominant form, and gradually individual modernization has become a dominant form.

Table 3. Composition of group and individual modernization

	Group modernization (ha)	%	Individual modernization (ha)	%
(Period 0)	182,401	62.8%	107,944	37.2%
Period 1	78,219	62.6%	46,779	37.4%
Period 2	40,700	55.0%	33,344	45.0%
Period 3	18,164	47.9%	19,787	52.1%
Period 4	8,125	40.9%	11,741	59.1%
Period 5	5,935	46.6%	6,814	53.4%
Period 6	2,816	33.9%	5,487	66.1%
Period 7	1,958	30.0%	4,560	70.0%

Figure 1 shows that there are significant differences among prefectures in terms of the development of modernization of commons forests. We therefore examined why more commons forests in certain prefectures were turned over to modernized forms of ownership than those in other prefectures (Table 4). We calculated Pearson's correlation coefficients between modernization percentages and variables that might be related to modernization, using initial conditions in 1960, and examined the interrelationships among them. The modernization percentages are taken from those for five-year periods from 1969 to 2010 (the seven-year period between 1969 and 1975 is the only exception) as well as for the whole 42-year period. The variables that might be related to modernization are

based upon the twelve hypotheses explained above. We then counted the variables with statistically significant coefficients.⁵

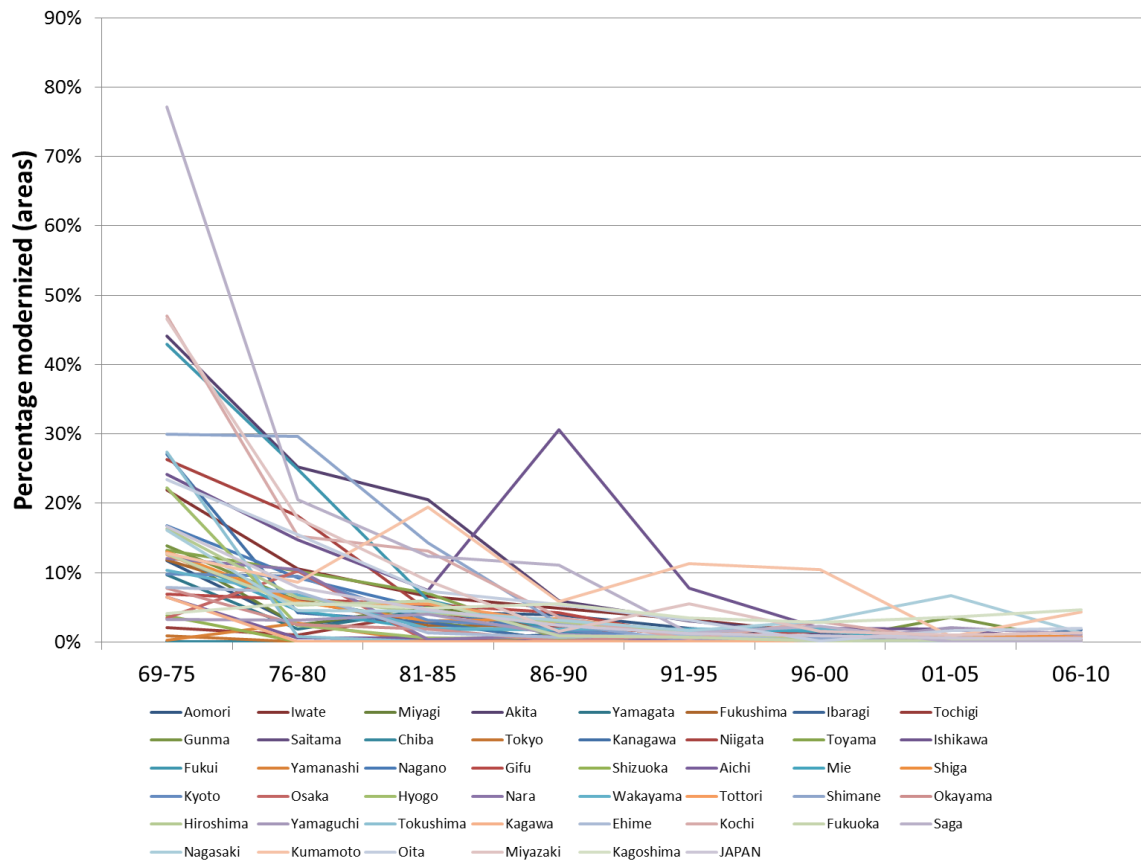


Figure 1. Percentage of Iriai commons forests modernized by prefectures

⁵ Since Japan has only 45 prefectures with Iriai-type commons forests statistics—a relatively small number—we counted correlation coefficients with less than 15 % statistical significance in order to explore the existence of relationships.

Table 4 Correlation coefficients from analyses

Indicators of modernization	Period	1. No. of households	2. Percentage of "larger than village"	3. Does not permit new members	4. Permits branch and coming back households	5. Permits residents	6. Tradable shares	7. House-moving to outside loses right	8. House-moving to outside retains right	9. Group management percentage	10. Plantation ratio	11. Labor investment	12. Obligatory labor investment
No. of approvals	0	0.008	-0.028	0.072	0.182	-0.016	0.018	-0.026	-0.111	-0.130	-0.190	0.031	0.121
	1	0.026	0.017	0.080	0.120	-0.003	0.020	-0.021	-0.103	-0.031	-0.227 -	0.088	0.152
	2	0.051	0.036	0.132	0.015	-0.017	0.045	-0.076	-0.091	-0.050	-0.179	0.161	0.204
	3	0.049	-0.021	0.195	0.069	-0.146	0.159	-0.208	-0.073	0.089	-0.186	0.192	0.310 **
	4	0.105	0.096	0.228 -	-0.007	-0.163	0.151	-0.244 -	-0.008	0.116	-0.192	0.302 **	0.388 ***
	5	0.112	0.067	0.326 **	-0.008	-0.282 *	0.113	-0.334 **	0.138	0.216	-0.129	0.346 **	0.469 ***
	6	-0.037	-0.044	0.114	0.053	-0.077	0.119	-0.136	-0.024	0.158	-0.215	0.225 -	0.321 **
	7	0.146	-0.004	0.147	0.102	-0.178	0.134	-0.229 -	0.111	0.038	-0.022	0.404 ***	0.441 ***
Whole	0.037	0.006	0.123	0.112	-0.045	0.052	-0.081	-0.091	-0.045	-0.208	0.127	0.209	
Areas approved	0	-0.196	-0.062	-0.087	0.169	0.099	0.001	0.056	-0.099	-0.128	-0.117	-0.024	0.064
	1	-0.250 *	-0.173	-0.160	0.260 *	0.136	-0.010	0.129	-0.135	-0.124	-0.205	-0.016	0.090
	2	-0.215	-0.039	0.047	0.030	0.018	0.082	-0.070	-0.030	-0.180	-0.102	0.129	0.229 -
	3	-0.197	-0.383 ***	-0.213	0.078	0.244 -	-0.053	0.128	-0.165	-0.060	-0.069	-0.029	0.058
	4	-0.097	-0.114	-0.053	-0.017	0.038	0.109	-0.064	-0.022	-0.093	0.032	0.207	0.260 *
	5	-0.106	-0.076	0.038	-0.018	-0.044	0.031	-0.123	0.153	-0.082	0.075	0.167	0.217
	6	-0.104	-0.096	0.025	0.048	-0.083	0.230 -	-0.060	-0.023	0.219 -	-0.078	0.143	0.209
	7	-0.045	-0.034	0.093	0.063	-0.144	0.126	-0.137	0.137	-0.039	0.080	0.318 **	0.350 **
Whole	-0.253 *	-0.163	-0.110	0.174	0.121	0.027	0.052	-0.107	-0.142	-0.135	0.042	0.156	
Group modernization (Areas)	0	-0.163	-0.128	-0.188	0.300 **	0.197	-0.081	0.219 -	-0.193	-0.132	-0.185	-0.066	0.020
	1	-0.210	-0.239 -	-0.227 -	0.319 **	0.178	-0.069	0.207	-0.180	-0.089	-0.266 *	-0.085	0.030
	2	-0.211	-0.089	-0.049	0.200	0.150	-0.029	0.131	-0.149	-0.114	-0.242 -	-0.002	0.081
	3	-0.208	-0.384 ***	-0.260 *	0.117	0.288 *	-0.057	0.218 -	-0.250 *	-0.115	-0.082	-0.104	-0.025
	4	-0.046	-0.272 *	-0.280 *	0.279 *	0.297 *	-0.069	0.250 *	-0.283 *	0.003	-0.170	-0.089	-0.029
	5	-0.032	-0.070	-0.014	0.085	0.052	-0.107	0.002	0.107	0.025	0.004	-0.031	-0.067
	6	-0.098	-0.045	-0.073	0.011	0.053	0.092	0.038	-0.099	0.466 ***	-0.066	0.100	0.074
	7	0.009	0.081	0.092	-0.045	-0.127	0.174	-0.001	-0.002	-0.142	0.123	0.238 -	0.181
Whole	-0.214	-0.216	-0.221 -	0.312 **	0.230 -	-0.075	0.238 -	-0.222 -	-0.118	-0.229 -	-0.071	0.031	
Individual modernization (Areas)	0	-0.160	0.049	0.078	-0.068	-0.066	0.106	-0.177	0.063	-0.070	0.019	0.040	0.095
	1	-0.169	0.035	0.041	0.015	-0.011	0.090	-0.071	0.016	-0.108	0.013	0.104	0.135
	2	-0.140	0.016	0.105	-0.116	-0.093	0.140	-0.204	0.075	-0.167	0.046	0.185	0.263 *
	3	-0.159	-0.333 **	-0.134	0.027	0.163	-0.041	0.014	-0.050	0.007	-0.046	0.055	0.141
	4	-0.091	-0.039	0.030	-0.105	-0.052	0.140	-0.148	0.064	-0.102	0.087	0.252 *	0.291 *
	5	-0.095	-0.054	0.052	-0.059	-0.071	0.077	-0.137	0.126	-0.100	0.085	0.187	0.249 *
	6	-0.071	-0.070	0.083	0.034	-0.145	0.232 -	-0.116	0.030	-0.003	-0.054	0.120	0.213
	7	-0.051	-0.072	0.057	0.086	-0.095	0.054	-0.144	0.145	0.022	0.029	0.229 -	0.289 *
Whole	-0.191	-0.032	0.066	-0.060	-0.057	0.134	-0.185	0.071	-0.109	0.031	0.154	0.235 -	

- 15% significance, * 10% significance, ** 5% significance, *** 1% significance
 Period 0 represents the period between 1969 and 1975.

DISCUSSION

Table 5 relates the results of the correlation analyses to the hypotheses in this paper.

Table 5 Correlation analysis and hypotheses

Initial conditions (Explanatory variables)	Modernization			Group modernization		
	Hypotheses	No. of signs		Hypotheses	No. of signs	
		+	-		+	-
1. No. of households	-	0	2			
2. Percentage of "larger than village"	-	0	5			
3. Does not permit new members	+	2	4			
4. Permits branch and coming back households	+	5	0			
5. Permits residents				+	3	0
6. Tradable shares				-	0	0
7. House-moving to outside loses right				+	4	0
8. House-moving to outside retains right				-	0	3
9. Group management percentage	+	2	0			
10. Plantation ratio	+	0	4			
11. Labor investment	+	8	0			
12. Obligatory labor investment	+	13	0			

A majority of the hypotheses were supported by this analysis, with the signs of their coefficients corresponding with the predictions of the hypotheses.

A few of the hypotheses were contradicted by the findings. We interpreted these contradictions as statistical phenomena, rather than as refutations of our original hypotheses. With regard to correlation coefficients related to H3 (Does not permit new members), four negative coefficients were statistically significant, while two positive coefficients were significant. However, as shown in Table 6, variable 3 (Does not permit new members) is negatively correlated with variables 5 (Permits residents) and 7 (House-moving outside loses right); the negative correlations obtained might be due to spurious factors. In fact, partial correlation coefficients were calculated among variables 3 (Does not permit new members), 5 (Permits residents), and 7 (House-moving outside loses right) and the variables for group modernization in Period 1, 3, 4 and the whole duration; the negative correlation between variable 3 (Does not permit new members) and the variable for group modernization in Period 4 turned out to be statistically insignificant.

Table 6. Correlation matrix among explanatory variables (initial conditions)

	1. No. of households	2. Percentage of "larger than village"	3. Does not permit new members	4. Permits branch and coming back households	5. Permits residents	6. Tradable shares	7. House-moving to outside loses right	8. House-moving to outside retains right	9. Group management percentage	10. Plantation ratio	11. Labor investment	12. Obligatory labor investment
1. No. of households	1.000	0.461	-0.181	0.051	0.154	-0.062	0.169	-0.235	0.159	0.088	-0.100	-0.145
2. Percentage of "larger than village"	0.461	1.000	0.284	-0.366	-0.236	0.030	-0.239	0.216	0.060	-0.044	-0.079	-0.148
3. Does not permit new members	-0.181	0.284	1.000	-0.538	-0.865	0.379	-0.871	0.653	0.076	0.093	0.553	0.528
4. Permits branch and coming back households	0.051	-0.366	-0.538	1.000	0.413	-0.305	0.515	-0.430	-0.098	-0.184	-0.319	-0.240
5. Permits residents	0.154	-0.236	-0.865	0.413	1.000	-0.615	0.936	-0.612	-0.066	-0.169	-0.555	-0.534
6. Tradable shares	-0.062	0.030	0.379	-0.305	-0.615	1.000	-0.591	-0.052	0.026	0.322	0.487	0.494
7. House-moving to outside loses right	0.169	-0.239	-0.871	0.515	0.936	-0.591	1.000	-0.646	-0.082	-0.165	-0.578	-0.546
8. House-moving to outside retains right	-0.235	0.216	0.653	-0.430	-0.612	-0.052	-0.646	1.000	0.058	0.146	0.324	0.225
9. Group management percentage	0.159	0.060	0.076	-0.098	-0.066	0.026	-0.082	0.058	1.000	0.020	0.212	0.205
10. Plantation ratio	0.088	-0.044	0.093	-0.184	-0.169	0.322	-0.165	0.146	0.020	1.000	0.396	0.177
11. Labor investment	-0.100	-0.079	0.553	-0.319	-0.555	0.487	-0.578	0.324	0.212	0.396	1.000	0.907
12. Obligatory labor investment	-0.145	-0.148	0.528	-0.240	-0.534	0.494	-0.546	0.225	0.205	0.177	0.907	1.000

These findings, augmented by the above statistical explanations of the apparent contradictions, generally support our assumptions. The ease of consensus building, inversely correlated with the sizes of commons forest groups and direct management by groups, has encouraged modernization under the Act (H1, H2, and H9). The cohesiveness of commons forest groups has encouraged modernization (H3, H4, H5, and H9). The strength of traditional customs related to Iriai-type forest management has promoted group-type, rather than individual-type, modernization (H7 and H8). Past investments in commons forests have led to active modernization (H11 and H12).

While a majority of the hypotheses were supported by the findings, H6 and H10 were not. Tentative working hypotheses are in order for these cases. With regard to correlation coefficients related to H6 (Tradable shares), no coefficient was statistically significant. This suggests that many groups with tradable share schemes might have pursued individual-type modernization outside the policies under the Act. With regard to H10, the higher the plantation ratio, the more stagnant the modernization, contrary to the hypothesis. This may be related to differences in policy efforts by prefectural governments. Because the original rationale for modernization was the lower plantation ratio among commons forests, i.e., the low intensity of forest management, prefectures with commons forests with high plantation ratios may not have aggressively pursued the modernization of their commons.

We tried to investigate further the relationship between the scales of groups involved in commons forests and progress in modernization. So far, we have found negative relationships between scale and modernization (H1 and H2). However, as suggested by Handa (2006), the relationship might be a non-linear, inverse-U shape one, because the balance of benefits and costs for commoners might change due to economies of scale and congestion phenomena. Table 7 shows correlation coefficients between group sizes and modernization processes. The group sizes were represented by the percentages of groups with certain numbers of households. It was found that group modernization is enhanced when group sizes are relatively small, around 11, while group modernization is difficult with groups sizes of more

than or equal to 301.

Table 7. Relationship between group sizes and modernization processes

	>=11 HH	>= 31HH	>= 51HH	>= 101HH	>= 151HH	>= 201HH	>= 301HH	>= 501HH
No. of approved projects	0.159	0.129	0.109	0.033	0.071	0.102	0.145	0.094
Areas of approved projects	0.118	-0.050	-0.129	-0.249 *	-0.219 -	-0.215	-0.166	-0.175
Group modernization	0.229 -	0.107	-0.008	-0.177	-0.175	-0.216	-0.222 -	-0.259 *
Individual modernization	-0.062	-0.211	-0.215	-0.228 -	-0.179	-0.124	-0.033	-0.004

">= 11 HH" indicates the percentage of gourps own Iriai commons forests with more than or equal to 11 households.
 - 15% significance, * 10% significance, ** 5% significance, *** 1% significance

We also investigated dynamic aspects of the correlations found in the above. We divided the eight periods into four first-half periods (periods 0 to 3) and four second-half periods (periods 4 to 7) and again counted the statistically significant positive and negative correlation coefficients. Table 8 shows the results of this analysis. Twelve pairs of statistically significant coefficients for first half and second half periods were identified. Among them, five pairs indicate increases (shown by orange color), and six pairs indicate decreases (blue color). It would be quite natural to expect the initial conditions of commons forests to lose their influence in later years. Contrary to this expectation, it appears that the influences last after more than 20 years, i.e., four periods in several instances. In particular, labor investments in commons forests display strong relationships with modernization development even after more than 20 years.

Table 8 First half and second half comparison

Initial conditions (Explanatory variables)	Modernization		Group modernization	
	Hypotheses	No. of signs	Hypotheses	No. of signs
		+ - (1st half)/(2nd half)		+ - (1st half)/(2nd half)
1. No. of households	-	0 1		1/0
2. Percentage of "larger than village"	-	0 5 4/1		
3. Does not permit new members	+	2 3 0/2 2/1		
4. Permits branch and coming back households	+	4 0 3/1		
5. Permits residents			+	2 0 1/1
6. Tradable shares			-	0 0
7. House-moving to outside loses right			+	3 0 3/0
8. House-moving to outside retains right			-	0 2 0/2
9. Group management percentage	+	2 0 0/2		
10. Plantation ratio	+	0 3 3/0		
11. Labor investment	+	8 0 0/8		
12. Obligatory labor investment	+	12 0 3/9		

The numbers of significant positive or negative signs do not match the ones found in the previous analysis since the signs for the whole period are excluded in the current analysis.

CONCLUSION

We examined the development of the modernization policy of forest commons in Japan over five decades and identified which factors influenced this development. We did not, however, examine the performance of this policy, for example, production outputs or investments in commons forests, in this study. As shown by the data for recent years, the modernization process has lost its momentum; and practitioners as well as some researchers have called for reform of the modernization policy (e.g., Kasahara, 1996). Further research on the consequences of the modernization policy is awaited.

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Exhibit 1 Descriptive statistics of variables for initial conditions (n=45)

	Average	Minimum	Maximum	Standard Deviation
1. No. of households	67.205	42.329	114.694	14.678
2. Percentage of "larger than village"	0.190	0.057	0.363	0.058
3. Does not permit new members	0.288	0.130	0.489	0.084
4. Permits branch and coming back households	0.111	0.038	0.211	0.046
5. Permits residents	0.399	0.185	0.606	0.101
6. Tradable shares	0.141	0.053	0.255	0.046
7. House-moving to outside loses right	0.575	0.282	0.776	0.115
8. House-moving to outside retains right	0.199	0.077	0.427	0.063
9. Group management percentage	0.485	0.344	0.835	0.094
10. Plantation ratio	0.365	0.060	0.791	0.176
11. Labor investment	0.487	0.232	0.680	0.095
12. Obligatory labor investment	0.341	0.106	0.533	0.092
Percentages of groups with certain numbers of households				
>=11 HH	0.795	0.670	0.932	0.056
>= 31HH	0.496	0.372	0.658	0.062
>= 51HH	0.320	0.200	0.458	0.055
>= 101HH	0.149	0.075	0.262	0.041
>= 151HH	0.089	0.032	0.166	0.031
>= 201HH	0.061	0.020	0.130	0.025
>= 301HH	0.036	0.008	0.094	0.017
>= 501HH	0.017	0.003	0.050	0.009