

Article

Innovativeness of Japanese Forest Owners Regarding the Monetization of Forest Ecosystem Services

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Abstract: The monetization of forest ecosystem services requires actors to innovate and tackle difficulties. We conducted a questionnaire survey with forest owners—important actors in implementing monetization—to investigate their innovativeness in Japan. We measured innovativeness regarding monetization by asking whether the owner was interested in, planning for, or had implemented four types of monetization: (i) multifunctional payments, (ii) habitat payments, (iii) non-wood forest product (NWFP) sales, and (iv) forest service industries. Based on the ordered probit analyses of 312 responses, we find that ownership type, age, holding size, and the purpose of forest ownership are associated with owners' innovativeness indices. Private and corporate owners, ones in their thirties, forties, or fifties, and with larger holding sizes are more innovative than others. Regional characteristics are not relatively important in terms of innovativeness. However, clear ownership purposes, such as investment and non-wood forest products (NWFP), are positively correlated with the indices. These findings shed new light on the entire process of innovation from conceptualization to implementation, as well as practices in under-researched geographical areas in Asia.

Keywords: innovation; innovativeness; payment for ecosystem services (PES); non-wood forest products (NWFP); Japan



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1. Introduction

There is an increasing number of novel practices regarding payments for ecosystem services and other measures that turn non-timber benefits from forests into revenue. Such practices were outside traditional timber-producing forestry activities in the past [1–4]. The rising interest in these measures reflects the need for forest managers to consider non-timber forest ecosystem services more seriously [5,6]. An international project—the economics of ecosystem services and biodiversity (TEEB)—is an attempt to validate this idea [7]. TEEB recommends policymakers and other stakeholders capture the values of biodiversity and ecosystem services after recognizing and demonstrating those values while cautioning that privatization or market-based solutions may not always be the answer. Toward businesses, TEEB presents opportunities such as voluntary payments for watershed management as “emerging markets” [8].

Due to some obstacles, such as the nature of public goods and the lack of well-defined property ownership for ecosystem services, it is difficult to achieve monetization of forest ecosystem services, which may provide a society with a wider range of opportunities for mainstreaming ecosystem services together with governmental policies. Innovations are required to realize these objectives [9–11]. To date, innovations in this area have been studied based on successful cases, which although well-known, are relatively small in number in the world. Relevant literature is scarce, and exploratory studies are still being conducted internationally [12]. These cases include watershed protection services provided by landowners in France to mineral water corporations, Vittel [13], and the

commercialization of wild mushrooms in Finland [14]. However, numerous trial-and-error undertakings have been attempted. An unsuccessful PES trial was reported in a European country [12], and one of the coauthors witnessed an ongoing consultation to develop mountain bike trails in a rural region of Japan [15]. Successful cases alone do not present a complete picture of innovation processes. Additionally, as shown in the literature, innovations for monetizing forest ecosystem services are context dependent and each requires a different solution [16–18]. Therefore, we must study them as different innovations. Consequently, the entire innovation process, from noticing an opportunity, planning for realization, and finally implementing the plan, must be followed.

In this study, we investigate innovations in monetizing forest ecosystem services from earlier conceptualizing to materializing stages, regarding the stages as the indices of innovativeness, employing a questionnaire survey methodology. It is well known that many pre-innovations, that is, innovations in their preparation stages, do not materialize [19]. Therefore, studies focusing on materialized innovations may miss those that do not materialize or become well known regionally or nationally. We investigate the types of forest owners (important decision makers for innovations) and the types of conditions under which they would engage with innovations. We believe that the insights into the innovativeness of forest owners will provide desirable and much needed types of policies regarding the monetization of forest ecosystem services. To the best of our knowledge, this study is the first attempt to analyze both potential and realized innovations by forest owners for monetizing forest ecosystem services. Apart from a large number of innovation studies conducted in European countries, this study took place in Japan, an industrialized Asian country.

2. Relevant Studies

Studies on innovations regarding the monetization of forest ecosystem services can be divided into two streams: research focusing on individual entrepreneurs and studies on environments or institutions in which entrepreneurs operate.

The first line of research includes that of Lunnan et al. who investigated entrepreneurs among non-industrial forest owners in Norway and recognized the importance of their entrepreneurial attitudes [20]. Such attitudes were acquired through “learning by doing”, according to their research. Štěrbová et al. examined eco-innovators in forestry service industries in Slovakia and acknowledged environmental awareness as an important factor, along with financial and information resources and other factors [21]. Nybakk et al. found that among Norwegian nature-based tourism operators, the innovativeness of operators was positively associated with their networking levels [22].

The second line of research focuses on the environment and institutions. One example is the study by Weiss et al., which compared cases of forest recreation industries in five European countries and identified the importance of interaction between tourism sectors and forest owners [23]. Kubeczko et al. conducted questionnaire surveys and case studies on innovation in central European countries [16]. The most relevant finding of that study is that product and service innovations, not process innovations, are generated in cross-sectoral regional arenas. This finding suggests that traditional forestry innovation institutions do not contribute to the creation of novel products or services, which is the focus of this study. Ludvig et al. found that entrepreneurs in the field of non-wood forest products (NWFP) in four European rural areas strategically used external support according to the contexts in which they started realizing their ideas [17]. New ways of using forests can cause conflicts, and such conflicts may prevent innovations. Wikes-Alleman et al. examined how institutional innovations for resolving conflicts were implemented by studying the cases of mountain biking trails in Austria and Switzerland [18].

These studies have several common findings. First, the importance of interacting with non-traditional actors in the field of forestry is emphasized. This suggests that innovations in monetizing forest ecosystem services may require resources or institutions different from those associated with traditional research and development schemes in forestry.

Second, as suggested in the introduction of this manuscript, most studies deal with realized innovations and not innovations at the conceptualization or planning stage. Third, all the studies are conducted in Europe. Research in other parts of the world is desirable for validating or developing existing knowledge.

Because this study investigates the attitudes of forest owners, we also look at studies that explored the general attitudes or values of forest owners. Most questionnaire surveys on forest owners' attitudes in developed countries considered here have reached similar conclusions: environmental services of forests are predominantly important. A study in Northwest Germany found that small-scale forest owners regarded regulating and cultural ecosystem services as more important than provisioning services, such as wood production [24]. For Finnish non-industrial private forest (NIPF) landowners, aesthetic values and biodiversity conservation were key motivations for forest ownership [25]. In Michigan, USA, for NIPF landowners, aesthetic appreciation was the strongest motivator for ownership [26]. In Virginia, USA, lifestyle and amenities were found to be more important than timber production and economic purposes for new forest owners [27]. For most forest owners in Quebec, Canada, appreciating and protecting the natural environment were the primary motivations for owning forests [28]. In contrast, a study in Sweden found that private forest owners considered both timber production and environmental preservation to be important [29]. Similarly in Sweden, Norden et al. found a strong orientation toward timber production among forest owners compared to general citizens [30]. The country-specific characteristics may have influenced these results.

Regarding innovativeness, a main concept of this study, Rogers proposed a typology of adopters' innovativeness based on the timing of adoption, for which typology will be discussed in the following section [31].

In this study, we observe and analyze the conceptualization and planning stages of innovations by forest owners and conduct a questionnaire survey in Japan (outside of Europe), with distinct patterns of ownership purposes. These points represent the study's novel contributions to the literature.

3. Materials and Methods

3.1. Study Area

First, we briefly introduce the current circumstances of forestry in Japan, where, because of historical developments, private small ownership is the dominant pattern [32]. In 2019, private owners owned 57% of the forests, while national and local governments owned 31% and 12%, respectively [33]. As of 2015, forest-owning households, surveyed by the Japanese government when they had more than or equal to 1 hectare (ha) of forest holdings, held an average of 6.2 ha forests. While households with small forest holdings dominate in terms of number, those with relatively larger forest holdings, more than or equal to 10 ha holdings, constituted 61% of the total area held by households. Currently, forest owners are focused on the management of plantation forests of Japanese cedar, cypress, and larch for the production of industrial logs. The ratio of demand for fuel wood to the total demand for wood has been low (1% in 2000, 2% in 2010, and 13% in 2019). Due to the low profitability of timber-producing forestry, forest owners' interests in forestry have been low, especially among those with small forest holdings (less than 20 ha) [34].

3.2. Data Collection

We conducted a questionnaire survey in July and August 2020 with two major national associations of forest owners and forest-related professionals in Japan: the Japan Forestry Association (Dai-Nippon Sanrinkai; approximately 800 members) and the Forest Management Association of Japan (Ringyo Keieisha Kyokai; approximately 240 members). Because the members voluntarily participated in these associations, we considered them active segments of forest owners in Japan. We chose these two associations as the population of our research because most owners with small holdings would not be interested in this questionnaire survey, and the expected response rate was low.

These two associations cooperated with the research team and mailed sets containing a cover letter and survey instrument to their members. These two associations include forest owners and non-owners, such as forestry professionals or researchers, but only forest owners were asked to participate in the survey. Respondents were asked about their views and practices regarding ecosystem services for their forests. We received 211 and 110 responses from the Japan Forestry Association and the Forest Management Association of Japan, respectively. While the number of forest owners in both associations was unknown—and there were membership overlaps between the associations—a simple calculation tells us that approximately 26% and 46% of the members of each association responded to the survey.

3.3. Variables

We measure the innovativeness of forest owners regarding monetization by asking them to identify their stage in terms of ecosystem service monetization. We presented the following four monetization measures: (i) payment for the multifunctional aspects of forests, such as disaster prevention, carbon sequestration, and water storage, (ii) payments for habitat preservation in their forests, (iii) NWFP and biomass energy projects, and (iv) services involving the use of forest environments for activities such as camping, forest therapy, guided nature tours, and forest funerals. (NWFP such as tree aroma and fuel wood are being marketed as new products even though they have been utilized by relatively few people in the modern era in Japan.) Next, we asked them to choose one of the following innovativeness stages: implemented (3), planning now (2), having an interest (1), having no interest (0), thinking it impossible (0), and having no idea (0). We consider the numbers in parentheses as indices of forest owners' innovativeness, considering stages closer to implementation as the manifestation of more advanced innovativeness.

We base these indicators on Rogers' diffusion theory (p. 262, "Adopter Categorization on the Basis of Innovativeness") [31]. Rogers divided a population into innovators, early adopters, early majority, late majority, and laggards according to their timing of adoption of an innovation or innovations. We measure respondents' attitudes toward innovation by observing their current stages from unawareness, recognition, and planning to realization. This is similar to a study of economic development based on cross-sectional data of countries. Although time-series analyses are ideal for studying dynamics, cross-sectional studies can also provide insights into the dynamic processes of economic development. We assign one to three scores for the following reasons. The three categories of "having an interest (1), planning now (2), and implemented (3)" are a logical order of progression, and the three categories of "having no interest (0), thinking it impossible (0), and having no idea (0)" are indistinguishable in terms of their positive or negative attitudes toward innovations. This measurement method captures both realized and potential innovations.

Additionally, we calculate a general innovativeness index by summing the four indices for each monetization measure.

We investigate the relationships between these innovativeness indices and forest owners' conditions, such as their types of ownership, ages, professions, educational backgrounds, forest types (sizes and plantation ratios = plantation/total area), regions where they lived, and purposes of ownership, by conducting ordered probit analyses.

Further, we include the characteristics of regions as explanatory variables because the literature review suggests that institutional settings can be important in innovation involving forest ecosystem services. These characteristics include the forest ratios of prefectures, 47 local jurisdictions in Japan, urban residents' population ratios, log production volumes, and numbers of forest volunteer groups in the prefectures. We assume that these variables representing natural and social conditions surrounding forests and forestry can be correlated to the innovativeness of respondents, based on a previous study [35].

The other explanatory variable included is the purpose of forest ownership. The dummy variables representing purposes chosen by respondents are as follows: the enjoyment of beauty and landscape, habitat preservation of wildlife, inheritance, preservation of

nature and biodiversity, timber production, preservation of water resources, land investment, hunting, recreational activities other than hunting, fuel, and charcoal, NWFP other than fuel and charcoal, a part of second home ownership, and other purposes.

4. Results

4.1. Profile of Respondents

The profiles of the respondents are listed in Table 1. The mean innovativeness index for the NWFP (1.436) is higher than the other three indices (0.847–1.100). A total 60% of the respondents are private owners, whereas corporate owners constitute 28.7%. The largest age group among respondents comprises those in their seventies (24.3%), followed by respondents in their sixties (19.0%). The largest group in terms of a profession is forestry workers (30.2%), followed by corporate officers (16.8%) and those involved in agriculture (13.1%) (multiple answers were permitted). Regarding educational background, university graduates are the largest group (48.3%) among the respondents.

Table 1. Descriptive statistics of dependent and explanatory variables.

Variable	Obs	Mean	Std. dev.	Min	Max	Description
(b) Indicates Baseline		(Number of 1's for Dummy var.)		(Number of 1's for Dummy var. (%Shares))		
MULTI_INDEX	321	1.100	1.007	0.000	3.000	Indices of innovativeness. MULTI_INDEX = payment for the multifunctional aspects of forests, HABITAT_INDEX = payments for habitat preservation in their forests, NWFP_INDEX = NWFP and biomass energy projects, SERVICE_INDEX = services involving the use of forest environments, INNOVATIVE_INDEX = sum of the four indices.
HABITAT_INDEX	321	0.847	0.938	0.000	3.000	
NWFP_INDEX	321	1.436	1.251	0.000	3.000	
SERVICE_INDEX	321	0.953	1.170	0.000	3.000	
INNOVATIVE_INDEX	321	4.336	3.455	0.000	12.000	
PRIVATE	321	0.607	(195)			Type of ownership, dummy variables (multiple answers were allowed). PRIVATE = private owners, CORPORATE = corporate owners, LOCAL = local government, COOPERATIVE = forestry cooperative. NA_OWN = no answer to question on ownership type.
CORPORATE	321	0.287	(92)			
LOCAL(b)	321	0.019	(6)			
COOPERATIVE(b)	321	0.050	(16)			
NA_OWN(b)	321	0.072	(23)			
UNDER_TWENTY	321	0.000	(0)			Ages of respondents, dummy variables. UNDER_TWENTY = under twenty years old, TWENTY = twenties, THIRTY = thirties, FORTY = forties, FIFTY = fifties, SIXTY = sixties, SEVENTY = seventies, EIGHTY = eighties and older ages. NA_AGE = no answer to question on respondent's age.
TWENTY	321	0.000	(0)			
THIRTY	321	0.034	(11)			
FORTY	321	0.059	(19)			
FIFTY	321	0.118	(38)			
SIXTY(b)	321	0.190	(61)			
SEVENTY(b)	321	0.243	(78)			
EIGHTY(b)	321	0.134	(43)			
NA_AGE(b)	321	0.221	(71)			
BUSINESS	321	0.056	(18)			Jobs of respondents, dummy variables (multiple answers were allowed). BUSINESS = business employee, OWN_BUSINESS = business owner, GOVERNMENT = governmental employees, CORP_OFFICER = corporate officer, ORGANIZATION = working for organizations other than corporations, FORESTRY = working for forestry, AGRICULTURE = working for agriculture, SELF_EMPLOY = self-employed, HOUSE_HUSWIF = house husband/wife, STUDENT = student, PARTTIME = part-time worker, NOT_EMPLOY = no job. NA_JOB = no answer to question on respondent's jobs.
OWN_BUSINESS	321	0.072	(23)			
GOVERNMENT	321	0.034	(11)			
CORP_OFFICER	321	0.168	(54)			
ORGANIZATION	321	0.078	(25)			
FORESTRY	321	0.302	(97)			
AGRICULTURE	321	0.131	(42)			
SELF_EMPLOY(b)	321	0.009	(3)			
HOUSE_HUSWIF(b)	321	0.006	(2)			
STUDENT(b)	321	0.000	(0)			
PARTTIME(b)	321	0.003	(1)			
NOT_EMPLOY(b)	321	0.065	(21)			
NA_JOB(b)	321	0.234	(75)			
JUN_HIGH	321	0.016	(5)			Educational levels of respondents, dummy variables. JUN_HIGH = junior high school, HIGH = high school, COLLEGE = college, technical college, etc., UNIV = university, GRAD = graduate school. NA_SCHOOL = no answer to question on educational levels of respondents.
HIGH	321	0.156	(50)			
COLLEGE	321	0.022	(7)			
UNIV(b)	321	0.483	(155)			
GRAD	321	0.097	(31)			
NA_SCHOOL(b)	321	0.227	(73)			

Table 1. Cont.

Variable	Obs	Mean	Std. dev.	Min	Max	Description
AREA	319	7.317	2.577	1.000	10.000	Holding sizes. 1 = less than 3 ha (21 {6.6}), 2 = 3 ha or more and less than 5 ha (3–5 ha) (4 {1.3}), 3 = 5–10 (15 {4.7}), 4 = 10–20 (10 {3.1}), 5 = 20–30 (13 {4.1}), 6 = 30–50 (20 {6.3}), 7 = 50–100 (32 {10.0}), 8 = 100–500 (97 {30.4}), 9 = 500–1000 (35 {11.0}), 10 = 1000 ha or more (72 {22.6}).
PLANT_N	313	7.645	2.387	1.000	10.000	Ratios of plantations in their holdings. 1 = less than 10% (8 {2.6}), 2 = 10% or more and less than 20% (10–20%) (6 {1.9}), 3 = 20–30 (8 {2.6}), 4 = 30–40 (10 {3.2}), 5 = 40–50 (34 {10.9}), 6 = 50–60 (24 {7.7}), 7 = 60–70 (28 {9.0}), 8 = 70–80 (46 {14.7}), 9 = 80–90 (59 {18.9}), 10 = 90% or more (90 {28.8}).
FOREST_RT	318	0.624	0.151	0.305	0.833	Forest ratio of prefecture where the respondent lives.
URBAN_RATIO	318	0.532	0.207	0.248	0.980	Ratio of urban population of prefecture where the respondent lives.
LOGS	318	454.293	669.909	6.000	3257.000	Log production volume in prefecture where the respondent lives in thousand cubic meters.
VOLUNTEERS	318	13.368	11.549	0.000	69.000	Number of forest volunteer groups in prefecture where the respondent lives.
BEAUTY	321	0.255	(82)			Purposes of forest ownership, dummy variables (multiple answers were allowed). BEAUTY = enjoyment of beauty and landscape, WILDLIFE = preservation of wildlife habitat, INHERIT = inheritance, NATURE_DIVERS = preservation of nature and biodiversity, TIMBER = timber production, WATER = preservation of water resource, INVEST = land investment, HUNTING = hunting, RECREATION = recreation activities other than hunting, FUEL = fuel and charcoal, NWFP = non wood forest products (NWFP) other than fuel and charcoal, SECOND_HOUSE = as a part of second house ownership.
WILDLIFE	321	0.137	(44)			
INHERIT	321	0.421	(135)			
NATURE_DIVERS	321	0.374	(120)			
TIMBER	321	0.866	(278)			
WATER	321	0.523	(168)			
INVEST	321	0.019	(6)			
HUNTING	321	0.016	(5)			
RECREATION	321	0.106	(34)			
FUEL	321	0.131	(42)			
NWFP	321	0.174	(56)			
SECOND_HOUSE	321	0.028	(9)			

The most frequent answer to ownership purpose is “timber production” (86.6% of the respondents), followed by “preservation of water resource” (52.3%) and “inheritance” (42.1%).

Figure 1 represents the distributions of the four specific innovativeness indices. MULTI_INDEX, HABITAT_INDEX, NWFP_INDEX, and SERVICE_INDEX represent the innovativeness indices for (i) payment for the multifunctional aspects of the forest, (ii) payments for habitat preservation in their forests, (iii) NWFP and biomass energy projects, and (iv) services involving the use of forest environments, respectively. Approximately 50–70% of the respondents have an interest in these measures or have planned for or implemented them. The largest response categories are “having no interest” and “having an interest”, except for NWFP_INDEX where “implemented” is the largest. Approximately 10 (HABITAT_INDEX) to 35% (NWFP_INDEX) have implemented each of these measures.

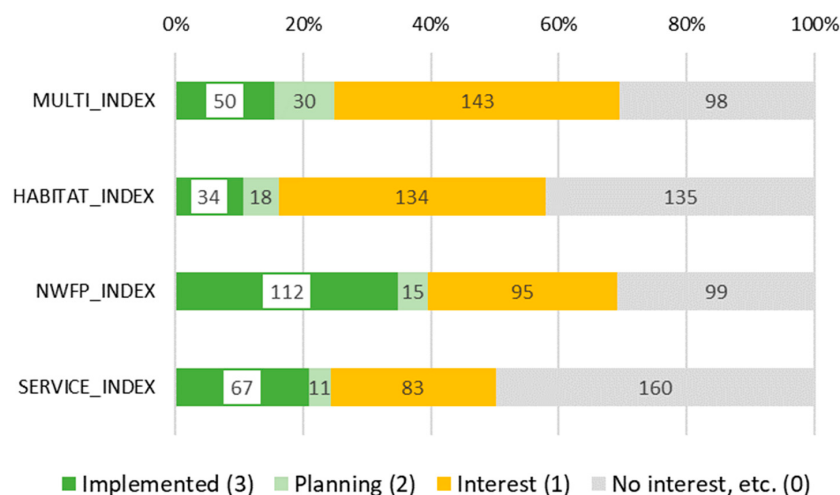


Figure 1. Specific innovativeness indices (figures in bars indicates the number of responses).

Figure 2 shows the distribution of the general innovativeness index (INNOVATIVE_INDEX), a sum of the four specific indices. This shows that the level of general innovativeness varies widely. More than 80% of the respondents have some interest in at least one of the four measures, as indicated by the fact that less than 20% (=100 – 80) of the respondents scored zero points (no interest in all four measures).

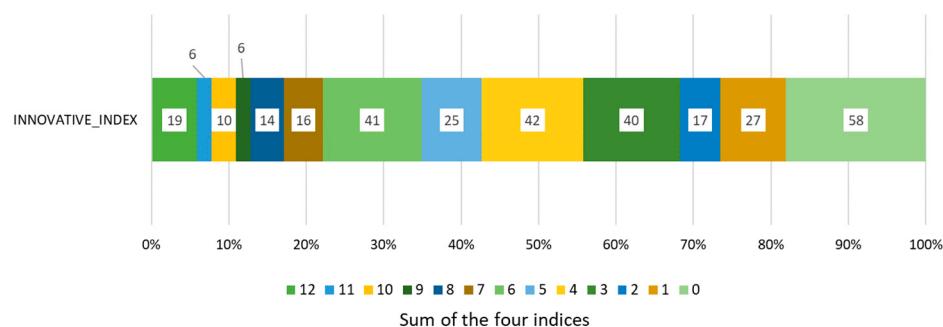


Figure 2. General innovativeness index (figures in bars indicate the number of responses).

4.2. Ordered Probit Analyses

The results of ordered probit analyses in which indices of innovativeness are dependent variables are presented in Table 2.

Table 2. Results of ordered probit analyses (N = 312).

	(1) MULTI_INDEX		(2) HABITAT_INDEX		(3) NWFP_INDEX		(4) SERVICE_INDEX		(5) INNOVATIVE_INDEX	
	Est. Coeff.	S.E.	Est. Coeff.	S.E.	Est. Coeff.	S.E.	Est. Coeff.	S.E.	Est. Coeff.	S.E.
PRIVATE	0.352 *	(0.208)	0.622 ***	(0.218)	0.325	(0.217)	0.451 **	(0.220)	0.457 **	(0.193)
CORPORATE	0.105	(0.212)	0.360	(0.220)	0.447 **	(0.220)	0.156	(0.222)	0.318	(0.195)
THIRTY	0.370	(0.380)	0.391	(0.382)	0.841 **	(0.398)	0.631	(0.402)	0.681 *	(0.352)
FOURTY	0.281	(0.307)	0.339	(0.306)	0.861 **	(0.340)	0.366	(0.321)	0.533 *	(0.283)
FIFTY	0.205	(0.223)	0.258	(0.225)	0.503 **	(0.233)	0.238	(0.231)	0.380 *	(0.206)
BUSINESS	−0.717 **	(0.326)	−0.561 *	(0.327)	−0.755 **	(0.327)	−1.066 ***	(0.381)	−0.939 ***	(0.299)
OWN_BUSINESS	−0.415	(0.277)	−0.249	(0.279)	−0.125	(0.277)	0.160	(0.276)	−0.112	(0.251)
CORP_OFFICER	−0.177	(0.198)	−0.0221	(0.202)	−0.349 *	(0.205)	−0.270	(0.211)	−0.299	(0.185)
FORESTRY	−0.191	(0.173)	−0.0191	(0.179)	0.101	(0.180)	−0.172	(0.184)	−0.0991	(0.161)
AGRICULTURE	−0.400 *	(0.239)	−0.469 *	(0.249)	−0.224	(0.245)	−0.460 *	(0.259)	−0.401 *	(0.219)
JUN_HIGH	0.451	(0.529)	−0.474	(0.627)	−0.414	(0.579)	−0.540	(0.667)	−0.102	(0.502)
HIGH	0.290	(0.207)	0.437 **	(0.212)	0.366 *	(0.215)	0.191	(0.218)	0.374 **	(0.190)
COLLEGE	0.621	(0.446)	0.534	(0.457)	−0.00229	(0.429)	0.477	(0.445)	0.536	(0.408)
GRAD	0.212	(0.247)	0.129	(0.249)	0.375	(0.256)	−0.259	(0.269)	0.152	(0.228)
AREA	0.105 ***	(0.0357)	0.0617 *	(0.0365)	0.140 ***	(0.0372)	0.0648 *	(0.0376)	0.116 ***	(0.0330)
PLANT_N	0.0304	(0.0300)	0.0324	(0.0308)	−0.0197	(0.0308)	−0.0408	(0.0314)	−0.00559	(0.0274)
FOREST_RT	−0.684	(0.612)	−1.584 **	(0.631)	−0.0833	(0.624)	−0.882	(0.650)	−0.882	(0.561)
URBAN_RATIO	−0.330	(0.448)	−0.711	(0.462)	−0.0837	(0.465)	−0.548	(0.482)	−0.417	(0.413)
LOGS	−0.000178	(0.000109)	−0.0000655	(0.000112)	−0.000161	(0.000112)	0.0000389	(0.000115)	−0.000110	(0.0000997)
VOLUNTEERS	0.0131 **	(0.00613)	0.00486	(0.00626)	0.00641	(0.00638)	0.00796	(0.00635)	0.0104 *	(0.00569)
BEAUTY	0.385 **	(0.183)	0.168	(0.187)	0.295	(0.190)	0.334 *	(0.189)	0.381 **	(0.168)
WILDLIFE	0.278	(0.234)	0.599 **	(0.236)	0.201	(0.251)	0.383	(0.240)	0.402 *	(0.216)
INHERIT	−0.0721	(0.146)	−0.0508	(0.151)	−0.184	(0.152)	−0.0202	(0.154)	−0.0691	(0.135)
NATURE_DIVERS	0.129	(0.172)	0.131	(0.178)	−0.0835	(0.177)	0.186	(0.182)	0.0961	(0.159)
TIMBER	0.220	(0.232)	−0.00516	(0.238)	0.0506	(0.235)	0.0993	(0.250)	0.115	(0.212)
WATER	−0.0452	(0.156)	−0.125	(0.160)	0.150	(0.160)	0.0766	(0.165)	0.0266	(0.144)
INVEST	0.993 *	(0.541)	0.289	(0.503)	1.280 *	(0.688)	1.311 **	(0.562)	1.061 **	(0.474)
HUNTING	0.176	(0.518)	0.410	(0.550)	0.281	(0.568)	0.950	(0.618)	0.472	(0.497)
RECREATION	0.213	(0.229)	0.405 *	(0.230)	0.0612	(0.238)	0.708 ***	(0.245)	0.355 *	(0.212)
FUEL	−0.286	(0.211)	−0.388 *	(0.216)	−0.328	(0.223)	−0.125	(0.225)	−0.340 *	(0.195)
NWFP	0.753 ***	(0.186)	0.682 ***	(0.189)	0.768 ***	(0.201)	0.332 *	(0.193)	0.710 ***	(0.172)
SECOND_HOUSE	−0.214	(0.420)	0.0522	(0.424)	0.478	(0.473)	0.460	(0.463)	0.151	(0.387)
Pseudo R ²	0.1018		0.1056		0.1190		0.1190		0.0739	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We explain here the estimated coefficients from the top of the table to the bottom.

Private (PRIVATE) ownership is positively correlated with four innovativeness measures (MULTI_INDEX, HABITAT_INDEX, SERVICE_INDEX, and INNOVATIVE_INDEX), and corporate (CORPORATE) ownership is also positively correlated with NWFP_INDEX. The baseline cases involve ownership by forestry cooperatives or local governments. The ages of the respondents are correlated with the NWFP and general innovativeness indices. The dummy variables for people in their thirties, forties, and fifties are positively correlated with the two innovativeness indices (NWFP, INNOVATIVENESS), and the baseline for this dummy variable is the group of respondents in their sixties or older. Notably, the estimated coefficients for the THIRTY or FORTY dummy are the largest among these age dummies. Variables related to respondents' jobs are not correlated with innovativeness measures, except for BUSINESS, CORP_OFFICER, and AGRICULTURE variables, representing business employees, corporate officers, and farmers, respectively. The BUSINESS variable is negatively associated with the indices for multifunction, habitat, NWFP, service industries, and general innovativeness. The AGRICULTURE variable is negatively associated with four innovativeness indices other than NWFP. The baseline dummy variables for respondents' jobs include "self-employed", "house husband/wife", "part-time worker", and "no job" categories. Education level is not positively correlated with innovativeness. With university graduates as the baseline cases, the coefficient for high school graduates is positive and significant for the three models (HABITAT_INDEX, NWFP_INDEX, and INNOVATIVE_INDEX). The size of the respondents' forest holdings (AREA) is positively correlated with all the indices. The ratios for plantations in respondents' holdings do not correlate with the innovative indices.

The explanatory variables representing the regional conditions under which respondents are operating are not generally correlated with the innovativeness indices. The only exceptions are the forest ratio of prefectures where the respondent lives (FOREST_RT), which is negatively associated with the habitat index, and the number of forest volunteer groups in prefectures where the respondent lives (VOLUNTEERS), which is positively associated with the multifunction and general innovativeness indices.

The purpose of ownership is associated with innovativeness. The enjoyment of beauty, wildlife, investment, recreation, and NWFP are positively associated with innovativeness measures. The "fuel" purpose is negatively correlated with habitat and general innovativeness.

The explanatory powers of the five models explaining innovativeness measures are low, with pseudo R^2 ranging from 0.0739 to 0.1190.

5. Discussions and Conclusions

We investigated the relationships between owners' innovativeness, which correspond to realized (implemented) as well as potential (planned or conceptualized) innovations, and owners' characteristics.

First, forest owners in this study are more advanced in the areas of innovations for NWFP and service industries compared to multifunction payments and payments for habitat preservation. We suppose that this is caused by the difficulties in implementing the latter two innovations because of their newness and abstractness. Multifunction and habitat payments are novel ideas and involve concepts such as ecosystem services, which cannot be presented concretely, such as mushrooms or camping areas.

The types of ownership have a relationship with innovativeness. Private and corporate ownership types are more active in the monetization of forest ecosystem services than cooperatives or public entities. Understandably, entities relying on sales revenue will be more eager to boost their income levels than entities that rely on public funding.

The age of forest owners also has a relationship with innovativeness. Owners in their thirties, forties, or fifties are more innovative in the NWFP area than older age groups. We can attribute this to generational memories—that is, memories of the prosperous days of timber-producing forestry in the 1960s and the 1970s in Japan. Generations

without such memories are more likely to accept ideas and practices that deviate from timber-producing forestry.

Regional characteristics generally do not appear to be important in the relationships with innovativeness. The chosen levels of geographical areas, 47 prefectures in Japan, may not have been appropriate. Innovations related to the monetization of ecosystem services may occur at different levels (e.g., local and national). The activities of forest volunteer groups, however, may improve the environment for multifunctional payments as indicated by the positive correlation between the number of forest volunteer groups and the multifunctional innovation index. This finding reiterates that of another study, in which political processes, including spending associated with prefectural environmental tax schemes, were related to the number of forest volunteer groups in the prefecture [35].

The results of this study underscore the finding by Lunnan et al. that formal education is not important for entrepreneurial activities in this field [20]. We find that educational level has no positive relationship with innovativeness. In certain fields, such as habitat preservation and NWFP, unlearning past experiences may be important in initiating or accepting innovations. Together with the finding that people in their thirties, forties, or fifties are more innovative, current or past education programs may not enhance innovativeness in these fields.

We did not find a positive correlation between jobs and innovativeness. If we accept the findings of several researchers that cross-sectoral interaction is important in initiating innovations [16,23], we suppose that the current styles of jobs in Japan do not accommodate such interactions.

Clear ownership purposes other than timber production appear to promote innovativeness in monetizing ecosystem services. In particular, purposes involving NWFP have positive relationships with all five innovative indices. The NWFP purpose may indicate the characteristics of their forests, for example, rich biodiversity, or the owners' attention to biodiversity as well as other non-timber aspects of their forests.

We note that the current sample appears to be different from those in other studies in terms of the purposes of ownership. In most other studies conducted in Europe and North America, environmental purposes are more important than timber production [24–28]. Because we opt to employ this sample as an active segment of forest owners in Japan, the respondents may have attitudes more inclined toward timber production than non-active owners.

Notwithstanding certain limitations of this study, we suggest several policy implications for promoting innovations in the monetization of forest ecosystem services.

The low explanatory power of the estimated models indicates that (1) innovation processes are governed by random factors to a large degree or (2) we did not identify important factors influencing innovation processes. Given this understanding, policymakers should not focus on certain subsectors of forest owners to support innovative activities, at least in Japan. Innovations are occurring and will continue to occur among a wide range of forest owners in Japan. An exception is related to the age of forest owners and holding sizes. Even though older forest owners are more likely to enjoy subjective well-being related to forests [36], innovativeness is higher for owners in their thirties, forties, and fifties. However, we should not err in the direction of age discrimination. Respondents with larger holdings appear to enjoy more opportunities in terms of innovations to monetize their forest ecosystem services. Policymakers should approach forest owners with large holdings, while obstacles for small- or medium-sized owners, such as information or resource availability, must be removed.

Understandably, forest owners with clear ownership purposes demonstrate greater innovativeness. Awareness-raising measures may contribute to enhancing the innovativeness of forest owners.

One of the limitations of this study is the lack of investigation into individual innovation processes. Since the Japanese government started promoting industries monetizing forest ecosystem services, more examples of the stages of innovation are anticipated [37].

Case studies of these examples will provide more in-depth and novel information on the factors that contribute to innovativeness in this field internationally.

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