

Appendix 1 Details of the third-tier variables used in this study. Minimum, median, and maximum values among the studied municipalities are shown.

First-tier variables	Code	Third-tier variables	Description	Min.	Median	Max.	Data source
Social, economic, and political settings (S)	S1-F	Financial strength index	The financial strength index is the average value of the past three years where the standard financial revenues calculated according to the Local Tax Allocation Act are divided by the standard financial needs. The local public organization becomes a non-granting organization of the local tax allocation when the financial strength index exceeds one; however, the organization is eligible to conduct administrative work that exceeds standard levels by the same amount that the value of the index is >1. Furthermore, organizations whose financial strength index is <1 will have larger reserves of financial resources for calculating the ordinary allocation tax the closer the financial strength index of the organization is to 1, which results in greater financial resources. Values from 2010 were used for the statistical values.	0.07	0.77	1.69	Population/economy-related data by municipality, Cabinet Office †
	S2-P	Population	Values from the 2010 census were used. Units are in persons.	1765	249271	3688773	Population/economy-related data by municipality †
Resource systems (RS)	RS31-P	Area of plantation forest	Area of plantation forest in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	8655220	773446598	Standardized land-use classification map for the whole of Japan ‡
	RS32-N	Area of natural, secondary, and other forest	Areas of natural forest, secondary forest, and other forest in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	42523730	572571755	Standardized land-use classification map for the whole of Japan ‡
	RS33-C	Area of cultivated meadow	Area of cultivated meadow in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	1807094	32958332	Standardized land-use classification map for the whole of Japan ‡
	RS34-N	Area of natural, secondary, and other grassland	Area of natural grassland, including the areas dominated by forbs and shrubs, secondary grassland, and other grassland (including sasa grassland) in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	3452281	115721316	Standardized land-use classification map for the whole of Japan ‡
	RS35-P	Area of paddy field	Area of paddy fields in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	23367465	386285481	Standardized land-use classification map for the whole of Japan ‡
	RS36-C	Area of other cultivated land	Areas of farmland, roadside, tea plantations, and nursery gardens in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	9937826	188817333	Standardized land-use classification map for the whole of Japan ‡
	RS37-M	Area of wetland and open water	Areas of marshes, waterside, seaside, and open water in the standardized land-use classification map for the whole of Japan. Units are in m ² .	0	3658439	188189854	Standardized land-use classification map for the whole of Japan ‡
	RS38-C	Coast	Coast was determined according to whether the municipality was adjacent to the ocean or not from the national land value information. 1: presence 0: absence.	0	0	1	Administrative area data, national land value information §
	RS4-D	Densely inhabited district	Densely inhabited districts were the proportion of regions with a high population density within municipal precincts.	0.0	8.28	100.0	Densely inhabited district data, national land value information ¶
	RS5-N	Net primary production	Calculated from 3D mesh data by Dr. Oguro and Dr. Sasai. Units are gC/year.	-188189854	2002082595	157003018473	Calculations from Dr. Oguro and Dr. Sasai (Oguro & Sasai et al., unpublished)
Resource units (RU)	RU41-A	Agricultural products	Agricultural production is the amount obtained by multiplying the annual production quantity for each item by the farmer's household sales price for that item. Values from 2006 were used for statistical values. Units are 1,000,000 yen.	0	4195	65530	Agricultural output by municipality (estimated) ¶
	RU42-W	Woody products	Woody production is the sum of the manufactured goods shipment value of wood, wood products, and furniture; processing fee income; other income; and shipment value of waste and scraps output from the manufacturing process. Values from 2010 were used for statistical values. Units are 10,000 yen.	0	61103	2929482	Industrial statistical survey, 2010. Confirmed report, Municipal Edition #
	RU43-F	Catch of fish	Catch of fish shows the amount of aquatic animals and plants caught on the sea surface. Values from 2010 are used for statistical values. Units are t.	0	0	44103	Fisheries/aquaculture production statistics, sea-level catch production statistics survey † †
Governance systems (GS)	GS2-N	NPO participated in the LBSAP committee	Number of NPOs included among LBSAP committee members.	0	2.5	9	Questionnaire survey
	GS31-R	Number of cooperated national and local governments	How many administrative organizations cooperated during the formulation of the LBSAP?	1	2	14	Questionnaire survey

	GS6-C	Presence of an implementation committee of LBSAP	Was an implementation committee established (1) or not established (0) after the formulation of the LBSAP?	0	0	1 LBSAP and local government HP
	GS7-B	Bylaw related to biodiversity conservation	Were bylaws related to biodiversity conservation created (1) or not created (0) after the formulation of the LBSAP?	0	0	1 LBSAP and local government HP
	GS81-M	Monitoring of natural environment	Were surveys/research for determining the situation of the natural environment (e.g., ecosystem, biota, distribution of organisms) shown (1) or not shown (0) as measures for the LBSAP?	0	1	1 "LBSAP Review", Ministry of the Environment ☯ ☯
	GS82-M	Monitoring of ecosystem service	Were surveys/research for determining the situation of ecosystem services (e.g., local natural resources, or methods for its use) shown (1) or not shown (0) as measures for the LBSAP?	0	0	1 "LBSAP Review", Ministry of the Environment ☯ ☯
	GS83-M	Monitoring by citizen	Were surveys on the natural environment and surveys/research relating to ecosystem services implemented with the participation of local residents (1) or not (0)?	0	1	1 "LBSAP Review", Ministry of the Environment ☯ ☯
Actors (A)	A11-S	Number of municipal officials involved	Number of municipal officials involved in the formulation of the LBSAP.	1	10	60 Questionnaire survey
	A12-C	Number of LBSAP committee members	Number of LBSAP committee members.	5	12	46 Questionnaire survey
	A21-D	Diversity of the LBSAP committee members	Of the 11 divisions of committee members (1: head or sub-head of local government, 2: administration, 3: legislators, 4: environmental council committee members, 5: local governments/neighborhood associations, 6: NPOs/citizen groups/public-interest corporations/voluntary groups, 7: businesses, 8: agricultural/forestry/fishery industry groups, 9: experts, 10: citizens, 11: other), how many divisions appeared as LBSAP members?	1	4	7 Questionnaire survey
	A22-E	Diversity of experts in the LBSAP committee	Of the LBSAP committee members, the number of specialized fields among experts.	0	3.3	10.5 Questionnaire survey
	A23-O	Number of municipal sections involved	Number of municipal sections involved in the formulation of the LBSAP.	1	2	3 Questionnaire survey
	A51-G	Number of influential organizations and people	Number of influential organizations and people on the LBSAP description content.	1	3	6 Questionnaire survey
	A52-L	Significant influence of the mayor	Whether the mayor had an impact on LBSAP description content (1) or not (0).	0	0	1 Questionnaire survey
	A71-T	Consciousness of traditional knowledge	The thought of incorporating wisdom and technology of natural management inherited across generations into the promotion of the LBSAP. This was evaluated on a five-point scale (5: very necessary, 4: somewhat necessary, 3: cannot be said either way, 2: not very necessary, 1: not necessary at all).	3.0	4.3	5.0 Questionnaire survey
	A72-L	Consciousness of local knowledge	Thought of incorporating wisdom and technology of region-specific natural management and use methods of natural resources into the promotion of LBSAP. This was evaluated on a five-point scale (5: very necessary, 4: somewhat necessary, 3: cannot be said either way, 2: not very necessary, 1: not necessary at all).	3.0	4.4	5.0 Questionnaire survey
	A73-T	Diversity of traditional knowledge	Amount of traditional knowledge used in the LBSAP.	0	1	3 Questionnaire survey
A74-L	Diversity of local knowledge	Amount of local knowledge used in the LBSAP.	0.1	1.0	2.7 Questionnaire survey	
Action situations: Interactions (I)	I2-A	Announcement of the progress	Achievement status and evaluation results of LBSAP are (1) or are not (0) published in white papers, reports, and websites.	0	1	1 Questionnaire survey
	I31-F	Number of meetings held in the LBSAP committee	Number of meetings held by the LBSAP committee.	2	5	34 Description of LBSAP (provided by Mr. Takahashi, IGES)
	I32-M	Informal meetings other than the LBSAP committee meeting	Informal meetings other than the LBSAP committee meetings. Units are in h.	10	44	600 Questionnaire survey
	I33-O	Overtime works of municipal officials	Overtime hour ranking of municipal officials involved in the formulation of LBSAP. This was evaluated on a five-point scale (5: constant overtime, 4: regular overtime, 3: occasional overtime, 2: almost entirely completed during working hours, 1: entirely completed within working hours and able to sufficiently work on other tasks).	2	4	5 Questionnaire survey
	I51-P	Actions reinforced by the LBSAP	Actions reinforced by the LBSAP.	1	4	9 Questionnaire survey
	I52-B	Actions reinforced by the LBSAP (related to biodiversity and environment)	Actions reinforced by the LBSAP (related to biodiversity and environment).	0	1	1 Questionnaire survey
	I53-A	Actions reinforced by the LBSAP (related to agriculture, forestry and fishery)	Actions reinforced by the LBSAP (related to agriculture, forestry and fishery).	0	0	1 Questionnaire survey
I54-P	Actions with a newly allocated budget	Actions with a newly allocated budget due to the formulation of LBSAP.	1	1	4 Questionnaire survey	

	I55-B	Actions with a newly allocated budget (related to biodiversity and environment)	Actions with a newly allocated budget (related to biodiversity and environment. 10,000 Yen.	0	250	1500 Questionnaire survey
	I56-A	Actions with a newly allocated budget (related to agriculture, forestry and fishery)	Actions with a newly allocated budget (related to agriculture, forestry and fishery. 10,000 Yen.	0	0	1100 Questionnaire survey
	I57-L	All Actions in LBSAP	All actions in the LBSAP.	8	47	186 Description of LBSAP
	I58-N	Inclusion of important ecosystems in the LBSAP	All ecosystems important to the region were incorporated as actions in the LBSAP and evaluated on a five-point scale (5: all incorporated, 4: somewhat incorporated, 3: neither fully nor not at all incorporated, 2: not much incorporated, 1: not at all incorporated).	2.0	4.0	4.4 Questionnaire survey
	I59-C	Establishment of a biodiversity center	A "biodiversity center", where staff and facilities for collecting biodiversity information, consulting, and specializing in the proposal and implementation of other policies, is (1) or is not (0) established.	0	0	1 "LBSAP Review", Ministry of the Environment ㊦ ㊧
	I8-G	Establishment of new organizations or new participation of existing organizations	Were new organizations established or did existing organizations newly participate (1) owing to LBSAP formulation, or not (0)?	0	1	1 Questionnaire survey
	I10-A	Activeness in evaluating actions of the LBSAP	Were the actions described in the LBSAP actively evaluated? Evaluated on a five-point scale (5: agree, 4: agree somewhat, 3: neither agree nor disagree, 2: disagree somewhat, 1: disagree).	2	4	5 Questionnaire survey
→ Outcomes (O)	O1-C	Extent of awareness change among citizens	Was there a change in awareness among residents owing to the formulation of the LBSAP? Evaluated by a five-point scale (5: very large change in resident awareness, 4: large change in resident awareness, 3: some change in resident awareness, 2: small change in resident awareness, 1: no change in resident awareness).	1.2	3.3	4.6 Questionnaire survey
	O2-U	Effectiveness of the LBSAP to the society, economy and daily life	Is the LBSAP effective in local society, economy, and daily life? Evaluated on a five-point scale (5: extremely useful, 4: very useful, 3: somewhat useful, 2: not very useful, 1: not useful).	1.2	2.4	3.3 Questionnaire survey

Data source:

† : https://www5.cao.go.jp/keizai-shimon/kaigi/special/future/keizai-jinkou_data.html
‡ : <https://www.nies.go.jp/biology/data/u.html>
§ : http://niftp.mlit.go.jp/ksj/gml/datalist/KsjTmplT-N03-v2_3.html
| : <http://niftp.mlit.go.jp/ksj/gml/datalist/KsjTmplT-A16.html>
¶ : http://www.maff.go.jp/j/tokei/kouhyou/sityoson_sansyutu/
: <https://www.meti.go.jp/statistics/tyo/kougyo/result-2/h22/kakuho/sichoson/index.html>
† † : http://www.maff.go.jp/j/tokei/kouhyou/kaimen_gyosei/#c
‡ ‡ : <https://www.env.go.jp/nature/biodic/lbsap/review.html>