PREDICTING & ASSESSING NATURAL CAPITAL & ECOSYSTEM SERVICES

PANCES

Predicting and Assessing Natural Capital and Ecosystem Services through an Integrated Social-Ecological Systems Approach

PolicyBrief

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Local Biodiversity Strategies and Action Plans (LBSAPs) to accelerate actions for biodiversity by local governments

The Environment Research and Technology Development Fund,
Strategic R&D Category
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Photo by Rei Shibata, Niigata University

Introduction

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report, published in May 2019, shed light on a global biodiversity crisis. The report warned that, under a "business-as-usual" scenario, most of the Aichi Biodiversity Targets set for 2020 by the Convention on Biological Diversity (CBD), as well as the 2030 Sustainable Development Goals (SDGs), will not be achieved. Solutions to this global biodiversity crisis require efforts at both global and local levels, as global and local drivers are integrally connected in contributing to biodiversity loss. It is thus imperative to strengthen linkages between global, national, and local biodiversity conservation efforts.

A Post-2020 Global Biodiversity Framework is currently under consideration and will be adopted at the next meeting of the Conference of the Parties to the CBD (CBD COP 15). In Japan, discussions are underway to revise the National Biodiversity Strategy and Action Plan (NBSAP). Local governments are expected to develop new, or revise existing, Local Biodiversity Strategies and Action Plans (LBSAPs) under the new NBSAP.

In 2017, the PANCES[i] research team conducted a questionnaire survey on the development and implementation of LBSAPs in 70 municipalities that had already developed them at that time. The team also conducted a similar questionnaire survey of all of the prefectures and case studies represented by PANCES model sites (in Hokkaido, Ishikawa, Niigata, and Okinawa prefectures). In addition, PANCES has produced a number of findings which we expect to be useful for the development, revision, and implementation of LBSAPs.

Based on findings from PANCES, this Policy Brief sets out policy recommendations to encourage more municipalities to develop LBSAPs and to help them improve their LBSAPs for better outcomes. It presents these results from PANCES broadly and concisely. For further details, please refer to the PANCES Summary for Policymakers (SPM) and research papers as indicated by the reference and citation numbers found in the text.

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[i] Predicting and Assessing Natural Capital and Ecosystem Services by Integrating Social and Ecological Systems (S-15), the Environment Research and Technology Development Fund, Strategic R&D Category, Ministry of the Environment, Japan.

Policy recommendations

1. LBSAPs, which facilitate sound regional development based on the natural, social, and cultural characteristics of the particular region, can increase municipal budgets and efforts for biodiversity, strengthen cooperation between relevant departments within local governments, and raise public awareness. However, few municipalities have developed LBSAPs to date. Many of those municipalities that do have LBSAPs have developed plans to update them around 2020. Support for development of new LBSAPs and revision of existing LBSAPs is needed in line with the forthcoming Post-2020 Global Biodiversity Framework and the new NBSAP.

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2. Local governments need budgets, biodiversity expertise, and more staff members for developing LBSAPs. Under budgetary and staff constraints, a local government has different options, including a joint LBSAP with neighboring municipalities and integrating the LBSAP into ordinances related to biodiversity. A joint LBSAP can strengthen cooperation among local governments that share common interests and problems, while ordinances can provide a rationale for policies and budgets and increase their effectiveness. Support from national and prefectural governments is essential as the capacity of local governments is often limited.

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3. A broad exchange of information among various actors is needed during the process of developing LBSAPs. The process provides opportunities for cooperation between different departments of a local government that are involved in biodiversity from different standpoints, and for mutual learning between different actors. Particularly, the participation of many departments, such as agriculture, education, and infrastructure, in the LBSAP development committee tends to increase the number of ecosystem services covered by the LBSAP, and thereby can accelerate mainstreaming of biodiversity across sectors.

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4. More efforts are needed to document and use traditional and local knowledge in new and revised LBSAPs. Biological indicators for connectedness between forests, agricultural landscapes, rivers, and seas that underpin local ecosystem services should be developed and used. PANCES has contributed to closing the knowledge gap about cultural ecosystem services deriving from lands and seas, as well as relationships between use of local ecosystem services by residents and their willingness to stay in the area for long periods of time. Such knowledge will be useful for future LBSAPs.

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5. Scenarios are a useful tool for setting future goals. The participation of local stakeholders in the scenario-building process enhances not only the salience of the scenarios for the local context, but also the sense of ownership among local people. Numerical model simulations of multiple scenarios and a spatially-explicit presentation of future biodiversity and ecosystem services using geographical information systems can help local governments identify the most desirable scenarios for the region.

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6. An effective LBSAP should engage a wide array of actors and policies beyond those involved in the conservation and sustainable use of biodiversity, including agriculture, forestry, fisheries, energy, and tourism. Such an LBSAP can help a local government better structure its policies related to biodiversity and can thereby effectively address locally-important issues in an integrated way. Knowledge gained from PANCES will be useful for developing an effective LBSAP, particularly for the integration of biodiversity policies with policies related to renewable energy, forests, agriculture, and population, as well as watershed and coastal management that cuts across the forest-farmland-river-sea continuum.

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7. PANCES launched a policy support tools website where users can search and refer to policies related to biodiversity and ecosystem services of all ministries and agencies (http://pances.net/search/). Local governments, when newly developing or revising LBSAPs, can identify policy options meeting their local needs by searching for priority policies and indicators for different objectives.

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What are LBSAPs?

1. What are Local Biodiversity Strategies and Action Plans (LBSAPs)?

Local Biodiversity Strategies and Action Plans (LBSAPs) are local versions of National Biodiversity Strategies and Action Plans (NBSAPs), which are basic plans for the nationwide conservation and sustainable use of biodiversity (Figure 1). In Japan, the need for LBSAPs was clearly stated in its third NBSAP (2007), while the Basic Act on Biodiversity (2008) required local governments to develop LBSAPs, which are necessary to implement effective local policies for the conservation and sustainable use of biodiversity optimised to local ecological and societal contexts[1,2]. The role of LBSAPs in the implementation of the Convention on Biological Diversity (CBD) in various countries is widely recognised[3]. The CBD adopted a decision on LBSAPs (Decision IX/28, "Promoting engagement of cities and local authorities") and has specific processes for them (in particular, the Edinburgh Process).

Municipalities worldwide have developed a wide variety of LBSAPs[4]. They generally address biodiversity conservation and land use[5] but some represent unique local characteristics. The LBSAP of Cape Town, South Africa, focuses on strengthening partnerships between government agencies, non-governmental organisations, research institutes, and the private sector[6]. The LBSAP of Delhi, India, aims to incorporate biodiversity into urban planning[7]. The LBSAP of Auckland, New Zealand, focuses on indigenous people's cultures[5]. As such, local governments in Japan can develop unique LBSAPs reflecting different ecological, social and cultural traits of respective areas while referring to "the Guide to the Development of LBSAPs (revised version)".

By the end of the 2018 fiscal year, 43 prefectures (91.5% of the total), 18 ordinance-designated cities

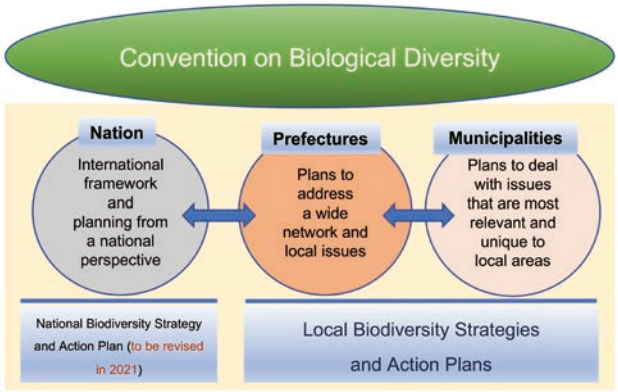


Fig. 1 Relationship between NBSAPs and LBSAPs of prefectures and municipalities

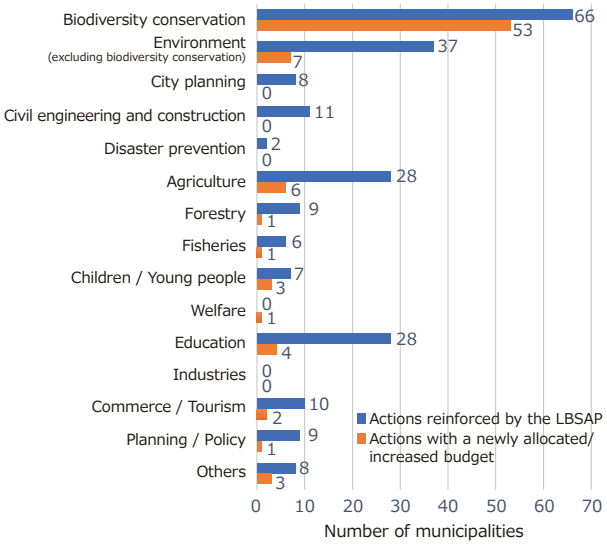


Fig. 2 The effect of LBSAPs on strengthening efforts and additional budget availability

Notes:
*1: Data from the Report on the National Survey of Local Governments on LBSAPs9 was re-calculated for each municipality;
*2: Municipalities were considered to have strengthened actions or budgets if at least one of the respondents answered "Yes" to the question regarding strengthening actions and budgets.

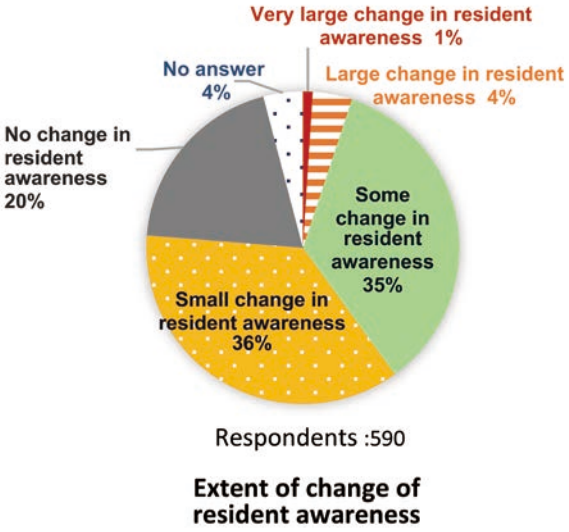
(90.0% of the total), and 77 municipalities (4.5% of the total) in Japan had developed LBSAPs[8]. The Ministry of the Environment, Japan (MOEJ) has provided support and encouragement to these municipalities, including through the Local Biodiversity Conservation Actions Support Program (2010–2014). As a result of LBSAP development, many municipalities have strengthened their actions to conserve biodiversity (Figure 2). Budgets have increased and range in size from ¥240,000 to ¥15,000,000 per year. In addition to biodiversity conservation, some municipalities have increased actions and budgets for agriculture and education. LBSAPs have strengthened cooperation among related sections in the local governments of the aforementioned municipalities. Although few municipalities have increased actions on disaster risk reduction through their LBSAPs, strengthened cooperation with sections in charge of disaster risk reduction is anticipated, as ecosystem-based disaster risk reduction and green infrastructure are closely related to biodiversity.

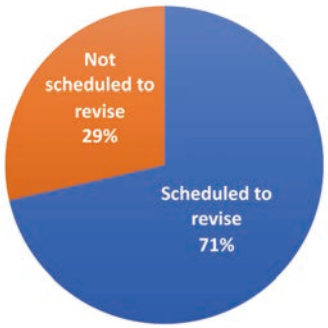
LBSAP development has also increased residents' awareness of biodiversity (Figure 3). The more municipalities incorporated traditional knowledge into their LBSAPs or the more they strongly recognised the need for local knowledge, the more awareness among residents increased. The process to develop an LBSAP can be an opportunity to recognise and learn

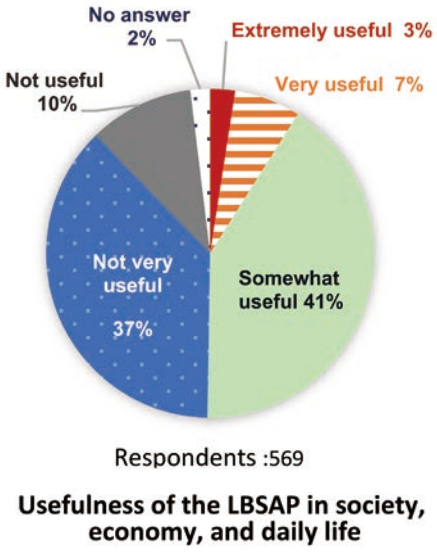
Photo by Atsushi Nanami, Japan Fisheries Research and Education Agency

about traditional and local knowledge that can increase residents' awareness if incorporated in an LBSAP. Approximately half of respondents recognised that the LBSAP was useful for society, economy, and daily life.

In 2021 the Post-2020 Global Biodiversity Framework will be adopted and then the Japan's NBSAP will be renewed. Meanwhile, the natural environment and social conditions are changing rapidly. Thus, efforts to develop new LBSAPs or to revise existing LBSAPs to respond to these conditions should be strengthened. Many municipalities with LBSAPs were planning to revise them in or around 2020 (Figure 4). Developing or revising an LBSAP requires removing barriers faced by local governments to strengthen its local focus and effectiveness.







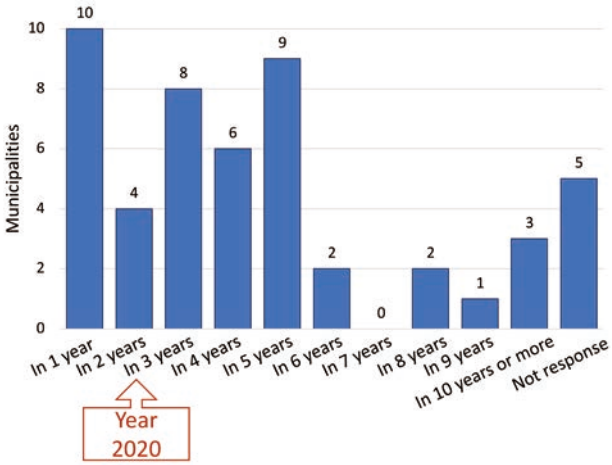


Fig. 3 Effects of the development of LBSAPs

Data from the Report on the National Survey of Local Governments on LBSAPs9 were re-calculated combining responses from municipal officials and those from LBSAP committee members involved in LBSAP formulation.

Fig. 4 Future LBSAP revision plans for municipalities with existing LBSAPs

Source: National Survey of Local Governments on LBSAPs (conducted in January–February 2017)[9]

How can the number of LBSAPs be increased?

2. Factors promoting and hindering the formulation of LBSAPs

According to local governments that have already formulated LBSAPs, the main reasons for doing so include that it is mandatory under the Basic Act on Biodiversity, an existing strong awareness of biodiversity issues, and being influenced by the formulation of LBSAPs by neighbouring municipalities or prefectures (Figure 5). On the other hand, most local governments who have not done so list insufficient knowledge, staff, and budget as the main reasons (Figure 6).

An exhaustive survey of municipalities found that those that had formulated LBSAPs were characterised by having more staff members, covering larger non-urban areas, and showing greater involvement of environmental experts in the formulation process. The scale of a municipality's manpower is significantly proportional to its population size, and more urbanised municipalities tend to have larger human and financial resources and are able to establish specific sections to formulate LBSAPs. They also tend to embrace ideocratic governance approaches (Figure 7). Meanwhile, municipalities with large nature-abundant non-urban areas have smaller staffs despite their extensive administrative requirements. Agriculture and fishery sections often oversee their biodiversity conservation. Hence, there are concerns that in municipalities with fewer staff members and abundant wild areas, the level of administrative services for natural environment conservation could be insufficient. These municipalities tend to show responsive governance, focusing on issues such as prevention of damage caused by wild animals.

Budgets and staff sizes for biodiversity conservation policies, including LBSAPs, of ordinance-designated cities peaked around 2010, when Japan hosted the tenth Conference of the Parties to the Convention on Biological Diversity (CBD COP 10) (Figure 8; Appendix Figures 1, 2). These dropped off afterwards, but related to the number of LBSAPs formulated, the trend has been towards a marginal increase. In addition to ordinance-designated cities, fiscal years 2010–2014, in which the MOEJ offered funding drawn from its "Local Biodiversity Activities Support Programme", saw significant LBSAP formulation. This demonstrates the impact of state funding.

The above suggests that continuing this increase in municipalities formulating LBSAPs will require expanded budgets, professional knowledge, and staff.

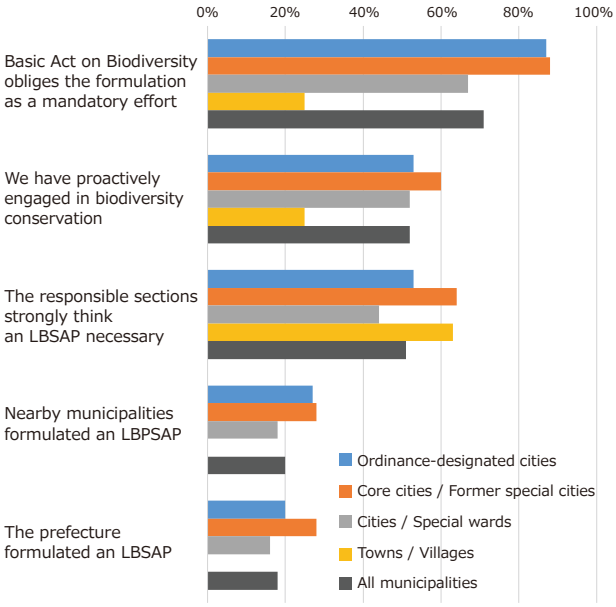


Fig. 5 Top five reasons given for formulating LBSAPs[2]

Notes:
*1 Multiple-choice format; answered by officials of responsible sections in municipalities formulating LBSAPs. Unit: Municipality.
*2 For municipalities which already had a formulated strategy, there were multiple respondents, so a response by even one staff member was counted as a reason for that municipality's strategy formulation.
*3 Amami Oshima has joint strategy formulation and is counted as one city. Villages and towns are aggregated in the same category as there is only one of the former.

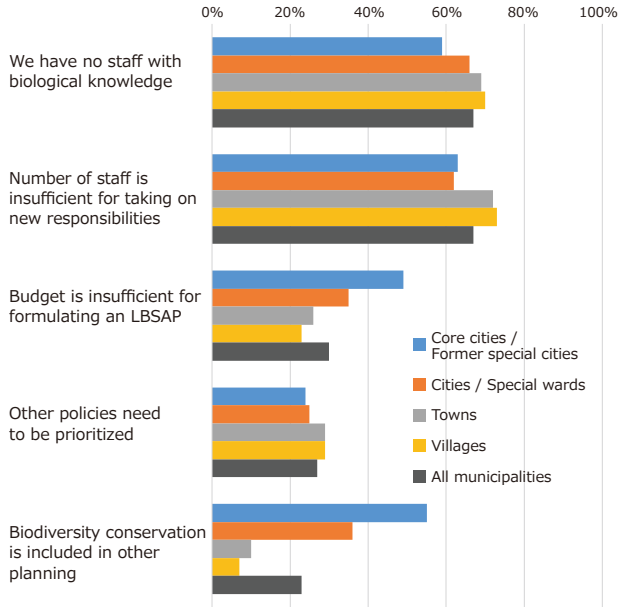


Fig. 6 Top five reasons given for not formulating LBSAPs[2]

* None of the respondent municipalities were ordinance-designated cities, so they are not listed in the graph.

Systems for formulating LBSAPs can be strengthened by: discussing LBSAPs to deepen awareness of the issue with local experts such as university researchers and non-profit organisations (NPOs), and with national institutions including the Ministries of the Environment, Agriculture, Forestry and Fisheries, and Land, Infrastructure, Transport and Tourism; forming a network with prefectures; hiring and training of staff with specialised knowledge; and provisioning of required budgets. Further, momentum for LBSAP formulation can be increased by seeking the understanding of heads of municipalities and other political elites, and through synergetic effects with regional industrial development. Visualising issues using evaluation indices[10] of biodiversity status and conservation efforts may lead to motivating strategy formulation.

To formulate LBSAPs when municipalities have limited staff and budget, options include joint LBSAP development with neighbouring municipalities and development[11]. The five municipalities of Amami Oshima spearheaded joint LBSAP development in Japan. They shared common issues such as invasive species management in preparation for the UNESCO World Natural Heritage site inscription. Since the strategy was formulated, these five municipalities have continued holding regular monthly meetings, and cooperation among the municipalities has strengthened through this joint LBSAP. Biodiversity ordinance

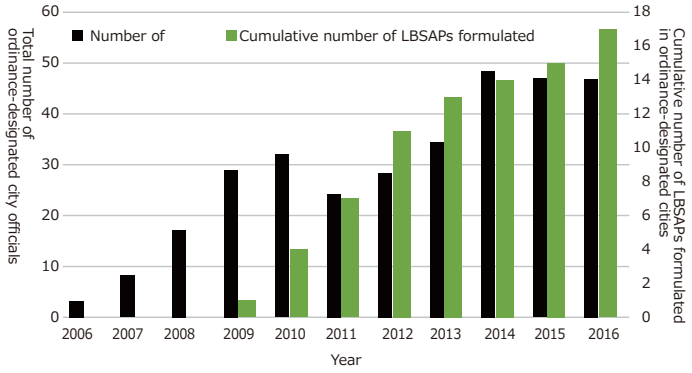


Fig. 8 Cumulative number of LBSAPs formulated by and size of staff in charge of biodiversity-related policies in ordinance-designated cities
Sources are 2016 data[12,13]

was developed first by Higashiohmi City on June 26, 2007. With the addition of Sagamihara City in 2019, there are now similar initiatives in 10 municipalities (Appendix Table 1). Among these, Suzu City, naming its ordinance "Biological and Cultural Diversity", took note of the interplay between biodiversity, culture, and local customs. LBSAPs accompanied by ordinances are effective because there is definite prioritisation of budgeting and policy implementation on topics such as rare species and habitat conservation. With the limitations on efforts by individual municipalities, support at the national and prefectural level is essential. Aichi Prefecture is considering how to support its municipalities, using the number of LBSAPs formulated as an indicator.

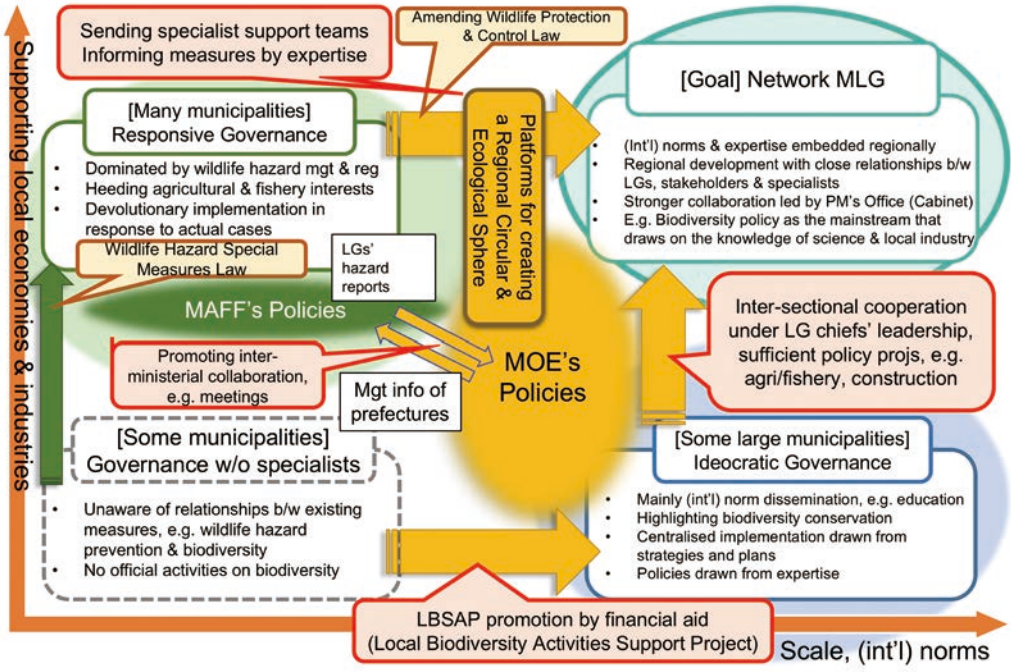


Fig. 7 Two modes of governance

How to develop effective LBSAPs and strengthen their implementation

3. Procedures and structures for development and implementation of LBSAPs

The basic procedures for LBSAP development include analysing the current status and issues related to local biodiversity; identifying target areas, goals, and basic policies; developing and systematising measures and action plans; and considering assessment, promotion, and progression mechanisms. The involvement of diverse actors from early stages is desirable, such as the national government, local governments, the private sector, and citizen groups. For effective implementation, LBSAPs should specify responsible sections of the local government and the organisational structure that will promote cooperation among various actors. It is also recommended to create a base for activities[1]. PANCES clarified cooperation efforts among actors and their effects in the formulation and implementation of LBSAPs.

A broad exchange of information among diverse actors is important for LBSAP development. Biodiversity conservation often creates conflicts of interest with agriculture, forestry, fisheries, and tourism[14–16], but LBSAP development provides an opportunity for cooperation and learning[17] between diverse actors designated to different positions—a requirement for problem-solving. By encouraging diverse actors to learn from one another, we expect awareness among residents to increase. Currently-formulated LBSAPs are primarily concerned with land rather than sea areas, but in coastal municipalities, conditions in sea areas can also be improved through participation by actors such as fishermen in the formulation and revision of the LBSAPs, for example as committee members.

The results of a PANCES survey of municipalities across the country that have developed LBSAPs (responses received from 70 municipalities)[9] showed that the number of local government sections involved was higher in municipalities with larger financial resources (up to 14 sections) and with larger areas of natural and secondary forests (up to 11 sections).

LBSAPs also play an important role as local science-policy platforms. Based on the results of the same questionnaire survey, we specified different type of efforts by local governments for LBSAP development that contributed to the accumulation of relevant knowledge and its use in LBSAPs. These included LBSAP development committees, study groups, local activity centres, independent research, demonstration projects, and public comments (Table 1). LBSAP development committees that involve multiple sectors, such as government, experts and business, was confirmed particularly effective. Additionally, the participation of a higher number of departments of local governments (e.g., agriculture, education and infrastructural services) in the development committee increased the number of ecosystem services covered by the LBSAP (Table 2). This is likely to inspire mainstreaming biodiversity across sectors.

Table 1 Contribution of different types of LBSAP development efforts to accumulation and use of necessary knowledge

Action items	Knowledge accumulation		Knowledge use		Number of ES types	
Personal work of officers in charge	0.373	*	0.338		0.032	
Personal networks	-0.204		-0.096		0.183	
Outsourced consultancies	-0.048		0.120		-0.054	
LBSAP formulation committees, etc.	0.845	**	0.837	**	0.430	
Study groups, workshops, etc.	-0.064		-0.166		0.387	*
Local activity centre development	0.176		0.380	*	-0.202	
National/prefectural cooperation	-0.157		0.065		0.189	
Cooperation with universities and museums	0.084		-0.050		-0.173	
Inter-municipal networks	0.305	*	0.066		-0.190	
Resident surveys	-0.158		0.167		-0.049	
Research, demonstration projects, etc.	0.298	*	-0.003		0.383	*
Communication and publicity	-0.140		-0.075		0.140	
Biodiversity inventory and databases	0.314	*	0.305		0.034	
Public comments, reviews, etc.	0.349		0.694	**	-0.205	

Note: Results of linear regression analysis with explanatory variables being the presence or absence of initiatives by each municipality for items that many municipalities implemented in the formulation of their LBSAPs; response variables are the level of knowledge required for the LBSAPs, the degree of utilisation, and the number of ecosystem services (ES) items covered by the LBSAPs. Numbers indicate regression coefficients, and **, *, and. to the right of the numbers indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 2 Contribution of other variables in the LBSAP development process to accumulation and use of knowledge

Variables	Knowledge accumulation		Knowledge use		Number of ES types	
Number of organisations and individuals who inspired the formulation	0.094		0.196		-0.193	
Number of people or organisations who significantly influenced the content	-0.217	*	-0.150		0.020	
Number of relevant departments within the local government involved in LBSAP development	0.013		0.084		0.219	***
Number of other governmental organisations involved in LBSAP development	0.625	*	0.174		0.411	*
Number of people and organisations involved in LBSAP development	-0.024		-0.110		-0.176	
Number of areas of expertise of the experts who participated as members of the formulation committee	0.105		0.177		0.022	
Total number of meetings of the formulation committee	0.029		0.005		0.045	
Formulation period (months)	0.031		0.012		0.037	*

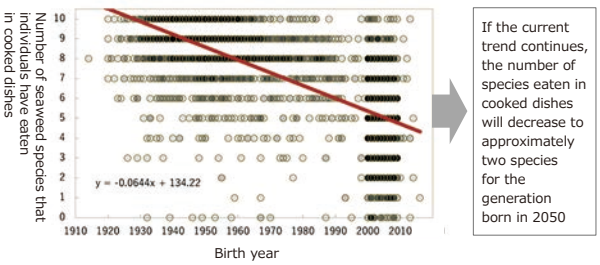
Note: Results of linear regression analysis on various indicators related to the system of LBSAP development as explanatory variables and the degree of knowledge required for LBSAPs, the degree of knowledge use, and the number of ecosystem service (ES) items covered by the LBSAPs as response variables. Numbers are regression coefficients, and ***, **, *, and. indicate significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

4. Collecting and organising information

LBSAPs need to explain, in simple terms, the importance of biodiversity and ecosystem services and the significance of their conservation and sustainable use[1]. PANCES has produced research results on the current state of traditional and local knowledge of biodiversity and indicators that can be used to improve scientific understanding of biodiversity and ecosystems. Additionally, we have worked on developing an understanding of cultural ecosystem services related to local culture and individual nature experiences.

Traditional and local knowledge

Ecosystem management based on local and traditional knowledge systems can be a useful tool for supporting sustainability[18]. Members of local communities have used traditional and local knowledge to quickly detect changes in ecosystems[19] and to promote sustainable management[20]. Additionally, participatory decision-making can encourage local residents to take positive action[21]. However, traditional and local knowledge of ecosystem management is being lost as a result of changes in social circumstances and the natural environment[22]. The application of traditional and local knowledge to LBSAPs is widely recognised as important but is not implemented due to lack of information among other reasons (Figure 9). Analysis of the questionnaire results revealed that the recognition and utilisation of traditional and local knowledge are related to sufficient deliberative processes for LBSAPs, reinforcement of actions, positive attitudes towards the evaluation of actions, and changes in awareness of local residents. This indicates that, when formulating or revising future LBSAPs, efforts should be made to collect traditional and local knowledge. Further, understanding, promoting, and adopting such knowledge should be explicitly prioritised by concrete measures in each municipality (SPM[ii] 4.2). The participation of diverse local actors with traditional and local knowledge is indispensable.

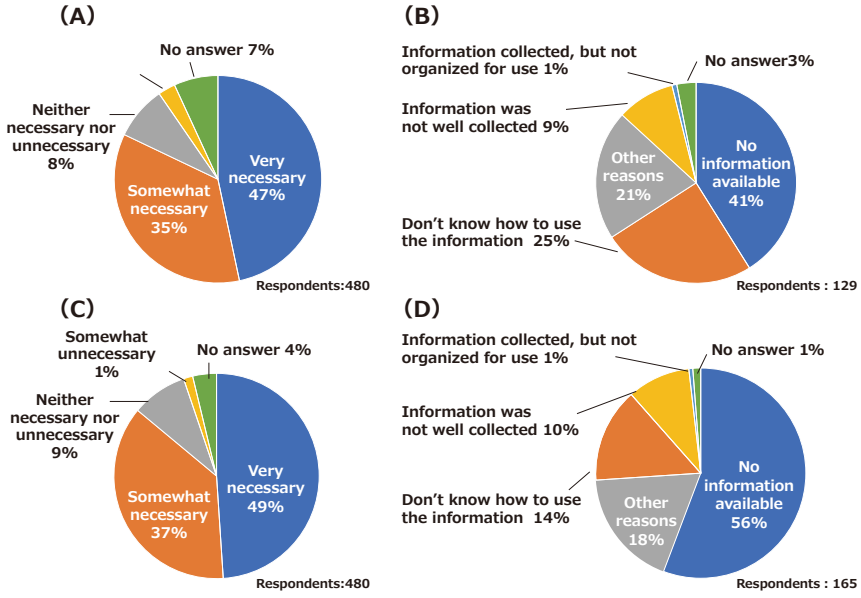


The number of seaweed species that individuals have eaten in cooked dishes decreases with birth year, and the inheritance of this knowledge is at risk. The red line indicates the result of a linear regression.

Fig. 10 Relationship between Sado Island residents' knowledge of use of seaweed and birth year

PANCES conducted a survey on local knowledge of seaweed use as food culture on Sado Island. The food culture of seaweed consists of both provisioning and cultural services from the coastal ecosystem. The results of the survey showed that younger generations recognised, ate, and cooked with fewer types of seaweed (Figure 10). If this trend continues, the generation born in 2050 will recognise only three types of seaweed, and the tradition of cooking with seaweed will be lost. To maintain the ecosystem services of the Sado Island seaweed-eating culture, knowledge must be passed to the younger generation. We recommend food education in schools, disseminating knowledge online, and increasing opportunities for the older generation to pass on their knowledge to the younger generation.

[ii] SPM refers to the PANCES Summary for Policymakers. For more information, please refer to the relevant numbered section of the Summary for Policymakers document (link provided).



A high degree of awareness exists regarding the importance of incorporating traditional knowledge (A) or local knowledge (C) for promoting LBSAPs.However, a lack of information or understanding were often expressed as reasons for not using traditional knowledge (B) or local knowledge (D).

Fig. 9 Recognition of the importance of and reasons for underutilisation of traditional and local knowledge in LBSAPs

Data from the Report on the National Survey of Local Governments on LBSAPs9 were re-calculated combining responses from municipal officials and those from LBSAP committee members involved in LBSAP formulation.

Photo by Atsushi Nanami,
Japan Fisheries Research and Education Agency

Biological indicators of forest-field-river-sea connectedness

Connectedness between forests, fields, rivers, and oceans is the foundation for provision of local ecosystem services. Identification and monitoring of biological indicators that assess this connectedness can deepen our understanding of forest-field-river-ocean interdependence. In the eastern region of Hokkaido, we monitored the relationship between *masu* salmon, which migrate between rivers and the sea, and their parasitic pearl mussel, which was used as an indicator species to assess forest, river, and sea connectivity (SPM 3.4.2). The habitat status of the pearl mussel allowed us to assess river water and sediment quality and the connectivity between the river and the sea (or the impact of fragmentation by dams and weirs).

Terrestrial ecosystem services

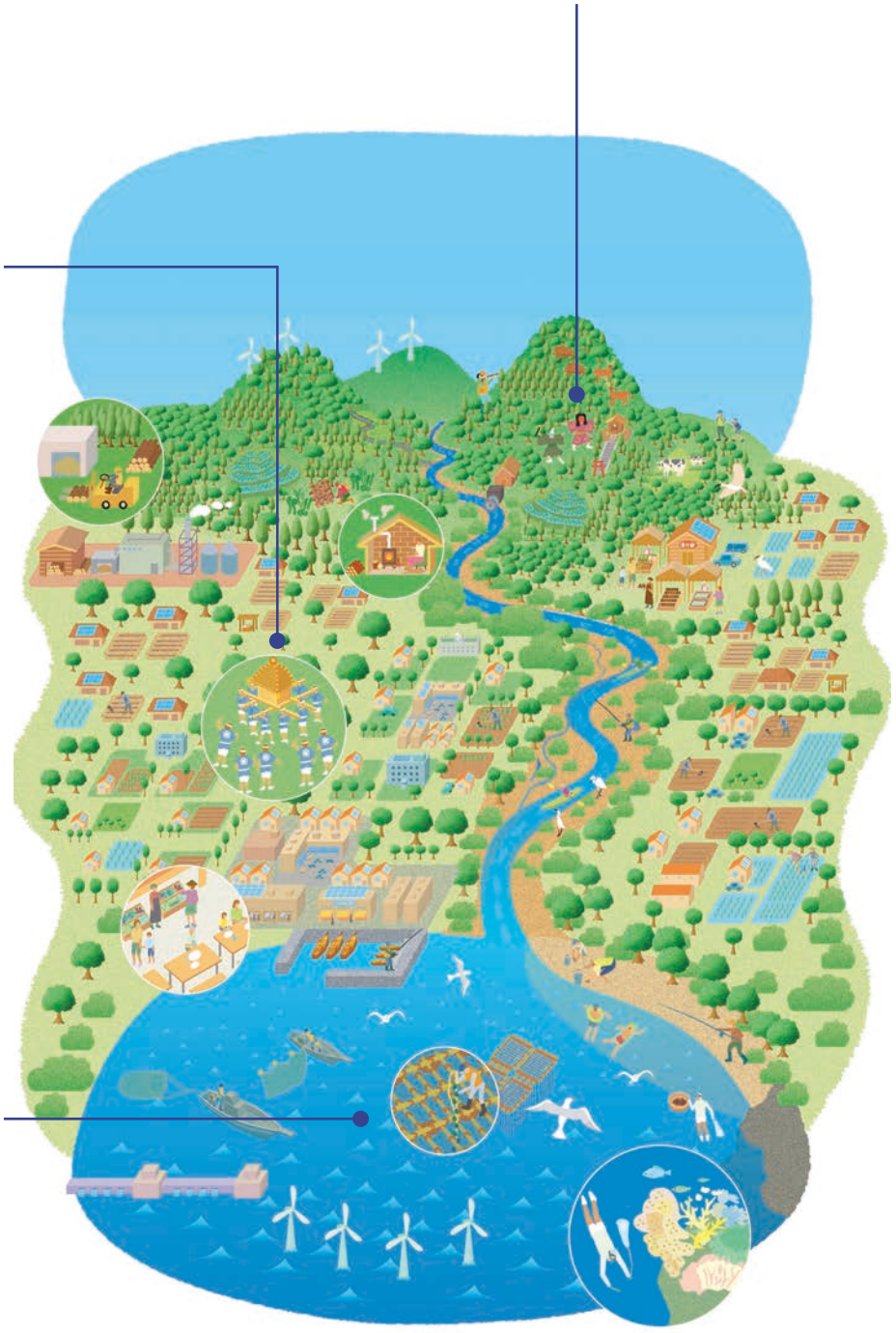
Among cultural ecosystem services, the use of the natural environment for leisure activities and education tends to be higher in the vicinity of large cities with larger areas of vegetation, and in mountainous areas with more natural vegetation. Thus, land use and ecosystem management should consider that cultural services vary according to location and ecosystem quality. For example, the conversion of plantation forests in mountainous areas to vegetation closer to that of natural forests can be expected to enhance leisure and educational activities (SPM 2.3.1).

Nature use and a sense of belonging to the community

Rural residents feel a close relationship with nature and a sense of belonging to their local community, or "identity utility", through their use of locally-specific ecosystem services, especially cultural services. Therefore, reducing population outflow from rural areas to cities can be achieved by promoting traditional events, outdoor recreation, and environmental learning that are closely related to the local natural environment (SPM 4.3). The development of LBSAPs can further this goal.

Coastal ecosystem services

Ecosystem services in the coastal zone demonstrate large regional differences. For example, capture fisheries, except for seaweeds, is important in western Japan, whereas in southern Japan people prefer recreational activities in coastal areas. The effects of global warming also differ by region (SPM 3.1.1). Our study in Sekisei Lagoon, Okinawa, identified five marine values: fisheries resources for livelihoods; sea-related culture; recreation; attachment to coral reefs; and protection against weather events (SPM 8.1). There are large regional differences in coastal ecosystem services and the impacts of global warming. Thus, the development of LBSAPs that takes into account such regional differences can lead to effective management of coastal ecosystems.



5. Future goal setting

There are two contrasting ways of setting future goals: backcasting, which identifies goals at the outset and then identifies pathways to reach those goal from the present; and forecasting, which builds up from the current situation to identify goals1. Scenarios are a useful tool for future goal setting via backcasting, taking into account uncertainties and suggesting multiple future options. Recently, researchers and local stakeholders have started collaborating to build scenarios. Local stakeholder participation can help in building a variety of scenarios that are salient to local contexts and can increase the sense of ownership among local stakeholders.

PANCES piloted participatory local scenario building with the support of Sado City's government, with some valuable lessons learned.[23] For instance, because participants have different concerns about the future, discussion is likely to lose focus if the organizer sets a broad theme such as "future society" for scenario development, so it is important to narrow down the discussion at an early stage. The organizer should attend to specific points if the scenarios are intended to be used for numerical model simulation.

Numerical model simulations of multiple scenarios and comparison of their results can help us understand which scenarios are desirable, how, and to what extent. Mapping future biodiversity and ecosystem services using geographic information systems (GIS) can help identify the desirable scenarios (Figure 11). Numerical model options for simulation depend on the type of policy and ecosystem services within the scope and on data availability. Wider options for simulation will be available if municipalities accumulate a variety of time-series datasets (e.g., land use, population distribution, forest biomass, and species ranges).

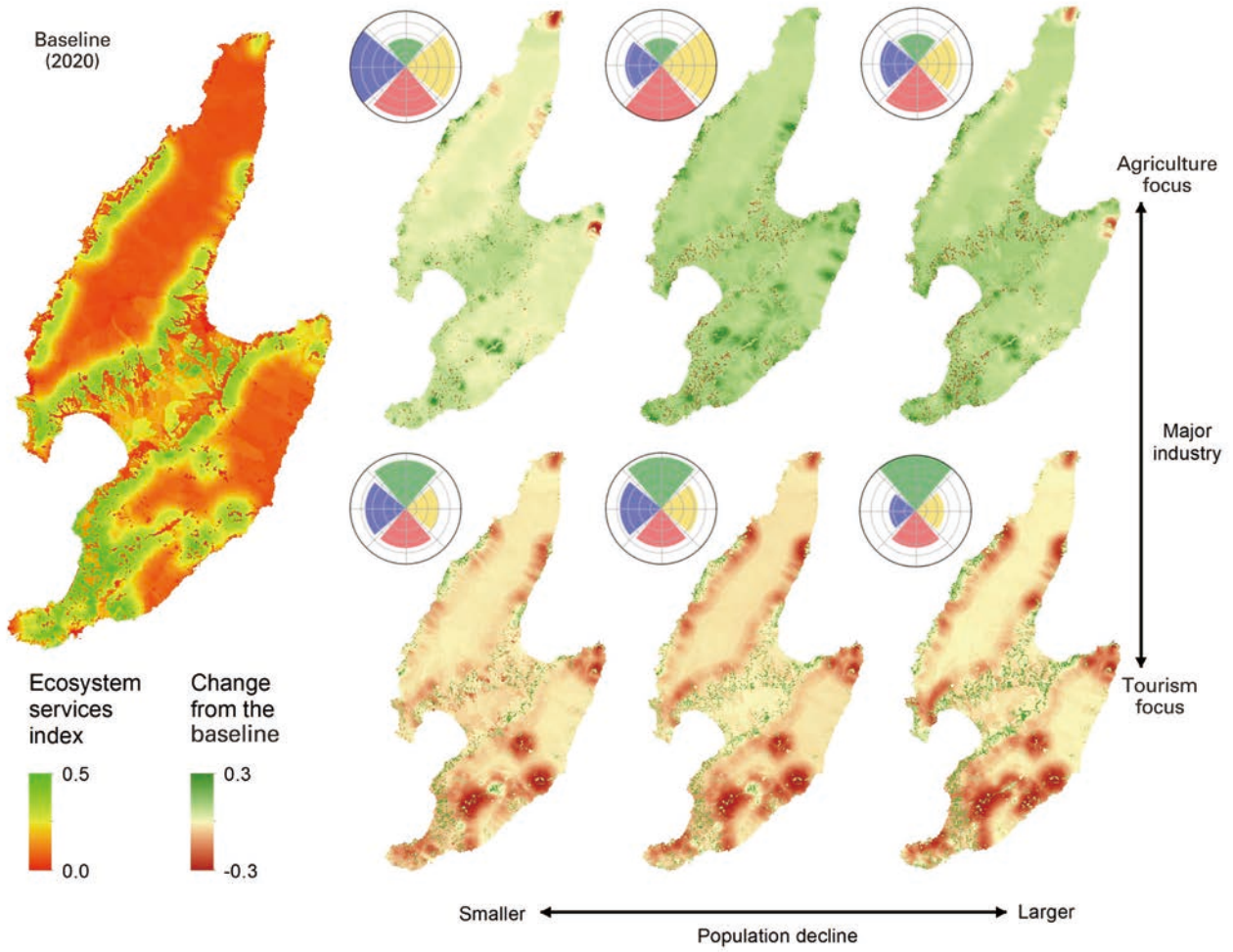


Fig. 11 Results of the Sado Island scenario analysis

Note:
The ecosystem service index is a weighted average of food production, carbon sequestration, water purification, and provision of crested ibis habitats, based on the importance scores calculated from a questionnaire of Sado Island citizens. The radar chart shows yellow (food production), green (carbon sequestration), blue (water purification) and red (crested ibis habitat provision) respectively, with the highest value for each service compared to each scenario standardised to 1.

6. Formulating policies and action plans

An LBSAP that engages a wide array of actors and policies including on agriculture, forestry, fisheries, energy, and tourism can help a local government better structure its policies related to biodiversity and thereby effectively address locally-important issues in an integrated way[1]. PANCES provided potentially useful knowledge to develop such an LBSAP, particularly for the integration of biodiversity policies with policies related to renewable energy, forestry, agriculture, and population, as well as watershed and coastal management, that cut across the forest-farmland-river-sea continuum.

Renewable Energy and Biodiversity

The electricity supply from photovoltaic power (PV), including mega-solar power plants, has increased rapidly in Japan since 2012 when the Feed-in-Tariff (FIT) scheme was introduced. PV is an important electricity source that does not emit greenhouse gases from power generation and contributes to energy security. It can, however, have notable ecological impacts if it is developed on land with natural ecosystems.

For this reason, we analyzed the amount of land alteration caused by the installation of mega-solar power plants throughout Japan by comparing aerial photographs of the present with past land-use maps. Our results showed that most mega-solar power plants were developed on lands previously covered by forests (Figure 12). Of these, deciduous broad-leaved forests, deciduous coniferous forests, evergreen broad-leaved forests and evergreen coniferous forests were the most heavily modified, accounting for about 30% of the total, with the Kanto and Kyushu-Okinawa regions being particularly heavily affected. Further analysis of changes in wood supply, carbon sequestration and runoff showed that ecosystem services were significantly reduced in forests that had undergone the greatest amount of land-use change. This suggests that ecosystem services are lost when forests are cleared for developing mega-solar power plants. Future solar power development should be properly planned taking into account the impact on ecosystems.

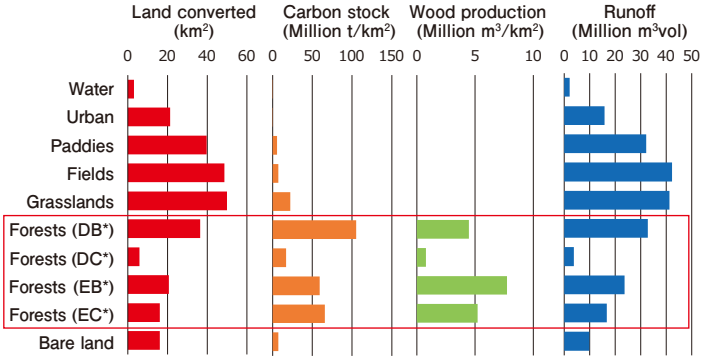


Fig. 12 Amount of land alteration and changes in ecosystem services as a result of mega-solar development across Japan

* DB: deciduous broad-leaved forests; DC: deciduous coniferous forests; EB: evergreen broad-leaved forests; EC: evergreen coniferous forests

Population policy

Rural areas that have been suffering from continuous population decline need population inflow from urban areas. Such areas first need to increase the number of people who visit the area for tourism and leisure activities, and to create opportunities for visitors to deepen their relationship with the area, eventually leading to temporary or permanent migration. An analysis of the distribution of distances between origins and destinations of visitors and their motivations for visiting their destinations revealed that the relevant population can be estimated in the range of several millions to several tens of millions in each prefecture (SPM 1.4). These results may be useful to develop policies for increasing these populations

Photo by Kei Kabaya, The University of Tokyo

Forestry

Trade-offs, i.e., cases where an increase in one ecosystem service impairs other ecosystem services, occur differently across regions. In southern Japan, for example, lands with higher timber production can also be used for campsites and thus may promote leisure activities. In Hokkaido, on the contrary, land use for higher timber production may inhibit leisure activities (SPM 2.4). Sound land-use planning is required that does not compromise the diverse nature of ecosystem services as they differ between regions.

Agriculture

Agricultural lands provide habitats for many species and a variety of ecosystem services. Many threatened species such as the crested ibis and storks represent examples of nature-symbiotic agricultural practices. PANCES analysed the ecological transformation of the rice paddy system that supported the recovery of the wild crested ibis population on Sado Island, focusing on the process in which the Crested Ibis Certified Rice system was developed and spread. Our analysis identified five major contributors to this transformation: a goal shared by a wide range of stakeholders, i.e., the recovery of the wild crested ibis population; a group of farmers pioneering innovations; networking to upscale innovations; local government leadership in institutionalizing and disseminating innovations; and exogenous factors such as disruption by a typhoon and the “great Heisei municipal mergers”. The study also suggested four major action points to move forward: continuous improvement of certification standards; strategic marketing of certified rice; more effective financial incentives; and integration with population policies. An LBSAP can play an important role to facilitate these actions.

Watershed management

Watershed management that takes into account interactions between forests, fields, rivers, and seas, as well as future land use change and climate change, can help maintain and improve ecosystem services from the watershed. Carbon sequestration and nutrient cycling maintained in upstream forests24 combined with food production and fertiliser management in agricultural lands contribute to maintaining optimal nutrient supply to downstream waters (SPM 3.4.1). For example, oyster farming in Hiroshima Bay is sustained by the forests of the Ohta River basin, which flows into the bay. The economic value of oyster production is estimated to exceed the cost of conserving the upstream watershed forest (SPM 3.4.3). Other effective measures include conservation of natural river channels and riparian vegetation, as well as watershed monitoring and management using biological indicators of connectedness of the forest-field-river-sea continuum (SPM 3.4.2).

Coastal management

Knowledge of the complex cause-effect relationships inherent in coastal socio-ecological systems is useful for coastal management. For example, an assessment of climate change impacts on the socio-ecological system of the Sekisei Lagoon demonstrated the importance of the protection and rehabilitation of coral reefs, as well as an increase in marine protected areas (SPM 4.1). Future scenario building should involve a wide range of local stakeholders including government agencies. It should also allow the development and comparison of multiple future scenarios that are salient to local contexts. Scenarios that define three indicators, i.e., protection objectives, species to be protected, and intensity of protection, can help identify priority areas for marine protected areas under different scenarios (SPM 8.3).

The Forest Environment Transfer Tax and biodiversity

The Forest Environment Transfer Tax, introduced in 2019 (initially around 20 billion yen, with a final amount of around 60 billion yen planned), has important implications for biodiversity policies. Prefectures and municipalities are eligible for the tax, the amount of which is calculated using the area of privately-owned plantation forests in each municipality (weighted 50%), the number of forestry workers (20%) and the total population (30%). The tax, which is allocated even to urban municipalities, is expected to promote wood use in urban areas as well as strengthen forestry management and training of foresters in rural areas. Currently, prefectures mainly use the transferred tax for surveys of forest owners, technical guidance and training, and recruitment of and support for foresters (Figure 13). This includes measures that contribute to both climate change and biodiversity, such as the planned transition from coniferous plantations to mixed forests. In one case, transferred tax revenue is used to strengthen cooperation between urban and rural municipalities (Figure 14). Municipalities that have both urban and rural areas, particularly those established by municipal mergers and designated by ordinance, can strengthen forest management and circular use of wood-based resources through urban-rural cooperation within their territories[25]. Thirty-seven prefectures have already introduced their own taxation schemes to support forest management. Such prefectural taxation schemes can be used synergistically and effectively together with the national Forest Environment Transfer Tax[26].

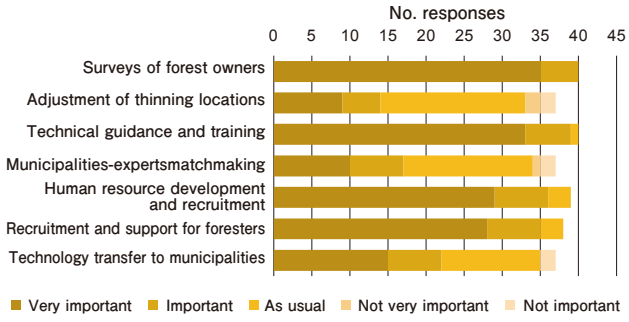


Fig. 13 Results of a survey of 47 prefectures on priorities in support policies for municipalities using the Forest Environment Transfer Tax[27]

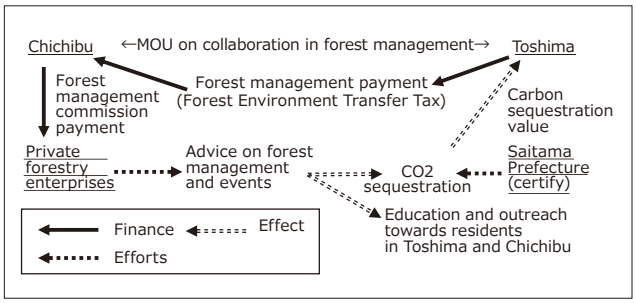


Fig. 14 A rural-urban municipalities cooperation scheme between Chichibu and Toshima[28]

Photo by Atsushi Nanami, Japan Fisheries Research and Education Agency

7. Policy support tools

PANCES has developed a comprehensive inventory of measures related to biodiversity and ecosystem services across ministries and agencies[29]. First, a total of 1,467 measures were extracted from six documents, including the NBSAP 2012-2020, and compiled into a database comprising a set of existing measures. Next, 153 important policies (89 for terrestrial and 64 for marine realms) were identified through discussions in the Policy Working Group, which were developed into PANCES policy options through a questionnaire survey of experts. Each option was categorised by target area (terrestrial/marine) and key ecosystem services (food, carbon sequestration, recreation, other), and linked to the proposed 2030 targets of the Post-2020 Global Biodiversity Framework (0.2 draft), the SDGs, and the set of existing measures. Based on these results, we developed an online database that allows users to search and display high-priority policy options in terms of target area, ecosystem services, Post-2020 Global Biodiversity Framework, SDGs, etc., and also to reference a list of related existing policies and their contents (Figure 15). This is called Policy Support Tools (trial version) and can be accessed at http://pances.net/search/. The original data is also available for download and can be used freely as needed.

By using these Policy Support Tools, it will be possible to identify high-priority policy options and understand the substance of related existing measures, which will contribute to the consideration of policy options to be included in LBSAP that are suitable to unique environmental traits of respective areas.

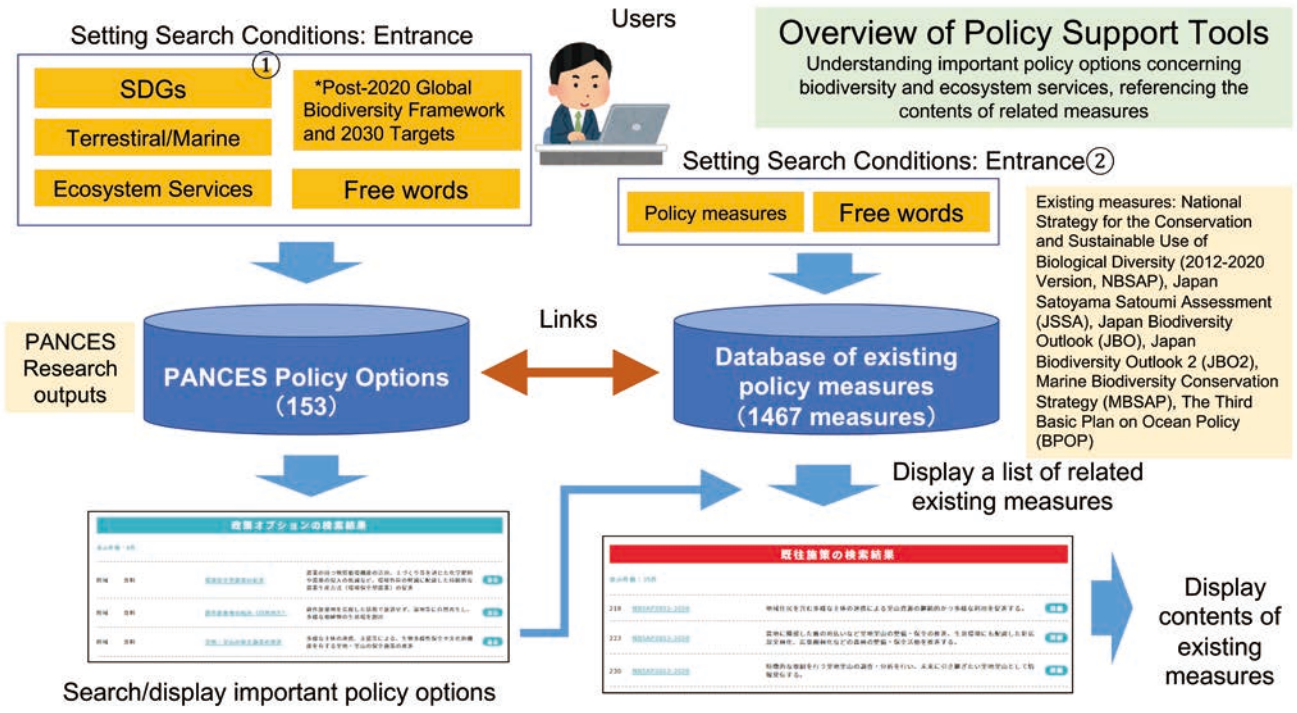


Fig. 15 Overview of policy support tools

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Appendix

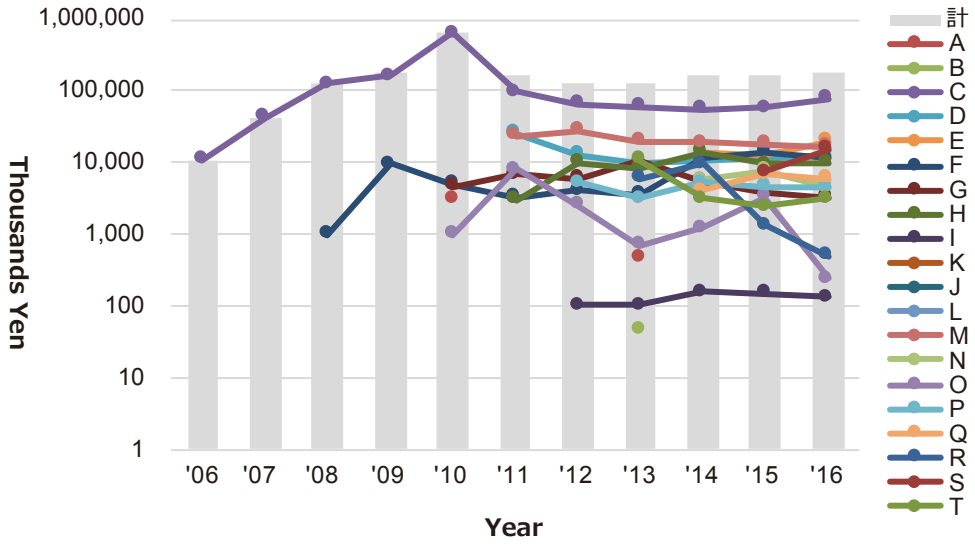

Fig. 1 Annual budget of ordinance-designated cities for biodiversity-related policies (including LBSAPs) between 2006 and 2016[1]

Note:
Data as of 2016. Grey bars indicate annual totals, while coloured lines with letters A through T indicate the budget amount for individual ordinance-designated cities.

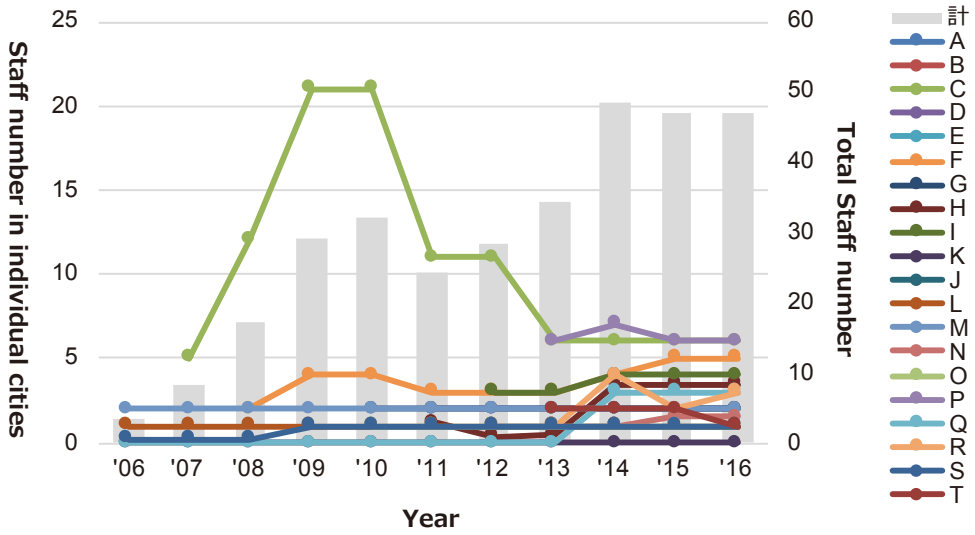

Fig. 2 Number of staff in ordinance-designated cities assigned to biodiversity-related policies (including LBSAPs) between 2006 and 2016[1]

Note:
Data as of 2016. Grey bars indicate annual totals, while coloured lines with letters A through T indicate the budget amount for individual ordinance-designated cities.

Ordinance name (provisional translation)	Date promulgated
Higashi-Ohmi City ordinance on nature protection and biodiversity conservation	26 June 2007
Nagasaki Prefectural ordinance on protecting and fostering nature for the future	25 March 2008
Okazaki City ordinance on conservation of natural environment	28 March 2008
Kita-Hiroshima Town ordinance on biodiversity conservation	26 March 2010
Okayama City ordinance on the promotion of participatory biodiversity conservation	1 April 2010
Minakami Town ordinance on the promotion of biodiversity conservation including insect protection	18 March 2011
Hokkaido Prefectural ordinance on biodiversity conservation	29 March 2013
Kobe City ordinance on biodiversity conservation	10 October 2017
Akiruno City ordinance on biodiversity conservation	27 September 2017
Suzu City basic ordinance on bio-cultural diversity	22 March 2019
Sagamihara City ordinance for a biodiversity-friendly and nature-symbiotic society	1 October 2019

Table. 1 Independent biodiversity ordinances of municipalities[2]

(For reference)
Ordinances with sections on concrete regulations related to biodiversity

Okayama City ordinance on environmental conservation chapter 3 section 2 (articles 29-29.20
Mita City ordinance on city development in harmony with production landscapes (Satoyama) article 18
Koga City ordinance on forest and green space conservation articles 11-12

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