


The Land Health Index

Developing a tool for gauging positive actions for biodiversity and ecosystem services

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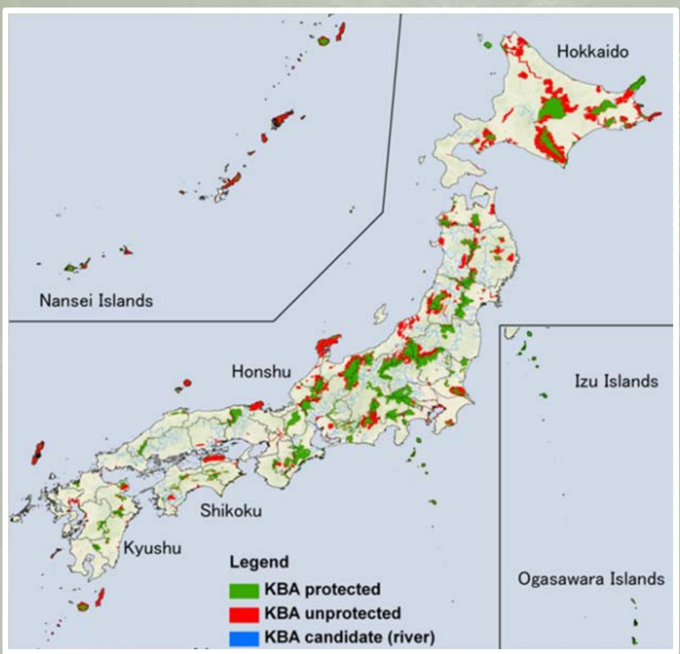


Biodiversity, or renewable natural capital, forms the basis of social development. The idea that environmental concerns can be subordinated to economic growth disregards this fact. The Land Health Index (LHI) is being developed as a tool to facilitate understanding by every member of society on the changes in the state of biodiversity, and the measures required to ensure sustainability. The LHI will be used to gauge the level of actions for conservation of biodiversity and ecosystem services from the perspective of sustainable use. Our approach follows that of the Ocean Health Index (Halpern et al., 2012), in which ideal sustainable states for multiple public goals are defined and models for quantitative evaluation of their status are provided. The LHI is intended for site-level applications in terrestrial environments, and the unit of analysis in this pilot study is the Key Biodiversity Area (KBA). KBAs are globally important sites for the conservation of biodiversity, and in the case of Japan, 18% of the land area can be classified under this category (Natori et al., 2011). Of the Japanese KBAs, approximately half are found outside of protected areas, and range from pristine natural ecosystems to human-influenced areas with high socio-economic value. The pilot study focuses on these areas to demonstrate the diversity of ecosystem services they provide beyond their conservation value, so that their proper management can be prioritised in planning and decision making processes.





Methodology

This study aims to build on the approach of the Ocean Health Index [1] (OHI) and to apply it to terrestrial ecosystems in order to highlight the roles of ecosystem services as well as the sustainability of their use. The pilot study attempts to apply this framework to the Key Biodiversity Areas (KBAs) of Japan[2].

The approach thus incorporated into the Land Health Index (LHI) consists in: (1) Identifying the diverse benefits people obtain from the ecosystems, (2) Setting the "ideal" state of sustainable use, or the reference, at a score of 100 and the complete collapse of the ecosystem at a score of 0, and (3) Assessing the current state between 100 and 0. The sustainable state is not set at pristine conditions, as the index aims to capture human activities and to encourage actions to make them more sustainable in a wide range of settings.

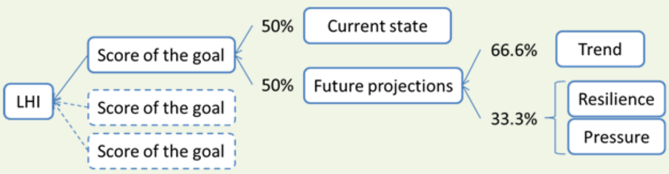
For the evaluation of the LHI, the following nine types of ecosystem services, or "goals", have been considered.

- Agriculture (provisioning service)
- Forestry (provisioning service)
- Inland fisheries (provisioning service)
- Freshwater (provisioning and regulating services)
- Soil stabilization (regulating service)
- Air quality (regulating service)
- Recreation (cultural service for visitors)
- Sense of place (cultural service for residents)
- Biodiversity (supporting service)

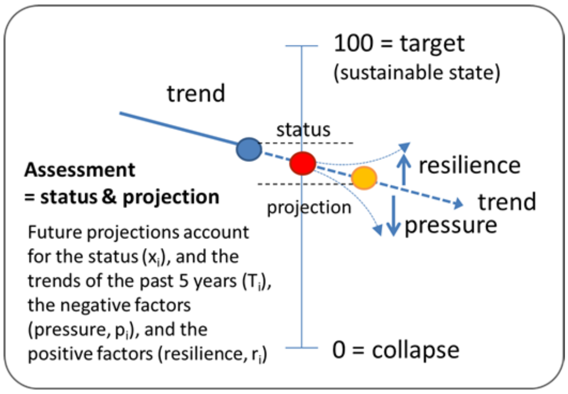
Scores are given to each goal *i* based on the current state of use of the target ecosystem service, in comparison to the "ideal" sustainable state worth a score of 100. The future projection is also scored based on the past trends, and existing factors that would either improve (resilience r_i) or degrade (pressure p_i) the status. The average between the current score X_i and the future projection $X_{i,F}$ constitutes the score of a given goal *i*. The final index is obtained by averaging the scores of all goals.

$$LHI_i = \frac{X_i + X_{i,F}}{2}$$

$$X_{i,F} = \left(1 + 0.67T_i + 0.33(r_i - p_i)\right)X_i$$



[1] Halpern, B.S. et al., 2012. An index to assess the health and benefits of the global ocean. Nature, 488(7413), p.615-620.
[2] Natori, Y. et al., 2012. Key Biodiversity Areas identification in Japan Hotspot. Journal of Threatened Taxa, 4(8), p.2797-2805.



The methodologies to assess and to score the current status of each goal under the LHI are described in the subsequent sections, followed by the methods to assess the resilience and pressure factors.

Agriculture

Agriculture is set as one of the goals of the LHI as food production counts among the provisioning services of the ecosystem. Modern day agriculture has reached high production rates thanks to chemical fertilizers and pesticides, but the excessive input of these substances cause serious environmental impacts. This goal evaluates the health of agricultural production based on whether it is likely to cause excessive soil degradation. The healthy state would be when high yields are achieved based on appropriate chemical inputs. Here, assessments focus on rice production, which is a major agricultural product in Japan. The reference point is set at the maximum amount of rice harvest expected from paddies with soil content of phosphorus pentoxide (P_2O_5) below the limit of 20 mg/100g dry soil as set by expert consultations on soil management held in 2008.

The health LHI_{AG} of the target area is assessed differently depending on whether the soil content S of P_2O_5 is below or over the reference amount S_R of 20 mg/100g dry soil. When the soil content exceeds the reference:

$$LHI_{AG} = 1 - \frac{(S - S_R)}{S_R}$$

When the soil content is below the reference:

$$LHI_{AG} = 1 - \frac{(P_R - P)}{P_R}$$

P represents the rice harvest of the target area (kg/a) according to government statistics. The reference harvest P_R represents the average harvest of rice when the paddies are at the reference soil content S_R of P_2O_5, and amounts to 550kg/a.

Forestry

Forest stock is the conventional measure of the health of a forest. For this goal the status of forest resources will be measured from the two perspectives of per hectare stock, and tree diversity. Needle-leaved species constitute the main forest resources used for construction materials, but there are other species used for woodchips, pulp, mushroom beds, firewood, furniture, and handicraft. This goal assesses forest stock for the three components of construction materials, woodchips, and mushroom beds/firewood for which statistics are available. For the estimation of forest stock per hectare, data from government forest surveys have been applied. Forest surveys have been conducted by the forestry agency to monitor national forest resources since 2000 and have measured trees every 5 years in selected plots. The data has been used to estimate the average stock per ha for each land use/land cover (LULC) type.

The score of this goal is based on estimates of per hectare stock of construction, woodchip, and firewood/mushroom bed materials available within the target area. The timber resources in the target area are calculated as the average stock per mesh per LULC type.
The stock per hectare for each plot was fit into the following equation.

$$Y_i = \beta^0 + \beta^{mesh}_{m(i)} + \beta^{LULC}_{l(i)}$$

Here m is the ID of the mesh, l the LULC type, and i the plot, and $m(i), l(i)$ represent the IDs of the mesh and LULC type of plot k. $\beta^0, \beta^{mesh}, \beta^{LULC}$ represent the parameters and $\beta^{mesh}, \beta^{LULC}$ have been modelled as random effects. Parameter estimates were obtained using the MCMC method of Stan 0.9.0, and used to estimate the per hectare stock $\widehat{Y_{lk}}$ for each target area k.

The per hectare stock for each target area is applied to the following equation to calculate the per hectare stock U for each type of use.

$$U_{nk} = \sum_{l \in LULC} p^1_{ln} \cdot p^2_{ln} \cdot \widehat{Y_{lk}}$$

The n indicates the type of use (construction materials $U_{c,k}$, woodchips $U_{wc,k}$, or firewood/mushroom beds $U_{f,k}$). The harvest rate is represented as p^1 and the demand rate as p^2 and have been estimated separately.

The scores per target area are calculated by attributing the reference score (of 1) to the area with the maximum stock per hectare per type of use out of all KBAs. The scores thus obtained for each of the three types of use are then weighted and averaged to calculate the aggregate score LHI_F for this goal. Construction materials are weighted at 0.5, and woodchips and firewood/mushroom beds at 0.25 each.

$$LHI_F = \left[0.5 \frac{U_{c,k}}{\max(U_c)} + 0.25 \frac{U_{wc,k}}{\max(U_{wc})} + 0.25 \frac{U_{f,k}}{\max(U_f)}\right] \times 100$$

Inland fisheries

This goal assesses the sustainability of inland fisheries. Due to data limitations, this goal would only be included when a target area includes water bodies that were included in the national fisheries census. Furthermore, although inland fisheries include rivers, due to the fact that they consist mainly of leisure fishing, and that data are scarce, this assessment currently only focuses on fisheries in lakes and ponds. As most inland fisheries conducted in Japan consist of fish farming in tanks with regulated water flows, the direct impacts on the surrounding ecosystem is considered minimal. Therefore the assessment under this goal is limited to fisheries in lakes and ponds located within the target areas (KBAs).

This goal compares the Maximum Sustainable Yield (MSY_k) for each fish species k with the actual catch data. The MSY_k has been estimated with the Fox Model (Sparre and Venema 1998) using the yield and fishing effort. The assessment is based on the multispecies maximum sustainable yield (mMSY). The status score (S_k) of each species is obtained by comparing the $rMSY_k$ (75% of MSY_k, taking into account the uncertainty of the MSY estimate), and the actual yield.

$$S_k = \left[1 - \frac{\delta B_k}{rMSY_k}\right]$$

B_k is the yield variation over the past four years, and δB_k varies as shown.

$$\delta B_k = \begin{cases} 0 & \text{if } |rMSY_k - B_k| < 0.05 \cdot rMSY_k \\ |rMSY_k - B_k| & \text{if } |rMSY_k - B_k| < rMSY_k \\ rMSY_k & \text{if otherwise} \end{cases}$$

The final score LHI_{FIS} for the target area is calculated as the mean of S_k.

$$LHI_{FIS} = \frac{\sum_k S_k}{k}$$

For fish species recorded to have been harvested within the past 20 years, but which are not harvested today, the score was considered as zero.

Freshwater

This goal assesses the health of freshwater systems from the two perspectives of quantity and quality. Regarding the assessment of the quantity of water provided, the conventional method would be to compare the amount of water supply and demand by watershed. However, this assessment is limited to the supply due to the fact that the water cycle is not restricted to the target areas (KBAs). For the assessment of water quality, although the purely ecological value of freshwater may not be constrained by its quality, the goal focuses on human use, and thus applies the water quality standards as a measure of the health of the ecosystem service.

The score LHI_{FW} of this goal is the average of the water quantity score S_V and the water quality score S_Q.

$$LHI_{FW} = \frac{S_V + S_Q}{2}$$

The water quantity score S_V is calculated based on the estimate of yearly per unit area water intake Y (mm). The national average water intake $\hat{Y}$ during a set reference year is given a score of 50, and a linear function is applied so that when the intake in the target area is above the value of average+2(standard deviation) the score becomes 100, and when the intake in the target area is below average-2(standard deviation) the score becomes 0.

$$S_V = \frac{50}{2\sigma}(Y - \hat{Y}) + 50$$

Y is the estimate of the per unit area yearly water intake (in cm), and $\hat{Y}$ and σ are the national average water intake and standard deviation of the reference year.

The yearly water intake in the target area can be obtained by subtracting the yearly evapotranspiration E (cm) from the yearly precipitation P (cm).

$$Y = P - E$$

P is the average precipitation of the grids corresponding to the target area taken from the GIS data provided in the National Land Numerical Information database. The evapotranspiration E is estimated using the model of Sanford & Selnick (2013) based on data collected in the US on daily average, maximum and minimum temperatures, yearly precipitation, area of open surface, area of forest, scrubland, grassland, farmland, and wetland. For climate data the average grid data for the target area was used from the National Land Numerical Information database.

For the water quality score S_Q governmental data measured in public water sources were used to attribute the scores. The scores were given depending on which rank the measurements of Biochemical Oxygen Demand (BOD) and Suspended Solids (SS) corresponded to. The average of these two scores was considered as the water quality score. When the target area had multiple measurement points, the average of their scores were applied.

Water quality scores

Rank	Water quality score S_Q
AA	100
A	80
B	60
C	40
D	20
E	0

Soil stabilization

Healthy soil is indispensable for the maintenance of vegetation and agricultural production. This goal defines the healthy state as one in which there is no excessive runoff of soils. This goal assesses soil loss using the Universal Soil Loss Equation (USLE) and compares results to the soil loss tolerance defined by the US Natural Resource Conservation Service (NRCS). The USLE is expressed as follows.

Soil loss tolerance

Soil erosion class	Potential soil loss (t/ha/year)
Very low	<6.7
Low	6.7 - 11.2
Moderate	11.2 - 22.4
High	22.4 - 33.6
Severe	>33.6

Source: NRCS (1993)

$$\mathrm{E} = \mathrm{R} \times \mathrm{K} \times \mathrm{LS} \times \mathrm{C} \times \mathrm{P}$$

E is the yearly amount of soil loss (t/ha/year), R is the rainfall and runoff factor (tf×m2/ha×h), K is the soil erodibility factor (h/m2), LS is the slope length-gradient factor, C is the crop/vegetation and management factor, and P is the support practice factor.

To calculate the score of this goal, the following function is applied to the average soil loss of the target area, so that when there is no loss, the score becomes 100, and when it is above 22.4, the score approaches 0.

$$\mathrm{LHI_{SL}} = 100\mathrm{e}^{-0.5\mathrm{E}}$$

Air quality

Ecosystems have the ability to absorb pollutants such as sulphur oxides (SOx) and nitrogen oxides (NOx) present in the atmosphere. This goal considers the air pollutants sulfur dioxide (SO2), suspended particulate matter (SPM), nitrogen dioxide (NO2), and photochemical oxidants (Ox), to assess the healthy state based on air quality standards.

$$S_i = 100 - \frac{q_i}{c_i Q_i} \times 100$$

$$LHI_i = \begin{cases} 0, & x < 0 \\ S_i, & x \geq 0 \end{cases}$$

$$LHI_{AR} = \frac{\sum LHI_i}{4}$$

S_i is the score for pollutant i, q_i the pollutant concentration, c_i the weight attributed to each pollutant, and Q_i the air pollution standard. Based on this function, for SO2 the score will become 0 when the concentration is equal to the standard value. For SPM and NO2, the score will become 0 when the measured concentration is the double of the standard value, and for Ox the score will become 0 when the concentration is four times that of the standard (score of 75 when equal to the standard). The score of this goal is obtained by averaging the scores for the four pollutant types.

Recreation

Recreational services are considered here as part of the cultural services provided by the ecosystem. The healthy state is considered as one in which the people living outside of the target area appreciate its natural assets and are motivated to contribute to its conservation. This is assessed on whether people visit the target area at a constant rate and recognize the value of its unique natural assets such as ecosystems or species.

$$LHI_{REC} = \frac{\mathrm{P}_{visit}}{\mathrm{P}_{local}} \times \mathrm{N} \times \alpha$$

The score of this goal is estimated from questionnaire results allowing the identification of the portion N of visitors for whom natural assets constituted a motive to visit the target area. To adjust for the scale of human habitation within the target area, the number of visitors is divided by the local population, with P_{visit}/P_{local} not exceeding a maximum value of 1. A weighting factor α is applied depending on the target area.

Tourist numbers are either obtained through official statistics of municipalities or of local institutions, or estimated from results of web-based surveys. For the target areas of this pilot study, web-based surveys were conducted to identify visitors to specific KBAs as well as the degree to which they were motivated by natural assets. The weighting factor α is set at 0.03%, an estimate of the portion of the local population who directly or indirectly contribute to the preservation of the local natural assets.

Sense of Place

The sense of place is the appreciation of natural assets by the people residing within or near the target area, and the identity they attribute to the ecosystems or the species that are characteristic of the area. It is considered that the higher the score of this goal, the higher the likelihood of local inhabitants contributing directly or indirectly to the conservation of the local natural assets.

$$LHI_{SP} = \mathrm{I} \times (\mathrm{I}_{good} - \mathrm{I}_{bad}) \times \mathrm{N}$$

I is the intensity of the impression people have of the target area (rated from 0 to 100), I_{good} is the rate of good impressions, I_{bad} the rate of bad impressions, and N the portion of responses which are specifically linked to the natural assets of the area.

The data on people's impressions are collected though web-based questionnaires. When the overall impression held on the natural assets is negative, the score of the goal will be 0.

Biodiversity

The biodiversity goal assesses the contribution of the target area to the conservation of biodiversity. The sustainable state is considered as one in which the habitats within the target area are maintained, thus contributing not only to endangered species conservation, but to the conservation of biodiversity in general. The score LHI_{BD} of this goal is thus obtained as the average of the changes in habitat extent x_{HAB} and their conservation status x_{PA}. These are measured from data on land use and land cover (LULC) of the target areas.

$$LHI_{BD} = (x_{HAB} + x_{PA})/2$$

x_{HAB} compares the weighted sum of various LULC areas in the reference year and at the time of assessment. The reference can be set to that of the LULC of the 1990s.

$$x_{HAB} = C_p/C_R = \sum_{i=1}^{K} a_{i、p} \cdot w_i \Big/ \sum_{i=1}^{K} a_{i、R} \cdot w_i$$

C_R: weighted area of land use in reference year

C_p : weighted area of current land use

$a_{i、R}$: area of land use type i in reference year

$a_{i、p}$: current area of land use type i

w_i: weight of LULC type i

K: number of LULC types

LULC types and weights

LULC type (i)	Weight (w_i)
Forest	5
Rice paddy	3
Farmland	2
Built land	0
Other	1
Inland waters	4
Barren land	1
Ocean	0

x_{PA} assesses the portion of the target area that has a protected status.

$$x_{\mathrm{PA}} = \frac{\mathrm{A_{PA}}}{\mathrm{A_{KBA}}}$$

$\mathrm{A_{KBA}}$: area of the target area

$\mathrm{A_{PA}}$: area of the target area that is under protected status

Resilience and Pressure

The LHI, in addition to the assessment of the current state, also takes into account future forecasts based on the past trends, the resilience of the target area, and the pressures it is facing. The Resilience is considered as the social, institutional, and ecological factors that support the achievement of a healthy state within target areas. The Pressure is considered as the factors that prevent the achievement of the healthy state through either ecological or social influence.

Resilience and pressure factors have been identified in the following tables, and their level of impact on each of the goals has been set in relative weights. The weighted average of the scores for resilience and pressure factors, summed with the past trend, will serve to determine the likely future status of each goal.

For resilience factors, the existence of nature restoration plans, environmental regulations, incentive mechanisms, and climate change adaptation plans have been considered in order to account for local efforts to achieve sustainability. Factors such as education, for which progress is difficult to measure in the short term, have not been included.

For pressure factors, the risk of habitat destruction, disruption by invasive alien species, and loss of traditional land uses due to rural depopulation have been considered. Other pressures such as climate change impacts which are difficult to measure at local scale have been omitted.

Relative weights of resilience and pressure factors

	Resilience				Pressure		
3: strong impact 2: medium impact 1: low impact Blank: no impact	Nature restoration plans	Regulations	Incentive mechanisms	Climate change adaptation plans	Habitat destruction	Alien species	Rural depopulation
Agriculture		3	3	1	1	1	3
Inland fisheries	3	3	2		3	3	
Forestry	1	2	3			1	3
Freshwater	2	3	3	1	1		
Soil stabilization	3	2	3		3		
Air quality	2	3			2		
Recreation	2	1	3		3		
Sense of place	1		3		3		
Biodiversity	3	3		1		3	

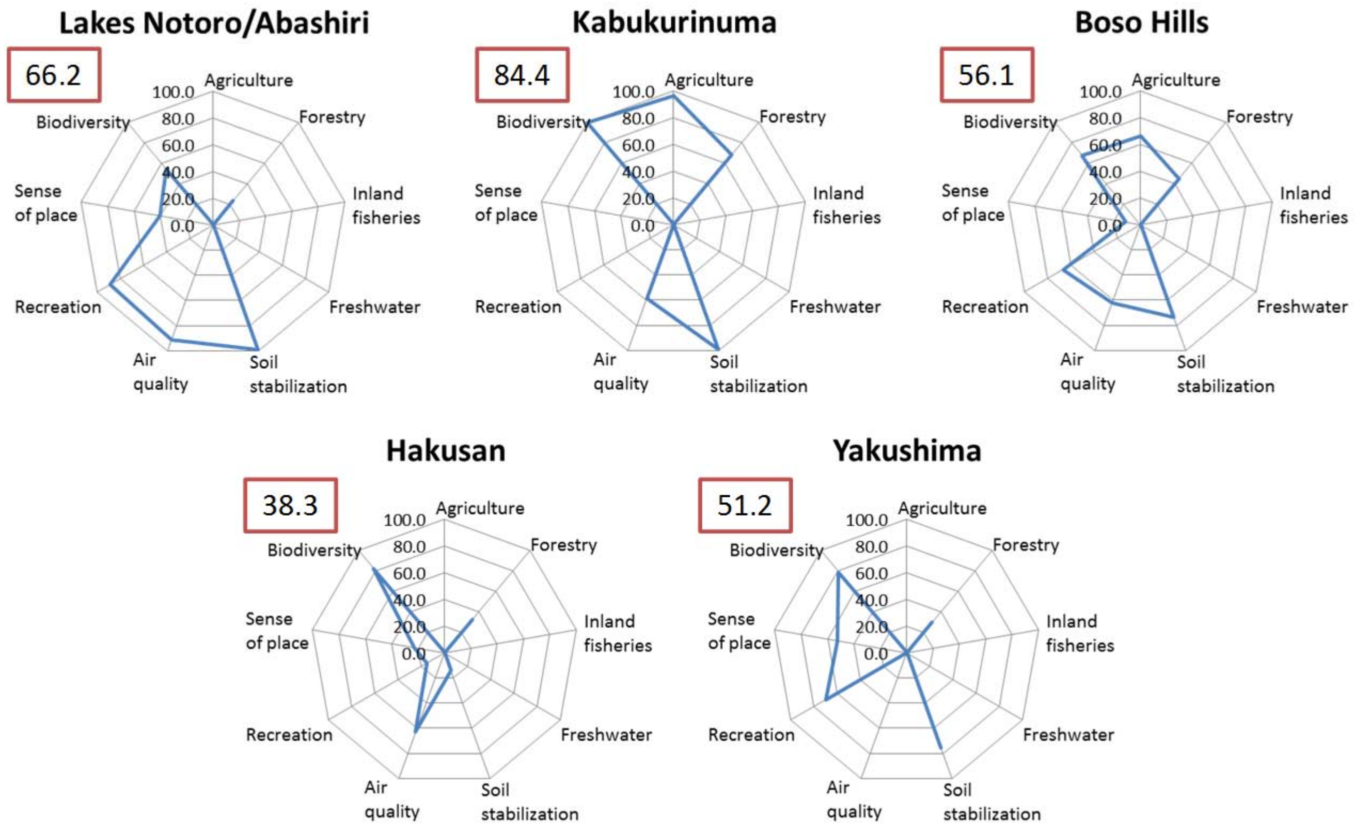
Methods for scoring the resilience and pressure factors

	Factor	Scoring
Resilience	Nature restoration plans	Nature restoration plans are adopted and/or nature restoration committees are set up, ensuring continued efforts for restoration = score 1.0 Nature restoration plans have been adopted = score 0.5 No particular plans or activities = score 0.0
	Regulations	Environmental regulations supporting the goals are in place at prefectural level = score 1.0 Environmental guidance or recommendations are published = score 0.5 No particular regulations or guidance = score 0.0
	Incentive mechanisms	Relevant incentives (certification, PES, etc.) are provided = score 1.0 No particular incentive mechanisms = 0.0
	Climate change adaptation plans	Local climate change adaptation plans include measures relevant to the goal = score 1.0 No climate change adaptation plan or no relevant measures = 0.0
Pressure	Habitat destruction	The portion of designated urbanization areas within the target area
	Alien species	Based on the regional distribution of alien species, all regions have been classified into deciles of alien species richness. Scores from 0.1 to 1.0 have been attributed to each decile class. The score of the target area will thus depend on the region in which it is situated.
	Rural depopulation	Based on population variation estimates for prefectures across Japan, if the target area is likely to see population increase in the future, the pressure score is 0.0. If the target area is likely to undergo population decline, the top quartile of the prefectures will score 1.0, and all others with lower decline rates will score proportionately to the decline rate.

Pilot results in Japanese KBAs

Based on the methodologies outlined in this paper, pilot assessments of various KBAs in Japan have been conducted by the study group. Five KBAs have been chosen as the first sample, aiming to cover a diverse range of geographical conditions such as islands, mountains, water bodies, as well as social conditions such as the expected level of public recognition, or protected status. The scoring of the freshwater goal is in progress, and has therefore not been included in the current assessment. For many KBAs, inland fisheries were not being conducted and thus have been excluded from the calculation of the index.

Scores of LHI trials on KBAs in Japan



Discussions

Various challenges have been faced in the development of detailed methodologies for the assessment of individual goals in the current version of the LHI.

Under the goal on Forestry, there is a need for further consideration on how to include the aspect of sustainable use within the assessment. The current version only addresses the stock of forest resources. In Japan, the use of forest resources is very low compared to its stock, and there is little prospect of degradation due to overexploitation. Furthermore, although some consider the low usage of ageing forest plantations as a threat to the ecosystem health, the probability of immediate degradation of forest health due to underuse is low. However, at a smaller scale such as municipalities, the introduction of new uses such as biomass power generation could increase the localised pressures on the forest ecosystem. The consideration of both the growth rate and the demand rate of the forest resources may become essential in the future.

In the current assessment, the forest resources are evaluated based on the stock of resources for various types of uses, but the data on the actual uses of forest resources are limited, which means that the measures of stocks of resources for various use types can only rely on estimates. Increasing the accuracy of these estimates is also a challenge.

In assessing the score of inland fisheries, the calculation of fishing efforts conventionally uses the number of fishermen and the number of days of work as indicators. However these data were not available for each lake or fish species within the target areas. Therefore this pilot study uses the only data available, which was that of the number of business entities per lake and per fish species, as a measure of fishing efforts. However, if there is a significant difference in the number of staff or the number of fishing days between these business entities, then the accuracy of the fishing effort estimates would be questionable.

There is also a need to consider the method of fisheries being conducted for the scoring of this goal. If fish are being raised and then released every year, the relevance of basing this assessment on the MSY may be questionable.

In Japan inland fisheries are mostly dominated by aquaculture, but this was not included in the assessment of the LHI, due to the fact that aquaculture is mostly conducted in artificial ponds and tanks which have little direct connection to natural ecosystems. There was also data shortage on aquaculture production in lakes and ponds. On the other hand, aquaculture methods where juveniles are released into natural water bodies before being captured again can cause ecosystem disruption, and therefore require consideration. For species which undergo this process, cohorts of fry are released on a regular basis regardless of the existing stock or of the carrying capacity. For these species, it may be possible to regard their cultivation as sustainable as long as the original nursery is maintained, and thus using the MSY may lead to an under estimate of the provisioning services of the species. On the other hand the excessive release of fry may disrupt the ecosystem and threaten the longer term survival of the species. Currently these aspects are not accounted for in the scoring of this goal due to data limitations, but should be included if appropriate data were to be found.

With regards to the assessment of scores under the Freshwater goal, the parameters developed based on data collected in the US have been applied directly to the Japanese case; therefore the accuracy of the estimates would require further examination. The relationship between climate and evapotranspiration would likely not differ significantly between the two countries, but the general meteorological patterns may differ and thus reduce the accuracy of estimates. Regarding the evapotranspiration factors per land use, the differences in LULC classification between the two countries may entail discrepancies in estimates, but as evapotranspiration is mostly determined by climate, it is expected that inaccuracies would not be as significant as with the difference in climate conditions. In either case, the parameters would require adjustment in the future based on data collected in Japan.

For the assessment of scores under the Biodiversity goal, there are two approaches to measuring the changes in LULC types. By attributing weights to the various kinds of land use change, these changes could be tracked in a spatially explicit manner. Otherwise, accounting for the total area of each LULC type would also allow the tracking of overall LULC changes within the target area. To apply the former approach, specific weights need to be attributed to the changes in LULC. However, this would require a prior setting of the "ideal" proportions of LULC types within the target area, which in itself constitutes a challenge. The current version of the LHI therefore applies the latter approach in tracking the changes in LULC.

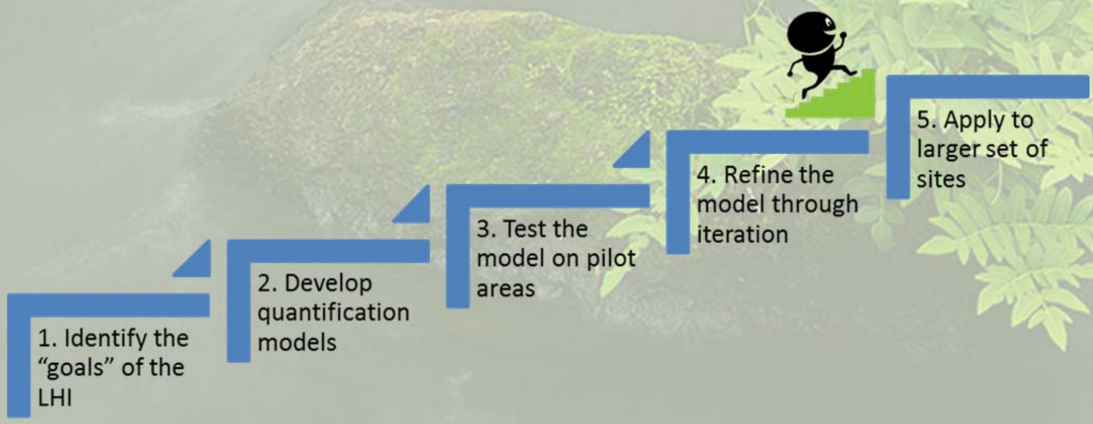
Another challenge for the scoring of the Biodiversity goal stems from the fact that KBAs are selected based on the presence of endangered species. The ideal composition of LULC types would differ according to the species in question, but concrete information on the endangered species presence cannot be disclosed due to conservation interests. Furthermore, as this goal aims to not only conserve endangered species, but biodiversity in general, a balance needs to be struck in determining the "healthy" distribution of LULC types within the target area.

In terms of accounting for the extent of coverage by protected areas, the current Biodiversity goal regards all types of protected areas equally, but their differentiation through weighting may be effective in reflecting priorities into the resulting scores.

An issue brought to light during the trial assessment of pressure and resilience factors was on how to account for geographical borders, especially when target areas are straddled across multiple municipalities. Many KBAs are located on the border between various administrative units, and thus when attempting to score the resilience factors such as environmental regulations, the question arises on whether it is enough to consider that a certain level of resilience is ensured as long as one of the municipalities already has a regulation in place. Although the current version of the LHI is based on this assumption, further consideration is required on refining the scoring system to allow for more scenarios.

Finally, as an overall challenge for the ongoing development of the LHI, the possible trade-offs as well as synergies between the various goals would need to be discussed in order to achieve a realistic representation of the sustainability of ecosystem services in target areas.

Next steps



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