

Indicator 15.4.2

Indicator Name, Target and Goal

Indicator 15.4.2 (a) Mountain Green Cover Index and (b) Proportion of degraded mountain land

Target 15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development

Goal 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Definition and Rationale

○ Definition

The Mountain Green Cover Index (MGCI) is defined as the percentage of green cover over the total surface of the mountain region of a given country and for given reporting year.

(Note: Of the two elements of the abovementioned indicator, only (a) is calculated because (b) is not available at present.)

○ Concepts

The Mountain Green Cover index is based on mountain classification data and land cover data:

1) Mountain classification data

This methodology adheres to the UNEP- WCMC mountain definition, relying in turn on the mountain description proposed by Kapos *et al.* (2000).

This description classifies mountain areas according altitude, slope and elevation range into 6 categories.

Mountain Class	Description
1	Elevation > 4.500 meters
2	Elevation 3.500–4.500 meters

- 3 Elevation 2.500–3.500 meters
- 4 Elevation 1.500–2.500 meters and slope > 2
- 5 Elevation 1.000–1.500 meters and slope > 5 or local elevation range (LER 7 kilometer radius) > 300 meters
- 6 Elevation 300–1.000 meters and local elevation range (7 kilometer radius) > 300 meters

2) Land over data

Land cover data are classified to green/non green. Currently, FAO uses land cover time series produced by the European Space Agency (ESA) under the Climate Change Initiative (CCI) as a general solution.

If countries have national land cover maps of higher spatial resolution and comparable or better quality, FAO advises using them, following the same methodology presented here, for the generation of MGCI values.

Here the high resolution land use and land cover map data produced by the Japan Space Exploration Agency (JAXA) is used.

JAXA classification	IPCC class	Green / Non green
6, 7, 8, 9, 11*	Forest	Green
5	Grassland	Green
3, 4	Cropland	Green
Not available	Wetland	Green
2	Settlement	Non Green
1, 10, 12*	Other land	Non Green

*11(Bamboo) and 12(Solar power panel) are available only for 2018-2020 data.

○ Rationale and Interpretation:

The mountain ecosystem provides valuable ecosystem services. Since the mountains are vulnerable and easily affected by natural and anthropogenic factors, it is necessary for sustainable

development of mountain areas to monitor the changes and reflect to the conservation and maintenance of the mountains. The ratio of green cover in the mountain areas indicates general states of health and maintenance of mountain ecosystems. Assessing the change of green cover differentiated by elevation is important in understanding the changes that are occurring in the mountain regions due to the influence of climate change including global warming and the decision of its adaptation measures.

Data Sources and Collection Method

- Data sources:

JAXA computed MGCI of Japan using the following data sources:

- 1) Land cover data

JAXA high resolution land use and land cover data (2006-2011, 2014-2016 and 2018-2020, resolutions at 250m, 100m, 50m/30m)

- 2) Mountain classification data

Following the definition of Kapos et al (2000), JAXA produced 90m resolution Kapos mountain classification data from the Shuttle Radar Topography Mission (SRTM) data.

- Collection method

The indicator is generated for all countries and regions having mountain areas by FAO. FAO shares country figures with NSO SDG focal points for their validation and requests countries to provide their own estimates for the indicator in case these are available.

Method of Computation and Other Methodological Considerations

- Computation Method

- ① Definition of MGCI :

The MGCI is the percentage (%) of green cover over the mountain areas.

When a high resolution land cover grid data is available, it can be computed:

MGCI = number of pixels of mountain green cover area/number of pixels of total mountain area x 100

② MGCI computation at country level :

The indicator can be computed following the Metadata produced by FAO as follows:

- I. The JAXA land cover classes are reclassified into six IPCC classes and Green/Non-Green cover map.
- II. The Kapos Elevation Ranges map is overlaid on top of the map resulting from step 1.
- III. Zonal histogram is calculated for each country and regional grouping in such a way that the number of pixels belonging to green and non-green classes are counted within each elevation range.
- IV. The ratio (%) between the sum of the green pixels and the total number of pixels (green plus non green) falling within each Kapos is calculated to obtain MGCI values per each Kapos class.

Here, a confusion matrix which indicates the accuracy of land cover classification is produced and sample errors and classification errors are corrected using a statistical method.

- V. Validation site data of mountain areas are selected from JAXA land cover validation site database using Kapos mountain classification data and a confusion matrix is produced.

Confusion matrix of two-category classification of green/non-green

		validated <i>b</i>	
		Green (<i>b</i> =1)	Non green (<i>b</i> =0)
classified <i>a</i>	Green (<i>a</i> =1)	<i>TP</i>	<i>FP</i>
	Non green (<i>a</i> =0)	<i>FN</i>	<i>TN</i>

Here, TP , FP , TN , FN are number of samples falling in the categories.

VI. When MGCI computed in IV is \hat{p}_i , its corrected value p_i can be given as follows:

$$p_i = \frac{\hat{p}_i - R(1|0)}{R(1|1) - R(1|0)}$$

Where,

$$R(0|0) = \frac{TN}{FP + TN}, R(1|0) = \frac{FP}{FP + TN}$$

$$R(0|1) = \frac{FN}{TP + FN}, R(1|1) = \frac{TP}{TP + FN}$$

○ Comments and limitations

The ESA CCI land cover maps are currently available at 300 meter resolution which limits their applicability in the monitoring of small and highly heterogeneous landscapes. Therefore, if countries have national land cover maps of higher spatial resolution and comparable or better quality, FAO advises using them, following the same methodology presented here, for the generation of MGCI values. Here JAXA high resolution land use and land cover map for Japan is used.

Data Disaggregation

MGCI at Kapos Mountain Classes (1 – 6)

References

[ESA CCI] ESA CCI land cover data (300m resolution) , [Download CCI LC Products | ESA CCI Land cover website \(esa-landcover-cci.org\)](https://esa-landcover-cci.org/)

[Kapos(2000)] Kapos, V., Rhind, J., Edwards, M., Prince, M., & Ravillous, C. (2000). Developing a map of the world's mountain forests. In M. F. Price , & N. Butt (Eds.), *Forests in Sustainable Mountain Development: A State-of-Knowledge Report for 2000* (pp. 4-

9). Wallingford: CAB International.

[FAO HP] Sustainable Development Goals, Food and Agriculture Organization of the United Nations, <http://www.fao.org/sustainable-development-goals/indicators/1542/en/>

[FAO Metadata] FAO Metadata, <https://unstats.un.org/sdgs/metadata/files/Metadata-15-04-02.pdf>

[JAXA] JAXA high-resolution land use and land cover map of Japan, https://www.eorc.jaxa.jp/ALOS/a/en/dataset/lulc/lulc_v2103_e.htm

[GSI Fundamental Geospatial Data] Geospatial Information Authority of Japan(GSI)/Ministry of Land, Infrastructure, Transportation and Tourism (MLIT)

Fundamental Geospatial Data
<https://fgd.gsi.go.jp/download/menu.php>

Custodian Ministries of Data

Japan Space Exploration Agency (JAXA),
Geospatial Authority of Japan/Ministry of Land Infrastructure and Construction (European Space Agency (ESA) and United States Geological Survey (USGS))

Custodian Ministries of Related Policies

Ministry of Foreign Affairs
Ministry of Education, Culture, Sports, Science and Technology
Ministry of Agriculture, Forestry and Fisheries
Forestry Agency of Ministry of Agriculture, Forestry and Fisheries
Ministry of the Environment

International Organizations

Food and Agriculture Organization of the United Nations (FAO)