Information on the review of the accuracy of land representation period

Over- or underestimation of total country area

In case there is over/underestimation, as a reviewer, you should check for the consistency of definitions of land categories/subcategories, as well as classification methodologies and rules across the time series. Over- or underestimation of areas can result from systematic errors in comparing land data sets/maps at two different points in time for detecting land-use changes. In particular, check for areas of land being classified under two different categories/strata (e.g., cropland versus grassland), or for portions of the country for which data are missing.

A classification methodology that either systematically excludes some of the lands in the country from classification (e.g., shrubland that cannot be classified under either forest land or grassland because, while it falls below the thresholds used to define forest land in the country, the country-specific definition for grassland also excludes it) or does not preclude a land being classified under two different land categories (e.g., some savannah lands that could be classified under both forest land and grassland based on national definitions and the country has not established and followed a hierarchy among the two land-use categories) does not qualify for accuracy. In such a case, the Party needs to revise the classification methodology by ensuring that definitions neither overlap nor leave a land out of classification and there is a hierarchy among definitions to avoid classification of a land under two or more categories.

Systematic misclassification of land

As an example of misclassification of land is when some orchards trees are classified as forest land. One of the ways in which Parties can verify their land-use/land-cover classification is through a comparison with ground-truth data, including images with very high resolution, and by preparing a confusion matrix (see annex I). In the confusion matrix, the diagonal and off-diagonal elements show the relative proportion of correctly classified and misclassified points, respectively, for a land-use category. In addition, it provides information not only on the accuracy of the land classification, but also on which categories are easily confused with each other. Multi-temporal analysis (analysis of images taken at different times to determine the stability of a land classification) can also be used to improve the classification accuracy, particularly in cases where ground-truth data are limited.

Note that when comparing land data sets/maps at two points in time for detecting land-category changes, error of omission and error of commission (see annex II) relating to the identification of land categories in overlapped data sets/maps may or may not occur in the same plot/pixels/mapping units in both data sets/maps. This means that assessing errors in the separate data sets/maps is not enough for knowing the errors generated when overlapping those maps/data sets, because errors combine (see the example below). Therefore, although land-use maps data sets have already been verified, land-category changes still need to be verified. When the accuracy of the land representation of a country is doubtful (e.g., for any of the above-discussed elements), you should recommend that the Party verify it by using time-series data from statistical sampling or independent data sets (e.g. ground-truth data or high resolution imagery).

For an example of possible combinations of errors when overlapping two data sets/maps with only two land-cover classes see annex III. In general, verification of

land data sets should always be performed where the data have a spatial/spectral resolution that is not adequate to capture single land-cover elements (e.g., when medium-/low-resolution satellite data are used for assessing forest cover and forest cover changes). Verification, of course, should be done using data with a high enough resolution to capture single land-cover elements, (e.g., ground data or aerial/satellite images with very high resolution).

Verification can also be necessary in cases where the data used have a temporal resolution that is not adequate for assessing land use, for example, for distinguishing between fallow lands and grassland, or for distinguishing between deforestation and temporary tree cover loss (e.g., clear cut or slash and burn). In these cases, use of ground-truth data or analysis of a time series of data from statistical sampling of remotely sensed data are effective and efficient ways to verify the land representation.

Annex I

Example of a Confusion Matrix with only two land categories: Forest Land and non-Forest Land

		Ground Truth			Total Classified Points
		Managed Forest	Unmanaged Forest	Non Forest	
Land Classification	Managed Forest	97	13	15	**125**
	Unmanaged Forest	4	11	7	**22**
	Non Forest	31	2	120	**153**
Total Ground Truth Points		**132**	**26**	**142**	**300**

In a Confusion Matrix the area of each class/stratum (land category/subcategory/subdivision) is reclassified into three subclasses/substrata:

1. Areas correctly classified under the given class/stratum (diagonal).
2. (commission errors) Areas belonging to any other classes erroneously classified under the given class/stratum (rows).
3. (omission errors) Areas of the given class erroneously classified under any other classes/strata (columns).

Note that the number (n) of subclasses/substrata (each cell is a subclass/substratum) is equal to the square of the number (N) of classes/strata (land categories/subcategories/subdivisions): $n=N^2$

Annex II

Error of omission

An example of an error of omission is when an area covered by a certain land-cover element (e.g., shrubs/grassland) is not classified as shrubs/grassland. Ground-truthing allows to prepare error matrices to be used to adjust the area statistics, so providing for a higher accuracy of the land representation.

Error of commission

An example of an error of commission is when an area reports the presence of a feature (e.g., trees/forest) that, is actually absent (no trees/forest are actually present but shrubs/grassland). Ground-truthing allows to prepare error matrices to be used to adjust the area statistics, so providing for a higher accuracy of the land representation.

Annex III

Example of possible combinations of errors when overlapping two data sets/maps with only two land-cover classes (e.g. forest and non-forest). The table shows, for each combination, what change actually occurred and what has been *detected* through 'overlapping' of the two maps. The errors generated are shown in red. Note that out of 16 subclasses (a cell corresponds to a subclass/substratum), 10 identify errors.

			Fake forest class Commission error in forest class/ Omission error in non-forest class	Fake non-forest class Omission error in forest class/ Commission error in non-forest class	True forest class	True non-forest class
			From map 1			
Fake forest class	Commission error in forest class/ Omission error in non-forest class	**To map 2**	No change occurred *No change detected*	Change occurred from forest to non-forest *Change detected from non-forest to forest*	Change occurred from forest to non-forest *No change detected*	No change occurred *Change detected from non-forest to forest*
Fake non-forest class	Omission error in forest class/ Commission error in non-forest class		Change occurred from non-forest to forest *Change detected from forest to non-forest*	No change occurred *No change detected*	No change occurred *Change detected from forest to non-forest*	Change occurred from non-forest to forest *No change detected*
True forest class			Change occurred from non-forest to forest *No change detected*	No change occurred *Change detected from non-forest to forest*	No change occurred *No change detected*	Change occurred from non-forest to forest *Change detected from non-forest to forest*
True non-forest class			No change occurred *Change detected from forest to non-forest*	Change occurred from forest to non-forest *No change detected*	Change occurred from forest to non-forest *Change detected from forest to non-forest*	No change occurred *No change detected*