3.7 OTHER LAND

"Other Land" is defined in Chapter 2 of this report as including bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five land-use categories treated in Sections 3.2 to 3.6. This land-use category is included to allow the total of identified land areas to match the national area, where data are available. Consistent with the *IPCC Guidelines*, change in carbon stocks and non-CO_2 emissions and removals would not need to be assessed for the category of "Other Land Remaining Other Land (OO)" assuming that it is typically unmanaged. At present, no guidance can be given for "Other Land" that is managed. "Other Land" is included, however, for checking overall consistency of land area and tracking conversions to and from other land since many methods require knowledge of associated carbon stocks. It is of particular importance to include complete information on forest land converted to other types of land uses, including "Other Land", in order to ensure consistency with the requirements in Chapters 4 and 5.

3.7.1 Other Land Remaining Other Land

Change in carbon stocks and non-CO_2 emissions and removals are not considered for this category as mentioned above.

3.7.2 Land Converted to Other Land

Although unlikely, lands may be converted to "Other Land", e.g. as a result of deforestation with subsequent degradation. This conversion of land use, either starting with a human activity or a natural driving force affecting managed land, requires the calculation of emissions of CO_2 because the act of conversion releases the carbon previously held on the land, and emissions and/or removals due to management activities cease. Emissions from land converted to bare soil as a result of development of settlements should be included in the "Settlements" land-use category (See Section 3.6.2, Land Converted to Settlements.).

It is *good practice* to estimate the change in carbon stocks associated with the conversion of all types of managed land to other land. Figure 3.1.2 provides the decision tree which can be used to identify the appropriate tier-level for land converted to "Other Land".

The summary equation for change in carbon stocks in land converted to "Other Land" (LO) is shown in Equation 3.7.1.

EQUATION 3.7.1
ANNUAL CHANGE IN CARBON STOCKS IN LAND CONVERTED TO "OTHER LAND"

$$\Delta C_{LO} = \Delta C_{LO_{LB}} + \Delta C_{LO_{Soils}}$$

Where:

ΔC_{LO} = annual change in carbon stocks in land converted to "Other Land", tonnes C yr^{-1}

$\Delta C_{LO_{LB}}$ = annual change in carbon stocks in living biomass in land converted to "Other land", tonnes C yr^{-1}

$\Delta C_{LO_{Soils}}$ = annual change in carbon stocks in soils in land converted to "Other Land", tonnes C yr^{-1}

3.7.2.1 CHANGE IN CARBON STOCKS IN LIVING BIOMASS

This section provides *good practice guidance* for calculating change in carbon stocks in living biomass due to the conversion of land from natural conditions and other uses to "Other Land". The method requires estimates of carbon in living biomass stocks prior to conversion, based on estimates of the areas of land converted during the period between land-use surveys. As a result of conversion to "Other Land", it is assumed that the dominant vegetation is removed entirely, resulting in no carbon remaining in living biomass after conversion. The difference between initial and final living biomass carbon pools is used to calculate change in carbon stocks due to land-use conversion. In subsequent years accumulations and losses in living biomass in "Other Land" are not considered (see Section 3.7.1).

3.7.2.1.1 METHODOLOGICAL ISSUES

3.7.2.1.1.1 Choice of Method

Equation 3.7.2 summarises how to estimate the change in carbon stocks in living biomass on land converted to "Other Land". Average change in carbon stocks on a per area basis are estimated to be equal to the change in carbon stocks due to the removal of living biomass from the initial land uses. Given the definition of the "Other Land", the default assumption is that carbon stock after conversion is zero.

EQUATION 3.7.2
ANNUAL CHANGE IN CARBON STOCKS IN LIVING BIOMASS IN LAND CONVERTED TO "OTHER LAND"

$$\Delta C_{LO_{LB}} = A_{Conversion} \bullet (B_{After} - B_{Before}) \bullet CF$$

Where:

$\Delta C_{LO_{LB}}$ = annual change in carbon stocks in living biomass in land converted to "Other Land", tonnes C yr^{-1}

$A_{Conversion}$ = area of land converted annually to "Other Land" from some initial land uses, ha yr^{-1}

B_{After}= amount of living biomass immediately after conversion to "Other Land", tonnes d.m. ha^{-1}

B_{Before}= amount of living biomass immediately before conversion to "Other Land", tonnes d.m. ha^{-1}

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonnes d.m.)$^{-1}$

Tier 1: A Tier 1 method follows the approach in the *IPCC Guidelines*, Section 5.2.3 (Forest and Grassland Conversion) where the amount of aboveground biomass that is removed is estimated by multiplying the forest area converted annually to other land by the average annual carbon content of biomass in the land prior to conversion. It is assumed that the entire biomass is removed in the year of conversion. The recommended default assumption for the Tier 1 calculation is that all carbon in biomass is released to the atmosphere through decay processes either on- or off-site.

Tier 2: A Tier 2 method can be used if country-specific data on carbon stocks in initial land uses are obtainable. In addition, under Tier 2, carbon losses can be apportioned to specific conversion processes, such as burning or harvesting. This allows more accurate estimation of non-CO_2 greenhouse gas emissions. (See Section 3.2.1.4 for the basic method for estimating non-CO_2 greenhouse gas emissions from biomass burning.) The portion of biomass removed is sometimes used as wood products or as fuel wood. In the case of wood products, countries may use the default assumption that carbon in wood products is oxidized in the year of removal. Alternatively, countries may refer to Appendix 3a.1 for estimation techniques for carbon storage in harvested wood products.

Tier 3: A Tier 3 method is similar to the Tier 2 method but requires more detailed data/information than the Tier 2 approach, e.g.:

- Actual areas converted annually are used for each forest land converted to "Other Land";
- Carbon densities and change in soil carbon stocks are based on locally specific information, possibly with a dynamic link between biomass and soil; and
- Biomass volumes removed are based on actual inventories and/or the model estimations.

3.7.2.1.1.2 Choice of Emission/Removal Factors

Tier 1: Default parameters are provided in both the *IPCC Guidelines* and in this report to enable countries with limited data resources to estimate emissions and removals from this source. The method requires the estimation of carbon stocks before conversion for the initial land use (C_{Before}) and assumes that the carbon stock after conversion (C_{After}) is zero. Tables 5-4 to 5-6 of the *IPCC Guidelines*, Table 3A.1.7 (Annual average aboveground volume increment in plantation by species) and Table 3A.1.8 (Average belowground to aboveground biomass ratio in natural regeneration by broad category) of this report, can be used to estimate carbon stocks before conversion in case the initial land-use category was forest land. If the initial land-use category is cropland or grassland, guidance is given in Section 3.3.2 or 3.4.2, respectively.

Tier 2: The default carbon stock values provided above can be applied to some parameters in a Tier 2 approach. However, the Tier 2 method requires at least some country-specific information, which may be obtained, for example, through systematic studies of carbon stock of initial forests and other land-use categories. Default parameters for emissions from biomass burning are provided in Section 3.2.1.4. However, inventory compilers

are encouraged to develop country-specific coefficients to improve the accuracy of estimates. The default value for the proportion of biomass oxidized as a result of burning is 0.9, as originally stated in the *IPCC Guidelines*.

Tier 3: Under Tier 3, all parameters should be country-specific and more accurate than the default values.

3.7.2.1.1.3 Choice of Activity Data

All tiers require some estimate of the area of land converted to "Other land" over a time period that is consistent with land-use surveys. The same aggregate area estimates should be used for both biomass and soil in the calculations of change in carbon stocks on land converted to "Other Land". As described below, higher tiers require greater specificity of areas.

Tier 1: For a Tier 1 approach, activity data on areas of different land-use categories converted to"Other Land" are needed. If countries do not have these data, partial samples may be extrapolated to the entire land base or historic estimates of conversions may be extrapolated over time based on expert judgement.

Tier 2: Under Tier 2, inventory compilers should strive to use actual area estimates for transitions from various land-use categories to "Other Land". Full coverage of land areas can be accomplished either through analysis of periodic remotely sensed images of land-use and land cover patterns, through periodic ground-based sampling of land-use patterns, or hybrid inventory systems.

Tier 3: The activity data used in Tier 3 calculations should be a full accounting of all land-use category transitions to other land and should be disaggregated to account for different conditions within a country. Disaggregation can occur along political (county, province, etc.), biome, climate, or on a combination of these parameters. In many cases, information on multi-year trends in land conversion may be available (from periodic sample-based or remotely sensed inventories of land use and land cover).

3.7.2.1.1.4 Uncertainty Assessment

Tier 1: Under Tier 1, the sources of uncertainty are the use of global or national averages for carbon stocks in forest land or other land uses before conversion and coarse estimates of areas converted to "Other Land". Most default values in this method do not have corresponding error ranges associated with them. Therefore, a default uncertainty level of +/- 75% of the estimated CO_2 emission or removal has been assumed based on expert judgement.

Tier 2: Actual area estimates for land converted to "Other Land" will enable more transparent accounting and allow experts to identify gaps and double counting of land areas. The Tier 2 method uses at least some country-specific values, which will improve the accuracy of estimates, provided they better represent conditions relevant to the country. When country-specific values are developed, inventory compilers should use sufficient sample sizes and techniques to minimize standard errors. Probability density functions (i.e. providing mean and variance estimates) can be derived for all country-parameters. Such data can be used in advanced uncertainty analyses such as Monte Carlo simulations. Chapter 5 of this report can be referred for guidance on developing such analyses. At a minimum, Tier 2 approaches should provide error ranges for each country-specific parameter.

Tier 3: Activity data should provide a basis to assign estimates of uncertainty to areas associated with land conversion. Combining emission/removal factors and activity data and their associated uncertainties can be done using Monte Carlo procedures to estimate means and confidence intervals for the overall inventory.

3.7.2.2 CHANGE IN CARBON STOCKS IN SOILS

The conversion of land to "Other Land", especially to bare soils, could result in the release of carbon previously held in soil on the land. On land converted to "Other Land" inventory compilers should estimate the change in carbon stocks in mineral soils under the initial land uses. The resulting carbon stocks in mineral soils for "Other Land" can be assumed as zero for many situations. It is also assumed that the change in carbon stocks in organic soils are not relevant in this section.

3.7.2.2.1 METHODOLOGICAL ISSUES

3.7.2.2.1.1 Choice of Method

The estimation method for mineral soil is based on change in soil carbon stocks over a finite period following change in management that impacts soil carbon stocks, as shown in Equation 3.7.3. Previous soil carbon stocks ($SOC_{(0-T)}$) and soil carbon stocks in the inventory year (SOC_0) are estimated from reference carbon stocks (Sections 3.3, Table 3.3.3) and stock change factors (Section 3.4, Table 3.3.4), applied for the respective time points. The default time period between these two time points is 20 years. This approach is similar to that

described in Section 3.2.2.3 (forest soil carbon section) except that it is assumed that the soil carbon stocks in the inventory year are zero for land converted to "Other Land".

EQUATION 3.7.3
ANNUAL CHANGE IN CARBON STOCKS IN MINERAL SOILS IN LAND CONVERTED TO "OTHER LAND"

$$\Delta C_{LO_{Mineral}} = [(SOC_0 - SOC_{(0-T)}) \bullet A\ ] / T$$

$$SOC = SOC_{REF} \bullet F_{LU} \bullet F_{MG} \bullet F_I$$

Where:

$\Delta C_{LO_{Mineral}}$ = annual change in carbon stocks in mineral soils in land converted to "Other Land", tonnes C yr^{-1}

SOC_0 = soil organic carbon stocks in the inventory year, tonnes C ha^{-1}

$SOC_{(0-T)}$ = soil organic carbon stocks T years prior to the inventory, tonnes C ha^{-1}

T = time period for the conversion, yr (default is 20 yr)

A = land area of each parcel, ha

SOC_{REF} = the reference carbon stocks, tonnes C ha^{-1}; see Table 3.3.3

F_{LU} = stock change factor for land use or land-use change type, dimensionless; see Table 3.3.4

F_{MG} = stock change factor for management regime, dimensionless; see Table 3.3.4

F_I = stock change factor for input of organic matter, dimensionless; see Table 3.3.4

Tier 1: Tier 1 methods rely on default values for reference carbon stocks in mineral soils under native vegetation (see Table 3.3.3) and coarse estimates of areas converted to "Other Land". Soil carbon stocks after conversion are assumed to be zero for "Other Land" such as bare or degraded soils or deserts.

Tier 2: Tier 2 methods involve country or region-specific reference carbon stocks and more disaggregated land-use activity data.

Tier 3: Tier 3 methods can involve a variety of more detailed and country-specific data and use model and/or measurement-based approaches along with data on highly disaggregated land use and management. For all tiers, it is assumed that soil carbon stock in the inventory year is zero due to conversion to the "Other Land" category.

3.7.2.2.1.2 Choice of Emission/Removal Factors

Mineral soils

The following variables are needed when using either the Tier 1 or Tier 2 method:

Reference carbon stocks (SOC_{REF})

Tier 1: Under Tier 1, it is *good practice* to use the default reference carbon stocks (SOC_{REF}) provided in Table 3.3.3.

Tier 2: For a Tier 2 method, reference soil carbon stocks can be determined from measurements of soils, for example, as part of a country's soil survey and mapping activities.

Stock change factors (F_{LU}, F_{MG}, F_I)

Tier 1: Under Tier 1, it is *good practice* to use default stock change factors (F_{LU}, F_{MG}, F_I) provided in Table 3.3.4. These are updated from the *IPCC Guidelines*, based on a statistical analysis of published research. Note that where lands are converted to "Other Land", all the stock change factors have the value of one, such that the pre-conversion soil carbon stocks are equal to the native vegetation reference values (SOC_{Ref}).

Tier 2: For the Tier 2 method, estimation of country-specific stock change factors for land-use conversion to cropland will typically be based on paired-plot comparisons representing converted and unconverted lands, where all factors other than land-use history are as similar as possible (e.g. Davidson and Ackermann, 1992).

3.7.2.2.1.3 Choice of Activity Data

It is *good practice* for inventory compilers to use the same area estimates for land converted to "Other Land" for estimating change in carbon stocks in living biomass and soils. Some general issues regarding activity data are

described in Section 3.7.2.1.1.3. For purposes of estimating soil carbon stock change, area estimates of land-use conversions to "Other Land" should be stratified according to major soil types, as defined for Tier 1, or based on country-specific stratifications if employed in Tier 2 or 3 approaches. This can be based on overlays with suitable soil maps and spatially-explicit data of the location of land conversions.

3.7.2.2.1.4 Uncertainty Assessment

The sources of uncertainty are from the use of global or national average rates of conversion and course estimates of land areas converted to "Other Land". In addition, reliance on default parameters for carbon stocks in initial and final conditions contributes to relatively high degrees of uncertainty. The default values in this method have corresponding error ranges associated with them and the values are included in default tables.

The use of actual area estimates rather than average rates of conversion will improve the accuracy of estimates. In addition, the tracking of each land area for all possible land-use transitions will enable more transparent accounting and allow experts to identify gaps and areas where land areas are accounted for multiple times.

3.7.3 Completeness

The total area of "Other Land" covered by the inventory methodology is the sum of "Other Land" remaining "Other Land" and land converted to "Other Land" during the time period. Inventory compilers are encouraged to track through time the total area of land classified as "Other Land" within country boundaries, keeping transparent records on which portions are used to estimate change in carbon stocks. As addressed in Chapter 2, all areas including those not covered by the greenhouse gas inventory, should be part of the consistency checks to help avoid double counting or omission. Areas under the "Other Land", when summed with area estimates for "Other Land" will enable a complete assessment of the land base included in a countries' LULUCF sector inventory report.

3.7.4 Developing a Consistent Time Series

It is *good practice* for inventory compilers to maintain records on the "Other Land" areas used in inventory reports over time. These records should track the total area classified as "Other Land" as included in the inventory, subdivided by "Other Land" remaining in "Other Land" and land converted to "Other Land".

3.7.5 Reporting and Documentation

The categories described in this section can be reported using the reporting tables in Annex 3A.2. It is *good practice* to maintain and archive all information used to produce national inventory estimates. Metadata and data sources for information used to estimate country-specific parameters should be documented, and both mean and variance estimates provided. Actual databases and procedures used to process the data (e.g. statistical programs) to estimate country-specific factors should be archived. Activity data and definitions used to categorise or aggregate the activity data should be documented and archived.

3.7.6 Inventory Quality Assurance/Quality Control (QA/QC)

It is *good practice* to implement quality control checks and external expert review of inventory estimates and data. Specific attention should be paid to country-specific estimates of stock change factors and emission factors to ensure that they are based on high quality data and verifiable expert opinion.