

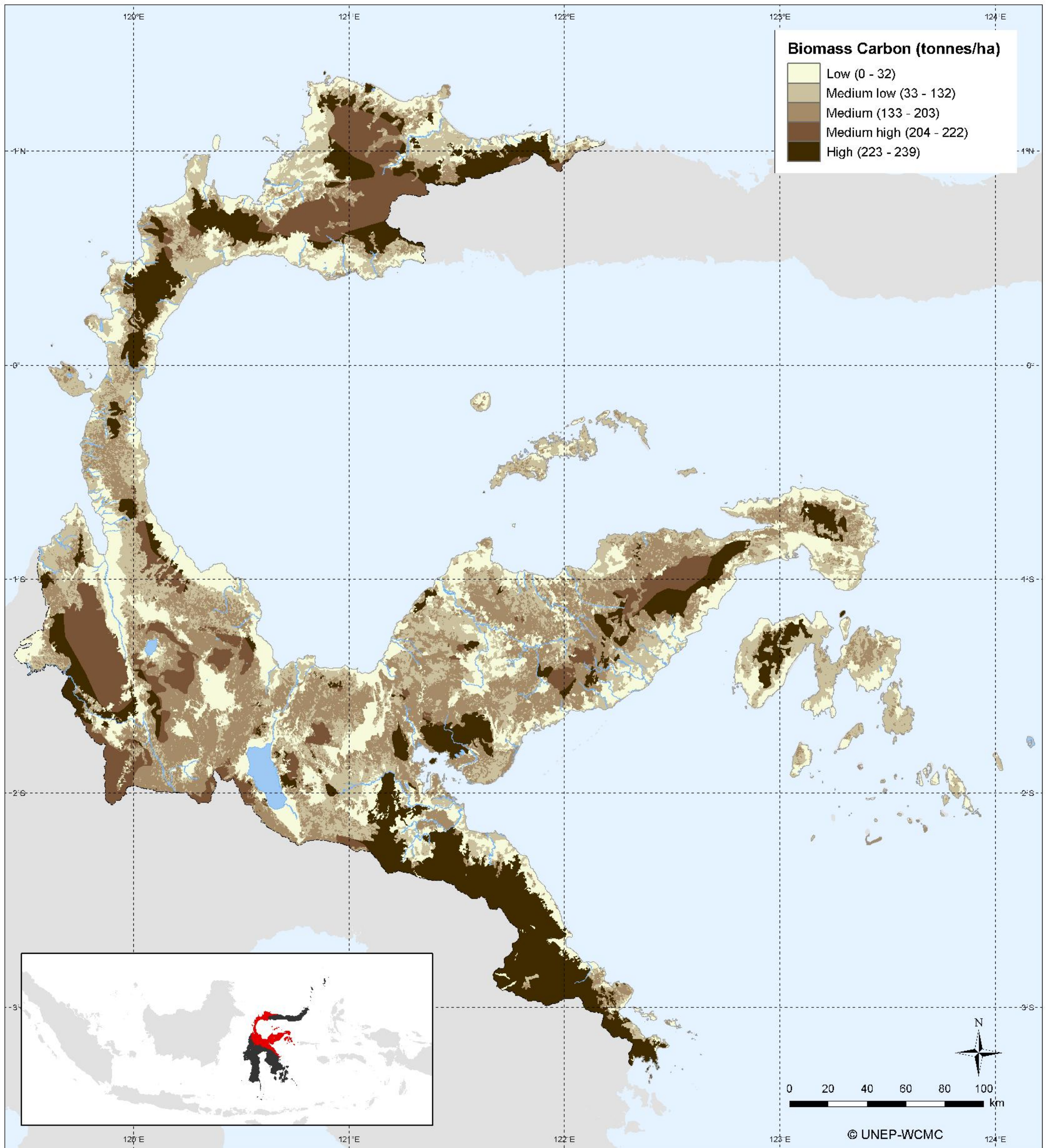


**UN-REDD**  
PROGRAMME  
INDONESIA

# METHOD and DATA SOURCE MAP CENTRAL SULAWESI



# Central Sulawesi Province - Biomass Carbon



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Biomass carbon:** carbon values for each land cover category assigned based on a literature search of published biomass values; land cover category 'secondary forest' was further stratified into areas of lower to higher disturbance using data from the ALLREDDI land cover dataset for 2005. **Source:** Ministry of Forestry, DG Forest Planning (in prep.): Land cover dataset for Central Sulawesi interpreted from LandSat ETM 7+ images from 2008+2009. Land cover dataset for 2005 produced by ICRAF in cooperation with the Ministry of Forestry, Forestry Planning Agency, under the ALLREDDI project (see: Ekadinata, A., Widayati, A., Dewi, S., Rahman, S., van Noordwijk, M. (2011); Indonesia's land-use and land-cover changes and their trajectories (1990, 2000 and 2005). ALLREDDI Brief 01. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA regional Office.

**Base map:** Land cover map for 2009 produced by the Ministry of Forestry

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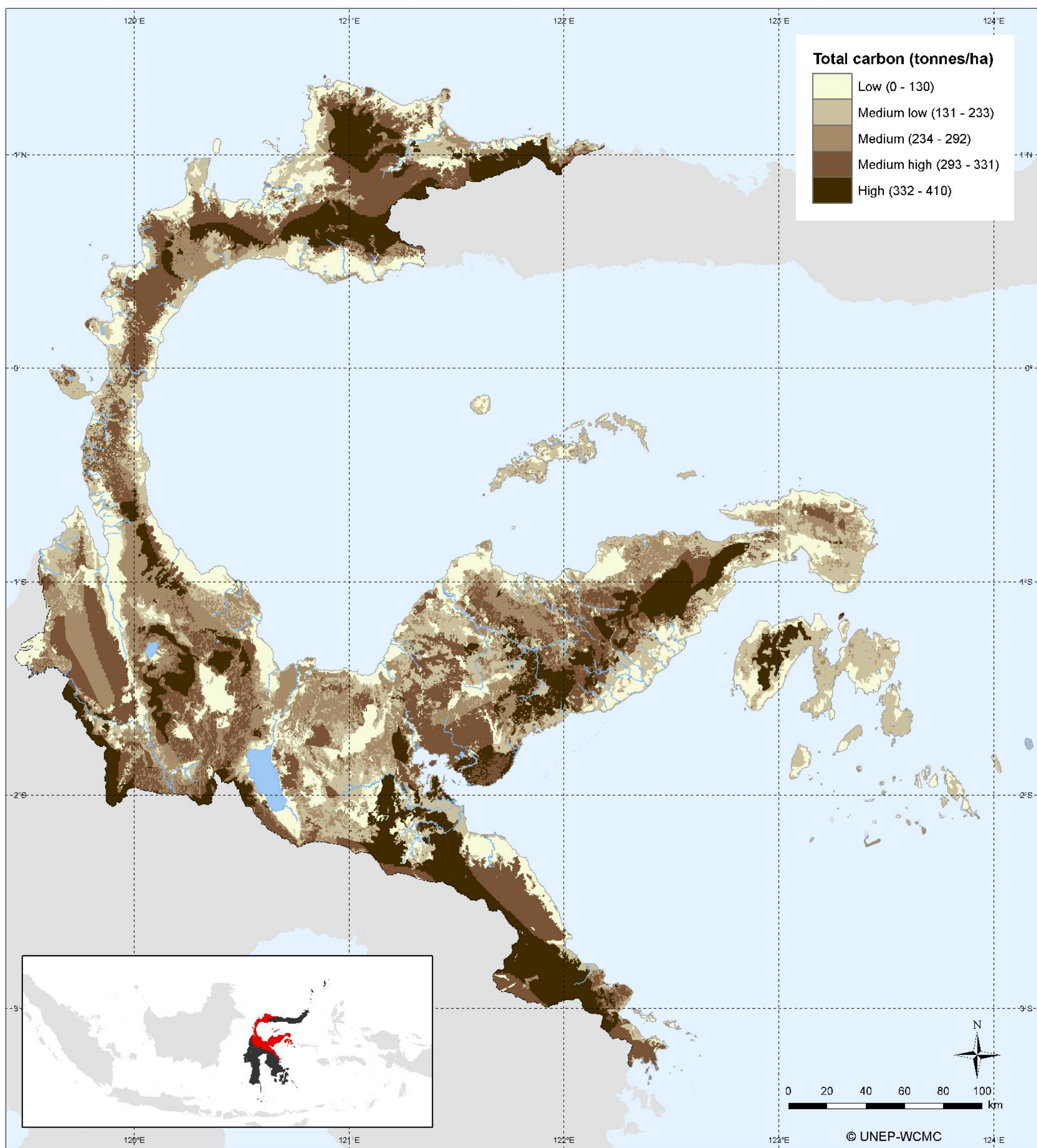


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# Central Sulawesi Province - Total Carbon

(Biomass carbon plus soil carbon)



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

## Method and Data Sources:

**Biomass Carbon Method:** Land cover map for 2009 produced by the Ministry of Forestry; carbon values for each land cover category assigned based on a literature search of published biomass values; land cover category 'secondary forest' was further stratified into areas of lower to higher disturbance using data from the ALLREDDI land cover dataset for 2005. **Source:** Ministry of Forestry, DG Forest Planning (in prep.); Land cover dataset for Central Sulawesi interpreted from LandSat ETM 7+ images from 2008+2009. Land cover dataset for 2005 produced by ICRAF in cooperation with the Ministry of Forestry, Forestry Planning Agency, under the ALLREDDI project (see: Ekadinata, A., Widayati, A., Dewi, S., Rahman, S., van Noordwijk, M. (2011): Indonesia's land-use and land-cover changes and their trajectories (1990, 2000 and 2005). ALLREDDI Brief 01. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office. **Soil Carbon Method:** Data for Central Sulawesi was extracted from the Global Soil Carbon Map. **Source:** Scharlemann, J.P.W., Hiederer, R., Kapos, V. (in prep.). Global map of terrestrial soil organic carbon stocks. UNEP-WCMC and EU-JRC, Cambridge, UK. **Combined biomass and soil carbon:** The biomass and soil carbon values were added to obtain an approximation of total ecosystem carbon.

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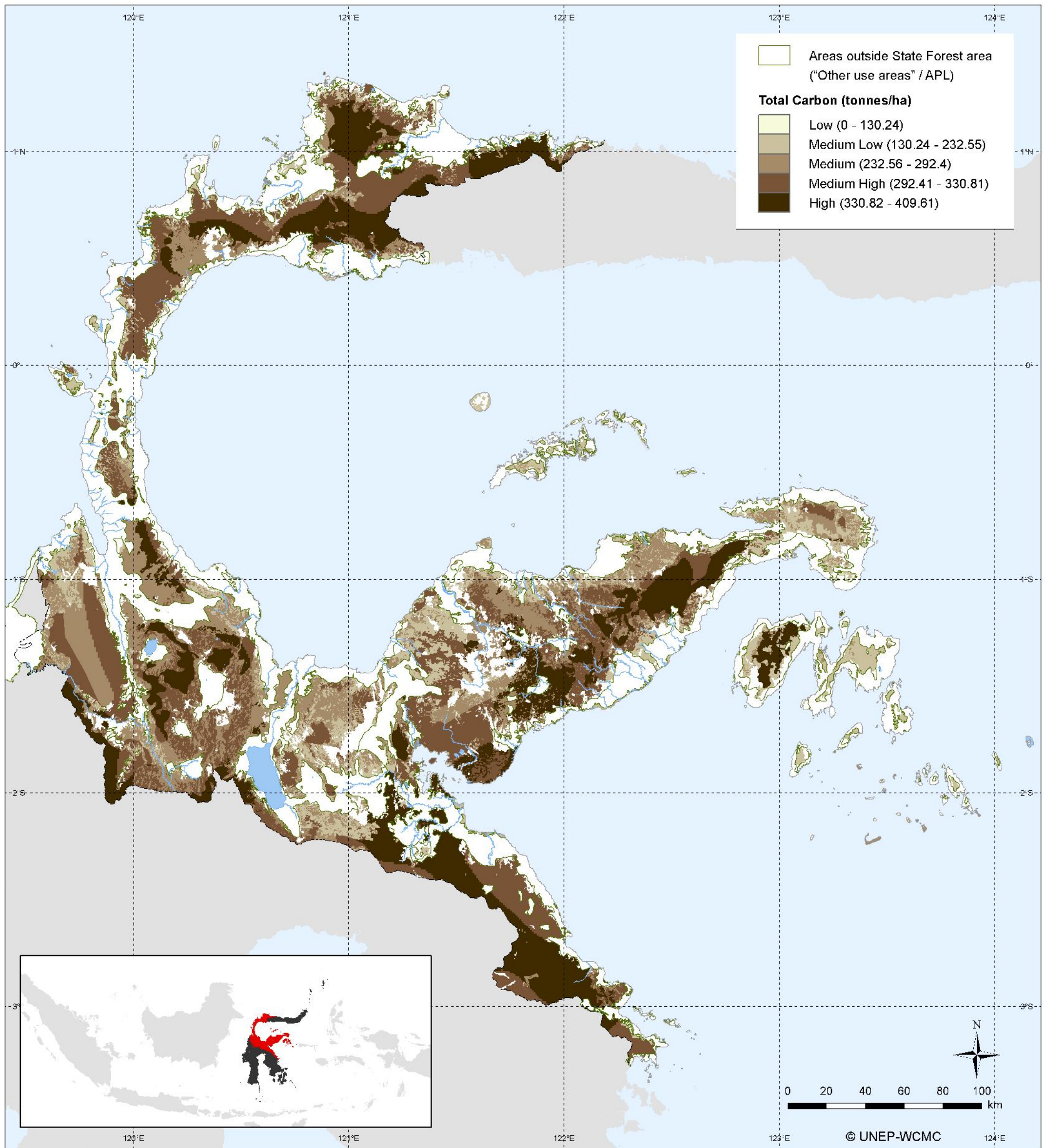


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# Central Sulawesi – Total carbon within the State Forest area

Regardless of actual land cover, land use within the designated state forest area comes under the authority of the Ministry of Forestry



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

## Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province;

**Method for the presentation of carbon within the State Forest area:** Based on data showing the boundary of the state forest area, obtained from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi, all areas inside the State Forest area are shown in brown shading indicating their total carbon stock. Areas outside of the State Forest area were blanked out (shown in white on the map).

The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations Environment Programme or contributory Organisations.

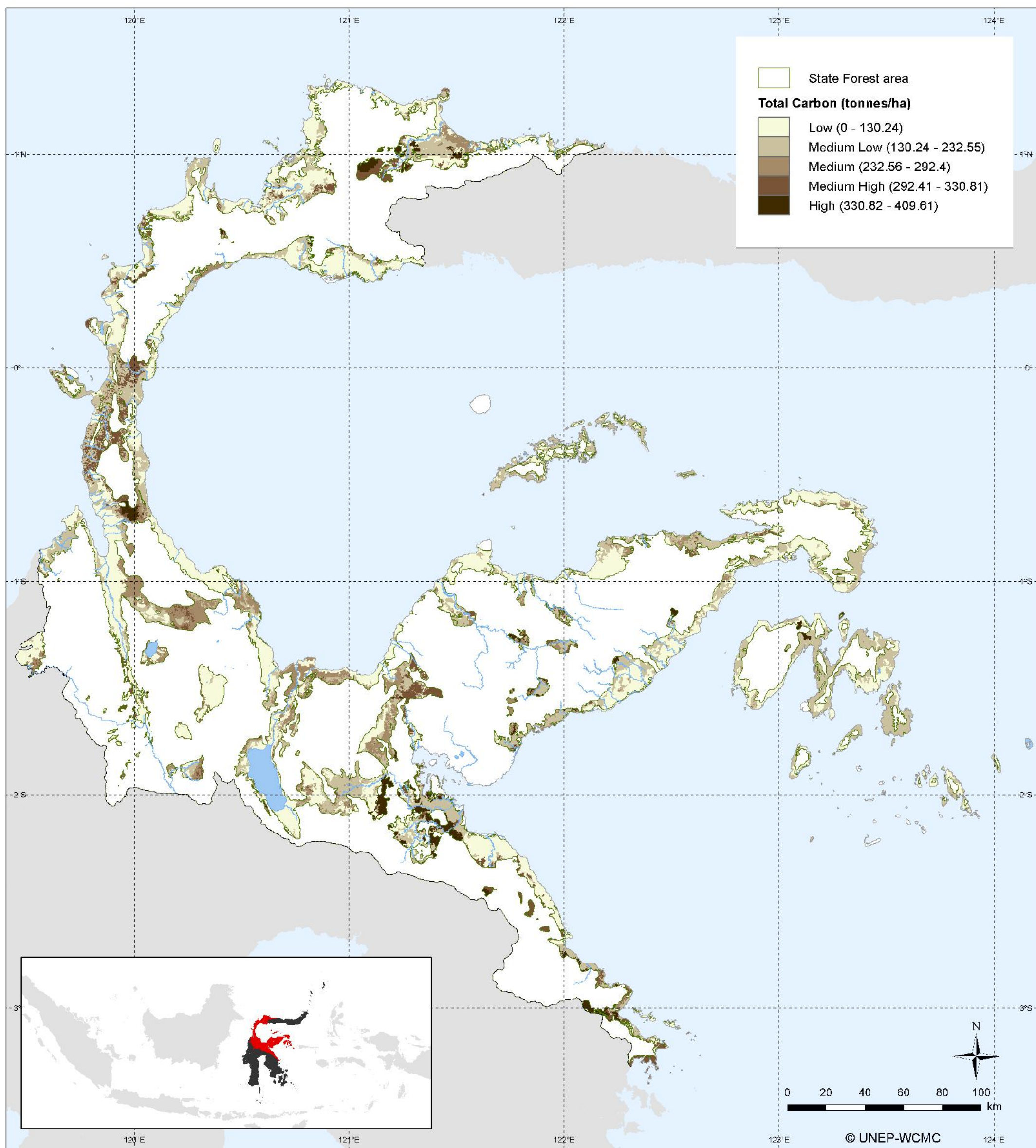


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# Central Sulawesi – Total carbon outside of the State Forest area

Substantial carbon stocks exist outside of the State Forest area. Although they are not administered under the Ministry of Forestry, forests outside the State Forest area can play an important role in REDD+ strategies.



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

### Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province;

**Method for the presentation of carbon outside of the State Forest area** Based on data showing the boundary of the state forest area, obtained from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi, all areas outside of the State Forest area ("Other Use areas"/APL) are shown in brown shading indicating their total carbon stock. Areas inside of the State Forest area were blanked out (shown in white on the map).

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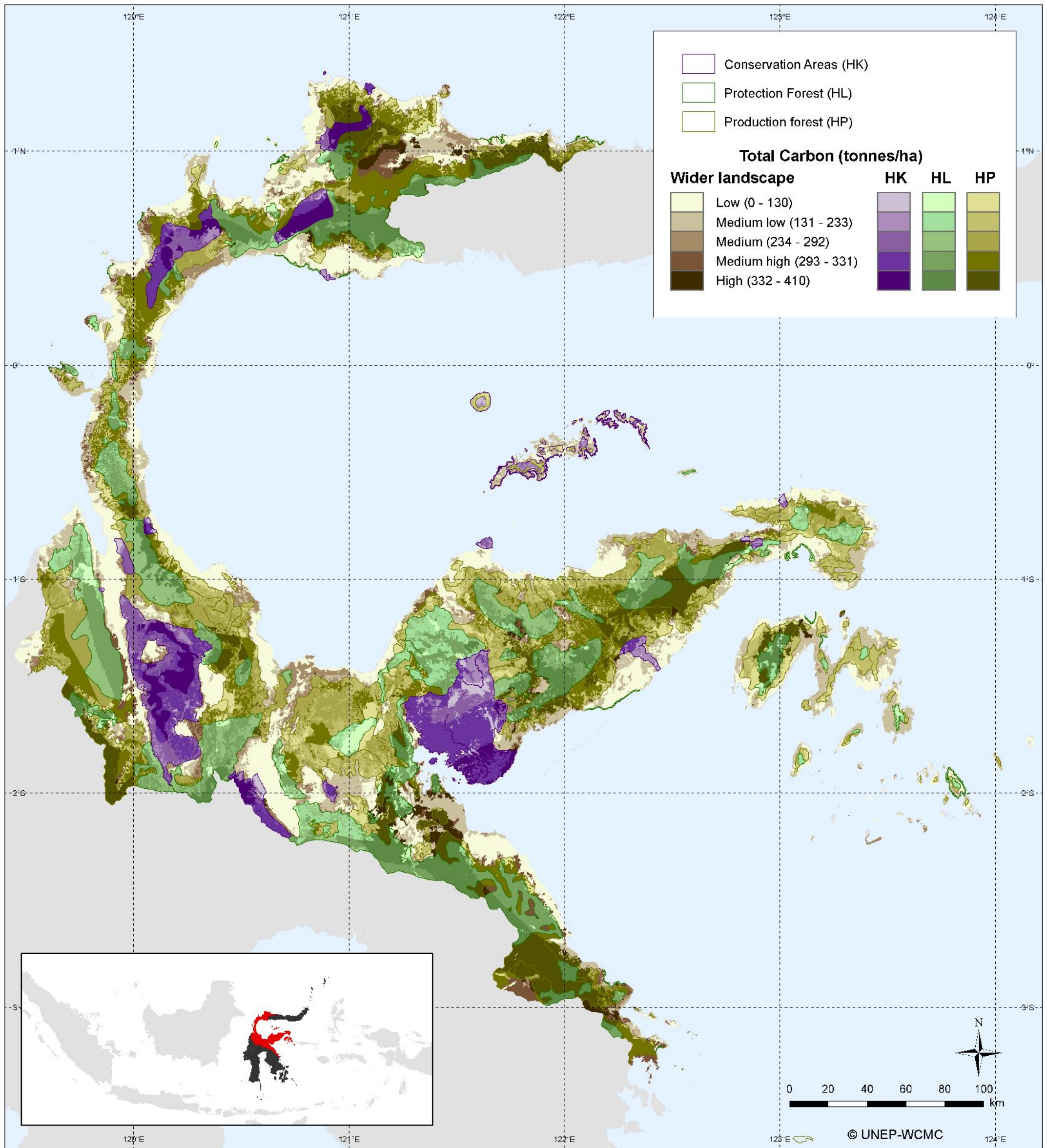


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# Central Sulawesi – Designated Forest Functions in relation to Total Carbon

The designation of forest functions as laid out in Ministry of Forestry decree 757/KPTS-II/1999 determines which management activities can be permitted in the different forest areas. It can also give a first indication of the value of these areas for maintaining biodiversity and ecosystem services.



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

### Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Location of production forest, protection forest and conservation areas:** Forest area map for Central Sulawesi based on Ministry of Forestry decree 757/KPTS-II/1999 (MoFor 1999) and complementary GIS data on conservation areas received from Ministry of Forestry, Agency for the Conservation of Natural Resources Central Sulawesi.

The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations Environment Programme or contributory Organisations.

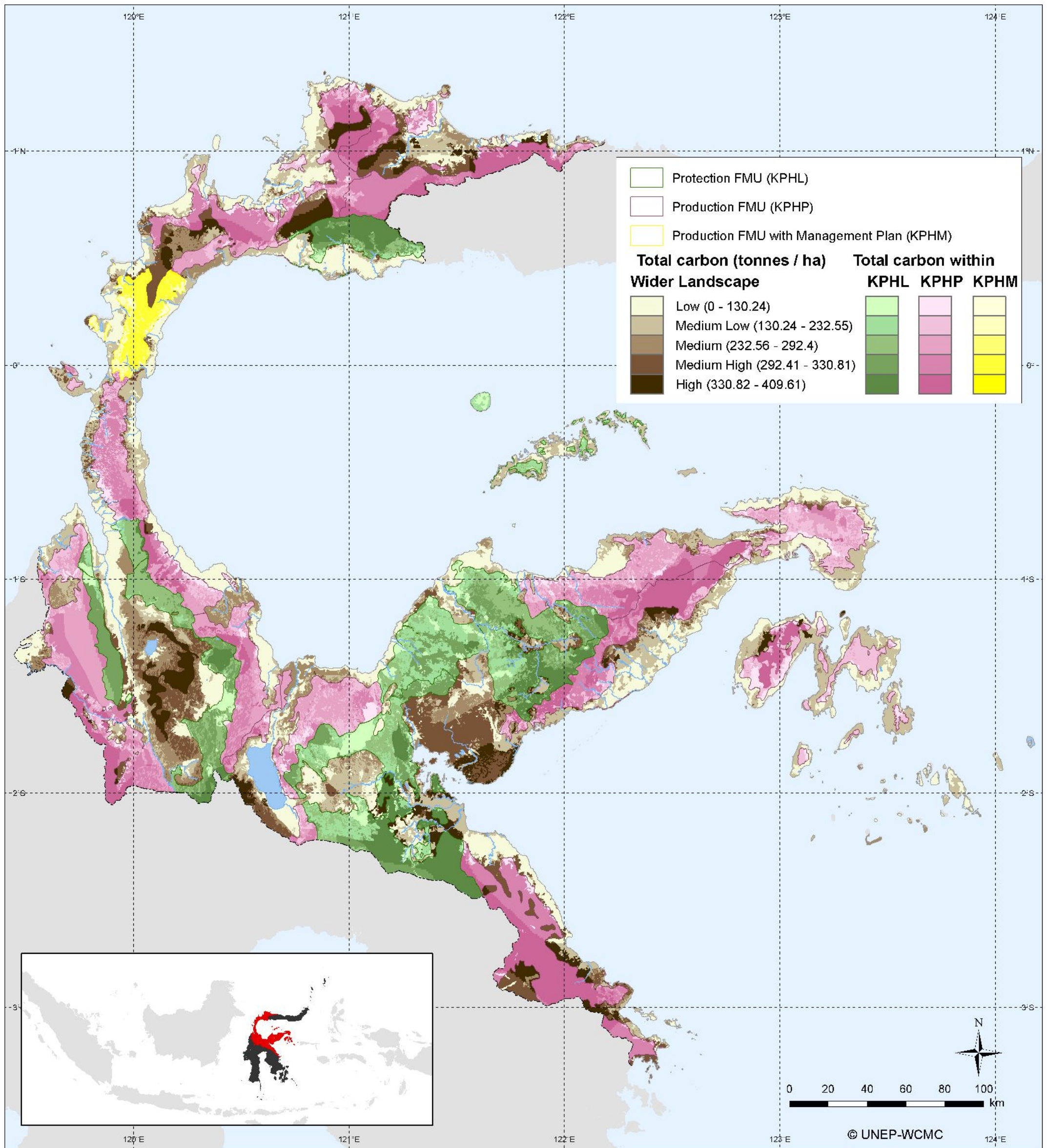


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# Central Sulawesi – Forest Management Units in relation to Total Carbon

Establishment and strengthening of Forest Management Units are important steps towards improved forest governance and can help to implement REDD+



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Forest Management Units:** Data on Forest Management Units obtained from Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi

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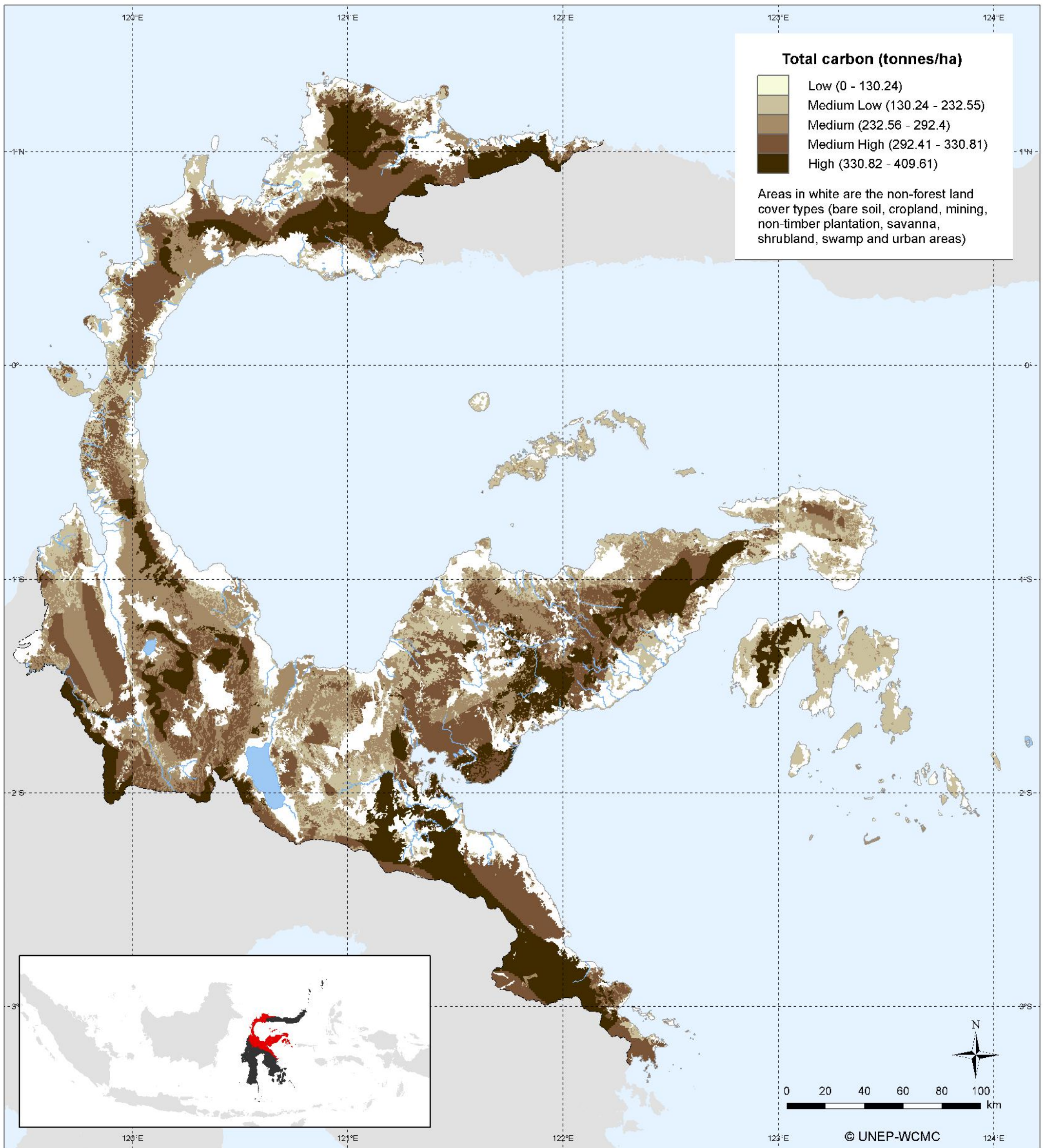


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# Central Sulawesi Province - Potential Areas for REDD+ Actions to Maintain Forest

This map shows total carbon stock in areas currently covered by forest.



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province;

**Method for presentation of potential areas for REDD+ actions to maintain forest:** Based on the land cover map for 2009 produced by the Ministry of Forestry, areas currently covered by forest are shown in brown shading indicating their total carbon stock. All non-forest areas were blanked out (shown in white on the map).

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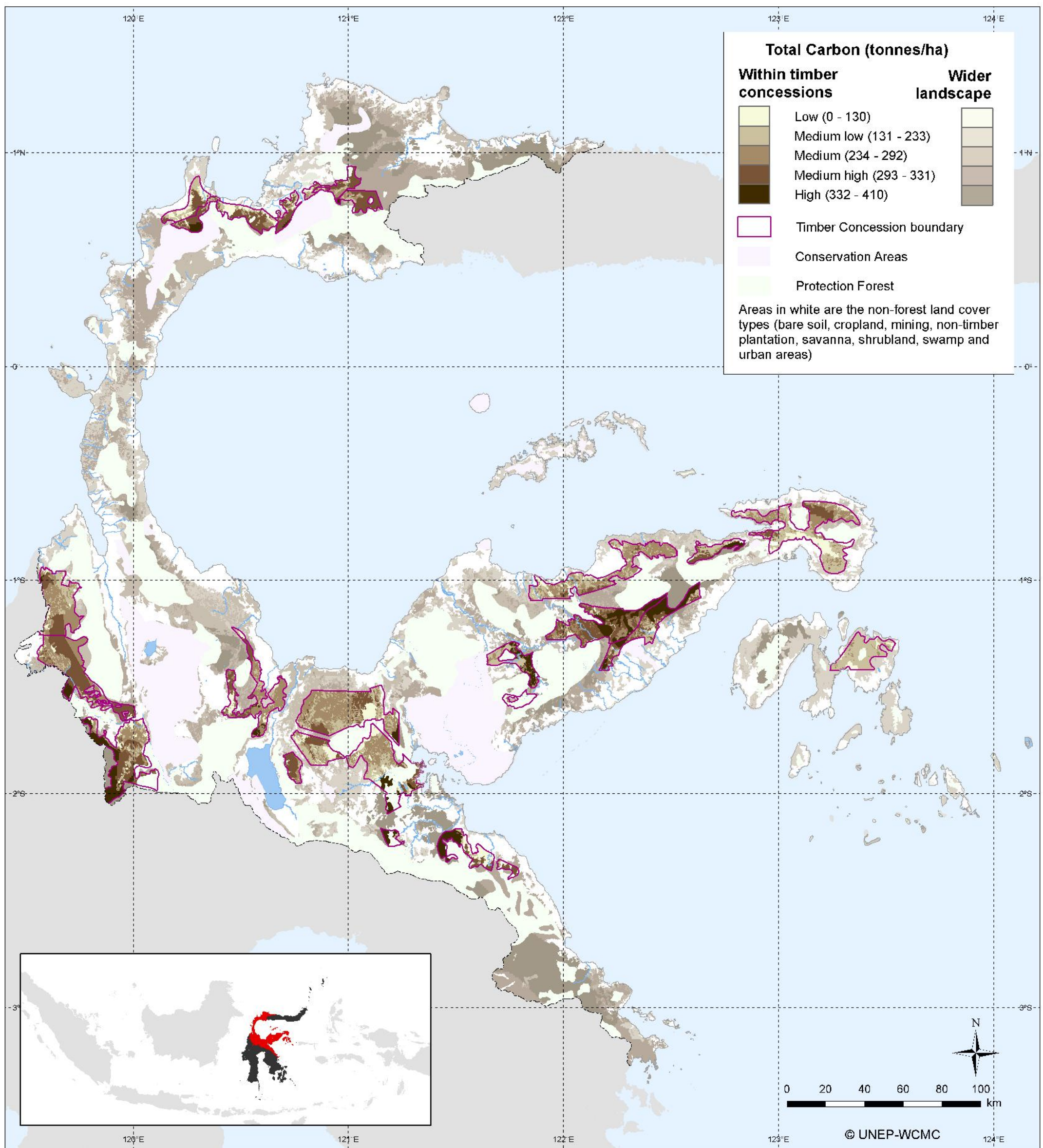
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# Central Sulawesi Province - Potential Areas for REDD+ Actions to Manage Forests Sustainably

This map shows total carbon stock in areas where timber extraction is currently permitted by law; existing concessions are highlighted



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

## Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province;

**Method for presentation of potential areas for REDD+ actions to manage forests sustainably:** Based on the land cover map for 2009 produced by the Ministry of Forestry and the Forest area map for Central Sulawesi based on Ministry of Forestry decree 757/KPTS-II/1999 (MoFor 1999), areas of production forest are shown in pale brown shading indicating their total carbon stock. Areas covered by existing concessions were highlighted based on data on timber extraction concessions from the Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi (2010). The following areas were blanked out: non-forest areas (shown in white on the map), conservation areas (shown in light purple) and protection forest (shown in light green). Conservation areas and protection forest shown as in Forest area map for Central Sulawesi based on Ministry of Forestry decree 757/KPTS-II/1999 (MoFor 1999), and updated with complementary GIS data on conservation areas received from Ministry of Forestry, Agency for the Conservation of Natural Resources Central Sulawesi.

The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations Environment Programme or contributory Organisations.

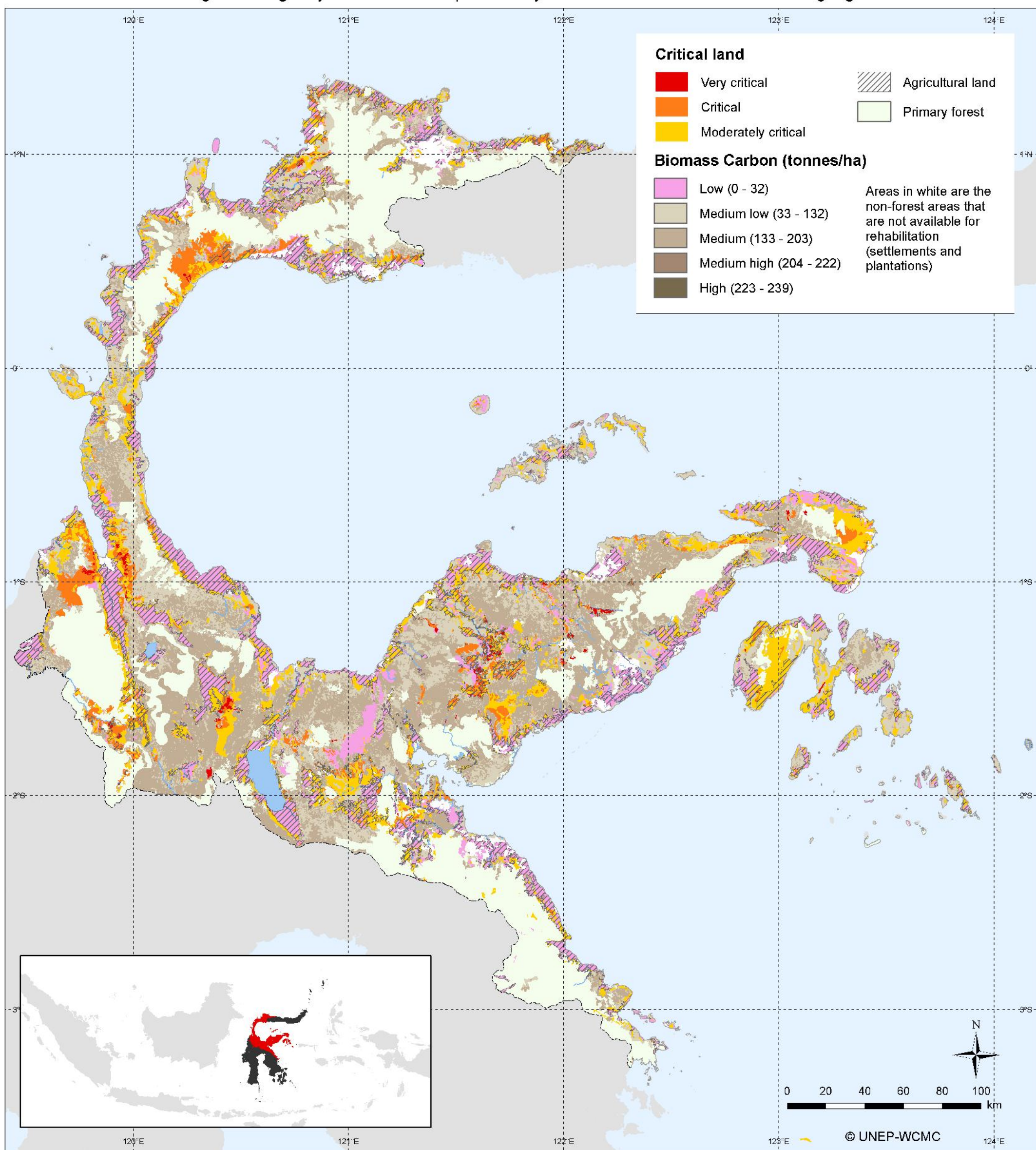


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# Central Sulawesi Province - Potential Areas for REDD+ Actions to Rehabilitate Forests

This map shows areas with potential for rehabilitation; "critical land" identified by Watershed Management Agency and areas with particularly low biomass carbon stocks are highlighted



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

## Method and Data Sources:

**Biomass Carbon:** see explanation on Map of Biomass Carbon for Central Sulawesi Province;

**Method for presentation of potential areas for REDD+ actions to rehabilitate forests:** Based on the land cover map for 2009 produced by the Ministry of Forestry, all areas that are considered to have potential and availability for rehabilitation are shown in brown shading indicating their biomass carbon stock. Low-carbon areas were highlighted in pink based on the Biomass Carbon layer. Areas identified as critical land were highlighted based on data from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi. Agricultural areas (unlikely to be available for rehabilitation) were marked with black hatching and the following areas were blanked out: non-forest areas that are not available for rehabilitation (shown in white on the map) and primary forest (shown in light green).

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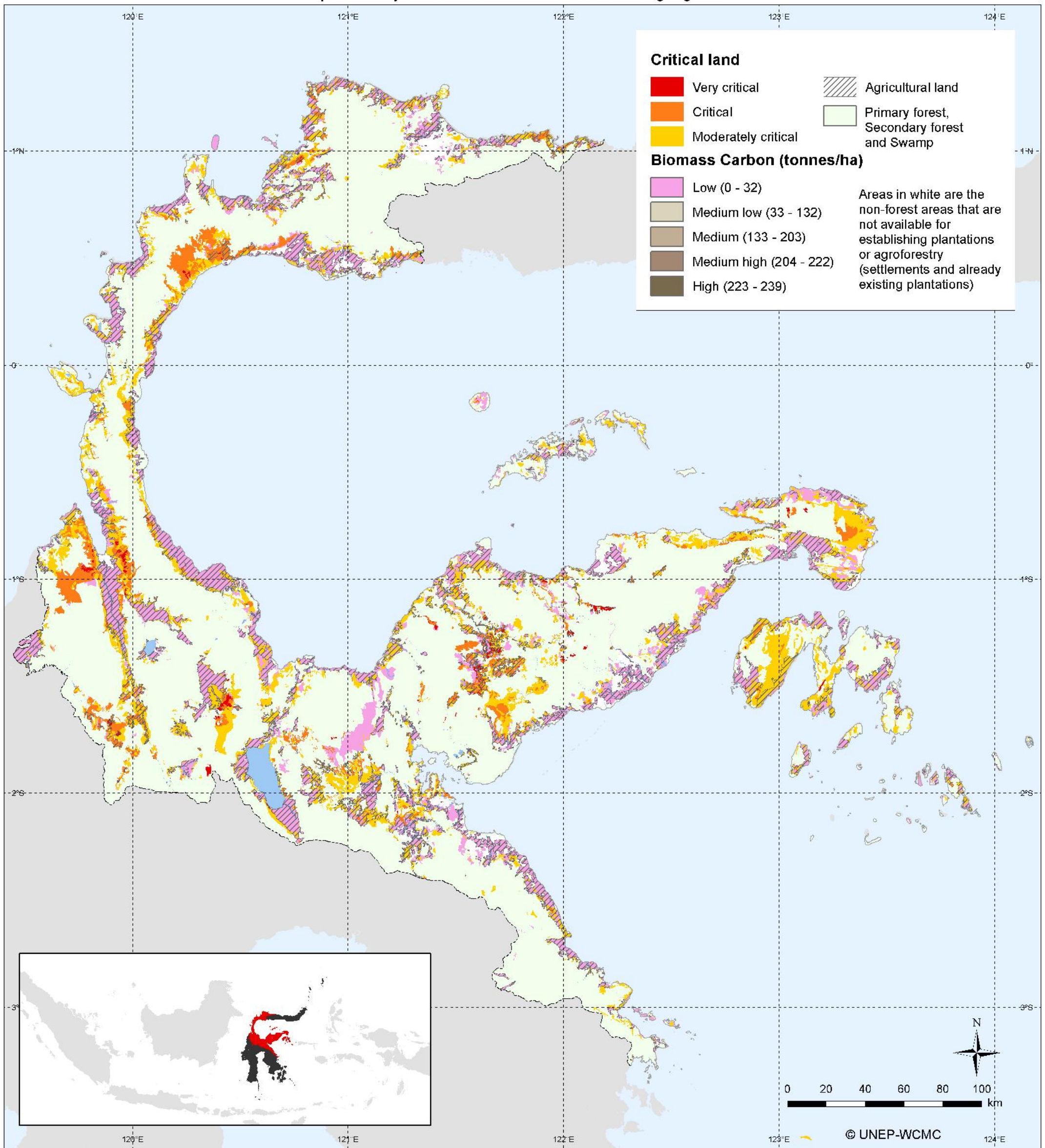


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# Central Sulawesi Province - Potential Areas for Actions to Establish Plantations or Agroforestry

Under certain conditions, plantations and agroforestry can form part of a REDD+ strategy. This maps shows areas which could be available for planting timber or crop trees; "critical land" identified by Watershed Management Agency and areas with particularly low biomass carbon stocks are highlighted



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

## Method and Data Sources:

**Biomass Carbon:** see explanation on Map of Biomass Carbon for Central Sulawesi Province;

## Method for presentation of potential areas for actions to establish plantations or agroforestry as part of a REDD+ strategy:

Based on the land cover map for 2009 produced by the Ministry of Forestry, all areas that are considered to have potential and availability for the establishment of plantations or agroforestry are shown in brown shading indicating their biomass carbon stock. Low-carbon areas were highlighted in pink based on the Biomass Carbon layer. Areas identified as critical land were highlighted based on data from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi. Agricultural areas (unlikely to be available for the establishment of plantations but possibly partly available for expanding agroforestry) were marked with black hatching and the following areas were blanked out: non-forest areas that are not available for establishing plantations or agroforestry (shown in white on the map) and areas of existing forest and swamp (shown in light green). Areas shown as existing forest on the land cover map are unlikely to become eligible for plantations or agroforestry under REDD+ due to safeguards against conversion of natural forest. Conversion of swamp areas to plantations and agroforestry is likely to cause net carbon emissions and thus be counterproductive to the aims of REDD+. Maps should be checked against situation on the ground.

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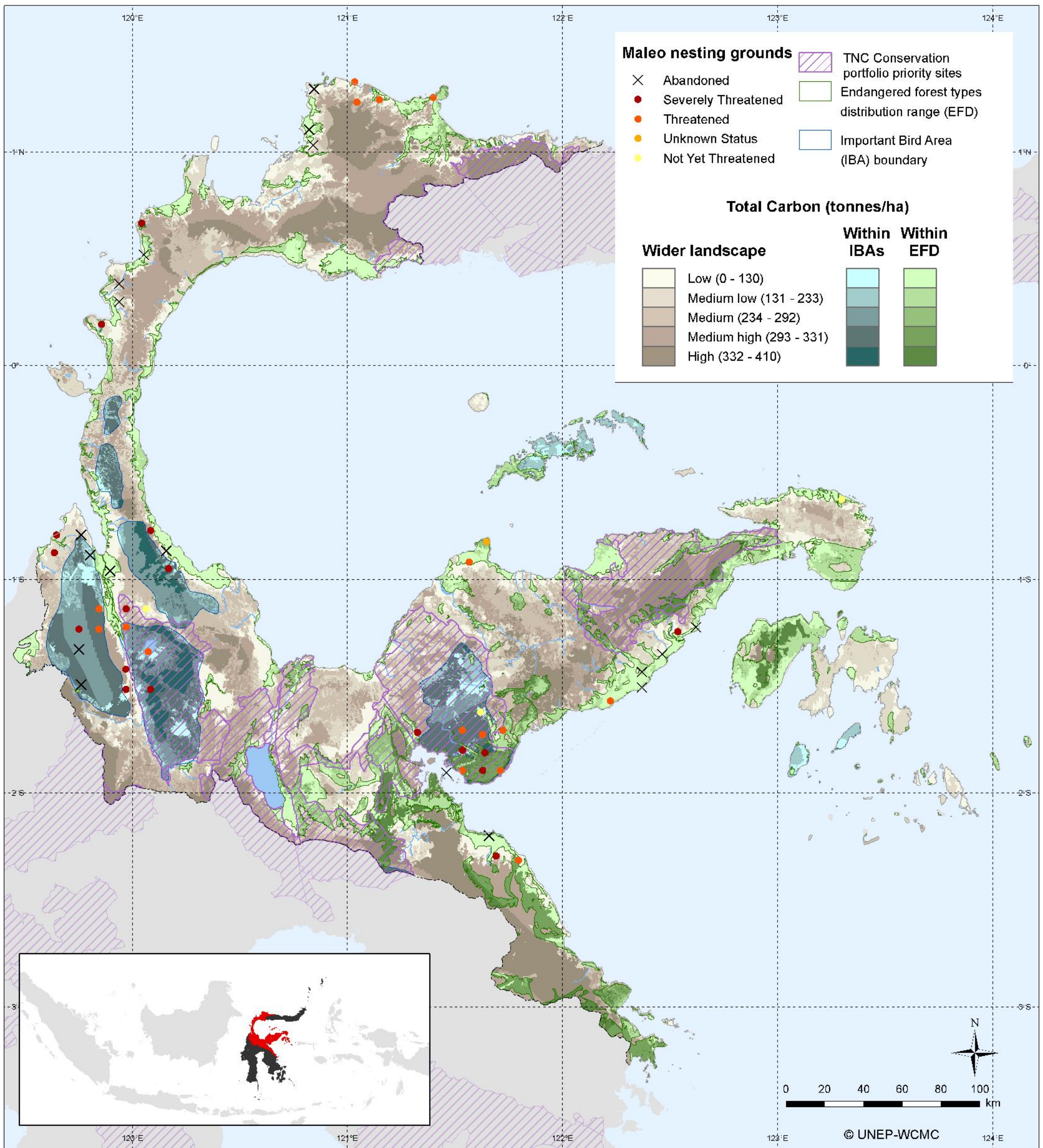


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# Central Sulawesi Province - Important Areas for Biodiversity in relation to Total Carbon

Biodiversity benefits from REDD+ can be enhanced if efforts to maintain (or restore) natural forest focus on areas important for biodiversity



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations Environment Programme or contributory Organisations.

**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province;

**Important Bird Areas (IBAs):** Birdlife International (2010): Important bird areas (GIS data). Birdlife International, Cambridge, UK. Accessed 27-05-2011.

**Maleo Nesting Sites:** GIS data on maleo (*Macrocephalon maleo*) nesting sites obtained from TNC Indonesia.

**Endangered Forest Types Distribution Range (EFD):** GIS data on distribution of forest types obtained from TNC Indonesia (see: Cannon, C. H., Summers, M., Harting, J. R., Kessler, P. J. A. (2007): Developing Conservation Priorities Based on Forest Type, Condition, and Threats in a Poorly Known Ecoregion: Sulawesi, Indonesia. *Biotropica* 39(6): 747-759 2007.)

**Conservation portfolio priority sites:** GIS data on conservation portfolio priority sites obtained from TNC Indonesia (see: Cannon, C. H., Summers, M., Harting, J. R., Kessler, P. J. A. (2007): Developing Conservation Priorities Based on Forest Type, Condition, and Threats in a Poorly Known Ecoregion: Sulawesi, Indonesia. *Biotropica* 39(6): 747-759 2007.)



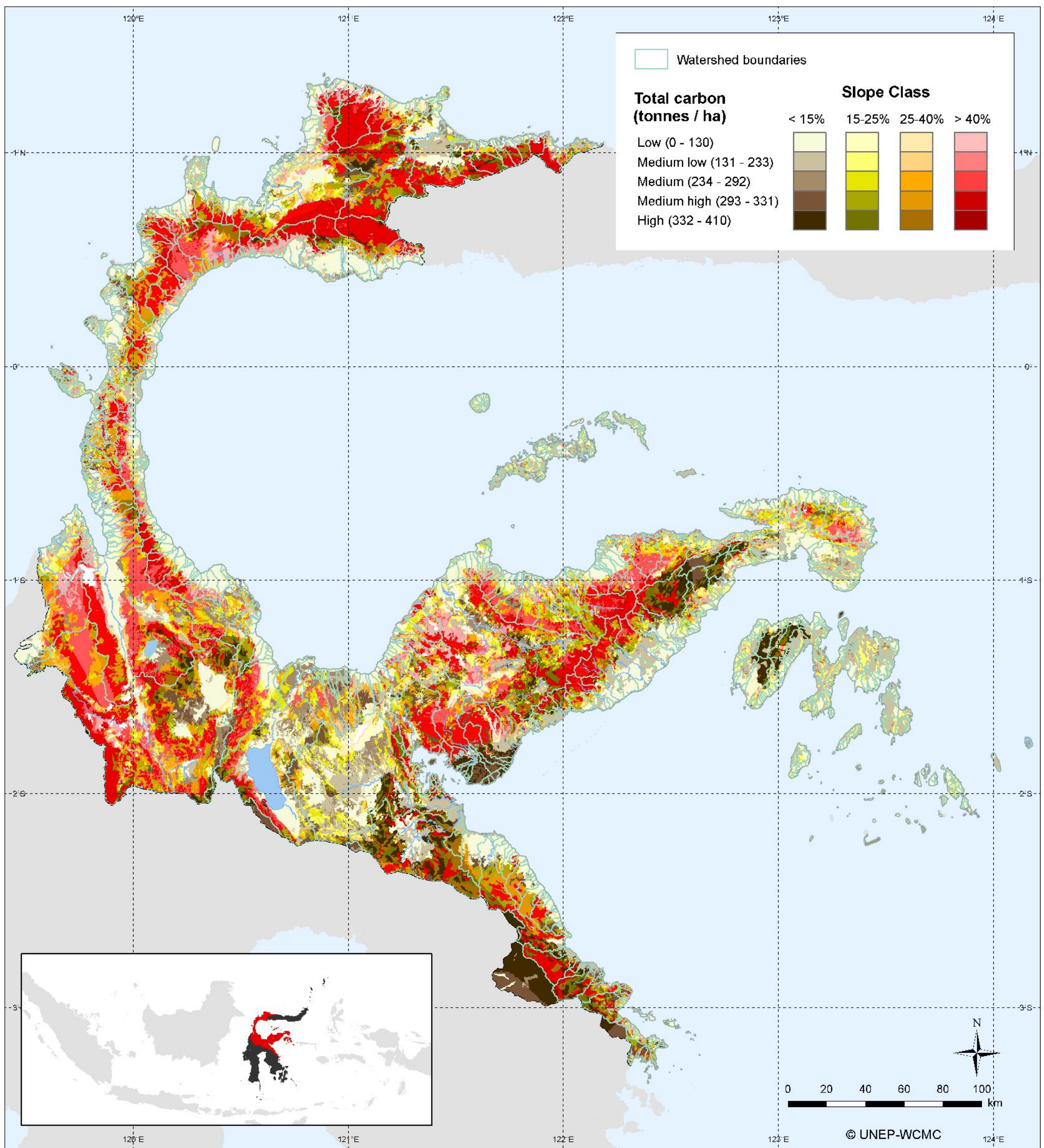
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# Central Sulawesi – Factors relevant to Erosion Control in relation to Total Carbon

This map shows total carbon stock in relation to slope class and watershed boundaries; the benefits for erosion control that can be achieved by maintaining or restoring forest are greatest on steep slopes or in watersheds where sensitive infrastructure is located



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

#### Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Watershed Boundaries and Slope Classes:** Data obtained from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi.

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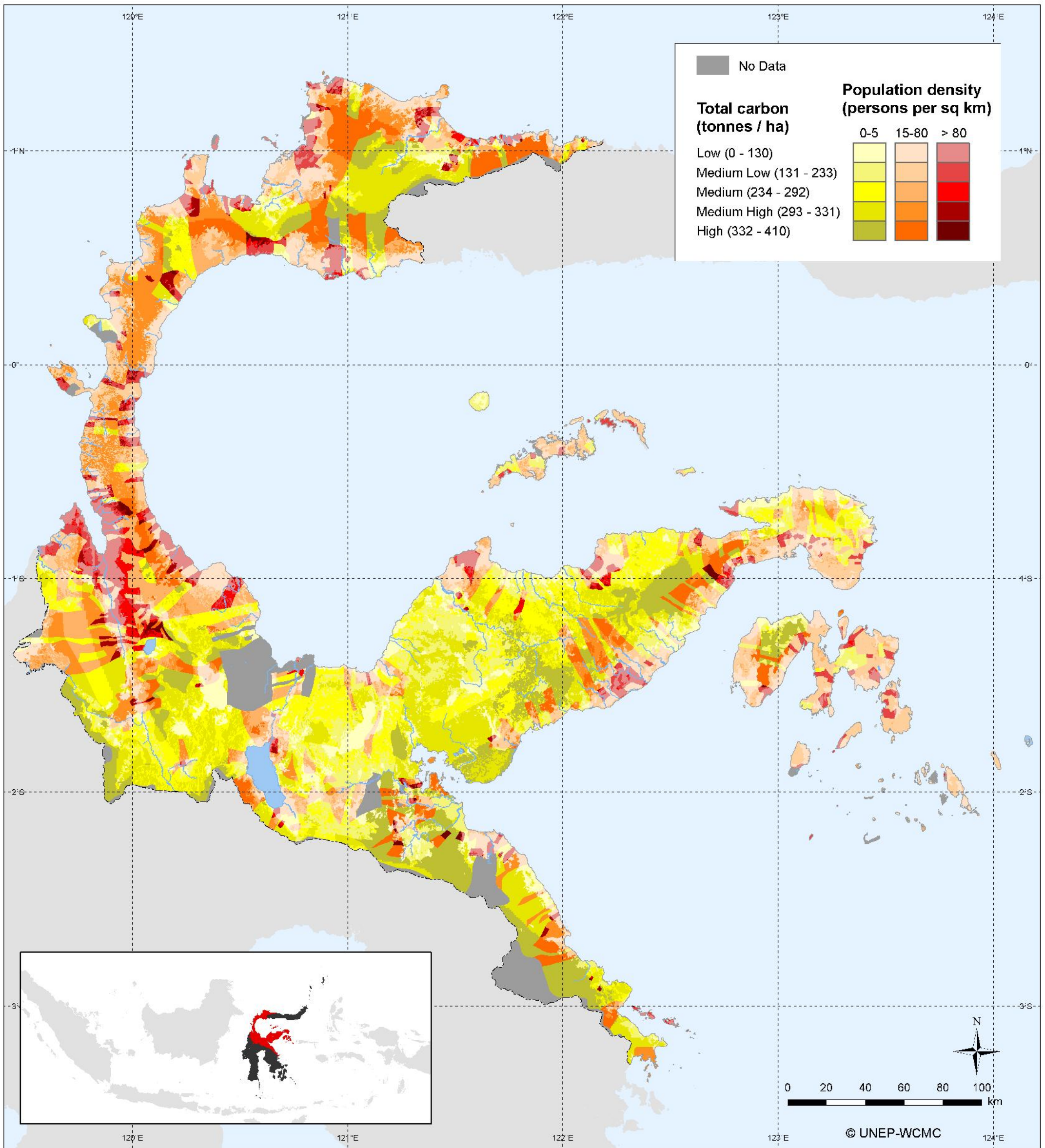


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# Central Sulawesi – Population Density per Village Territory in relation to Total Carbon

Actors designing REDD+ strategies need to pay attention to possible impacts on the wellbeing of local populations and take their needs and aspirations into account. This may be more demanding in areas of high population density



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Population Density:** Data on population numbers per village obtained from Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi.

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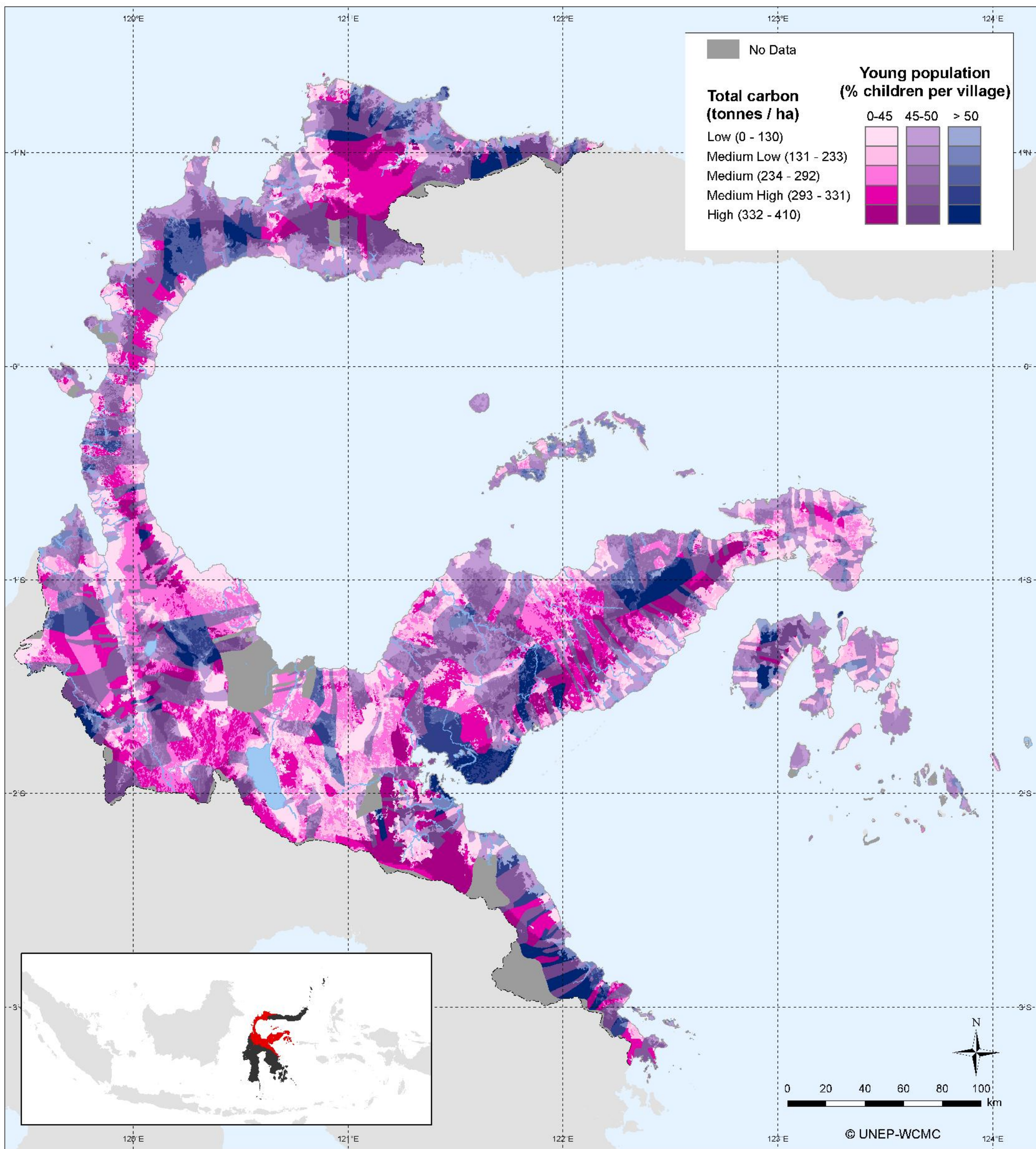


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# Central Sulawesi – Children as a Percentage of the Population in relation to Total Carbon

The proportion of young people in the population can be an indicator of population trends. REDD+ strategies for areas with high population growth rates may need to pay particular attention to the development of sustainable livelihood opportunities



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Percentage of children in the population:** Data on total population and number of children per village obtained from Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi.

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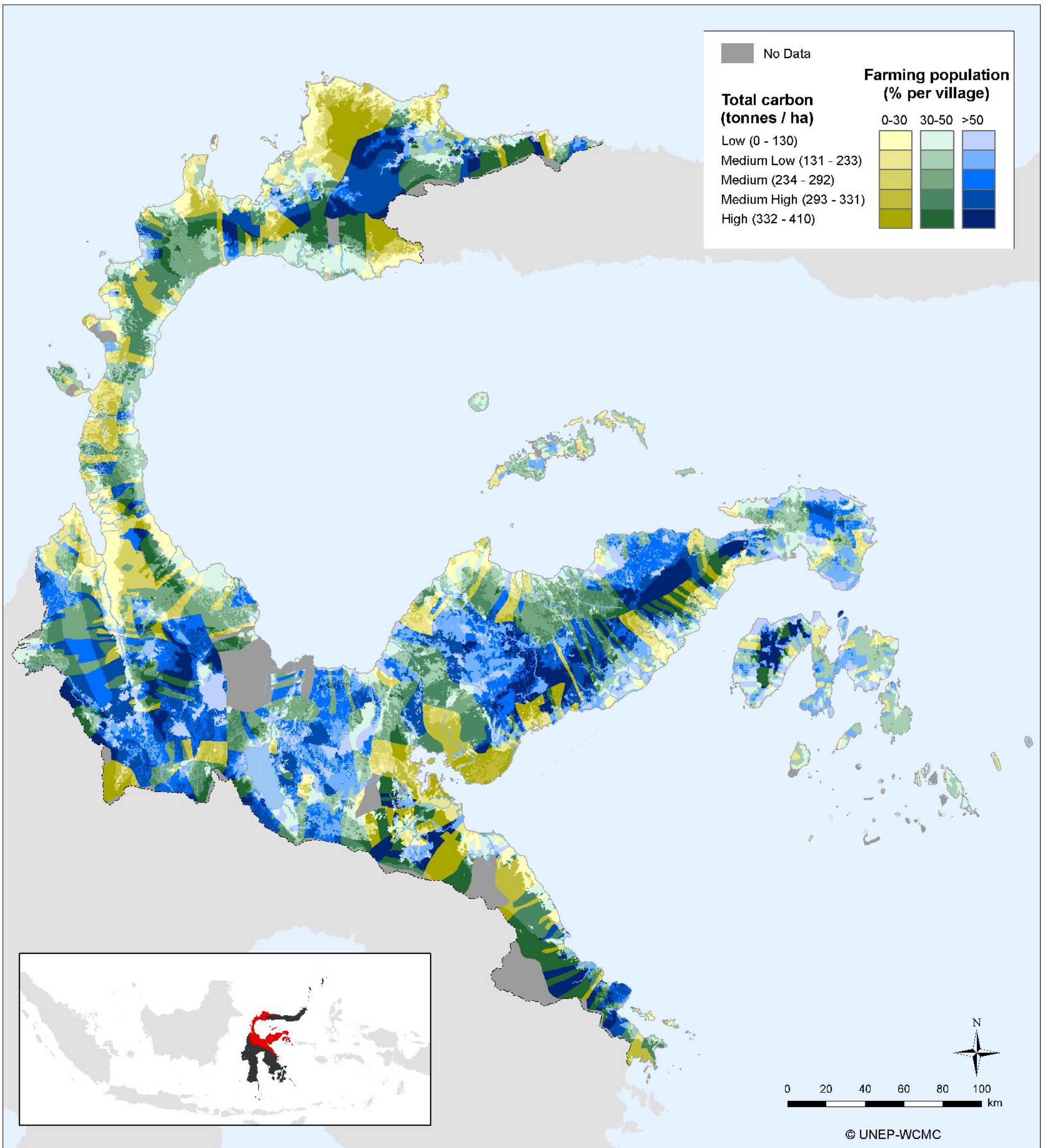


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# Central Sulawesi – Percentage of the Population engaged in Farming in relation to Total Carbon

Agriculture is one of the main drivers of deforestation. REDD+ strategies for areas where a high percentage of the population is engaged in farming may need to place a special focus on actions that reduce conversion pressure without endangering local livelihoods



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**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Percentage of farmers in the population:** Data on total population and number of farmers per village obtained from Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi.

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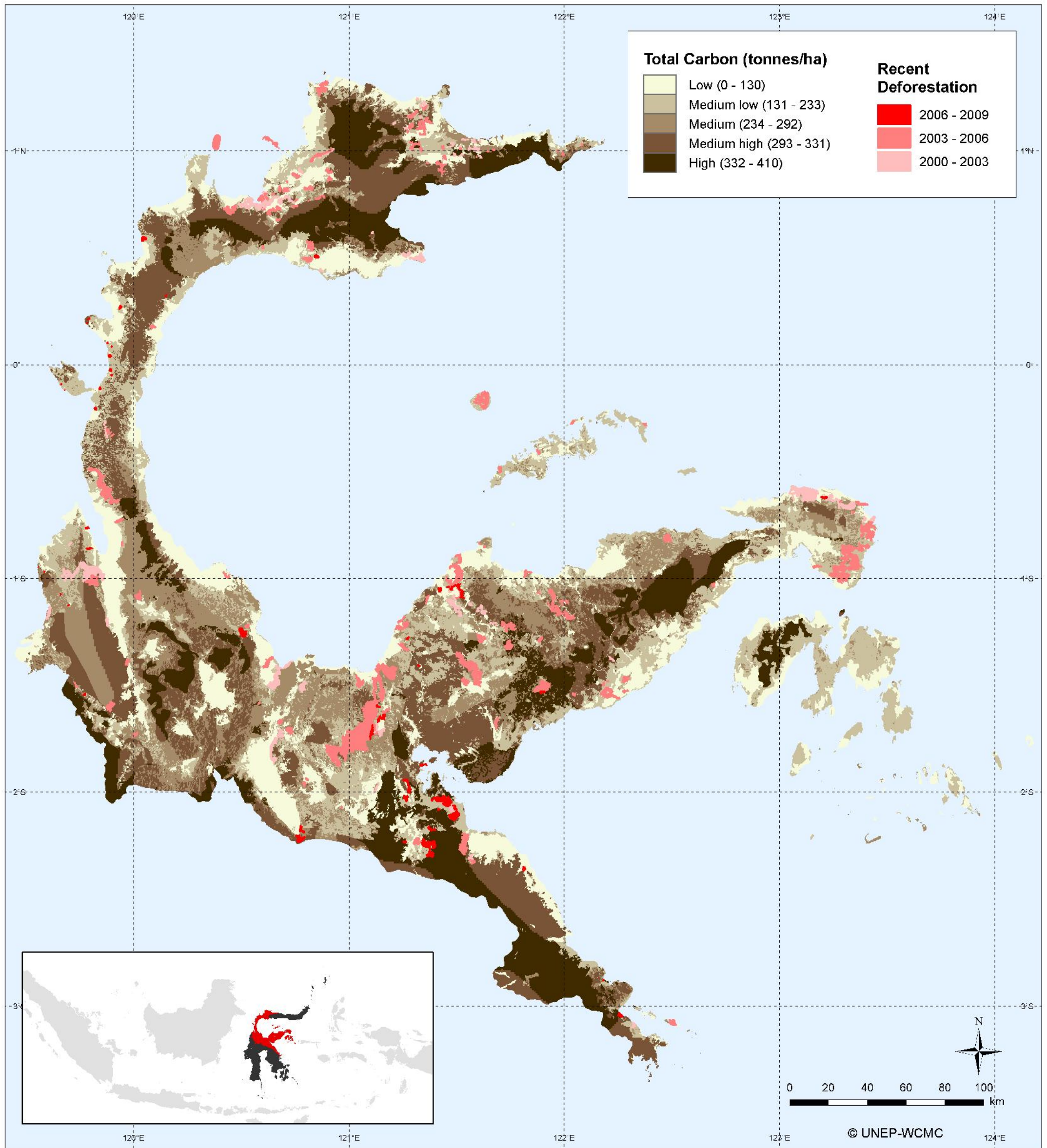
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# Central Sulawesi – Areas of Recent Deforestation in relation to Total Carbon

Depending on local conditions, carbon in forest areas close to recent deforestation may be at high risk of being lost.



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Areas of Recent Deforestation:** Based on the land cover maps for 2003, 2006 and 2009 produced by the Ministry of Forestry, recently deforested areas were identified.

The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations Environment Programme or contributory Organisations.

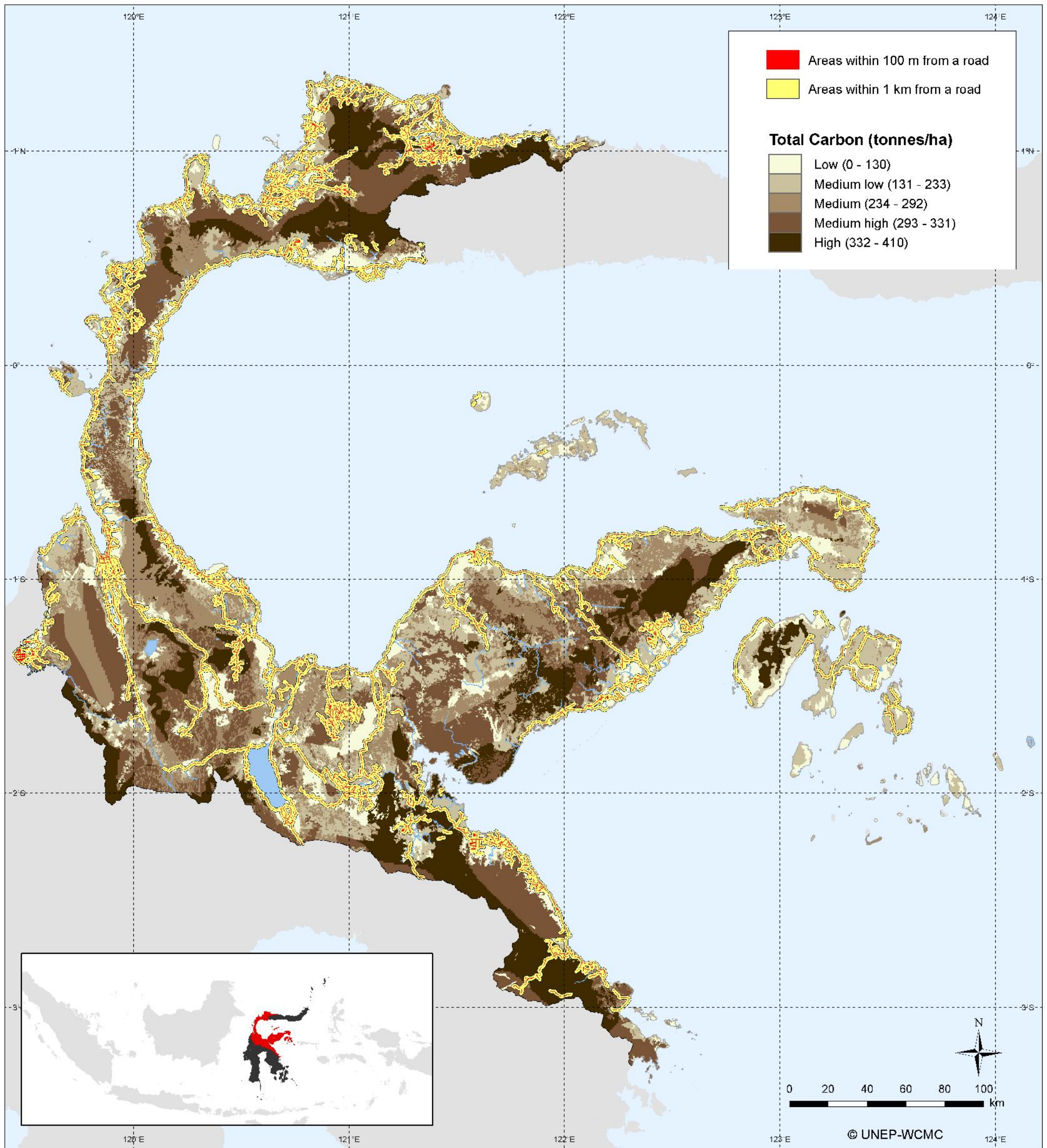


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# Central Sulawesi – Areas adjacent to Roads in relation to Total Carbon

Carbon in forest areas that are close to a road is often more vulnerable to anthropogenic pressure. It is therefore useful for REDD+ planning to pay attention to high carbon areas adjacent to roads, to assess the risk of deforestation and forest degradation and whether it can be addressed.



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The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations Environment Programme or contributory Organisations.

### Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province;

**Areas adjacent to Roads:** Based on GIS data on the road network in Central Sulawesi obtained from Ministry of Forestry DG Forest Planning, areas located within a distance of 100 m and 1 km from roads were marked.

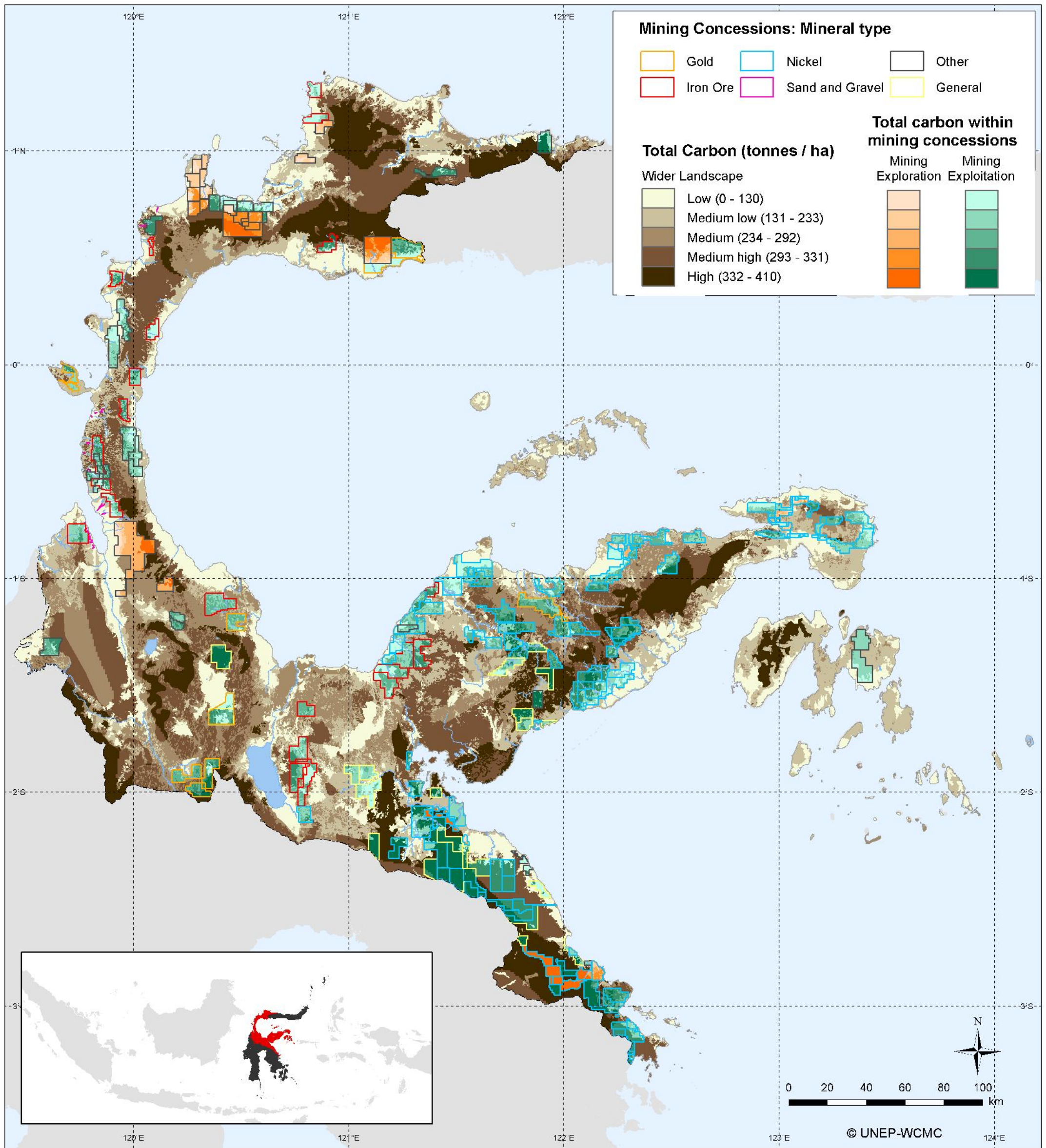


**UN-REDD PROGRAMME**



# Central Sulawesi – Mining Concessions in relation to Total Carbon

Where mining concessions coincide with areas of high carbon density, trade-offs between REDD+ and mining interests may need to be managed



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

**Method and Data Sources:**

**Methods:** Biomass and Soil Carbon layers: see explanation on Map of Total Carbon for Central Sulawesi Province.

**Mining concessions:** Data obtained from Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi.

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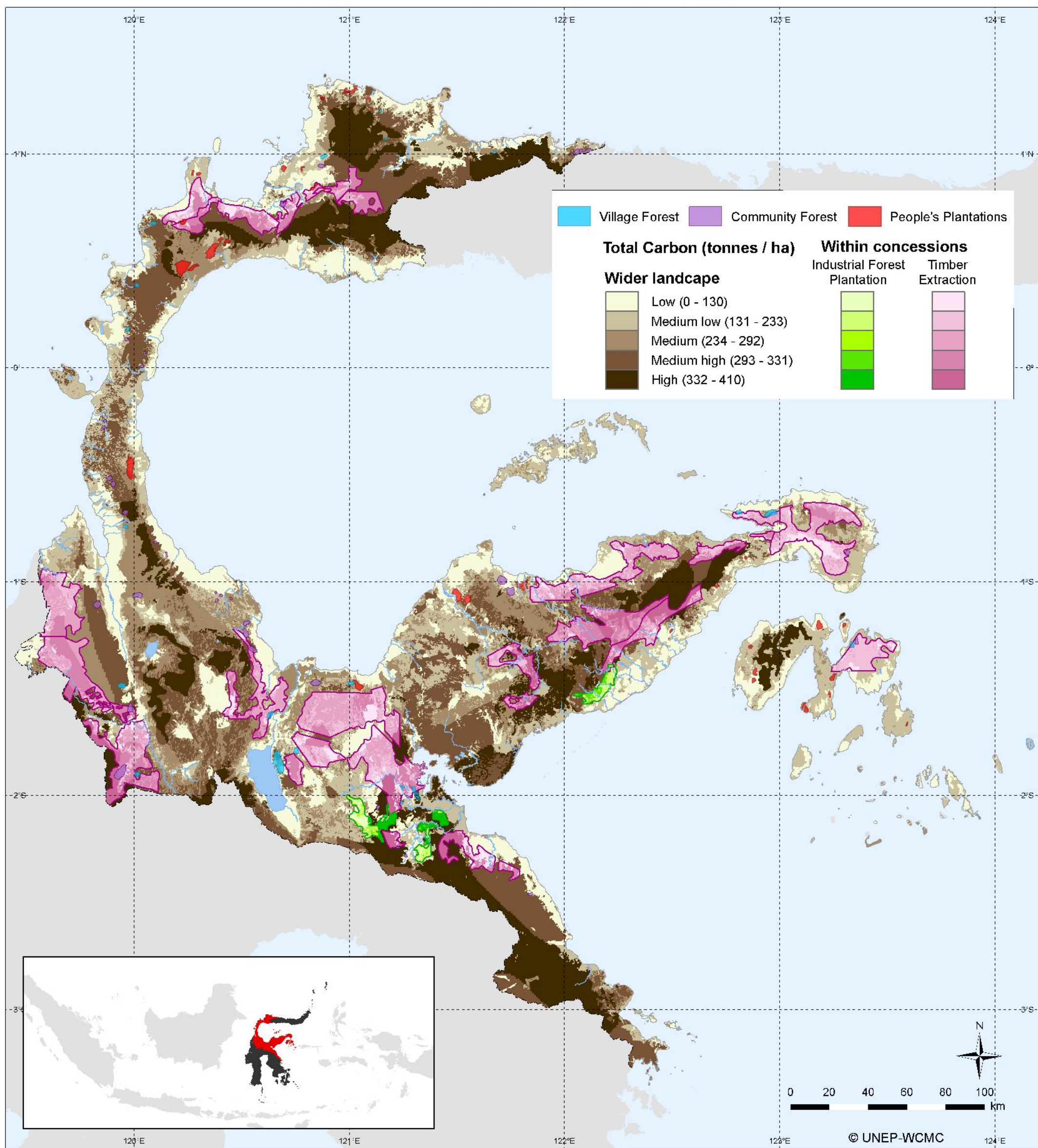


**UN-REDD PROGRAMME**



# Central Sulawesi – Concessions for Utilization of Natural Forest and Forest Plantations in relation to Total Carbon

All holders of rights to use timber and non-timber forest products or to establish timber plantations can be important partners in implementing REDD+



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

## Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Timber Extraction concessions and concessions for Industrial Forest Plantations:** Data obtained from Ministry of Forestry DG Forest Planning.

**Village Forests, Community Forests and People's Plantations:** Data obtained from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi.

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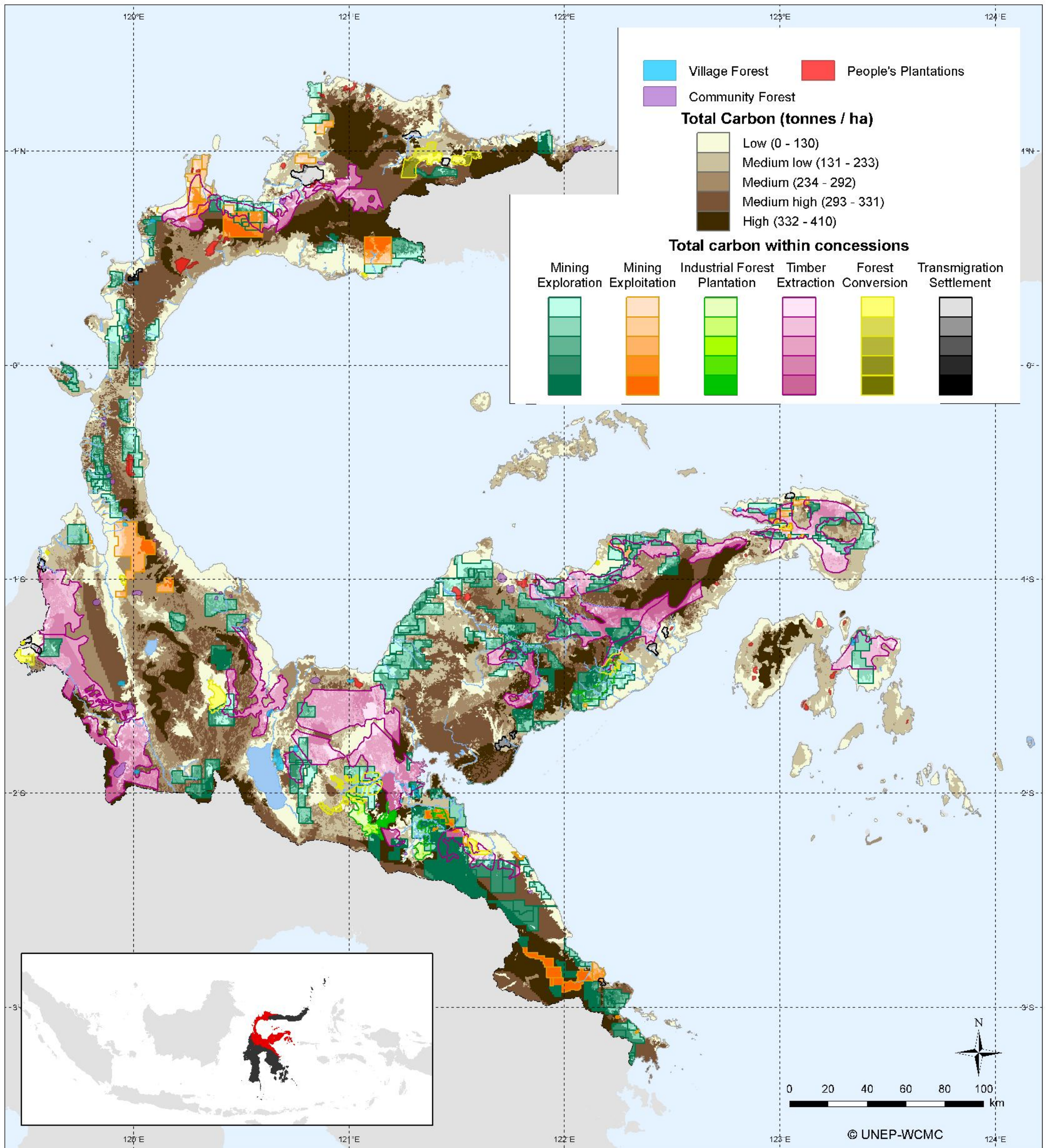


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PROGRAMME**



# Central Sulawesi – Concessions and Community Involvement in Forest Use in relation to Total Carbon

Plans for REDD+ implementation need to take account of all currently existing rights to the use of forest land



This map was produced for the UN-REDD programme in Indonesia in collaboration between UNEP-WCMC and the Ministry of Forestry of Indonesia, DG Forest Planning (Jakarta Office and Office for Forest Planning Region XVI), the Regional Forest Service Central Sulawesi and Tadulako University.

#### Method and Data Sources:

**Biomass and Soil Carbon layers:** see explanation on Map of Total Carbon for Central Sulawesi Province.

**Timber extraction concessions and concessions for Industrial Forest Plantations:** Data obtained from Ministry of Forestry DG Forest Planning.

**Concessions for Transmigration settlements, non-timber Plantations and Mining:** Data obtained from Ministry of Forestry DG Forest Planning, DG Forest Planning Region XVI Palu, Regional Forest Service Central Sulawesi.

**Village Forests, Community Forests and People's Plantations:** Data obtained from the Ministry of Forestry, Agency for Watershed Management Central Sulawesi.

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**UN-REDD PROGRAMME**



UN-REDD Programme Indonesia merupakan kerja sama kemitraan antara Kementerian Kehutanan Republik Indonesia, Food and Agriculture Organization (FAO), United Nations Development Programme (UNDP), dan United Nations Environment Programme (UNEP). Program ini mendukung upaya pemerintah Indonesia menurunkan kadar emisi akibat deforestasi dan degradasi hutan (*Deforestation and Forest Degradation*)