Annex 8.3. References for non-forest emission factors

The estimates of non-forest emission factors are obtained from several published literature mainly from Indonesian sources including journals, theses, working papers, project reports, guidelines and books. When multiple published sources are available for a given land cover class, an average is used.

Similar to estimates for forest emission factors, below ground biomass (BGB) is also estimated using root-shoot ratio based on IPCC default values IPCC GPG GL for LULUCF page 3.168 table 3A.1.8). The values of the ratio vary between land cover types, i.e. 0.32 for forest plantation and estate crops), 0.48 for dry and wet shrubs, mix dryland agriculture and transmigration area, and 1.58 for savanna/grassland, pure dryland agriculture, rice paddy, bare ground and settlement (Table 1).

Table 1. Carbon stock for non-forest land cover

Land Cover	Mean AGC-stock (tC/ha)	Mean BGC-stock (tC/ha)	Total C-stock (tC/ha)	Uncertainty (%)	References
Plantation forest	62.6	20.0	82.6	22.5	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
					Hairiah, K, Sitompul, SM., van Noordwijk, M, Palm, C. 2001. Carbon stocks of tropical land use systems as part of the global C Balance: Effects of forest conversion and options for 'clean development' activities. ICRAF, Bogor, Indonesia
					JICA and CER Indonesia. 2009. Report on REDDI Feasibility Study for Musi Banyuasin and Musi Rawas Districts, South Sumatra. Bogor.
					Markum, Arisoesilaningsih, E., Suprayogo, D., and Hairiah, K. 2013. Plant species diversity in relation to carbon stocks at Jangkok watershed, Lombok island. Agrivita 35: 207-217
					Palm, C.A., Woomer, P.L., Alegre, J., Arevalo, L., Castilla, C., Cordeiro, D.G., Feigl, B., Hairiah, K., Kotto-Same, J., Mendes, A., Moukam, A., Murdiyarso, D., Njomgang, R., Parton, W.J., Ricse, A., Rodrigues, V., Sitompul, S.M. and van Noordwijk, M.: 1999, 'Carbon sequestration and trace gas emissions in slash and burn and alternative land uses in the humid tropics', Nairobi, Kenya, ASB Climate Change Working Group Final Report, Phase II, ASB Coordination Office, ICRAF.
					Rahayu S and Pambudi S. 2017. Tree diversity and carbon stock in various land use systems of Jayapura, Jayawijaya and Merauke Districts, Papua Province. Working Paper 268. Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia

					Regional Program. DOI: http://dx.doi.org/10.5716/WP17359.PDF
Dry shrub	20.2	9.7	29.9	41.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta. Agust Prahara, Gusti Hardiansyah, Ganjar Oki Widhanarto. 2015. STUDI POTENSI BIOMASSA DAN KARBON PADA TEGAKAN HUTAN DI KPHP MODEL SUNGAI MERAKAI KABUPATEN SINTANG PROVINSI KALIMANTAN BARAT. Jurnal Hutan Lestari 3:173-183 IPCC, 2006. JICA and CER Indonesia. 2009. Report on REDDI Feasibility Study for Musi Banyuasin and Musi Rawas Districts, South Sumatra. Bogor. Palm, C.A., Woomer, P.L., Alegre, J., Arevalo, L., Castilla, C., Cordeiro, D.G., Feigl, B., Hairiah, K., Kotto-Same, J., Mendes, A., Moukam, A., Murdiyarso, D., Njomgang, R., Parton, W.J., Ricse, A., Rodrigues, V., Sitompul, S.M. and van Noordwijk, M.: 1999, 'Carbon sequestration and trace gas emissions in slash and burn and alternative land uses in the humid tropics', Nairobi, Kenya, ASB Climate Change Working Group Final Report, Phase II, ASB Coordination Office, ICRAF. Rahayu S and Pambudi S. 2017. Tree diversity and carbon stock in various land use systems of Jayapura, Jayawijaya and Merauke Districts, Papua Province. Working Paper 268. Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program. DOI: http://dx.doi.org/10.5716/WP17359.PDF Susanti, E & Dariah, A. 2014. PERUBAHAN PENGGUNAAN SEMAK BELUKAR PADA LAHAN GAMBUT DITINJAU DARI ASPEK DINAMIKA CADANGAN KARBON TANAMAN. Proceeding SEMINAR NASIONAL PENGELOLAAN BERKELANJUTAN LAHAN GAMBUT TERDEGRADASI, 18-19 Agustus, Jakarta
Wet shrub	18.1	8.7	26.7	41.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta. Istomo (2006) Phosphorus and calcium contents in soil and biomass of peat swamp forest: A case study at the concession area of PT Diamond Raya Timber, Bagan Siapi-api, Riau Province, Sumatera. Jurnal Manajemen Hutan Tropika 12(3):38-55 Istomo, Hardjanto, Sri Rahayu, Permana, E., Suryawan, S.I., Hidayat, A. & Waluyo. 2007. Kajian perolehan karbon sebagai dampak intervensi pada lokasi kegiatan proyek CCFPI di eks-PLG Bloka A Mentagai, Kalimantan Tengah dan Sekitar TN. Berbak, Jambi. UNEP, Wetland International, Bogor, Indonesia JICA and CER Indonesia. 2009. Report on REDDI Feasibility Study for Musi

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Savanna and Grasses	2.8	4.4	7.2	41.0	Hairiah, K, Sitompul, SM., van Noordwijk, M, Palm, C. 2001. Carbon stocks of tropical land use systems as part of the global C Balance: Effects of forest conversion and options for 'clean development' activities. ICRAF, Bogor, Indonesia Palm, C.A., Woomer, P.L., Alegre, J., Arevalo, L., Castilla, C., Cordeiro, D.G., Feigl, B., Hairiah, K., Kotto-Same, J., Mendes, A., Moukam, A., Murdiyarso, D., Njomgang, R., Parton, W.J., Ricse, A., Rodrigues, V., Sitompul, S.M. and van Noordwijk, M.: 1999, 'Carbon sequestration and trace gas emissions in slash and burn and alternative land uses in the humid tropics', Nairobi, Kenya, ASB Climate Change Working Group Final Report, Phase II, ASB Coordination Office, ICRAF. Rahayu, S., Lusiana, B. & van Noordwijk, M. 2005. Aboveground carbon stock assessment for various land use system in Nunukan, East Kalimantan. Wasrin, U.R., Rohiani, A, Putera, A.E. and Hidayat, A. 2000. Assessment of aboveground C-stock using remote sensing and GIS technique. Final Report, Seameo Biotrop, Bogor, 28p.
Pure dry agriculture	7.5	11.9	19.4	35.5	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta. Murdiyarso, D., and Wasrin, U.R. 1996. Estimating land use change and carbon release from tropical forests conversion using remote sensing technique. J. of Biogeography 22:715-721.
Mixed dry agriculture	22.5	10.8	33.3	41.0	Markum, Arisoesilaningsih, E., Suprayogo, D., and Hairiah, K. 2013. Plant species diversity in relation to carbon stocks at Jangkok watershed, Lombok island. Agrivita 35: 207-217 Rahayu, S., Lusiana, B. & van Noordwijk, M. 2005. Aboveground carbon stock assessment for various land use system in Nunukan, East Kalimantan. van Noordwijk, M., Hairiah, K., Sitompul, S. M., 2000. Reducing uncertainties in the assessment at national scale of C stock impacts of land use change, in Proc. IGES/NIES Workshop on GHG Inventories for Asia-Pacific Region (ed. Macandog, D. B.), Hayama, Japan: Institute for Global Environmental Strategies (IGES), p: 150-163
Estate	49.7	15.9	65.6	23.3	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum,

crop					Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta. Gintings, A. N. 2000. The progress of establishing cinnamon and candlenut demonstration plots in Jambi and their potential to absorb carbon, Bogor, Indonesia: Science and Policy Workshop on Terrestrial Carbon and Possible Trading under the CDM, IC-SEA, BIOTROP Hairiah, K, Sitompul, SM., van Noordwijk, M, Palm, C. 2001. Carbon stocks of tropical land use systems as part of the global C Balance: Effects of forest conversion and options for 'clean development' activities. ICRAF, Bogor, Indonesia Markum, Arisoesilaningsih, E., Suprayogo, D., and Hairiah, K. 2013. Plant species diversity in relation to carbon stocks at Jangkok watershed, Lombok island. Agrivita 35: 207-217 Ni'matul Khasanah, Meine van Noordwijk and Harti Ningsih, 2015. Aboveground carbon stocks in oil palm plantations and the threshold for carbon-neutral vegetation conversion on mineral soils. Cogent Environmental Science (2015), 1: 1119964. http://dx.doi.org/10.1080/23311843.2015.1119964 Palm, C.A., Woomer, P.L., Alegre, J., Arevalo, L., Castilla, C., Cordeiro, D.G., Feigl, B., Hairiah, K., Kotto-Same, J., Mendes, A., Moukam, A., Murdiyarso, D., Njomgang, R., Parton, W.J., Ricse, A., Rodrigues, V., Sitompul, S.M. and van Noordwijk, M.: 1999, 'Carbon sequestration and trace gas emissions in slash and burn and alternative land uses in the humid tropics', Nairobi, Kenya, ASB Climate Change Working Group Final Report, Phase II, ASB Coordination Office, ICRAF. Prasetyo, L. B., Murdiyarso, D., Rosalina, U. et al., 2000. Analysis of land-use changes and greenhouse gas emission (GHG) using geographical information system (GIS) technologies, Bogor, Indonesia: Workshop on Improving Land-use/cover change and greenhouse gas emission biophysical data, Institute Pertanian Bogor, Bogor Sitompul, S.M.& Hairiah, K., 2000. Biomass measurement of homegarden, Bogor, Indonesia: Workshop on LUCC and Green-house Gas Emissions Biophysical Data, Institute Pertanian Bogor, Bogor Wasrin, U.R., Rohiani, A, Putera, A.E. and Hidayat, A. 2000. Assessment of aboveground C-stock using remote sensing and GIS technique. Final Report, Seameo Biotrop, Bogor, 28p.
Paddy field	4.4	7.0	11.4	35.5	Rahayu, S., Lusiana, B. & van Noordwijk, M. 2005. Aboveground carbon stock assessment for various land use system in Nunukan, East Kalimantan. Wasrin, U.R., Rohiani, A, Putera, A.E. and Hidayat, A. 2000. Assessment of

					aboveground C-stock using remote sensing and GIS technique. Final Report, Seameo Biotrop, Bogor, 28p.
Transmigration areas	10.0	4.8	14.8	41.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Fish pond/aquaculture	0.0	0.0	0.0	0.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Bare ground	2.5	4.0	6.5	35.5	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Mining areas	0.0	0.0	0.0	0.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Settlement	4.0	6.3	10.3	35.5	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Port and harbor	0.0	0.0	0.0	0.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Open water	0.0	0.0	0.0	0.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.
Open swamps	0.0	0.0	0.0	0.0	Agus, F., Santosa, I., Dewi, S., Setyanto, P., Thamrin, S., Wulan, Y.C., Suryaningrum, Y. (eds.). 2013. Pedoman Teknis Penghitungan Baseline Emisi dan Serapan Gas Rumah Kaca Sektor Berbasis Lahan: Buku I Landasan Ilmiah. Badan Perencanaan Pembangunan Nasional, Republik Indonesia, Jakarta.