Review Report for
IPCC's 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Chapter 2)

1. Introduction

Organic soil, also defined as peat, can be easily found across various climatic zones. There has been much literature documented on peatlands in boreal, temperate, and tropical zones; however, there is little data on high-altitude peatlands (above 3,000 m a.s.l), despite the large number of peatlands distributed in remote mountain areas, such as the Hindu Kush Himalayan (HKH) region (including the Tibetan Plateau). High-altitude peatlands develop in an environment completely different from those in lowlands, resulting in distinct differences between the two. First, the atmospheric pressure at high altitudes is significantly lower than lowland altitudes, which could have implications on the level of greenhouse gas (GHG) emissions from peatlands. Secondly, variations between high-altitude regions and lowlands in both diurnal and seasonal air temperature patterns could lead to major differences in gas flux (e.g. temporal pattern) from peatlands.

Although there is still a large data gap on emissions from peatlands in most parts of the HKH region, a series of work has been carried out since 2005 to monitor greenhouse gas (GHG) fluxes on the Zoige Plateau, the eastern extension of the Tibetan Plateau. The Zoige Plateau, with the largest area of alpine peatlands in the world (area=5,000 km^2; average elevation=3,500 m a.s.l.), has been grazed by livestock for over 3,000 years (Joosten et al. 2012). Long before recent intensification, grazing and activities in catchments have made the Zoige peatlands vulnerable to degradation and terrestrialization (Schumann et al. 2008; Jain et al. 2004). Over the last few decades, the ecosystems of the Zoige Plateau have experienced great changes driven by both climate change and socioeconomic pressures (Yan and Wu 2005). Most of the monitoring work implemented in Zoige has been in marsh meadows, fen-like sites located in the central part of the peatlands, which are dominated by sedge community with seasonal surface water of 10-20 cm in the summer (details cf. references).

2. Calculations and Suggestions

Based on publications with research from the Zoige Plateau, we would like to suggest the addition of new scientific findings of CO_2 and CH_4 emissions from high-altitude peatlands to partly fill the data gap on GHG emissions from the HKH region.

(1) Adding data in **"Table 2.1 CO_2 Emission/Removal Factors for Drained Organic Soils in All Land-use Categories",** Page 2.13, line 345

A line could be added in Table 2.1 as follows:

Land-use Category	Climate zone	Soil emission factor (tonnes CO_2-C ha^{-1} a^{-1})	95% Confidence interval (centred on mean)	No. of site	Citation
Peatland under grazing	Alpine	0.066		1	(Hao et al. 2011)

Formula: Soil emission factor = NPP - NEE

Data of NPP and NEE can be found in Hao et al. (2011). The total aboveground biomass was calculated as NPP because most plants in the community are perennial and 40 per cent of the total aboveground biomass (dry weight) is carbon (Wang et al. 2007), thus:

NPP = total aboveground biomass = (166+184)*0.5*0.4 = 70 g C m^{-2} a^{-1}

NEE = (47.1+79.7)*0.5 = 63.4 g C m^{-2} a^{-1}

Soil emission factor

= 70 - 63.4 = 6.6 g C m^{-2} a^{-1}

= 0.066 tonnes CO_2-C ha^{-1} a^{-1}

(2) Adding data in **"Table 2.3 CH_4 Emission/Removal Factors for Drained Organic Soils in All Land-use Categories",** Page 2.24-2.26, line 774

A line could be added in Table 2.3 as follows:

Land-use Category	Climate zone	Soil emission factor (tonnes CH_4-C ha^{-1} a^{-1})	95% Confidence interval (centred on mean)	No. of site	Citation
Peatland under grazing	Alpine	0.17		1	(Chen et al. 2008, Zhu et al. 2011, Chen et al. 2013)

Formula: Soil emission factor = $E_w * D_w + E_c * D_c + E_f * D_f$

Where E = emission rate and w, c, and f = warm season, cool season and frozen season, respectively. D = the number of days in the corresponding season.

Here, the warm season was defined as July, August, and September (92 days), the cool season as March, April, May, June, October, and November (183 days), and the frozen season as December, January, and February (90 days). Data on emissions in October and November were treated the same as that from April and May, also defined as the cool season. Based on Chen et al. (2008); Zhu et al. (2011); and Chen et al. (2013), the calculation is as follows:

Soil emission factor

$= E_w * D_w + E_c * D_c + E_f * D_f$

$= 200.88 * 92 + 13.34 * 183 + 22.56 * 90$

$= 22952.58$ mg CH_4 m^{-1} a^{-1}

$= 0.17$ tonnes CH_4-C ha^{-1} a^{-1}

(3) Note

The CO_2 emission rate from the Zoige peatlands was much lower than emission rates from peatlands in boreal and temperate zones (Table 2.1). For CH_4, the emission rate from the Zoige peatlands was much higher than those from boreal, temperate and tropical/subtropical zones (Table 2.3). Based on existing knowledge about peatlands, these results suggest that the peatlands in the case study site of Zoige are still in a healthy condition, i.e., undegraded. This could be attributed to the traditional seasonal, short-term use of marsh meadows – an ecotone between a permanent water body and grazing pastures – during the spring season when they have not been waterlogged and are still accessible by livestock before the coming of the rainy season. However, according to Schumann et al. (2008), 77% (equal to 3,850 km^2) of the peatlands in Zoige should be considered as degraded. Therefore, further investigation and monitoring should be carried out in degraded sites, including degraded peatlands although they have been dominated by mesophyte. In the future, more monitoring sites should be established in different eco-regions of the Hindu Kush Himalayas as well as other high-altitude regions so that an overall picture of GHG emissions could be established.

3. References

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