Application of Tier 3 method/model for the AFOLU sector in Japan

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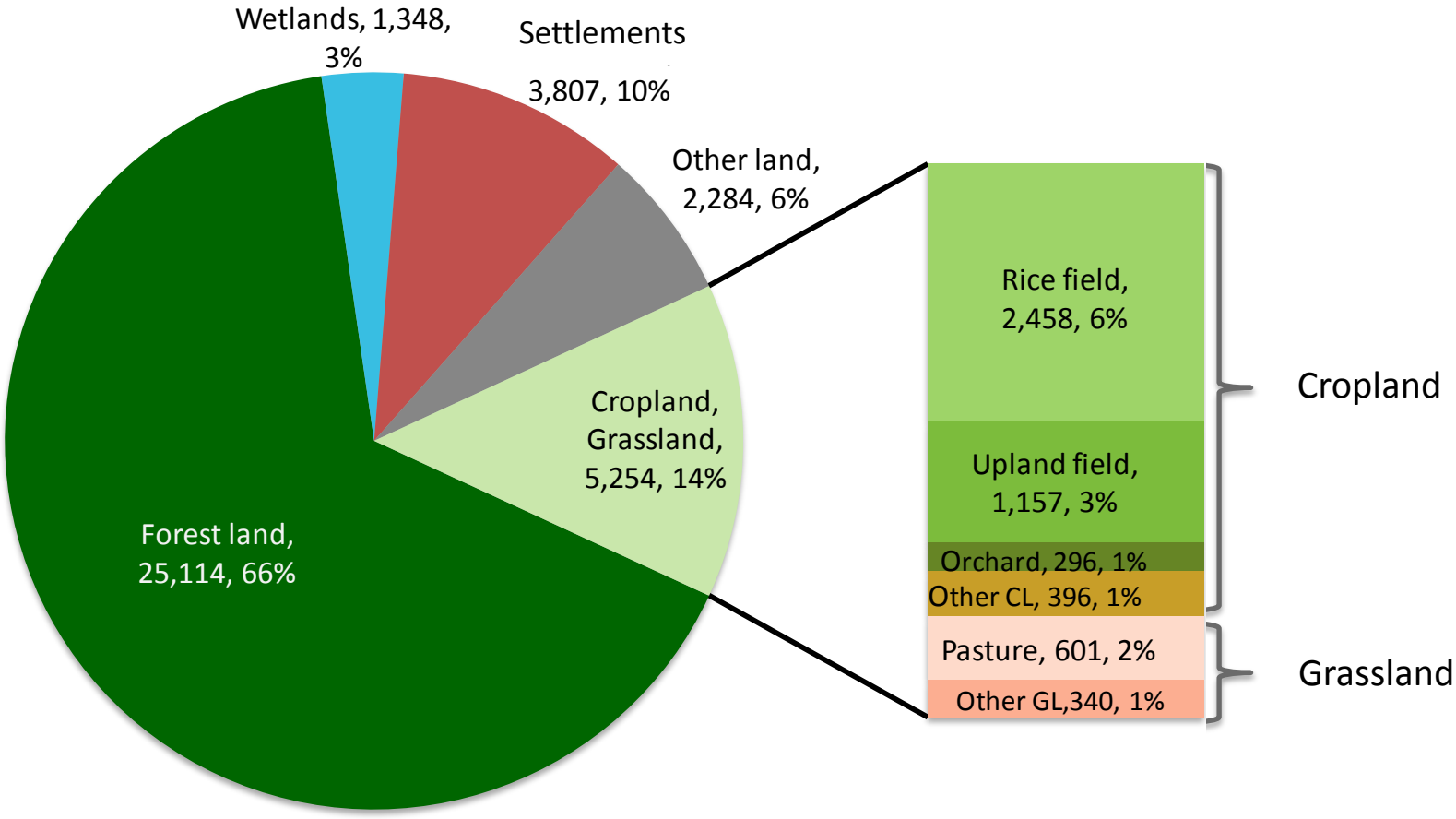
1. Brief overview of the land use in Japan

- 2/3 of land is covered by forest. Most of forest are located in mountainous area.
- 1/2 of agriculture area is used for rice cultivation.



Source: 2017 data from 2019 GHG inventory Japan, (Unit: kha, %)

2. Advanced methods used in the AFOLU sector in Japan

Land use, pool/source	Summary	Reported tier	Year of first application
Forest land - Living biomass	Bottom-up estimation of carbon stock change based on the forest inventory data (million of patches) with yield-curves and country-specific parameters.	Tier 2	2006 (improved from NE)
Forest land - Mineral soil, litter, dead wood	Carbon stock change is estimated by CENTURY-jfos model, which was adjusted to Japanese situation by a research institute.	Tier 3	2007 (improved from NE)
Cropland/Grassland - Mineral soil	Carbon stock change is estimated by Roth C model, which was adjusted against to the long-term monitoring data of Japanese agriculture land by a research institute.	Tier 3	2015 (improved from NE)
Cropland - Rice cultivation	CH_4 emission is estimated by DNDC-rice model, which was developed by a research institute, allowing to reflect time series data of organic material application amount.	Tier 3	2015 (improved from Tier 2)
Settlements (urban park) - Mineral soil, litter	Developed own carbon accumulation ratio based on the field survey. Carbon stock change is estimated by AD*EF style.	Tier 3	2012 (improved from NE)

3. Why tier 3 method/model?

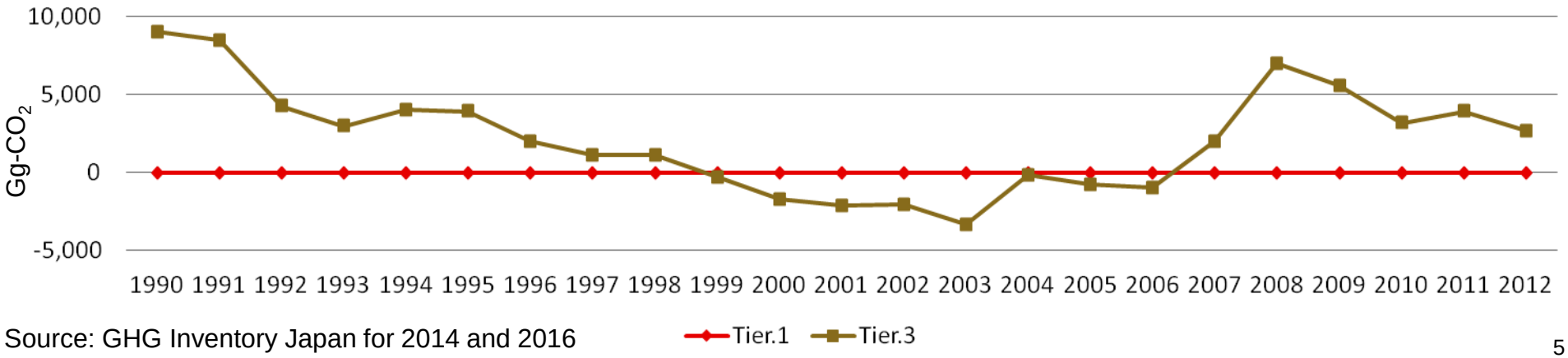
- GHG emissions and removals in soil is a primary source/sink in agricultural land use, and has some level of contribution to forest land and other land uses. It is desired to be accurate as much as possible, when the relevant land use is included in the target.
- It is difficult to apply Tier 1/Tier 2 method of soil CSC according to the 2006 IPCC guidelines. (development of appropriate country-specific parameter need many data, hardly available of appropriate AD). It takes same level of (or even more) effort like developing Tier 3 method. If so, going directly to Tier 3 will be a pragmatic target.
- Unavailability of entire data. Expanding spot data to overall estimation can be done by model.
- Academic interest by researchers. It usually takes at least three or four years to incorporate into GHG inventory after the development of model by researchers because development of proper AD and checking of the results are necessary.

4. Verification and uncertainty

- All models are verified/calibrated with monitoring data.
- For CENTRY-jfos, uncertainty is assessed by Monte-carlo analysis.
- Sometimes, calculation by model is the only data of national level estimates. Careful consideration is needed whether or not the comparison with the result of model and lower tier estimation is meaningful.

[example] Comparison with lower tier estimation

Item	Related Factors	Status of estimation	
		Tier.1	Tier.3
Variability of environmental condition	-	No	Included
Change in internal land use under CL, GL	F_{LU}	Yes	Yes
Change of management (tillage frequency)	F_{MG}	No (change of tillage intensity is not common mitigation option in Japan and F_{MG} was set as constant value)	Implicitly included
Organic materials input (quantity / quality)	F_I	No (Difficulty of setting different F_I over time)	Yes



Source: GHG Inventory Japan for 2014 and 2016

Factors on soil carbon stock changes in CL, GL

Mechanism of soil carbon stock changes

Factors	Impact to SOC	Change by agriculture practices	Carbon Factor
Temperature	Low temperature > slow decomposition > more SOC	Unlikely	-
Water content	Excessive moisture > more SOC Excessive dry > more SOC	Unlikely	-
Soil physical and chemical properties	Viscous > more SOC Excessive acid > more SOC Excessive alkaline > more SOC	Unlikely	-
Cultivation frequency	No/Reduced tillage > more SOC	Possible / but not suitable in Japan	F_{MG}
Organic materials (plant residue, compost) input	More input > more SOC	Possible	F_I
Quality of organic materials (ease of decomposition)	High C/N ratio > more SOC High content of persistent material (such as lignin) > more SOC	Possible	

The effects most relevant in Japan

5. Report of the results

- The volume of the NIR has been increasing over years The proper amount of information is an overall issue of the national system.
- The elements identified in the Sydney expert meeting of model in 2010 is taken into account for the explanation of models.
- It is difficult to describe everything in the NIR. No one knows how much is transparent enough. Both compiler and reviewer become frustrated during the review.
- Personal impression: it seems better to explain two aspects.
  - key information of model and how the key parameters are developed - this is usually described in the relevant academic papers and examined by the academic side very well.
  - how the input data is developed - this is often based on assumptions or not discussed enough in the academic side.

Thank you for your attention!