World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Carbon Stock Change Estimation in Buffer Area of Lamandau River Wildlife Reserve using Rapid Carbon Stock Appraisal (RACSA)

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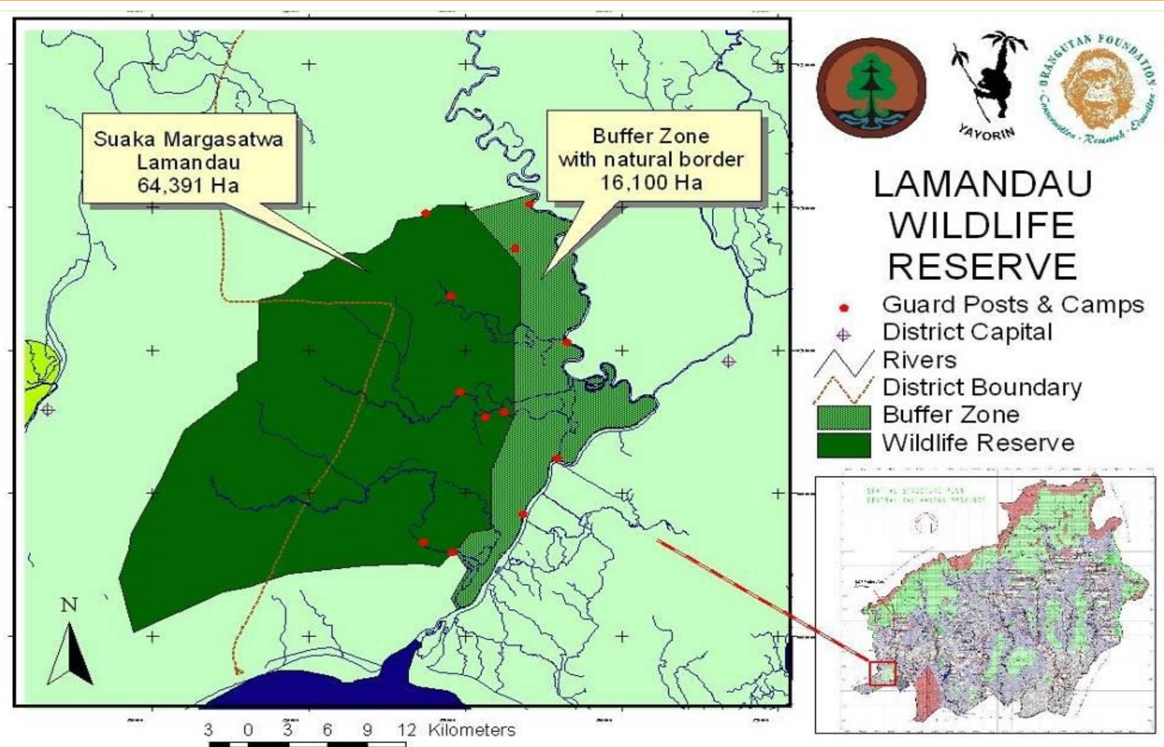
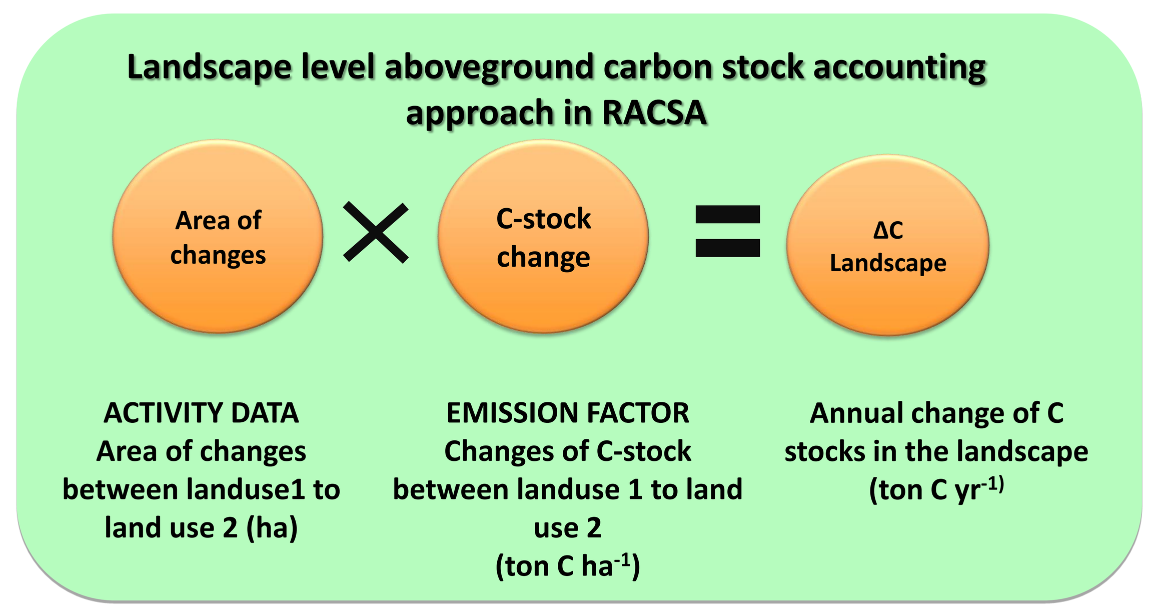
INTRODUCTION

The area between the eastern side of Lamandau river and the western side of Lamandau River Wildlife Reserve (LRWR), Kota Waringin Lama, Central Kalimantan, is considered to be a 'buffer area' for the reserve. This area was classified as 'production forest' with logging rights assigned to a private forestry company and slated for 'conversion' to non-forest uses. Given this 'planned conversion' status, reassigning the area to remain under natural forest cover could qualify for support as early REDD (Reducing Emissions from Deforestation and Degradation) implementation action. The logging activity ceased in 2003 and left a pretty much depleted landscape of logged-over forest. Part of the area has peat soils. Quantification of the carbon stock and recovery potential is an essential component of REDD planning for the buffer area. The LRWR is important for orangutan conservation and a buffer zone with wildlife-friendly, human land use is desirable.



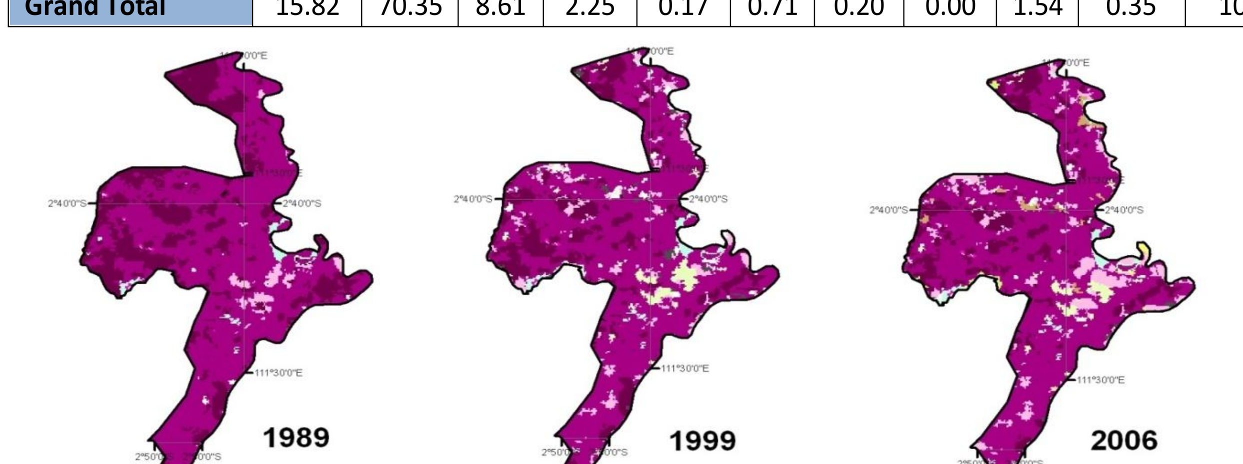
As part of a comprehensive REDD feasibility study, the Rapid Carbon Stock Appraisal (RACSA) method was used to explore the impacts of land-cover change on carbonstorage and to measure the change of carbon stocks over the past 15 years. The objectives this study were to estimate (1) aboveground carbon stock at plot level in representative land-cover classes; (2) belowground carbon stock at plot level, for peat as well as mineral soils; (3) the carbon emission and sequestration rate of the buffer area and its surrounding landscape (two sub-districts: Arut Selatan and Kota Waringin Lama); and (4) the feasible recovery rate of carbon stocks (under a REDD+ scheme that includes 'restoration'). Land-cover change was quantified using *area-based change analysis* and *trajectory analysis* methods. Information of changes was derived from land-cover maps constructed from satellite imagery from 1990, 2000 and 2005.



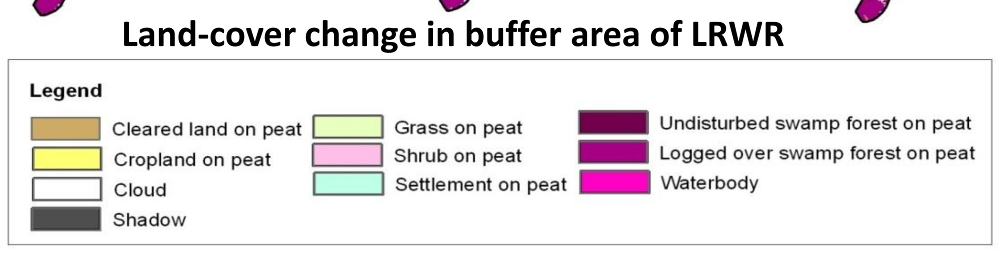
Change matrix (% of total area) for the buffer area in the periods 1990–2000 and 2000–2005

1990 \ 2000	Undisturbed mangrove	Undisturbed/ lightly disturbed swamp forest on peat	Logged over swamp forest on peat	Shrub on peat	Grass on peat	Shrub	Cropland	Settlement	Water body	Grand Total
Undisturbed mangrove	0.00			0.06						0.06
Undisturbed/ lightly disturbed swamp forest on peat		19.20	5.39	2.60	0.40	0.01	0.00			27.60
Logged over swamp forest on peat			64.29	2.97	1.01			0.18		68.45
Shrub on peat				0.74	1.50					2.23
Shrub				0.01		0.00				0.01
Settlement								1.31		1.31
Water body									0.35	0.35
Grand Total	0.00	19.20	69.68	6.37	2.90	0.01	0.00	1.48	0.35	100

2000 \ 2005	Undisturbed/ lightly disturbed swamp forest on peat	Logged over swamp forest on peat	Shrub on peat	Grass on peat	Shrub	Cleared land on peat	Cropland on peat	Cropland	Settlement	Waterbody	Grand Total
Undisturbed/ lightly disturbed swamp forest on peat	15.82	3.39			0.05						19.26
Logged over swamp forest on peat		66.96	2.15		0.03	0.47			0.01		69.61
Shrub on peat			5.82		0.07	0.24	0.20		0.04		6.37
Grass on peat			0.65	2.25		0.00					2.91
Shrub					0.01						0.01
Cropland								0.00			0.00
Settlement									1.49		1.49
Water body										0.35	0.35
Grand Total	15.82	70.35	8.61	2.25	0.17	0.71	0.20	0.00	1.54	0.35	100

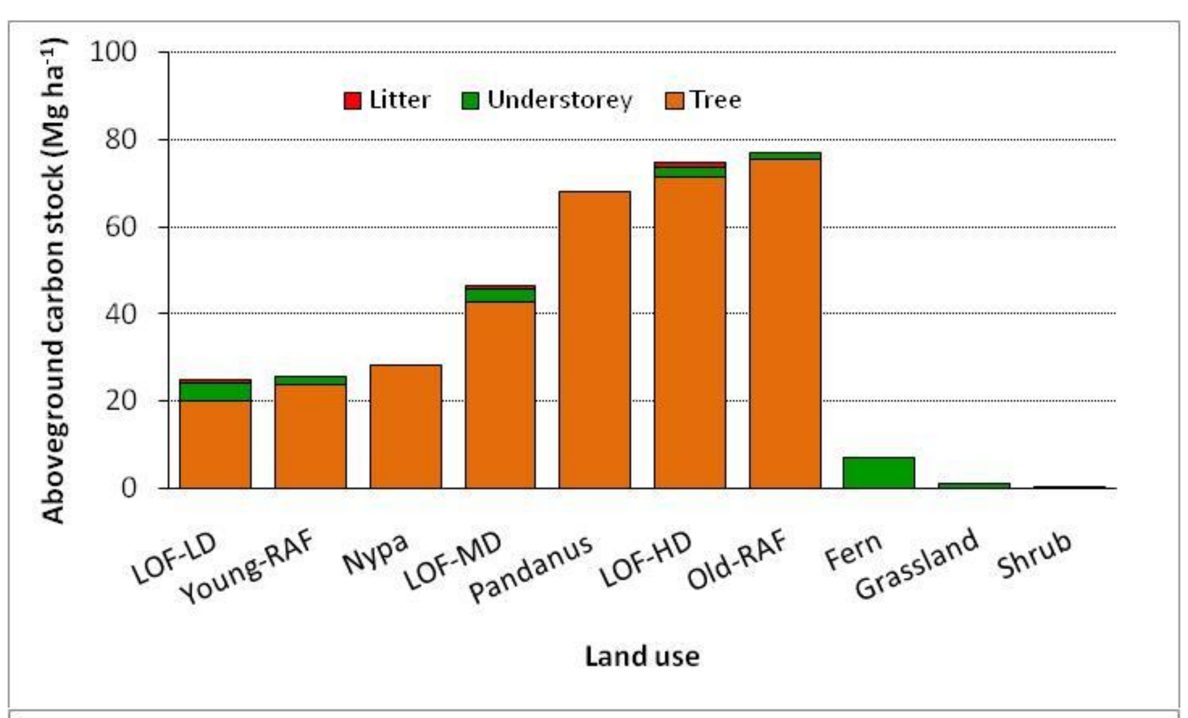


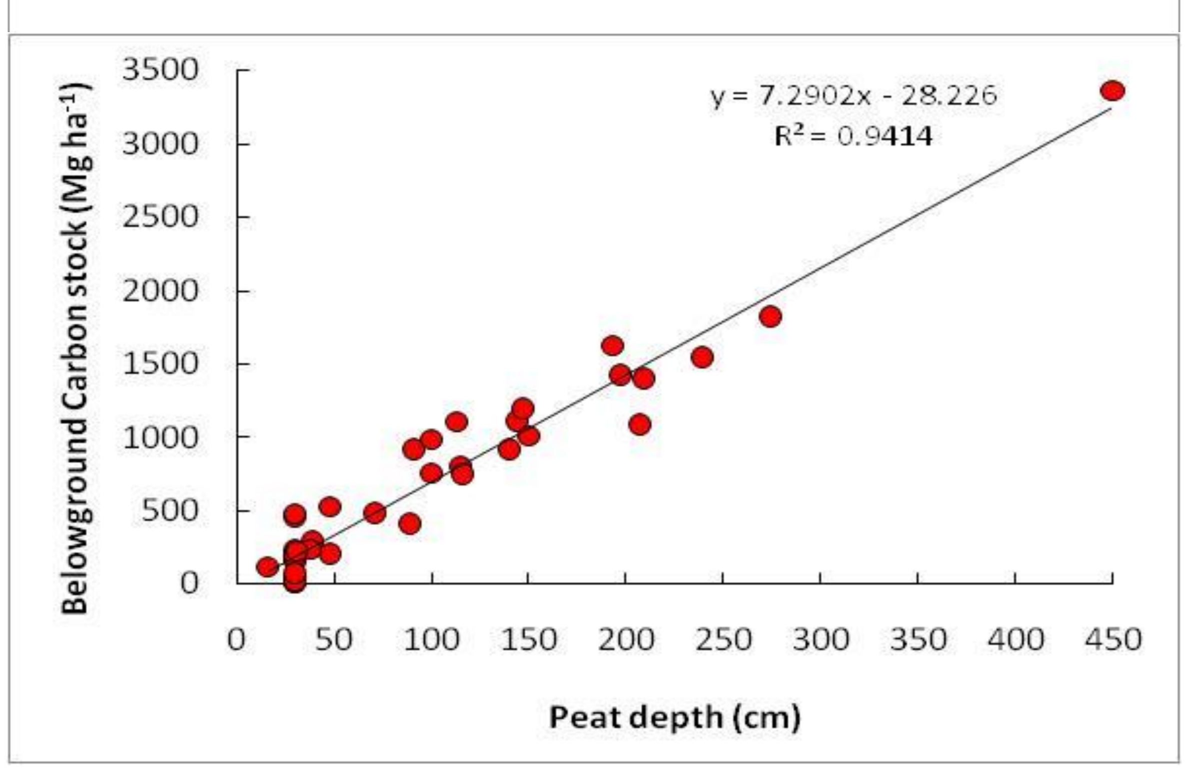
Land-cover change in buffer area of LRWR



Above and below-ground carbon stock

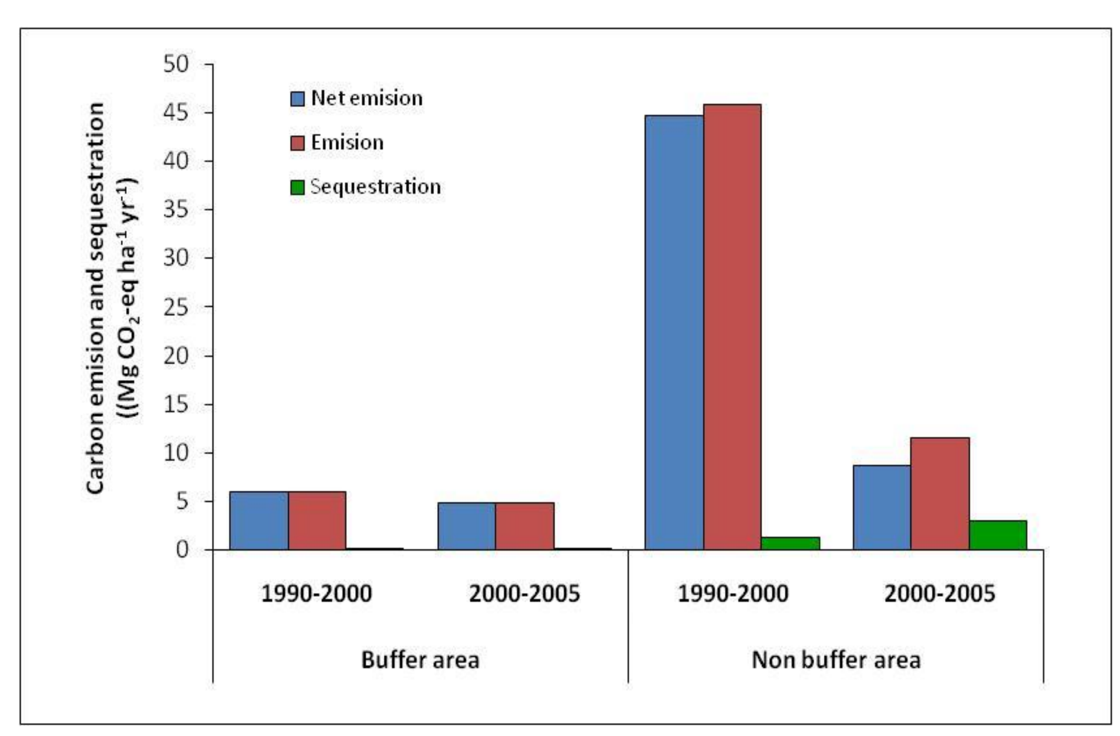
- **Previous logging in the buffer zone of LRWR affected carbon stock depending on logging intensity. High intensity of logging resulted in low carbon stock.**
- **Trees contained 80% of aboveground carbon stock in low-density logged-over forest and more than 90% in medium and high density logged-over forests .**
- **Peat depth and bulk density were the main components that influenced belowground carbon stock. Deeper peat layer contains higher carbon stock. One hundred centimetre of peat depth holds 729 tonne of carbon.**





Land-cover change and CO_2 emission

- The period 1990–2000 was the historical peak of peat swamp forest degradation to logged-over forest and shrub due to logging activities and timber extraction by the local community and a private company, reacheing 30% (3.5% per year).
- The 2000–2005 forest conversion rate was 2% per year.
- By 2005, 16% of the buffer zone remained as intact forest and 67% as logged-over forest, with the remainder in more open vegetation types.
- Conversion of undisturbed peat swamp forest to logged-over swamp forest appeared to be the highest source of emission (3.04 Mg CO_2-eq ha^{-1} yr^{-1} and 1.90 Mg CO_2-eq yr^{-1}, respectively). For the 2000–2005 period, the rate of emission decreased by 20%. But conversion of undisturbed swamp forest (3% to logged-over swamp forest and 2% to shrub, respectively) was still the largest source of emission (3.82 Mg CO_2-eq ha^{-1} yr^{-1} and 0.71 Mg CO_2-eq ha^{-1} yr^{-1}, respectively). Carbon emission rates outside the buffer zone were nearly eight times higher in the 1990–2000 period and at least double during 2000–2005.



"Non-buffer area" is the rest of the two sub-districts including LRWR. The main source of emission is conversion of undisturbed forest into other types of land cover/use in the northern part of the area.

CONCLUSION

The protection of LRWR and the buffer zone since 2005 has had significant positive impact on forest restoration, biodiversity conservation and carbon storage. It is unlikely that any REDD+ project will bring significantly more benefits to carbon stock and the carbon sequestration rate. Additional planting of tree species, especially in open and degraded areas may be beneficial.

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