Bauxite Mining & Greenhouse Gas (GHG) Emissions

Part 1: Tracking emissions from forest clearing – 1958-2020

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BACKGROUND

Land use changes, including tropical deforestation, are important contributors to global greenhouse gas (GHG) emissions from human activities. Bauxite mining can involve the clearing (and often burning) of forests, and soil disturbance, wasting valuable timber and non-wood forest resources and generating the release of substantial quantities of biogenic carbon, while preventing biogenic uptake (at least until rehabilitation of the landscape post-mining). Since the late 1950s, large areas of native forest around Weipa in tropical northern Australia have been cleared and burnt for bauxite mining (Figure 1). GHG emissions have not yet been documented. Bauxite mining around Weipa is likely to continue for many more decades. It is important to highlight the extent of historical GHG emissions and opportunities for improved forest resource use efficiency to mining industry operators and government regulators to encourage changes to current poor practices.

Figure 1. To clear the landscape for bauxite mining, native forest is often burnt to waste. This is common practice around Weipa in northern Australia.

METHOD (What we did)

We estimated historical GHG emissions from forest clearing associated with the bauxite mining from the granted mining lease area around Weipa (Figure 2). Cleared areas are sometimes rehabilitated. At times, rehabilitated areas are cleared again. We derived temporally and spatially explicit estimations of the GHG emissions related to the clearing and burning of forest from 1958 to 2020. We also estimated the amount of CO_2 removed from the atmosphere by storing carbon in mine rehabilitation.

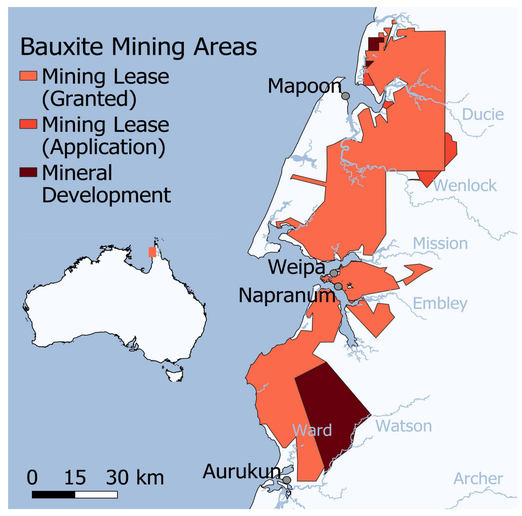

Figure 2. Bauxite Mining areas around Weipa. (Data Sources: State of Queensland 2020 for mineral development licence, mining leases, and watercourse areas; Geoscience Australia 1997 for Australia's River Basins)

We divided the area mined for bauxite into 27 x 27 m squares. For each square, we looked out for events that changed the vegetation cover (Figure 3) between 1958 (just before extensive mine clearing started) to 2020 using satellite images and computer algorithms (FLINTpro software). The biomass of the native forest was measured on the ground through a forest inventory. This inventory information, combined with the observed events on each square and assumptions of how forest rehabilitation grows, allowed us to estimate the changes in forest biomass — and therefore the related emissions or storage of biogenic carbon as CO2 and other GHGs.

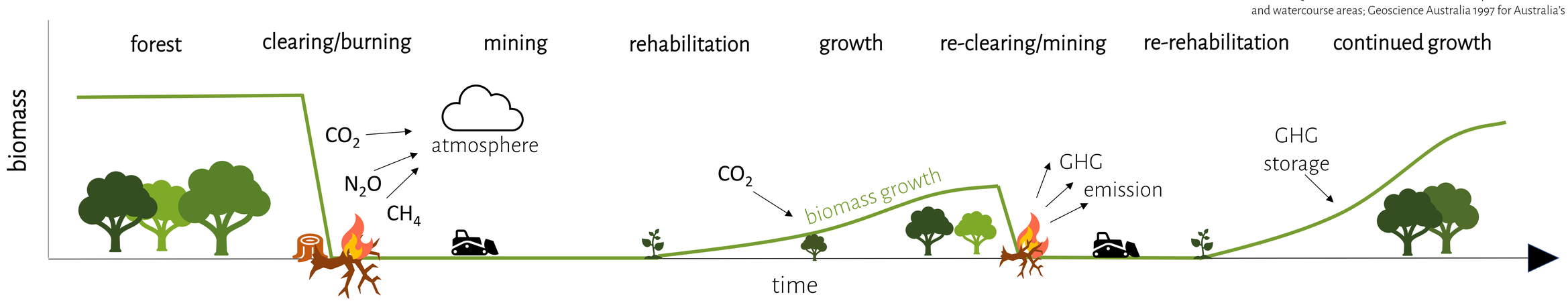

Figure 3. Example of forest clearing and rehabilitation events observed for one 27 m x 27 m square of bauxite mining lease over time.

FINDINGS

- **35,867 ha** of forest were **cleared** for bauxite mining around Weipa (1958 to 2020).
- **13.6 million tonnes** of CO_2 equivalent* have been **emitted** from the forest clearing (Figure 4).** This includes methane (CH_4) and nitrous oxide (N_2O), which are released in addition to CO_2 when biomass is burned.***
- Only around **1 million tonnes** of the emissions from the forest clearing were **re-captured in the mine rehabilitations** between 1988 and 2020.
- **Net emissions** (emissions from forest clearing minus net re-capture from rehabilitation) are shown as cumulated net emissions over the years 1998-2020 **in Figure 4.**

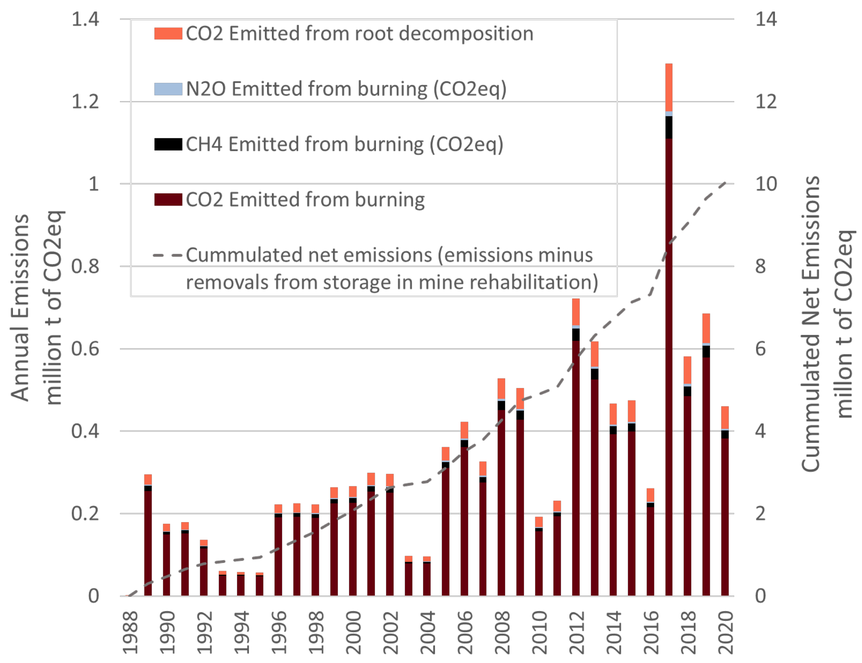

Figure 4. GHG emissions from forest clearing and burning for bauxite mining around Weipa, 1988-2020.

* Both CH_4 and N_2O have a much higher global warming potential than CO_2. To make the effect of these gases comparable, they are multiplied by a factor and expressed as a CO_2 equivalent.
** Fig. 4 shows GHG emissions from 1989-2020. For the 1958 to 1987 period, no specific forest cover maps were available. For this period and the respective area of forest clearing, an equal annual clearing rate was assumed. Natural biomass reductions from termites and wildfire have not been taken into account, which would lower the emissions.
*** Here we assumed a burning efficiency factor of 0.95. This means that 5% of the biomass is not released as gas. A high efficiency is justified since trees are purposefully piled up and burnt, and this process is often repeated to maximise disposal.

WHERE TO FROM HERE?

Our results show that large amounts of GHGs have been emitted through the clearing and burning of forests ahead of mining around Weipa. Current mining rehabilitation practices result in a low proportion of CO_2 removals (storage) from the atmosphere.

The current bauxite mining practices should be improved. The results of these simulations can be used as a reference to evaluate management alternatives (see Part 2 of the '*Bauxite Mining & GHG Emissions*' poster series). The method can be used to measure, verify and report future GHG emissions from mining.

Not all sources of GHGs related to the forest clearing have been integrated in this study. For example, more research is needed to understand the GHG fluxes from and into the forest soils.

GHGs are not the only impacts that mining-related forest clearings and rehabilitations have on the environment. The impacts on biodiversity and ecosystem services can also be significant, and should be simultaneously considered and integrated into the simulations.

Acknowledgements
This work was funded by UniSc through the '*Indigenous Employment, Forestry Livelihoods, Mining*' project and the Aluminium Stewardship Initiative. The simulations were conducted with the FLINTpro software and supported by FLINTpro, with special thanks to Dr Rob Waterworth and Mr Geoff Roberts at FLINTpro.