

Using publicly available remote sensing products to evaluate REDD+ projects in Brazil

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Problem

- Proliferation of sub-national initiatives to Reduce Emissions from Deforestation and forest Degradation (REDD+) in the Brazilian Amazon.
- The perpetuity and improvement of REDD+ require rigorous impact evaluations of the effectiveness of existing interventions.
- Remote sensing (RS) products are publicly available for detecting changes in forest cover worldwide.
- The suitability of using such products to perform impact evaluations of sub-national REDD+ initiatives has rarely been questioned so far.

Contribution

- Combining ready-to-use RS products and property-level Geographic Information Systems (GIS) data to evaluate the long-term impact of a local REDD+ program implemented in a country characterized by the highest annual loss of forest in the world.

Materials and Methods

- Reconstruction of forest loss for the period between 2008 and 2018 of 21,492 farms located in the Transamazonian region, using data derived from two land-cover change datasets: Global Forest Change (GFC) and Amazon Deforestation Monitoring Project (PRODES).

Table 1: Comparison between datasets

	PRODES	GFC
Data source	Mainly Landsat	Landsat
Resolution	30 meters	30 meters
Minimum detectable size of forest disturbance	6.25 hectares	0.09 hectares
Coverage	Brazilian Amazon	Global
Method	Image segmentation and analyst interpretation (contextual)	Automated decision tree (pixel-based)
Observation period	August 1 – July 31	January 1 – December 31

- Compare forest cover loss from GFC with the deforestation extent from PRODES using t-tests on the equality of means.
- Estimate the average treatment effect on the treated (ATT) of the Sustainable Settlements in the Amazon (SSA) program using matching estimators.

$$ATT = E(y^1 - y^0 | D = 1) = E(y^1 | D = 1) - E(y^0 | D = 1)$$

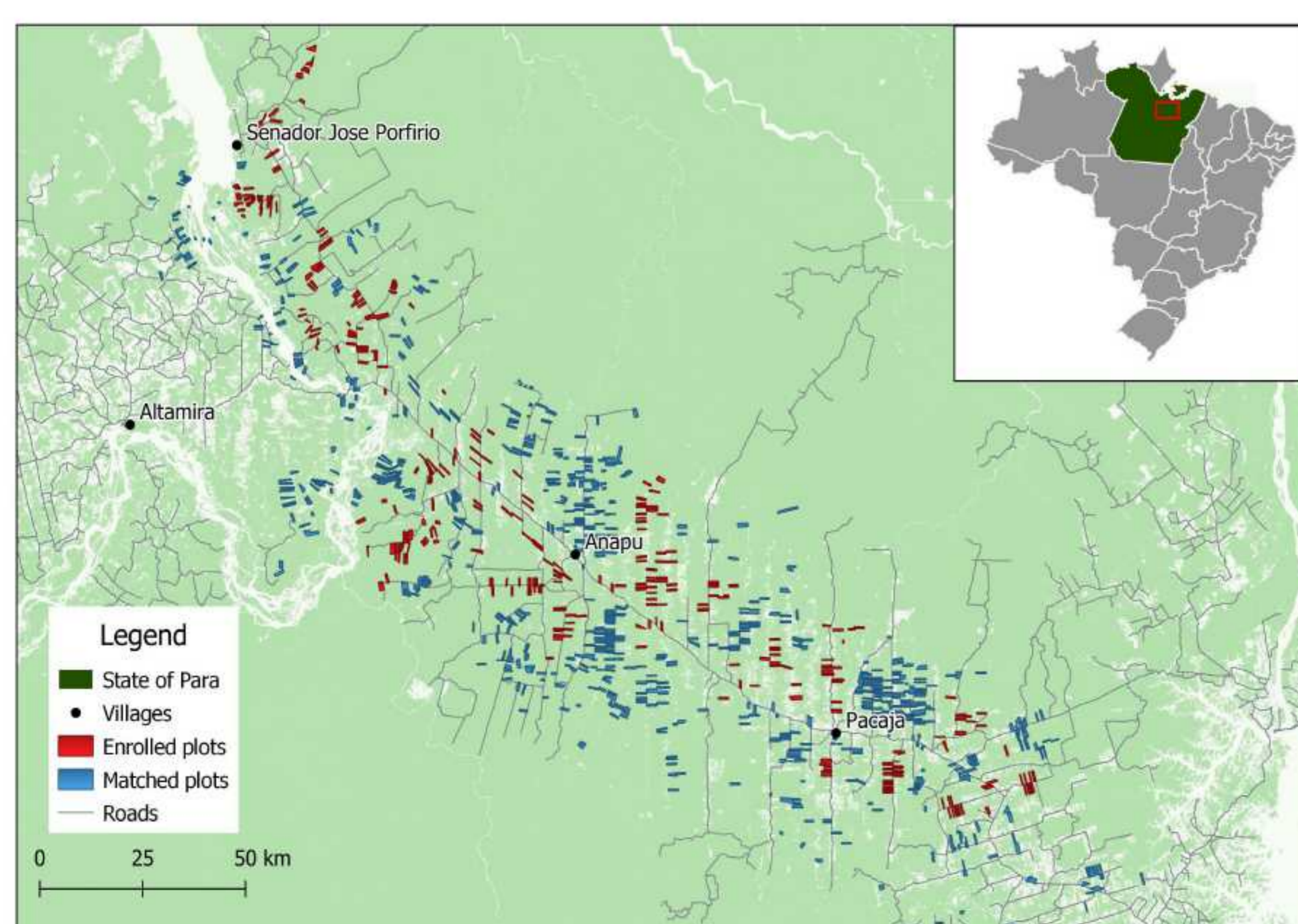
y^1 is the area deforested (hectares) in 2013, 2014, 2015, 2016, 2017 and 2018 for a plot enrolled in the program

y^0 the deforested area at the same years for a plot not enrolled in the program

D is a dummy for the participation in the REDD+ initiative

- The SSA program has offered payments for ecosystem services (PES) and technical support to 348 smallholders that live in settlements located in the Transamazon highway.

Figure 1: Localization of enrolled and matched farm-holds



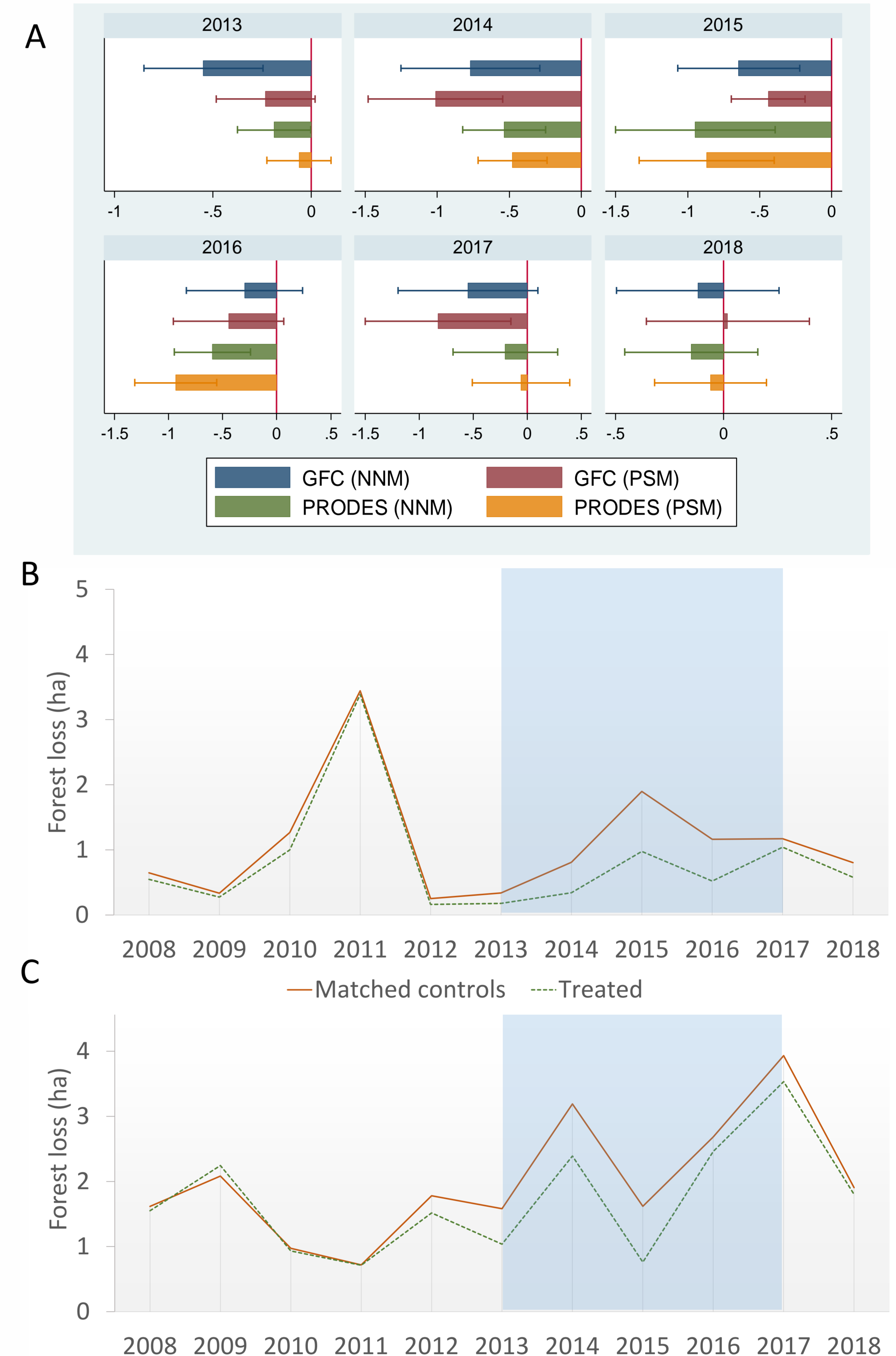
Results

Table 2: Paired t tests on the equality of means.

Year	GFC	Std. Dev.	PRODES	Std. Dev.	ND	t	p-value
2008	3,139	7,223	1,897	6,659	0,126	21,330	0,000
2009	2,494	5,678	0,832	3,945	0,240	33,338	0,000
2010	1,395	4,060	1,928	6,113	0,073	-11,411	0,000
2011	1,358	3,491	2,958	7,195	0,200	-28,493	0,000
2012	2,490	5,750	0,350	1,926	0,353	47,143	0,000
2013	1,696	4,146	0,413	2,400	0,268	39,736	0,000
2014	3,097	7,123	0,705	3,618	0,299	48,686	0,000
2015	1,519	5,641	1,553	5,526	0,004	-0,753	0,451
2016	2,903	6,944	1,145	5,337	0,201	40,166	0,000
2017	3,942	7,256	1,230	4,821	0,311	55,209	0,000
2018	2,351	5,115	0,871	3,532	0,238	40,164	0,000

Note: When p-value is lower than 0.05, one can reject the null of equality and conclude that the two series differ.

Figure 2: Effect of the SSA program on avoided deforestation (in hectares)



Mean difference in forest loss (hectares) between participants (n=348) and control group (n=11,466). (A) Yearly estimates using GFC and PRODES datasets for 2008 to 2018 and propensity score matching (PSM) and nearest neighbors matching (NNM) outputs. (B) NNM estimates using PRODES dataset. (C) NNM estimates using PRODES dataset. The SSA REDD+ program was implemented from 2013 to 2017 (blue panel).

Conclusion

- Despite the divergence of forest cover loss estimates, GFC and PRODES represent a valuable source of data to evaluate forest conservation projects.
- Findings suggests that the SSA project have failed on inducing more sustainable agricultural practices on the following years, since the additionality disappeared even before the end of the program.
- Project sponsors need to emphasize permanence objectives in REDD+ contracts.