# Forecasting additionality in dynamic forests

Where can forest conservation change the future - and create net social value?

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Inkinen et al. (2026) 'Forecasting additionality in dynamic forests.' Working paper. † Equal contribution.

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DRAGON CAPITAL

## 1. CONTEXT AND QUESTION

### Additionality is the difference conservation makes

Forest conservation and carbon offsets are effective only when they deliver more forest cover and carbon than would have existed without intervention.

Yet interventions are often placed where standing forest faces little threat, or where forest would regrow anyway. That wastes scarce conservation finance and undermines the integrity of carbon credits.

Prediction is especially difficult because forests are dynamic: the same site may be cleared, regrow, and be cleared again. The number and timing of these transitions determine carbon value.

**SCOPE • South America • 30 m pixels • annual land cover 1985-2021 • 30-year forecast**

**Where can protection or regrowth most alter the future forest-carbon trajectory?**

## 2. WHAT IS FORECAST?

### A dynamic counterfactual, not a static baseline

**BUSINESS AS USUAL (BAU)**


F = forest N = non-forest

**INTERVENTION**

**PROTECT**
Keep standing forest from following a predicted loss pathway.

**ENHANCE REGROWTH**
Induce forest where natural regrowth is otherwise unlikely.

**POTENTIAL ADDITIONALITY**

**PV[INTERVENTION] - PV[BAU]**

This is the upper-bound benefit of a perfectly successful intervention. It is necessary for targeting, but no guarantee of real-world success.

## 3. HEADLINE FINDINGS

### Forecasting changes what looks valuable

**32.8 Mha** net forest-area loss under BAU — over 30 years

**8.9 Pg C** net aboveground biomass loss — over 30 years

**~4×** greater net value at high-additionality sites — than at "easy-win" sites

**$656bn** potential value from protection

**$527bn** potential value from enhanced regrowth

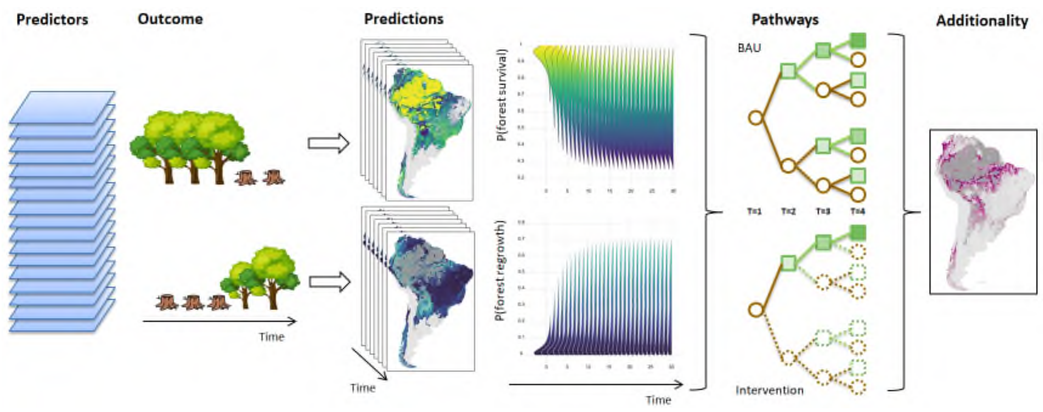
**$209bn** net present value after opportunity cost

**$9bn** net present value after opportunity cost

**Protect threatened standing forest near the frontier; regrowth is rarely cost-effective once opportunity cost is counted.**

## FROM EARTH OBSERVATION TO ADDITIONALITY

### Random Survival Forests turn annual land-cover histories into 30-year carbon forecasts

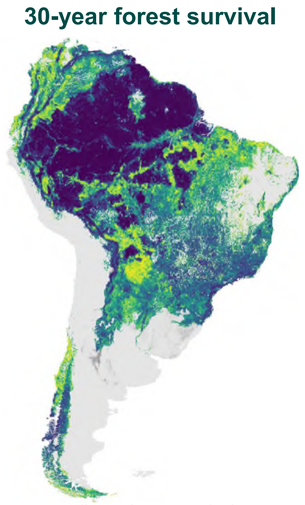



1. **OBSERVE** — MapBiomas land cover and 67 biophysical, topographic and land-use features.
2. **FORECAST** — Four Random Survival Forests separately model primary/secondary deforestation and regrowth.
3. **BUILD PATHWAYS** — Annual hazards generate 1,024 possible forest/non-forest sequences per pixel over 30 years.
4. **VALUE THE DIFFERENCE** — Map forest age to carbon, discount climate damages, then compare BAU with best-case intervention.

## 4. FOREST DYNAMICS

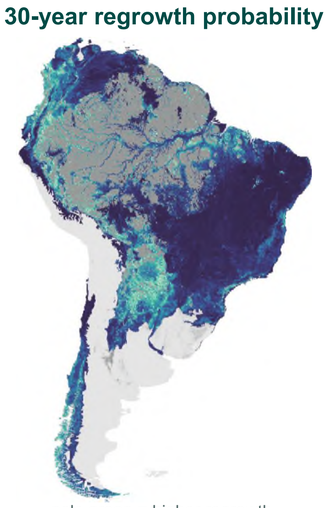
### Where loss and regrowth are likely

**30-year forest survival**



yellow = lower survival
purple = more stable forest

**30-year regrowth probability**

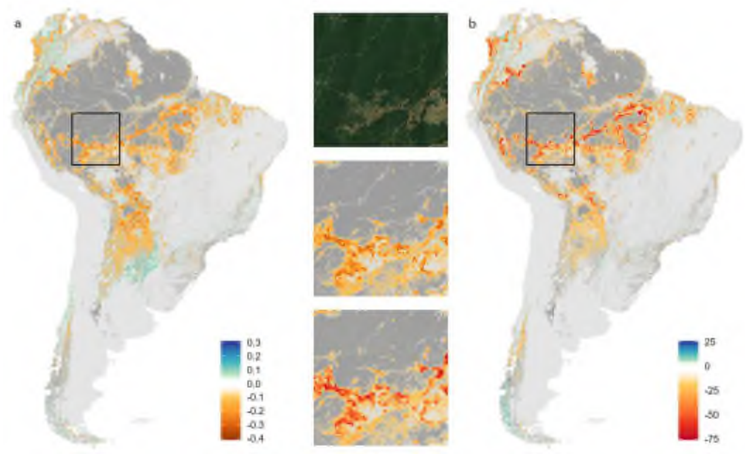


pale green = higher regrowth
purple = lower regrowth

**12% of primary forest is forecast to deforest within 30 years. 22% of deforested land may regrow within 10 years, but 42% of secondary forest is forecast to be lost again within 10 years.**

## 5. BUSINESS AS USUAL

### The counterfactual is spatially uneven



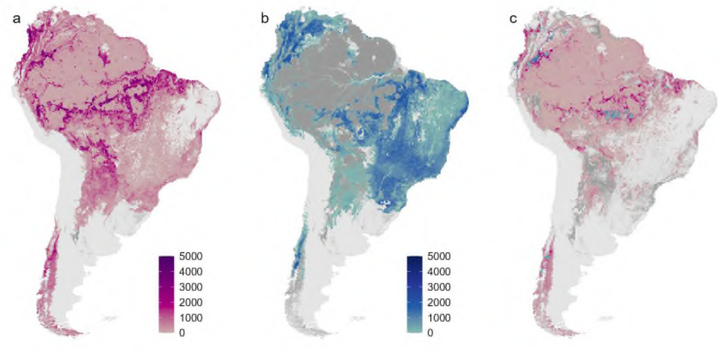

a change in forest cover density b change in aboveground biomass (Mg C ha⁻¹)

**-32.8 Mha** net forest area

**-8.9 Pg C** biomass carbon

## 6. ADDITONAL NET VALUE

### Benefit hotspots and the cost of land




a protection value b enhanced-regrowth value c highest positive-NPV intervention

Protection value is concentrated along the agriculture-forest frontier in the southern Amazon. Regrowth has biophysical potential across wider areas, but productive land makes it expensive.

**Net-positive protection is widespread. Net-positive regrowth is rare.**

## 7. ADDITIONALITY THROUGH TIME

### Protection and regrowth store carbon on different schedules

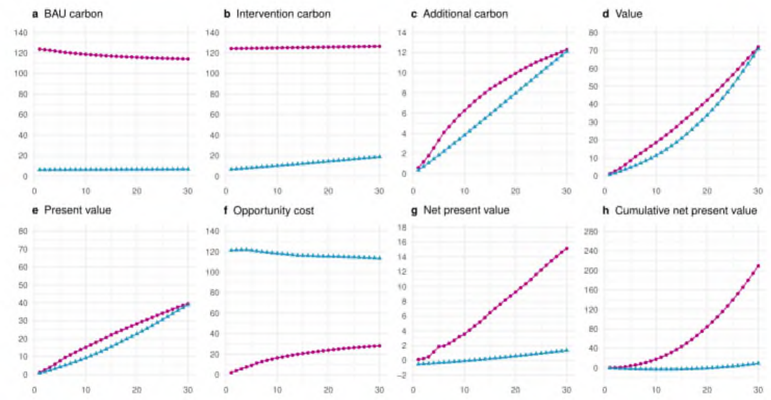



Figure 5 follows BAU carbon, intervention carbon, additional carbon, value, opportunity cost and net present value over 30 years.

1. **CARBON TIMING** — Protection preserves a large existing stock immediately; regrowth accumulates carbon gradually.
2. **PRESENT VALUE** — Discounting changes magnitudes, but not the ranking of the two intervention types.
3. **LAND COST** — Expected forgone agricultural income is much larger for regrowth than for protection.

**30-year cumulative NPV ≈ $209bn protect vs $9bn regrow**

## 8. POLICY AND MARKET DESIGN

1. **TARGET THREAT, NOT EASY WINS** — High-additionality locations generate about four times more net value.
2. **PROTECT BEFORE REGROWING** — Threatened standing forest is generally the more cost-effective use of scarce finance.
3. **UPDATE DYNAMIC BASELINES** — Refresh predictions as forest conditions, policy and commodity prices evolve.

**FORECAST THE COUNTERFACTUAL • ACCOUNT FOR THE TIMING • VALUE THE INTERVENTION**

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