More Forests, Better Farms: Gains for Brazil From Forest Protection

Gradually Ending Deforestation Can Boost Revenue for Brazil by $146-$306 billion

This analysis examines the impact on Brazil of gradual reductions in deforestation in accordance with its national commitments. Drawing on a variety of published research and economic analysis, Brazil stands to see gross revenue increases between $146-306 billion from ending deforestation by 2030 through a combination of shifting agricultural production, agricultural intensification and improvement, and forest protection financing. These gains are dependent on fulfillment of Brazil's national commitments for forest protection, and assume no legal, regulatory, or enforcement changes that would increase deforestation.

Protecting Forests: Impact on Brazilian Agriculture

Reducing deforestation in Brazil will gradually shift production towards non-deforestation based agriculture, and spur intensification and modernization of existing agricultural operations (see results below). Under the model, non-deforestation agriculture operations in Brazil gain market share from protecting forests, just as non-deforestation agriculture in other countries also benefit.

Brazilian agriculture has many competitive advantages, allowing it to easily absorb shifts in production away from deforestation-based agriculture: among them, relatively constant temperatures, advanced agricultural and transportation systems, and the availability of tens of millions of hectares of degraded lands that can be returned to production with relatively minimal investment. In the words of the World Bank's *Brazil Low Carbon Country Case Study*, "The potential to release and recover degraded pasture is enough to accommodate the most ambitious growth scenario."[1] For some commodities, such as soybeans, productivity exceeds that of the United States and other developed countries.[2] For these reasons, Brazil has substantially increased agricultural production even as deforestation has declined in recent years, breaking the link between carbon emissions and development.

The results below are the result of a partial equilibrium analysis of the effects of gradually reducing tropical deforestation on an annual basis. The analysis assumes a 10 percent drop in deforestation, followed by 5 percent drops each subsequent year, until net deforestation is reduced to zero by 2030, but does not specify how such reductions are achieved.[3]

Revenue Increase to Brazilian Non-Deforestation Agriculture by Gradually Ending Deforestation, 2012-2030*	
Soybeans	$55.574 - $60.405 billion
Beef	$40.196 - $43.895 billion
Total	$95.771 - $104.30 billion

*excluding oilseeds and agroforestry

It's important to note that these numbers do not include additional factors that would further increase gains to Brazil's agricultural sector. Tropical forest protection can spur better use of existing agricultural lands – such as adoption of superior breeding stock and improved grazing plans in the cattle sector – while also making Brazilian beef more attractive to global consumers looking to ensure the products they consume aren't tied to deforestation.

One impact of this shift will be improvements in the profitability of Brazilian livestock operations. Cattle operations in Brazil, especially those reliant on deforestation, have historically suffered from low and negative profitability, drawing resources away from more productive development activities.

A recently concluded analysis of low-carbon development scenarios for Brazil found that reducing deforestation will increase the investment rate of return for livestock operations from the negative rates currently found to an average of +11 percent – providing resources for the cattle industry to play a far more important role in Brazilian economic growth.[4]

As importantly, this model excludes added revenue increases to non-deforestation based agriculture from oilseeds and agroforestry, which are beyond the model's scope for Brazil. Based on current Brazilian timber and oilseed production, including these commodities would likely show tens of billions of dollars in additional gains for Brazilian agriculture.

Development Potential in Forest Protection

In addition to gains through agricultural shifts and intensification, financing from Reducing Emissions Deforestation and Degradation (REDD+) programs can significantly boost revenue for governments, local communities, indigenous peoples, and agricultural producers on the deforestation frontier and elsewhere. In order to function, this financing exceeds any of the opportunity costs of forest protection. A 2009 study in the journal *Science* found that financing for reduction of deforestation in Brazil could generate revenues valued at $37-111 billion between 2013 and 2020.[5] This estimate rises to $50 - $202 billion between 2013 and 2030.[6]

Financing for tropical forest protection is already emerging. For instance, Brazil recently partnered with Norway through the Amazon Fund to secure public investment for forest protection compensation. Norway has pledged to deliver US$1 billion total by 2015 in exchange for reductions in deforestation. The agreement depends on Brazil fulfilling its national plan to reduce deforestation. In 2009, Brazil fulfilled its goals and received the first installment of $110 million.[7] Other industrial countries have pledged a total of US$4 billion in finance for tropical forest protection internationally over the next three years – funds that are expected to grow substantially as international efforts for reducing deforestation advance.

Revenue Increase to Brazil from Forest Protection Investments (REDD+) by Gradually Ending Deforestation, 2012-2030	
2013-2020	$37 - 111 billion
2013-2030	$50 – 202 billion
Gross Agricultural Gains (Table 1)	$95.771 - $104.30 billion
Total for Brazil, 2012-2030	**$146 - $306 billion**

Brazil's eligibility for this financing is dependent on its continued reduction in deforestation according to its national plan. Its ability to do so is heavily dependent on continued enforcement of a variety of Brazilian forest laws and continued participation in a program for reducing deforestation.

In sum, a first estimate of the gross revenue increase to Brazil from gradually ending deforestation reaches $146 – $306 billion by 2030. These benefits depend on fulfillment of Brazil's national plan for reducing deforestation and a continued commitment to existing forest protection laws and regulations. Brazil has a valuable resource in its standing forests. Protection of these forests can offer major potential to improve and develop its agriculture sector while producing multiple benefits for the country as a whole.

With any questions, please contact Glenn Hurowitz of Avoided Deforestation Partners at glenn@adpartners.org or at +1-202-232-3317 x. 128 or +1-917-386-3571 (mobile)

Methodology

The effect of reduced deforestation on Brazil's soybean and beef revenues was estimated using a partial equilibrium model. The model assumes gradual reductions in deforestation from 10% in 2012 to 100% in 2030, at annual intervals of five percent, but does not specify how such reductions are to be achieved. Inputs are from the Food and Agriculture Organization of the United Nations and the USDA.[8]

The range of elasticities used in the paper were derived from existing literature, drawing largely from the database of the Food and Agricultural Policy Research Institute (FAPRI) for both demand and supply elasticities, and other literature. For beef supply elasticities, the model also used Brazil-specific estimates of land use that included pastureland and also Brazil-specific cattle and calf estimates from the FAPRI database.[9] A single elasticity of demand per commodity was used, representing a single global demand market for each good. The analysis employed region-specific supply elasticities, representing the ability of each region to supply the commodity at a given price. The higher elasticity of supply represents a scenario where Brazil has a relatively higher ability/willingness to produce at given prices. This scenario produces the higher revenue estimate and the scenario with a low relative elasticity of supply produces the low revenue estimate.

Demand Elasticities (FAPRI)			
	Low	**High**	**Average**
Soybeans	-.15	-.4	-.275
Beef	-.15	-.75	-.45

Supply Elasticities		
	Elasticity	**Source**
Soybeans - Low	.25	FAPRI
Soybeans – High	.6	FAPRI and Fernandez-Cornejo & Caswell[10]
Beef - Low[11]	.245	Barr et al.
Beef - High	.5	FAPRI

The impacts are based on both price and production changes. Price changes are global and production changes are regional. In other words, the model estimates a change in global price based on a given reduction in deforestation in a given year and also estimates each regional production response. Total revenue for a given year is the price multiplied by the production amount.

The analysis indicates potential shifts that could be useful in understanding the impacts from moving to non-deforestation based agriculture. Below are several limitations of the analysis and factors that we believe will lead to better understanding:

- ***Factors that could affect production under a reduced deforestation scenario.*** Increasing yield per acre or a more intense focus on expanding production on non-forest land, could expand production in response to increases in price. Analysis is needed to understand how reduced deforestation affects these factors and the degree to which these other production paths can be used, the effect that the increased costs will have on price, and the potential impact of technology on price.

- ***Elasticities***. Elasticities of supply are key to understanding how individual countries can and will react to restricted supply and increased prices. Our analysis uses a range of estimates to capture upper and lower bounds. Additional research could improve the understanding of different countries' responses and the resulting revenue changes. Elasticity estimates could also be improved by incorporating the likelihood of a region to intensify production per hectare when faced with land constraints. Also, an improved model would account for changes in supply and demand elasticities over the long-run and global ability to react to long-term price increases.

- ***Interaction between commodity markets.*** Our analysis uses a partial equilibrium model that assesses a country's capacity and willingness to produce more of a given commodity based on price, with other commodity production assumed to remain equal. It does not account for the interaction among and between markets for different commodities. For example, the markets for soybeans and beef are linked through the market for livestock feed. A general equilibrium model (or more comprehensive agricultural and forest sector model) would improve this analysis given the interactions between the agricultural crops, beef production and forestland

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[1] Christophe Gouvello et al. *Brazil Low-carbon Country Case Study* The World Bank Group et al. May 31, 2010. p. xx. (http://siteresources.worldbank.org/BRAZILEXTN/Resources/Brazil_LowcarbonStudy.pdf)

[2] Gouvello P. 28.

[3] *For more details on the model, see* Shari Friedman. "Farms Here, Forests There: Tropical Deforestation and U.S. Competitiveness in Agriculture and Timber." David Gardiner & Associates, 2010. *This report was an analysis of the impact of global reductions in deforestation on the United States, in the context of the ongoing debate in the U.S. Congress about domestic climate legislation.*

[4] Gouvello p. 134.

[5] Daniel Nepstad. "The End of Deforestation in the Brazilian Amazon" *Science.* Vol. 326. December 4, 2009.

[6] P. Piris-Cabezas and R. Lubowski. *The Brazilian National Plan on Climate Change: Potential Impacts in a U.S. Cap-and-Trade System.* Environmental Defense Fund, 2009. (http://www.edf.org/documents/10563_Brazilian_national_plan_on_climate_change.pdf)

[7] O banco nacional do desenvovimento. "BNDES receives US$ 110 million from Norway for the Amazon Fund" March 25, 2009. (http://inter.bndes.gov.br/english/news/not036_09.asp)

[8] For more detail on inputs, elasticity and prices, see Friedman.

[9]Kanlaya J. Barr et al., "Agricultural Land Elasticities in the United States and Brazil," Working Paper 10-WP 505 (Center for Agricultural and Rural Development, Iowa State University, February 2010): 15.

[10] Jorge Fernandez-Cornejo and Margriet Caswell. "The First Decade of Genetically Engineered Crops in the United States." USDA Economic Research Service. April 2006

[11] These numbers are for Brazil and the rest of the world outside of the United States, for which the FAPRI database includes a .01 supply elasticity for beef.