Title: Will Brazil lead the world to more sustainable farming?

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Standing on the frontier of the Amazon in the state of Mato Grosso is a humbling experience. To the north are 2000 km of the most intact, diverse, and important forests on earth. To the south is the Cerrado, one of Earth's oldest, most threatened, and unique savannas. And under your feet is one of the newest, most productive, and intriguing farming systems anywhere.

We have worked for many years to understand tropical ecosystems and the way that people use them. We have never seen farms as vast, or as quickly growing, as those in Mato Grosso. The initial growth of these farms led to massive clearing of Amazon forest and cerrado. As the industry matures, what will these farms mean for the future of Brazil, and the planet?

With the right incentives, and the best science, these farms could lead a national and global movement toward sustainable farming and development in the 21st century. Alternatively, they could be what much of the world already fears they are – a key driver of the destruction of the Amazon and Cerrado and an agent of regional and global climate change.

In the past fifteen years, Mato Grosso's farms have helped make Brazil a global agricultural powerhouse, and improved the income, education and health of farmers and non-farmers alike. Unlike the giant farms of the United States and Europe, these farms have not left rivers choked with algae as a result of fertilizer pollution (at least, not yet). Wildlife teems where intact native ecosystems remain. Unlike previous Amazonian cycles of rubber, gold, and jute, this soy boom has not left a socioeconomic bust in its wake.

But these farms are still far from sustainable, either economically or ecologically. If sustainability is the goal, farmers must end deforestation (both legal and illegal) associated with soy production, and they must lead the charge to produce more food on less land.

In 2006, soy producers agreed to a moratorium on illegal deforestation for soy production. Mato Grosso's Amazon was one of the world's deforestation hotspots. To their credit, the moratorium slowed Amazon forest clearing considerably. Any backsliding on the moratorium would be a deathblow to sustainability.

Furthermore, the moratorium is not enough, because farmers can still legally clear forest on their land, and are doing so rapidly in the Cerrado, even as deforestation rates have slowed somewhat in the rainforest. While it may be

possible for farms to continue to expand onto degraded pastures, the legal clearing of native forest and savanna must stop, or the farms will sow the seeds of their own destruction.

This dire prediction arises because the forests, cerrado, and the farms of Mato Grosso are linked. What links them is water. The intact ecosystems surrounding Mato Grosso's farms act as a giant pump, recycling the abundant rainfall so that it can rain again. Recent scientific studies show that the pump supplying Mato Grosso's soy farms is particularly at risk if clearing of forest and cerrado continues. In addition, water that does not go back to the atmosphere through the vegetation pump rushes down rivers, causing flooding of communities and reservoirs choked with soil.

If deforestation continues apace, rainfall in Mato Grosso may drop 10-15% or more, mostly because of a longer dry season. A longer dry season will make it harder to grow two crops a year. But this "double cropping" brings the largest economic and social benefits. Thus the link between farm and forest will become more important, and tenuous, if clearing continues. The only path to sustainability, economic or ecologic, lies in the preservation of enough of Mato Grosso's, and the region's intact forests and savannas to keep disruption of water cycles to a minimum.

There is a related barrier to sustainability – how to manage animal and crops on the smallest amount of land. Currently, soy produced in Mato Grosso goes to feed animals, but those animals are mostly in Europe and China. At the same time, Brazil's vast cattle herd, over 200 million head, grazes on land separate from its massive farm fields. This separation of crops and animals is increasingly the trend in much of the world. This leads to pollution of rivers where animals are fed, and the need to heavily fertilize farm fields to replace the nutrients lost in animal excrement.

Putting animals back on the farm in a way that does not cause additional deforestation would make Brazil a true leader on the path to sustainable farming. Scientists at EMBRAPA, Brazil's agricultural research agency, are already working to get animals back on farms, even big farms. Some version of their program, Integração lavoura-pecuária, will need to be adopted globally. Federal and state governments should accelerate these programs, investing in training of personnel and financial incentives to offset the potentially lower profits relative to soybean-only production systems. Smart integration of animals and crops, one that leads to more food production on less land, could show the world that food production and forests are compatible. It would be one of the most important achievements of the 21st century, and Brazil could be the leader of this innovation for both the economy and the environment.

Will Brazil's soybean farms be the first industrial scale operations to reintegrate animals in the production system? Coupled with bringing deforestation rates (legal and illegal) to zero, these steps would make Mato Grosso's farms a beacon of hope and a stellar model in the quest to sustainably feed a global population of 9-10 billion by mid century. Without them, they will be yet another short-term economic gain for a few at the long-term expense of people and the environment.

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