


NTS Insight October 2010

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Can Asia Learn from Brazil's Agricultural Success?

Over the last four decades, Brazil has transformed its agricultural sector to become the first tropical agricultural giant and the first to challenge the dominance of the world's major food exporters. This paper examines the secrets of Brazil's success and ponders whether Asia should try to emulate the Brazilian model to help achieve food security for its people and contribute to an increased level of self-sufficiency in the region.

By Margarita Escaler and Paul Teng.



Coffee trees cultivated under irrigation in Brazil's *cerrado* farms.

Credit: Anderson Galvao

An article on Brazil's agricultural miracle which appeared in the 26 August 2010 edition of *The Economist* begs the questions: can Asia learn from Brazil's agricultural success? Should Asia try to emulate the Brazilian model of agriculture to help feed its people, or could it do so even if it wanted to? The Brazilian success highlighted in the article further suggests that it is time to re-examine the paradigm which has dominated food security discussions, i.e., that increasing productivity is the only way to ensure that there is sufficient food to feed the future global population. Most serious workers in the field recognise that growing more food from the available arable land area is a must. However, Brazil's success at putting new land into production seriously changes the food supply equation. The question which has to be asked then is: where else can land which is currently not farmed be put into food production without sacrificing the goals of conserving wild species and preserving pristine natural areas?

Before attempting to answer these questions, let us first look at some of the features of Brazilian farming and retrace the steps of its remarkable transformation over the last four decades.

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Brazil is endowed with a number of resources that allows for a successful agricultural sector. First, Brazil has more spare farmland than any other country. According to the Food and Agriculture Organization of the United Nations (FAO), Brazil has around 400 million hectares of potential arable land – as much spare farmland as can be found in the next two countries combined (the US and Russia) – and only 50 million hectares are being used. Suffice to say, the potential for growth is enormous. Capital-intensive large farms are already producing 76 per cent of its total farm output. Second, Brazil is home to the world's largest reserves of renewable fresh water. It has more than 8,000 cubic kilometres of renewable water each year, easily more than any other country (Bruinsma, 2009). With a population of 190 million, it has as much renewable water as the whole of Asia with a population of 4 billion. Third, Brazil has a favourable climate for agricultural production. Fourth, Brazil has cheap labour. The last factor – which many believe is the primary reason for the extraordinary growth in Brazilian agriculture – is significant investment in research and innovation through Embrapa, the Brazilian Agricultural Research Corporation. Embrapa has been credited at home and abroad for raising the country to its position among the top agricultural producers in the world.

Brazil is now the world's largest producer of coffee, oranges and sugar cane. It is also the largest beef and poultry exporter. It is the second-largest grower of soybeans, and the fourth for corn. And it is growing faster than its competitors. Amazingly, Brazil has achieved this success without much government subsidies. According to the Organisation for Economic Co-operation and Development (OECD), state support accounted for only 5.7 per cent of total farm income during the period 2005–2007 compared with 12 per cent in the US, an average of 26 per cent in OECD countries and 29 per cent in the European Union (EU).

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The Role of Research and Innovation

Embrapa's main achievement since its establishment in the 1970s has been the transformation of the *cerrado* (Brazil's savannah), which today accounts for 70 per cent of Brazil's farm output. When Embrapa was first started, the *cerrado* was considered unfit for farming as the soils were too acidic and too poor in nutrients. Embrapa did four things to change that. First, it applied lime (pulverised limestone or chalk) to soils to reduce acidity. Scientists also bred varieties of *Rhizobium*, a bacterium that helps fix nitrogen – i.e., convert nitrogen into ammonia – in legumes and which works well in the soils of the *cerrado*, thus reducing the need for fertilisers. Second, Embrapa imported from Africa a grass called *Brachiara* which, with additional traditional cross-breeding,



resulted in a new variety of grass that produced 20–25 tonnes of grass feed per hectare, many times more than what the native *cerrado* grass produces and three times the yield in Africa. This paved the way for the *cerrado* to be turned into pasture thus expanding Brazil's beef sector. Third, Embrapa turned soybean, which is normally a temperate-climate crop, into a tropical crop by traditional cross-breeding. More recently, Brazil has also been importing genetically modified (GM) soybean and is now the world's second-largest grower of GM soybean after the US. And this year, Embrapa won approval for its first very own GM soybean seed. The company has also created varieties of soybean that are more tolerant to acidic soils and that have shorter growing cycles, thus allowing for the growing of two crops a year. Lastly, Embrapa has pioneered new farm techniques such as 'no-till' agriculture, in which the soil is not ploughed nor is the crop harvested at ground level. It has also initiated what it calls forest, agriculture and livestock integration, a system whereby there is a rotation of crops and livestock in the fields with trees planted in between for cattle to forage (The Miracle of the Cerrado, 2010). In brief, having spent years increasing production and acreage, Embrapa is now looking at new ways to increase the intensity of land use so as to feed more people without cutting down forests.

Credit: Anderson Galvao

Many may argue, however, that Brazil's agricultural success has come at the expense of the environment. Activities such as cattle ranching have been widely blamed for the further deforestation of the Amazon rainforest. Like the rainforest, the *cerrado* is one of the oldest and most diverse tropical ecosystems and is under threat because of the country's agricultural growth. Over 37 per cent of its original vegetation cover has disappeared due to activities such as farming and agriculture (Conservation International, n.d.). Whether these trade-offs are justified is still subject to intense debate. Nevertheless, the fact remains that in less than 30 years, Brazil has turned itself from a food importer into one of the world's great bread baskets. Brazil has become 'the first tropical agricultural giant' and the first to challenge the dominance of the 'big five' food exporters (the US, Canada, Australia, Argentina and the EU).

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Does Asia Have What It Takes?

Having identified just some of the key ingredients of Brazil's agricultural success, the question is: can countries in Asia follow in Brazil's footsteps? Do they have the same assets such as spare land, abundant water resources, a favourable climate, cheap labour, a positive policy environment and more importantly, a vibrant research and development sector? The following paragraphs explore these points one at a time.

Unlike Brazil, which alone has around 400 million hectares of potential arable land, there is virtually no spare land available for agricultural expansion in South Asia and only a limited amount in East Asia, mainly in China and Indonesia (approximately 130 million hectares). Further, much of this spare land may lack infrastructure, be partly under forest cover or in wetlands which should be protected for environmental reasons, or the people who could exploit it for agriculture lack access to appropriate technologies or the economic incentives to adopt them. In South Asia, it is estimated that some 45 per cent of land with crop production potential (but not yet in agricultural use) is occupied by human settlements. Population growth and further urbanisation will undoubtedly continue to be significant factors in reducing land availability for agricultural use in the region.



Cotton fields in Brazil's *cerrado* farms.

Credit: Anderson Galvao

Aside from limited potential for cropland expansion, Asia has a unimodal land distribution which is dominated by smallholders. It is estimated that 87 per cent of the world's 500 million small farms (defined as those less than 2 hectares in size) are in Asia (Thapa, 2009). China and India account for 193 million and 93 million small farms respectively. The average size of actual area cultivated is only 0.5 hectares in Bangladesh and China, 0.8 hectares in Nepal and Sri Lanka, and 1.4 hectares in India. About 81 per cent of farms in India have land holdings of less than 2 hectares while in China, the figure is 95 per cent. This is in stark contrast to Brazil which has a bimodal land distribution where the majority of farms are small but where most of the land is occupied by large farms; the average farm size in Brazil is around 73 hectares (Thapa, 2010). Another difference between Asia and Brazil with respect to farm size is that the overall trend in the former is that of declining farm size over time while in the latter, the opposite trend is being observed. In Brazil, farms are getting bigger thus allowing for more efficient farming systems.

As for water, Brazil's renewable water resources dwarf those of any country in Asia. Although East Asia, particularly China and Indonesia, have significant renewable water resources with potential for further irrigation development, South Asia is reaching alarming levels of water scarcity and the situation is likely to worsen as a result of climate change. During the period 2005–2007, South Asia used almost 40 per cent of its water resources for irrigation. Some national figures may give an overly optimistic impression of the level of water stress as the figures do not reflect regional disparities. For example, China is facing severe water shortage in the north while the south still has abundant water resources.

The climate in Asia, compared to that in Brazil is extremely variable. Asia is one of the most disaster-prone regions in the world. According to one estimate, 80 per cent of all natural disasters worldwide occurred within Asia and the Pacific (UNEP, 2004), and climate change has aggravated the situation. The increasing frequency and intensity of extreme weather events, such as heat waves, droughts, floods and tropical cyclones are already wreaking havoc in the region. Floods are a normal occurrence for the people of South Asia with some of the worst monsoon flooding in recent memory affecting over 50 million people in India, Bangladesh, Pakistan and Nepal; destroying croplands, livestock and property; and raising fears of new health crises in the densely populated region (Extreme Weather, 2007). Meanwhile, Southeast Asia is also one of the world's most vulnerable regions due to its long coastlines, high population density and economic activity in coastal areas, and heavy reliance on agriculture, natural resources and forestry.

When it comes to the agricultural labour force, no region in the world can match Asia's numbers. Asia dominates the regional distribution of economically active population in agriculture with almost 80 per cent (1 billion) of the world's total (1.3 billion), followed by Africa with 14.3 per cent, Latin America with 3.6 per cent and the rest of the world with 3.7 per cent (FAO, 1996). Two countries alone, China and India, account for over 60 per cent of the world's agricultural labour force and 78 per cent of the total for Asia.

With regard to agricultural and economic policies, how do Asia's compare to those of Brazil or the rest of Latin America? Although overall gross domestic product (GDP) growth rates in East and South Asia have outpaced those of Latin America in recent decades, the picture for agricultural growth shows a different story. From 2000 to 2008, Latin American countries outperformed countries in South Asia and almost equalled those in East Asia in terms of agricultural GDP. These countries' robust performance in the agricultural sector is due to major economy-wide policy reforms in the last two decades which centred on macroeconomic stabilisation, trade liberalisation, deregulation and some privatisation (or abolition) of state agencies (Anderson and Valenzuela, 2010). There was a considerable reassessment of the role of government in guiding economic development. These reforms created a better climate for productivity and private investment in all

economic sectors, including agriculture, which enhanced competitiveness and led to greater integration with the world economy. Brazil, in particular, benefited greatly from these reforms. Instead of trying to protect farmers from international competition, the reforms opened up the country to trade and allowed its more capital-intensive larger farms to compete in the world market, thus letting inefficient farms go out of business. However, many believe that because of unequal asset distribution, growth in Brazil and the rest of Latin America has not been favourable to the poor.

Asia, on the other hand, consists of a mix of economic and development models and it is difficult to speak of a single 'Asian model'. East Asia, particularly South Korea, Taiwan, China and later on Vietnam, commenced economic liberalisation with agricultural and land reforms (Kay, 2001). In South Korea and Taiwan, agrarian reform came before any significant industrialisation had taken place and was a key ingredient in the success of the subsequent industrialisation process. Land reform was not considered a prerequisite for industrialisation in Latin America while in Taiwan and South Korea, it was a major factor in initiating the industrialisation course. These reforms included the decentralisation of agricultural production systems and the liberalisation of pricing and market systems. There was also significant investments in agricultural R&D and rural infrastructure in these East Asian countries.

Moving onto South Asia, we see another picture emerging. India, which is often described as a lumbering elephant compared with the tigers of Southeast Asia (such as Malaysia and Thailand) and the dragon of East Asia (China), has also had significant agricultural reforms but implementation has proven to be politically difficult and the pace of its reforms has been much slower (Landes, 2004). India's agricultural sector suffers from under-investment and is heavily tilted towards subsidies. The heavy focus on the information technology sector, while resulting in significant economic growth for India, has not been effective in reducing poverty for the majority of India's agriculture-based population. According to the World Development Report 2008 which reviewed the development strategies of countries from all over the world, growth in the agricultural sector is at least twice as effective in reducing poverty compared to growth in the non-agricultural sector. In the case of China, it was 3.7 times more effective in reducing poverty (World Bank, 2007).

The final ingredient of Brazil's agricultural success is the substantial investment made in research and innovation over the last few decades by the state agricultural research company, Embrapa. Asia has also seen some well-managed and funded agricultural R&D systems that have produced world-class research, particularly in China and India (Beintema and Stads, 2010). In 2002, the entire region as a whole (excluding its high-income countries such as Japan and South Korea) spent US\$6.2 billion (in 2005 prices using the purchasing power parity, or PPP, exchange rate) on agricultural R&D (compared to Brazil's US\$1.3 billion in 2006), and China and India accounted for nearly 70 per cent of this total (US\$3 billion and US\$1.4 billion respectively). Other smaller countries in Asia, such as Malaysia and Vietnam, also realised impressive growth in agricultural R&D spending in the last two decades, whereas spending in Pakistan, Indonesia and Lao PDR was sluggish and at times decreased due to the 1997 Asian financial crisis, the completion of large donor-financed projects or high rates of inflation.

While Asia boasts surpluses of rice, fish, fruit, sugar and vegetable oil, it still has to import a significant amount of maize, wheat, soybean, meat, dairy and vegetables. Thus, the region could stand to benefit from increased research and innovation in the production of any one of these commodities. One research area in which Asia could benefit from Brazil's expertise is in the development of tropical varieties of soybean. Soybean, a temperate-climate crop is native to Northeast Asia where there are four distinct seasons. Indonesia, in particular could benefit from raising the productivity of soybean as well as planting soybean on more land since its two favourite processed foods, tofu and tempeh, are made from it. Domestic demand for the crop was 2 million tonnes in 2009, making the nation a net importer, mainly from the US and Brazil (Ekawati, 2009). Another area of research which could benefit Asia is the development and planting of GM crops. At present, there are only four countries in the region actively growing GM crops, i.e., Australia, China, India and the Philippines, although significant research is taking place in both the private and public sectors within the region. However, a word of caution about Brazil's agricultural success is in order. It did not happen overnight through a simple technological fix. Rather, Embrapa used a 'systems approach' – with the various interventions complementing one another. 'Improving the soil and the new tropical soybeans were both needed for farming the *cerrado*; the two together also made possible the changes in farm techniques which have boosted yields further' (The Miracle of the Cerrado, 2010).

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No One Size Fits All

It is clear from the above that the Brazilian agricultural model would be difficult to export to Asia as it is. With its highly diverse geography, culture, politics, history and not to mention its different economic and agricultural development pathways, Asia would have to create its own distinct models by taking parts of the Brazilian model and adapting them to local conditions. No one agricultural model fits all but there are certainly many opportunities for mutual learning and cooperation. Brazil's agricultural development pathway has many features that could be adopted and adapted by Asia, particularly in terms of ways to bring in new land into crop production without sacrificing conservation goals or indigenous people's rights, or to harness science and technology to increase agricultural productivity.

A bigger issue of course is whether in an increasingly globalised food supply chain, it would make any sense to focus on substitution of food imports into Asia, particularly those food products currently sourced from the big net food exporters outside the region. The answer to

this question lies in the need to address the employment and livelihood aspects of the 435 million small farmers in Asia, and implicitly, the fate of the rural poor. Improved agricultural productivity from new research and innovation, leading to improved economic status for small farmers and an increased level of food self-sufficiency in the region may prove to be the Asian counterpart of the Brazilian success story, especially in countries such as China, Indonesia, India and the Philippines.

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