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## **Brazil: A Country of Contrasts**

Brazil is a country of enormous contrasts – large economy experiencing enviable growth and vast supply of natural resources amid squalid poverty that is crippling sectors of its society and growing gap between its rich and poor. Brazil is a leader in biofuel production. It is an important producer and exporter of many agricultural products including sugar, ethanol, beef, poultry meat, coffee, orange juice, and tobacco (15). It exports agricultural and food products, such as soybeans, pork, and poultry to most countries of the world, including large markets in the European Union (EU) and the United States. Brazil's agro-food sector accounted for over two-thirds of its total trade surplus in 2005. At US\$27.5 billion, its agro-food trade surplus is the largest in the world (15). In contrast, Brazil imports significant portion of food grain staples such as wheat, corn and rice for domestic consumption. The main factor contributing to these contrasts is the fact that Brazil's economic miracle engine is only benefitting a fraction of the Brazilian population – the urban elite in bigger cities. Today, a significant portion of the food export economy is handled by large farming corporations who represent only 15% of Brazilian farmers (15). The other 85%, mainly subsistence family farmers, are being left behind in this economic boom. Despite the industrialization of its agriculture, the majority of its farmers live and farm in dense forests, steep slopes and unfavorable land conditions using crude, traditional and subsistence methods. They have neither the means nor the resources to dig themselves out of this poverty to take part in the economic wealth of their city counterparts. If this disparity is not addressed, the unhappy majority could derail the country's economy and food security. Brazilian government and the food industry should balance their interests and invest significantly in appropriate scientific research into crop biology, sustainable agricultural systems and technologies for improving yields of food crops and not just cash crops. Appropriate scientific research will provide the Brazilian family farmers with the right combination of economic independence and food security, while preserving the biodiversity and natural resources of the landscape that enable this country to be the economic engine it is today.

The majority of the Brazilian poor lives in small villages and relies on agriculture. Approximately 21 per cent of the total population lives in rural areas, and the country has the largest rural poor population in the Western hemisphere (12). The major portion of the 4 million farms in Brazil are very small, and most are subsistence farms. Small subsistence farms far outnumber large plantations. Huge numbers of subsistence farmers make a living by working as day laborers in agriculture to supplement the inadequate production on their land. Typical farm families eat basic staples, such as maize, rice, manioc and cassava, supplemented with fish and meat in some areas. The surplus produce is sold in the local markets. The value of their products being sold at the local markets, essential for their subsistence, is being diminished by cheap imports (16). With very limited access to technology, and poor infrastructure such as electricity and transportation, poor communities struggle to supplement farming incomes through low-wage labor and small-scale enterprises such as handicrafts. The largest concentration of rural poverty, mainly in the form of landless and subsistence farmers, is in the North-East region, the poorest and least developed region in Brazil. Adverse climatic conditions and lack of arable land lead these farmers to practice "slash and burn" cultivation, further depleting the natural resources, destroying habitats and damaging biodiversity. In addition, lack of public assistance services to improve agricultural yield and productivity have led to the migration of large numbers of farmers to urban areas, mainly to big cities in south-eastern Brazil. In recent times, another attraction for these migrants is the prospect of working in mechanized commercial farms of the agribusiness corporations. But, the wages that these jobs provided are very low, and the only thing that migration has led to is a loss of rural development. The most vulnerable groups among Brazil's rural poor people are women, children and ethnic minorities. . When their husbands migrate to other parts of the country in search of seasonal work,

women are left with the responsibility for running the family farm as well as the household. This has led to 27% of rural households being headed by women (12). The many forms of discrimination against women often worsen poverty in these households. On the whole, lack of access to formal education, skills training, limited access to essential infrastructure, markets, and to appropriate technologies inhibit the subsistence farmers' capacity to raise their families with a reasonable standard of living.

Brazil's disparity in wealth comes from the fact that the large agribusiness sector contributes to most of its wealth. Consequently, the big corporations and people associated with the big corporations attract the largest amount of government attention and privileges. Even though Brazil has one of the most developed economies in Latin America in terms of agricultural and biotechnology research, the majority of the research, if not all of it, is done in the private sector and directly benefits the interest of agribusiness. This situation deprives the subsistence family farmers of taking part in the economic boom, and they continue to persist in their poverty, toiling long hours with low wages and minimum benefits to show.

Biotechnology is the collection of techniques that use living organisms or substances from these organisms to make or modify a product for practical purposes. It can be applied to all classes of organism - from viruses and bacteria to plants and animals - and is one of the major features of modern agriculture and industry. Modern agricultural biotechnology includes a range of tools that scientists employ to understand and manipulate the genetic make-up of organisms for use in the production or processing of agricultural products. Currently, the predominant biotechnology research in Brazil is part of the "Gene Revolution", a body of research primarily conducted in the private sector to benefit agribusiness. It focuses on important cash crops like corn, sugarcane, and coffee that form the major source of export and, thus foreign exchange reserve for Brazil. As opposed to this "Gene Revolution", the Green Revolution taught us that technological innovation - higher-yielding seeds and the inputs required to make them grow - can bring enormous benefits to poor people through enhanced efficiency, higher incomes and lower food prices. Biotechnology should form part of an integrated and comprehensive agricultural research and development program that gives priority to the problems of the poor. Additionally, biotechnology should complement but not substitute for research in other areas such as plant breeding, integrated pest and nutrient management, and livestock breeding, feeding and disease management systems (13). Public-sector research that focuses on generating technologies that produce the Green Revolution should become a national priority for the Brazilian government. It should provide incentives, institutions and an enabling environment for public-sector and private-sector agricultural and biotechnology research, development and deployment. Public-private partnerships and other innovative strategies to mobilize research and technology delivery for the poor should be encouraged. This includes research on the crops that provide the bulk of the food supply and livelihoods: rice and wheat. In addition, research should extend to a variety of so-called "orphan crops" such as sorghum, pearl millet, pigeon pea, chickpea and groundnut to sustain and improve the biodiversity that exists in the Amazon (7). This research should focus on traits of particular interest to the poor, such as resistance to production stresses like drought, soil erosion, disease and pests, as well as nutritional enhancement.

Tropical forests cover only 7% of the Earth's surface, and contain almost half of the world's biodiversity (5). The consequences of tropical deforestation therefore results in extensive losses in biodiversity. Brazil contains the largest expanse of tropical forest in the world. Brazil, along with Indonesia, account for over a third of tropical forests in the world. It is also one of seven countries that contribute to over half of the world's global deforestation. Between 1991 and 1996, Brazil lost about 1.8 million hectares per year due to deforestation, which is approximately 0.4% of the whole Amazon rainforest (5). The majority of this deforestation occurs along the exterior border of the rainforest where more and more land is reclaimed for cultivation. As the tropical forests disappear, the research into sustainable agricultural activities and promotion of these activities become exceedingly important.

The adoption of sustainable agricultural activities such as intercropping, agroforestry, and wetland draining, can help reduce deforestation. Many subsistence farmers use Slash and Burn techniques to increase their land available for cultivation little realizing that this kills their land's productivity (4). Brazilian Government programs relocated temperate farmers to tropical areas, who then continued to use their temperate farming practices in the tropical areas. Unlike temperate areas, which contain the nutrients in their soil, tropical areas contain all of their nutrients in the leaf litter and topsoil. So, when farmers use the Slash and Burn technique that destroys all trees, the nutrient-rich topsoil and leaf litter gets washed away by subsequent heavy tropical rains making production of many agricultural crops difficult and unsustainable. When all the nutrients are washed away, it only leaves very poor soil for cultivation of crops, such as rice, beans, corn and peppers. Trees with their spreading root system are an essential part of tropical agricultural systems. This is one of the major problems contributing to deforestations and it also reduces the yield of subsistence farms.

Agroforestry, which incorporates trees and perennial crops with the production of annual crops, is a sustainable form of agriculture in the tropics that will help this situation. Agroforestry or intercropping is a farming technique that requires only small amounts of forest to be cut down for crop cultivation. The regular annual crops are planted along with trees. The intercropping of annual and perennial crops between standing trees is necessary to sustainably produce crops. Trees provide nutrients through leaf litter cycle and the perennials prevent the rain from washing away the nutrients in the topsoil (5). If we contain the deforestation, the need to migrate into interior Amazon will be reduced, thus leaving the rainforest and its resources intact.

More research into agroforestry will provide the subsistence farmers with the tools they need to make better decisions. In the absence of knowledge and technology, they continue to toil long hours for meager income and persist in the cycle of poverty. Research could be done to find which crops fare well in the intercropping scheme and which are more profitable, higher-yielding, and manageable. This will help the farmers adopt agrocropping without the fear of losing the current income, however meager it is.

“Drained field agriculture” could benefit the small subsistence farmers in the economically disadvantaged northeastern area of Brazil. To start with, more research and survey needs to be done in identifying the wetland areas. The Brazilian semiarid region has a many intermittent shallow lakes. Some states have many more of these lakes than others. In Latin America, drained field agriculture was a highly developed form of sustainable agriculture used by the Mayans (6). While paddy rice, corn and other such crops would be detrimental to the environment in the semiarid regions, other high-value vegetable crops such as beans, papaya, chili pepper, tomato, manioc and maize are all crops normally grown for home consumption by the local people (6). Thus, the crops grown with the 'new technology' will be acceptable to the local community. While this method seems promising towards aiding development of sustainable agriculture, more research needs to be done to make sure that the new method will provide higher yields than the conventional farming methods. In addition, more research needs to be done concerning the type of crops that will be suitable and sustainable for the local people.

Brazil is one of the leaders in the biofuel industry. It is the world's second-biggest producer of ethanol after the United States. Brazil is also the world's biggest ethanol exporter. Additionally, the country has taken a lead in producing soybean-based biodiesel. Eight out of ten Brazilian cars run on ethanol, which emits far less greenhouse gases than fossil fuels (2). In continuation of its story of contradictions, this very success also has led to a host of social and environmental problems. Brazil's main feedstock for ethanol is sugarcane. While sugarcane cultivation is minimal now in the Amazon, some environmentalists fear growing demand for the fuel could push cane growers into the Amazon, which has been losing forest to make way for agriculture in the recent years. The Amazon region, which covers nearly 60 percent of Brazil, has lost 20 percent of its forest — 1.6 million square miles (4.1 million square kilometers) — to development, logging and farming. Since sugarcane

plantations require greater infrastructure for growing, harvesting and transportation, they are taking up more and more of farmland in Brazil's south and central regions and this is pushing soybean growers into the Amazon. "While the whole process of alcohol fuel is less damaging to the climate than fuel from gasoline or oil, what can be positive for the environment can turn negative depending on the extension of the plantations," says Paulo Adario, director of the Greenpeace's Amazon Campaign (2).

Reports indicate that Brazil's biofuel market suffers from poor regulatory structure and a lack of long-term planning. "The industry is growing faster than a sustainable rate. That is why prices are falling so much," said Plinio Nastari, president of Datagra consultancy (2). Sugar and ethanol prices have fallen around 35 percent since the beginning of the 2007/08 cane crop, and the drop's effect on the industry is raising concerns also in government. Unchecked and unplanned expansion in the biofuel industry might lead to oversupply and subsequently, a decrease in ethanol prices in the international market. "I think there is still not any (international ethanol) market. We're all working irrationally. There is not any strategy either from the private sector or from the government," said Roberto Rodrigues, director for the Inter-American Ethanol Commission (2). Brazil has hedged its bet on the ethanol market at the expense of subsistence farming and indigenous farming communities. If the market does not absorb all of Brazil's production, then all the investments in the commercial agro sector will be wasted, and consequently, threatens food security for Brazil's poor subsistence farmers.

Until now, Brazil has relied entirely on sugarcane as its feedstock for biofuel – sugarcane is not an indigenous crop and takes much care and space to grow. However, if the focus was changed to biodiesel and cellulosic ethanol, then there could be a significant role for subsistence farmers. Since most subsistence farmers live in rural areas and interior Amazons, any biofuel related research into plants that grow natively in those areas will benefit the farmers. They could cultivate the crops easily in their family farms, and make a profit. Some native species, such as Babacu (*Attalea speciosa M.*), Buriti (*Mauritia flexuosa*) and Tucuma (*Astrocarium asculeatum*) show promise as potential feedstock for biodiesel (10). African palm and Castor are two other non-native species that show biofuel potential for the family farmers working in degraded land (10). Intensive research is necessary to develop commercial production. This will help create jobs and income in the poorest regions of the country, especially in the northeastern semi-arid region.

The United Nations and other organizations do have a role to play in conserving Brazil's treasure trove of natural resources. As an example, The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has created a new biosphere reserve in Brazil's Pantanal region, the planet's largest tropical wetland ecosystem(3). Biosphere reserves are protected ecosystems where priority is placed on conservation, research and sustainable development. While this doesn't mandate any action from local governments, it raises the awareness among local and international communities. This new status is expected bring fresh funding for research and conservation.

Subsistence farmers in the semi-arid regions of Brazil will benefit from research by scientists of the Consultative Group on International Agricultural Research, who are developing new breeds of crops and animals that grow faster and stronger, need less water, and are genetically selected for high levels of nutrition (17). CGIAR's research has led to many new hybrids and agricultural techniques that have empowered small farmers in three continents. Hardy varieties of cereals (barley, sorghum and pearl millet) and legumes (groundnut, lentil, fava beans and chick peas), water supplementary irrigation and biological pest control are some of the results of the research (17).

In the savannahs of the Brazilian Cerrados, soybean monoculture created many problems associated with land development. In 1994, NGOs and national government and international researchers launched an initiative to help conserve the Cerrados. This effort has led to "Zero Tillage" expansion

which has delivered many agricultural services to family farmers and has helped family farmers take charge of the land(8).

Brazil's future depends on a balanced economy and ecosystem. Today, it is world's 11<sup>th</sup> largest economy(15). Its biofuel industry is enviable in its growth and reach. However, this seemingly exclusive attention to commercial agriculture, big agro-industry corporations, and the push to export without consideration of its vast millions of subsistence farmers and their livelihood could endanger its own food security and natural environment. What if the demand for biofuel does not pick up in export markets? What if every country in the world wants to develop its own biofuel so it can be energy-independent? Where does that leave Brazil and its export over-supply if it continues to invest in commercial agriculture and biofuel products to the exclusion of its own food production? The large farm holdings are exclusively devoted to commercial crops while indigenous farmers grow food crops in their small family farms. Without major investments into scientific research that will benefit the poor subsistence farmers, Brazil will continue to rely on imports for its food staples. The subsistence farmers, lacking adequate wealth and purchasing power, will continue to suffer from lack of food security. Brazil has enough wealth to invest in public-private collaborative research to help this situation. It can and should bring about the Green Revolution to the masses. Biotechnology research focusing on traits of particular interest to the poor, conducting agricultural research to identify crops suitable for intercropping and ways of preventing deforestation, research into producing biodiesel using native plants are activities that will bring wealth to the subsistence farmers. With its experience in commercial agro industry, Brazil does have the means to do this. Does the government have the will? It is true that Brazil is a country of contrasts, but, effectively combined, these contrasts could form one strong union.

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