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Lecture

Environmental and Agronomic Issues of Genetically Engineered Soy in South America

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Of all human activities, farming presents the greatest conflict between satisfying our basic needs and maintaining the sustainability of the natural environment. Some types of farming impact the environment more than others. For several thousands of years in Latin America, highly diversified ecological farming systems evolved that fostered the sustainable use of resources. Different cultural groups developed various complementary cropping methods: maize, beans and squash in Central America; tubers, roots and maize in the Andes; and camote and yucca in the Caribbean. These practices have been progressively undermined by the influence of colonization, modernization and globalization, which have replaced them with systems that encourage **extractive processes and the mining of resources. Latin America's natural and human resources could sustain its own long-term development**. Some 23 percent of its land is suitable for farming and another 23 percent is tropical rainforest (almost half the world's tropical rainforests are found in Latin America). Some 13 percent of the surface area is grassland and the region holds 31 percent of the planet's available fresh water. Furthermore, it is home to rich reserves of renewable and non-renewable energy, and the wealthiest biodiversity on the planet. Of the twelve so-called 'mega-diversity' countries, five are in Central and South America: Mexico, Colombia, Ecuador, Peru and Brazil. Nevertheless, that wealth has not created the quality of life or environment for Latin America's peoples that it should. This is because governments have focused on a defective development model that has excluded the majority of people, especially over the last thirty years.

During this period, the agricultural sector - one of the most promising productive sectors of the region - changed dramatically. Large-scale, export-oriented production requiring the intensive use of chemical inputs started to dominate the agricultural landscape. **This Green Revolution-style approach to farming started to suffocate the diversified local and self-sufficient farming practices of small and medium-sized farmers. Traditional campesino (peasant) culture had demonstrated a high degree of sustainability within its own historical and ecological contexts, and fulfilled the vital needs of the population even under adverse environmental conditions.** Farming practices were built on sophisticated social, geographical and cultural frameworks, appropriate processing technologies, and a precise knowledge of resources, consumption and labour habits, all adjusted to the conditions of each locale. These diverse farming systems fed millions of Americans five hundred years ago. Today they are largely relegated to the poorest ten percent of agricultural land, yet they still generate 40 percent of the region's livestock and agricultural produce. In Central and South America, campesinos comprise up to 80 percent of the rural producers, and they supply 51 percent of the most important grain harvested in the region: maize. In at least seven countries (Brazil, Chile, Colombia, El Salvador, Guatemala, Mexico and Paraguay), campesinos are primarily responsible for their own food security. Nevertheless, their farming methods - so successful from a social and environmental point of view - have not received the support or the official backing of the governments.

Since the mid-nineties, South America and Argentina initially, were confronted with a **new twist to the Green Revolution model**, with the introduction of genetically modified (GM) crops. Transgenic soybean is the flagship of this transformation. The GM Revolution extends the logic of the Green Revolution from controlling the inputs (seeds and chemicals) to controlling the whole chain of agro-industrial activities from seed to supermarket packaging. **New technologies, regulatory measures, patents, commercial agreements, cheaper lands and territories, new global demand for feeding animals and biofuels, were the keys to**

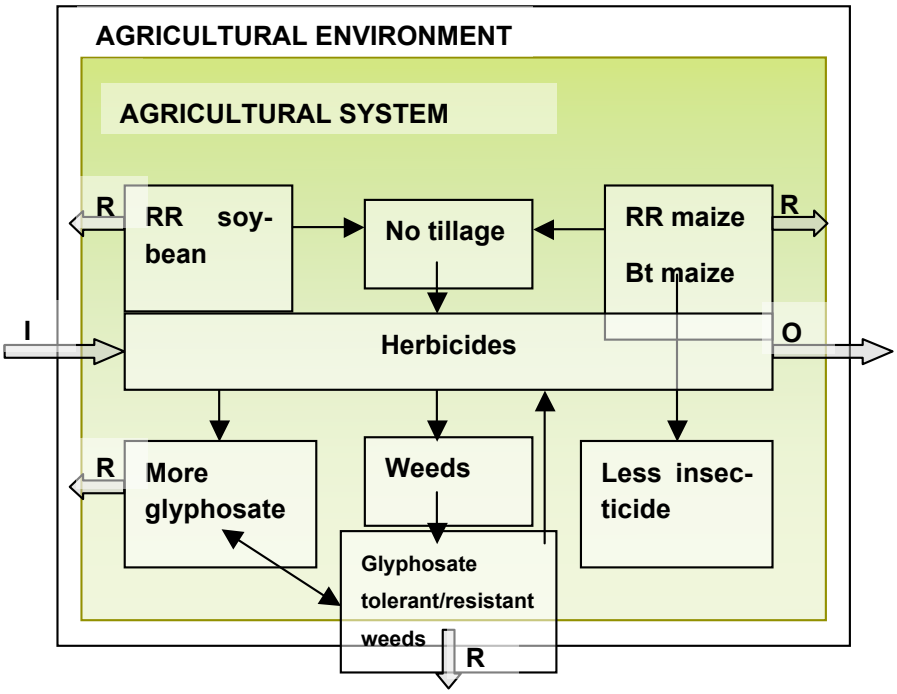
introducing GM products in South America. Argentina has allowed the most extensive introduction of transgenic crops and has rushed through oversight mechanisms for genetically modified organisms (GMOs), via its governmental agencies and private sector. Similar agencies have been set up in Brazil, Uruguay, Bolivia and Paraguay. Most of them have been more involved in matters regarding the promotion of the new technologies than with their regulation, largely ignoring integrated social-environmental impact studies. There have been no instances of broad-based public participation, nor are the decisions of the agencies subject to review by independent researchers. Argentina was the spearhead of this agricultural transformation, with the releasing of transgenic soybean resistant to glyphosate (Roundup) in 1996. **For the farmers, Round-up Ready (RR) soybean came up with a solution for one of the main problems in farm management, namely weed control.** With "only one herbicide", farmers could control a broad spectrum of weeds (including the most conspicuous weed problems (such as *Sorghum halepense*, *Cynodon dactylon*, *Cyperus rotundus* or *Chenopodim album*) and, at a very low cost. A cost reduction in the herbicide price, less fossil energy consumption and simple application made the offer of the technical package very attractive. The other aspect of this model presents **no tillage** as a unique alternative that avoids the ploughing of the soils and gives more time for the acceleration of agricultural alternatives, giving the farmers three harvests (RR soy/wheat/RR soy) every two years. The rural and natural environment is under this process and an important portion of the country is being transformed in a cluster productive of commodities, especially cake, oils and soy beans. The shift in production systems has resulted in the **agriculturization phenomenon**. That is, the displacement of cattle production to marginal areas and the concentration in the use of land for agricultural production, with a main crop at the centre of the model – transgenic soybean. It is associated with the agricultural management implementation of 'technological packages' and land concentration of the Pampean and extra-Pampean regions. This has meant significant changes during the last 15 years in the agrarian structures and technologies and has resulted in the expansion of monocultures that substituted previous rotation systems of crops and pasture lands (a historical agronomic way of production under rotation of cattle and soy production, that allows a "sustainable agriculture" during the short agricultural history of South America). The expansion of this model has been spread not only in the Pampas (55,000,000 hectares of the richest soils in the world), but also over other very rich areas with high biodiversity, opening a new agricultural border in important ecoregions such as the Yungas, Great Chaco and the Mesopotamian Forest.

The **dominant technology is monoculture glyphosate-resistant soybeans associated with no-tillage practices and the use of glyphosate** (see figure 1). Of the total soybean production, 99 percent are genetically modified glyphosate-resistant soybeans. The simplicity of weed management under the glyphosate scheme allows farmers to manage more hectares and increase overall productivity and profitability based on a vertical integration model. In the extra-Pampean areas, with more complex environments, the system also implies a growing application of external inputs related to weed and pest control. Demand for new lands in this area implies a complete deforestation. Argentina is leading the rates of deforestation, 0.85 precent, superior to those of Africa (0.78 percent) or the average of South America (0.50 percent). The process, called "**pampeanization**", implies the importation of the technological, financial and agronomical model of the Pampas to another ecoregions, that in types of soils, biodiversity and climate are not the same, such as the Great Chaco (Paraguay, Bolivia and Argentina), the Yungas (Bolivia and Argentina), the Pantanal (Brazil), and the savannas (Pampas) (Uruguay).

In most countries, formal agricultural research has historically been linked with a process of technological modernisation and agronomical transformation that only benefited large-scale farmers. The research agenda of national agricultural research institutes - many of which have

now been privatised - focuses largely on extensive cropping for export markets. In the nineties, many of these institutes received the direct benefit of a small percentage of the resulting export sales, which further skewed their research priorities. In these agencies, as in the universities and public-private joint ventures, research was done “on demand”, which is dangerous territory for determining research and development policy. Very few and independent research was developed focussing on environmental, social or health issues related to transgenic releases. While Argentina, Brazil, Bolivia, Uruguay and Paraguay were advancing and allowing the release of transgenic soybean on their own territories, environmental impacts and social conflicts have started to appear and cannot be hidden. In the south centre of South America, environmental impacts have resulted: Deforestation of very high biodiversity areas, appearance of herbicide tolerant weeds (*Parietaria debilis*, *Petunia axilaris*, *Verbena litoralis*, *Verbena bonariensis*, *Hybanthus parviflorus*, *Iresine diffusa*, *Commelina erecta* and *Ipomoea sp,*) (Pengue 2004), appearance of herbicide resistant weeds (such as the case of *Sorghum halepense*) (Binimelis et al. 2009), soil depletion and virtual soil exportation (Pengue 2010), agrochemical contamination, soil structure degradation with potential desertification processes, and a lost of food diversity and food sovereignty are some of the consequences.

Figure 1. The agricultural environment and the simplication via RR soybean
I: input, O: output, R: resistance



Transgenic soybean is not a demand of the small farmers and peasants. The main demands of these millions of small farmers responsible for the majority of agricultural production in South America favour the implementation of agricultural policies that are consistent with and adequate for their own needs. Their message is simple: **the GM soybean developed to date does not provide solutions for the small family farm.** The evaluation of a new technology and its risks should involve providing complete information about all the possible alternatives, as well as a comparative analysis of the benefits, risks, means of distribution and the variety of alternatives. The evaluation should involve broad, complex and holistic criteria that our authorities and scientists in South America need to take into account and implement to change the environmental and health effects of the dark side of this agricultural history.

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