GM Soya Disaster in Latin America

Hunger, Deforestation and Socio- Ecological Devastation

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Hollow triumph of GM crops

In 2004, the biotech industry and their allies celebrated the ninth consecutive year of expansion of genetically modified (GM) crops. The estimated global area of approved GM crops was 81 million hectares, a growth of 15 per cent over the previous year. In 22 countries, they claim, GM crops have met the expectations of millions of large and small farmers in both industrialized and developing countries; delivering benefits to consumers and society at large through more affordable food, feed and fiber that require less pesticide and hence more environmentally sustainable [1].

It is difficult to imagine how such expansion in GM crops has met the needs of small farmers or consumers when 60 percent of the global area of GM crops is devoted to Roundup Ready herbicide- tolerant crops. In developing countries, GM crops are mostly grown for export by big farmers, not for local consumption. They are used as animal feed to produce meat consumed mostly by the relatively wealthy.

The new soya republics in Latin America

The Latin America countries growing soybean include Argentina, Brazil, Bolivia, Paraguay and Uruguay. The expansion of soybean production is driven by prices, government and agro-industrial support, and demand from importing countries, especially China, which is the world's largest importer of soybean and soybean products. The expansion is accompanied by massive transportation infrastructure projects that destroy natural habitats over wide areas, well beyond the deforestation directly caused by soybean cultivation. In Brazil, soybean profits justified the improvement or construction of eight industrial waterways, three railway lines and an extensive network of roads to bring inputs and take away produce. These have attracted private investment in logging, mining, ranching and other practices that severely impact on biodiversity that have not been included in any impact assessment studies [2]. In Argentina, the agro-industry for transforming soybean into oils and pellets is concentrated in the Rosario region on the Parana river. This area has become the largest soy-processing estate in the world, with all the infrastructure and the environmental impacts that entails.

Soybean deforestation

The area of land in soybean production in Brazil has grown on average at 3.2 percent or 320 000 hectares per year since 1995, resulting in a total increase of 2.3 million hectares. Soybean today occupies the largest area of any crop at 21 percent of the cultivated land. The area has increased by a factor of 57 since 1961, and the volume of production by a factor of 138. In Paraguay, soybeans occupy more than 25 percent of all agricultural land. In Argentina, in 2000, soybean cultivation area reached 15 million hectares and the total production was 38.3 million tonnes. All this expansion is at the expense of forests and other habitats. In Paraguay, much of the Atlantic forest has been cut [3]. In Argentina, 118 000 hectares of forests have been cleared in Caco State, about 160 000 hectares in Salta, and in Santiago del Estero a record 223 000 hectares. In Brazil, the cerrado and the savannas are falling victim to the plow at a rapid pace.

Expulsion of small farmers and loss of food security

Biotech promoters always claim the expansion of soybean cultivation as a measure of the successful adoption of the transgenic technology by farmers. But these data conceal the fact that soybean expansion leads to extreme land and income concentration. In Brazil, soybean cultivation displaces 11 agricultural workers for every one who finds employment in the sector. This is not a new phenomenon. In the 1970s, 2.5 million people were displaced by soybean production in Parana, and 0.3 million in Rio Grande do Sul. Many of these now landless people moved to the Amazon where they cleared pristine forests. In the cerrado region, where transgenic soybean is expanding, there is relatively low displacement because the area is not widely populated [4].

In Argentina, the situation is quite dramatic as 60 000 farms went out of business while the area of Roundup Ready soybean almost tripled. In 1998, there were 422 000 farms in Argentina while in 2002 there were only 318 000, a reduction of a quarter. In one decade, soybean area increased 126 percent at the expense of dairy, maize, wheat and fruit production. In the 2003/2004 growing season, 13.7 million hectares of soybean were planted but there was a reduction of 2.9 million hectares in maize and 2.15 million hectares in sunflowers [5]. For the biotech industry, huge increases in the soybean area cultivated and more than a doubling of yields per unit area are an economic and agronomic success. For the country, that means more imports of basic foods, therefore loss of food sovereignty, and for poor small farmers and consumers, increased food prices and more hunger [6].

Millions of hectares of Roundup Ready soybean were planted in Brazil in the period 2002-2003, while a moratorium was in effect. How did the big multinationals manage to expand cultivations of transgenic crop so extensively in developing countries? During the early years of introducing transgenic soybean into Argentina, Monsanto did not charge farmers royalties to use the technology. But now that farmers are hooked, the multinational is pressuring the government for payment of intellectual property rights, despite the fact that Argentina signed UPOV 78, which allows farmers to save seeds for their own use. Nevertheless, Paraguayan farmers have just signed an agreement with Monsanto to pay the company $2 per tonne.

Soybean cultivation degrades the soil

Soybean cultivation has always led to erosion, especially in areas where it is not part of a long rotation. Soil loss has reached an average rate of 16 tonnes per hectare per year (t/ha/y) in the US Midwest, far greater than is sustainable; and soil loss levels in Brazil and Argentina are estimated at between 19-30 t/ha/y depending on management, slope and climate. No-till agriculture can reduce soil loss, but with the advent of herbicide tolerant soybean, many farmers now cultivate in highly erodible lands. Farmers wrongly believe that with no till systems there is no erosion, but research shows that despite improved soil cover, erosion and negative changes in soil structure can still be substantial in highly erodible lands if weed cover is reduced.

Large-scale soybean monocultures have rendered Amazonian soils unusable. In areas of poor soils, fertilizers and lime have to be applied heavily within two years. In Bolivia, soybean production is expanding towards the east, and in many areas soils are already compacted and suffering severe soil degradation. One hundred thousand hectares of land with soils exhausted due to soybean were abandoned for cattle-grazing, which in turn further degrades the land. As land is abandoned, farmers move to other areas where they again plant soybeans and repeat the vicious cycle of soil degradation.

In Argentina, intensive soybean cultivation has led to massive soil nutrient depletion. It is estimated that continuous soybean production has extracted about 1 million metric tons of nitrogen and about 227 000 metric tons of phosphorous. The estimated cost of replenishing this nutrient loss via fertilizers is US$ 910 million [5]. Increase of nitrogen and phosphorus in several river basins of Latin America is certainly linked to the increase of soybean production.

A key technical factor in the rapid spread of soybean production in Brazil was soybean's pseudo-symbiotic relationships with nitrogen-fixing bacteria living in root nodules that allowed soybean to be produced without fertilizers. This claimed productive advantage of soybeans in Brazil can quickly disappear in the light of findings reporting direct toxic effects of the herbicide glyphosate on the nitrogen-fixing rhizobium bacteria; which would make soybeans dependent on chemical fertilizers for nitrogen. Moreover, the common practice of converting uncultivated pasture to soybeans results in a reduction of the economically important rhizobia, again making soybean dependent on synthetic nitrogen.

Soybean monocultures and ecological vulnerability

Ecological research suggests that the reduction of landscape diversity caused by the expansion of monocultures at the expense of natural vegetation has led to insect pest outbreaks and disease epidemics. In such poor and genetically homogenous landscapes insects and pathogens find ideal conditions in which they can grow unchecked by natural controls. This leads to increased used of pesticides, which after a while are no longer effective due to the development of pest- resistance or ecological upsets typical of the pesticide treadmill. Pesticides also cause major problems of soil and water pollution, elimination of biodiversity and human poisonings. The humid and warm conditions of the Amazon are also favourable for fungal growth, resulting in the increased used of fungicides. In Brazilian regions under tillage soybean production, the crop is increasingly being affected by stem canker and sudden death syndrome.

Soybean rust is a new disease, increasingly affecting soybeans in South America, requiring increased fungicide applications. In addition, since 1992, more than 2 million hectares have been infected by cyst nematodes. Many of these pest problems are linked to the genetic uniformity and increased vulnerability of soybean monocultures, and also to the direct effects of Roundup on the soil ecology, through the depression of micorrhizal fungal populations and the elimination of antagonists that keep many soil-borne pathogens under control [7].

A quarter of all pesticides applied in Brazil are used on soybean, which in 2002 amounted to 50 000 tonnes. As the soybean area rapidly expands, so does the growth in pesticide use; it is now increasing at a rate of 22 percent per year. While biotech promoters claim that one application of Roundup is all that is needed for whole season weed control, studies show that in areas of transgenic soybean, the total amount and number of herbicide applications have increased. In the USA, the use of glyphosate rose from 6.3 million pounds in 1995 to 41.8 million pounds in 2000, and now the herbicide is used on 62 percent of the land devoted to soybeans. In Argentina, Roundup applications reached an estimated 160 million litre equivalents in the 2004 growing-season. Herbicide usage is expected to increase as weeds start developing resistance to Roundup.

Yields of transgenic soybean average 2.3 to 2.6 t/ha in the region, about 6% less than conventional varieties, and are especially low under drought conditions. Due to pleiotropic effects (stems splitting under high temperatures and water stress) transgenic soybean suffer 25 percent higher losses than conventional soybean. Seventy-two percent of the yields of transgenic soybeans were lost in the 2004/2005 drought that affected Rio Grande do Sul, and a 95 percent drop in exports is expected with dramatic economic consequences. Most farmers have already defaulted on 1/3 of government loans.

Other ecological impacts

By creating crops resistant to its herbicides, a biotech company can expand the market for its patented chemicals. The market value of herbicide-tolerant crops was $75 million in 1995; by 2000, it was approximately $805 million, more than 10-fold increase. Globally, in 2002, herbicide-tolerant soybean occupied 36.5 million hectares making it by far the number one GM crop in terms of area [1]. Glyphosate is cheaper than other herbicides, and although it reduces the use of other herbicides, companies sell altogether much more herbicide (especially glyphosate) than before. The continuous use of herbicides and especially of glyphosate (or Roundup, Monsanto's formulation) with herbicide-tolerant crops, can lead to serious ecological problems.

It has been well documented that when a single herbicide is used repeatedly on a crop, the chances of herbicide- resistance developing in weed populations greatly increases. About 216 cases of pesticide resistance have been reported in one or more herbicide chemical families [8]

Given industry pressures to increase herbicide sales, the acreage treated with broad-spectrum herbicides will expand, exacerbating the resistance problem. The increased use of glyphosphate will result in weed resistance, even if more slowly. This has already been documented with Australian populations of annual ryegrass, quackgrass, birdsfoot trefoil, Cirsium arvense, and Eleusine indica [7]. In the Argentinian pampas, eight species of weeds, among them two species of Verbena and one species of Ipomoea, already exhibit resistance to glyphosate [5].

Herbicide resistance becomes more of a problem as weeds are exposed to fewer and fewer herbicides. Transgenic soybean reinforces this trend on account of market forces. In fact, weed populations can even adapt to tolerate or "avoid" certain herbicides. For example, in Iowa, populations of common waterhemp have demonstrated delayed germination, which allows them to avoid planned glyphosate applications. The GM crop itself may also assume weed status as volunteers. For example, in Canada, volunteer canola resistant to three herbicides (glyphosate, imidazolinone, and glufosinolate) has been detected, a case of stacked, multiple resistance. And now farmers have to resort to 2,4-D to control the volunteer canola. In northern Argentina, there are several "strong weeds" than cannot be controlled with glyphosate, forcing farmers to resort to other herbicides.

Biotech companies claim that when properly applied, herbicides should not pose negative effects on humans or the environment. In practice, however, the large-scale planting of GM crops encourages aerial application of herbicides and much of what is sprayed is wasted through drift and leaching, affecting human beings as well as soil mycorrhizal fungi and earthworms. The companies contend that glyphosate degrade rapidly in the soil, do not accumulate in ground water, have no effects on non-target organisms, leave no residue in foods and water or soil. Yet glyphosate has been reported to be toxic to some non target species in the soil - both to beneficial predators such as spiders, mites, and carabid and coccinellid beetles, and to detritivores such as earthworms, including microfauna as well as to aquatic organisms, including fish [9].

Glyphosate is a systemic herbicide (i.e. it is absorbed into and moves through the whole plant), and is carried into the harvested parts of plants. Exactly how much glyphosate is present in the seeds of HT corn or soybeans is not known, as grain products are not included in conventional market surveys for pesticide residues. The fact that this and other herbicides are known to accumulate in fruits and tubers because they suffer little metabolic degradation in plants, raises questions about food safety, especially now that more than 37 million pounds of this herbicide are used annually in the United States alone [8]. Even in the absence of immediate (acute) effects, it might take 40 years for a potential carcinogen to act in enough people for it to be detected as a cause (see "Glyphosate toxic and Roundup worse" and "Roundup kills frogs", SiS 26).

Moreover, research has shown that glyphosate seems to act in a similar fashion to antibiotics by altering soil biology in a yet unknown way and causing effects such as [8,9]

Reducing the ability of soybeans and clover to fix nitrogen.

Rendering bean plants more vulnerable to disease.
Reducing growth of beneficial soil-dwelling mycorrhizal fungi, which are key for helping plants extract phosphorous from the soil.

In the farm-scale evaluations of herbicide resistant crops recently completed in the United Kingdom, researchers showed that reduction of weed biomass, flowering, and seeding parts under herbicide resistant crop management within and in margins of beet and spring oilseed rape involved changes in insect resource availability with knock-on effects resulting in abundance reduction of several beetles, butterflies, and bees. Counts of predacious carabid beetles that feed on weed seeds were also smaller in transgenic crop fields. The abundance of invertebrates that are food for mammals, birds, and other invertebrates were also found to be generally lower in herbicide resistant beet and oilseed rape [10]. The absence of flowering weeds in transgenic fields can have serious consequences for beneficial insects (pest predators and parasitoids), which require pollen and nectar for survival. Reduction of natural enemies leads unavoidable to enhance insect pest problems.

Conclusions

Soybean expansion in Latin America represents a recent and powerful threat to biodiversity in Brazil, Argentina, Paraguay and Bolivia. Transgenic soybeans are much more environmentally damaging than other crops because in addition to the effects from the production methods that involve heavy herbicide use and genetic pollution, they require massive transportation infrastructure projects (waterways, highways, railways, etc), which impact on ecosystems and make wide areas accessible to other environmentally unsound economic and extractive activities.

The production of herbicide resistant soybean leads to environmental problems such as deforestation, soil degradation, pesticide and genetic contamination, as well as socio-economic problems such as severe concentration of land and income, expulsion of rural populations to the Amazonian frontier and to urban areas, compounding the concentration of the poor in cities. Soybean expansion also diverts government funds otherwise usable in education, health, and alternative, far more sustainable agroecological methods.

The multiple impacts of soybean expansion also reduce the food security potential of target countries. Much of the land previously devoted to grain, dairy products or fruits has been diverted to soybean for exports. As long as these countries continue to embrace neoliberal models of development and respond to demand from the globalized economy, the rapid proliferation of soybean will increase, and so will the associated ecological and social impacts.