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The Limits and Contradictions of Agricultural Technology in Latin America: Lessons from Mexico and Argentina

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Abstract
Based on a collective research project designed to analyze the links between scientific and technological production, development and democracy in Latin America, this paper deals with the performance of the agrarian economy under conditions of scant internally generated technology. We begin by acknowledging that this resource has historically been imported. We frame the objective of analysis in terms of assessing its economic and social implications through an empirical approach to the process of technological diffusion. Two representative experiences of the agricultural structure are examined in the region, namely, peasant productive units in Mexico and capitalist enterprises on the Argentine plains. For the former, we look at the post-war era, examining the content of the technological package contained in the green revolution and its repercussions. In the latter case, we look at present-day agro-business and analyze the propagation of the transgenic soybean known as "Roundup Ready" in the pampas region. In both cases, we consider the positive and negative characteristics within the productive and macroeconomic order, including impact on employment, environment, and social welfare.

Keywords
Technology; Peasant agriculture; Agribusiness; Mexico; Argentina

Introduction

This article forms part of the collective research project titled Science for Development and Democracy.[1] The general objective consists of advancing theoretical work that (a) explains the structural problems of scientific creation

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in Latin American countries, (b) allows for the strategic role of the *state development function*[2] to overcome the conditions of underdevelopment in the countries of the region, and (c) establishes a correlation between the two above mentioned points and the exercise of political rights in a democratic society.

One of the objectives of our collective research is to demonstrate that the lack of organization that prevails in the *scientific work*[3] of underdeveloped nations has contrary effects for the creation of material conditions that make the exercise of democracy possible, that is, a true democracy and not merely a formal or electoral one. In that regard, it is necessary to show how the economy works in those countries where leading-edge technology is not created domestically. We propose to pursue this larger objective from a focused analysis of agricultural industry and rural society. Specifically, we would like to explain why it is that in those parts of the world where agricultural technology is not created domestically to satisfy agro-industrial needs, the results of innovations become contradictory. We say contradictory because the resulting economic dynamic can be considered positive in terms of productivity and profitability, or can be represented as such in macroeconomic indicators, even while a de-accumulation process is taking place that results in the loss of jobs, declining social indicators and severe imbalances in domestic ecosystems.

With respect to agronomic sciences and all those scientific developments that have practical applications for agriculture, we will not concern ourselves here with looking into the causes of why these technologies are not generally created by Latin American countries. Rather, we shall accept as our starting point the fact that they are imported and instead focus on investigating the resulting social effects and their importance for relations between countries. In so doing, we shall reaffirm our belief that this behavior cements into place the conditions of underdevelopment that are shared by the countries of this region.

Due to the extent of the problem and given the abundance of bibliographical, statistical, and institutional information that allowed us to empirically approach our subject, we focus here on two experiences that did not occur simultaneously. We consider that these two cases are indeed representative of the patterns of conduct found throughout the region in the agricultural sector.

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[2] Significant work has been already advanced on the state development function concept by Figueroa (1995), and by that we understand the government intervention designed to generate the national basis (infrastructure, research centers, human resources, etc.) to generate basic and applied vanguard science.

[3] It is *scientific work* that translates into capital goods, new materials, improved productive processes, etc., and that makes the increase of productivity of manual work possible. For more details on the use of this concept in its theoretical context, see Figueroa (1986).

Each case involves the adoption of foreign technological packages that are administered under capitalist criteria and have broad geographic reach. In the first case, we chose peasant-type productive units and focused in on the Mexican experience. In the second case, we considered the soybean producing companies of Argentina that represent a prototype of being highly successful. To study the former, we look at the postwar era observing the vicissitudes, content, and extent to which the incorporation of the *technological package of the green revolution* (GRTP) was harnessed. In the latter case, present-day companies in Argentina were examined in terms of their turn to the transgenic soybean via adoption of the "Roundup Ready" technological package (RRTP) across the vast grassy plains or "*pampas*" region. In both cases, we examine the repercussions and limits of the technologies deployed, considering both the productive and macroeconomic implications, while examining their respective impact on work, social and ecological issues.

Our analysis explores the *state management of development* and *scientific work* in the context of underdevelopment. We conceive of underdevelopment not as a situation of backwardness that will gradually be overcome, but rather as a result of capitalist growth in other parts of the world. This implies that in order for some countries to develop and prosper, they do so at the detriment of others. Underdevelopment defined as such affects the organization of work in our countries. The processes of creating and producing goods and services are carried out through structurally delimited social relations of production that are different from those taking place in the developed world.

Figueroa (1986) observed that in Latin American underdevelopment, *scientific work* has not been adequately organized to satisfy the internal needs of the region's countries. Instead, products that embody the scientific work performed in other regions where they *are* being generated must be acquired on the world market, including machinery, equipment, patents, and technological packages. As a consequence, it is *manual work* that is taken advantage of in the context of underdevelopment, utilizing the scientific work from other countries through the systematic importation of capital goods and unilateral technology transfers.

We refer to *manual work* as the kind of work performed by machine operators in factories or direct producers in other areas of the economy. It amounts to that living energy applied directly to the other productive inputs for their transformation. In contrast, *scientific work* refers to the knowledge materialized in technology (be it tangible or not) that is capable of multiplying productivity. Both methods of work, manual and scientific, generate value, but the latter does it indirectly through the manual worker-operator (Figueroa 1986: 38).

We can clearly observe that scientific work is organized in developed countries and generates internal benefits as well as links with other nations. While the second industrial revolution, in terms of technology as well as the social relations of production, was propitious for the splitting of productive work into the two specific activities that we have mentioned (manual and scientific), this process was territorially external to Latin American societies. Just as international links later became forged in the imperialist phase of capitalist expansion, "Third World" underdevelopment was compelled to prop up "First World" development in detriment to the former's internal accumulation and overall progress. It is precisely due to the underdeveloped character of the region that our economies are structurally incapable of absorbing the totality of the population that aspires to employment.

In the conditions of underdevelopment, the dependency on foreign scientific work becomes the source of serious macroeconomic imbalances. So while the deepening links of dependency contribute to the prosperity of the developed world and its acquisition of products, it does so at the expense of the developing world's overall accumulation. The drain of resources overseas that this implies actively reduces the possibilities for growth and results in the suppression of opportunities for creating jobs throughout the underdeveloped world. For this reason, it should not at all prove surprising that the job market in underdeveloped countries displays chronic imbalances.

In this context, many workers cannot be incorporated into the underdeveloped economy as wage earners and they instead find themselves becoming part of the *surplus population* with respect to the capitalist revalorization process. This kind of surplus population or "overpopulation" is for that reason inherent to underdevelopment, and we find that the peasantry of our countries inexorably makes up the lion's share of the surplus population located in rural areas just as other sectors immersed in non-wage-earning subsistence activities fuel the surplus population in more urbanized areas. Whether capitalism is developed or underdeveloped, the typical method of organizing production revolves around wage-earning work. However, we also find productive units that are organized in a different way like the small farm producer, and this is what constitutes the difference between *agribusinesses*, an essentially capitalist activity, and subsistence peasant production in the countryside.

GRTP and Peasant Agriculture

For the Latin American region, the 1950s and 1960s remain in our collective memory as important times of social, economic, and political progress. The

working class in particular proved able via union negotiations and a favorable correlation of forces to gain access to salary benefits and social public policies through the public sector that materialized in better living standards. The region's governments backed intensive industrialization processes in their countries during that period, which together with urban expansion fueled the overall model. Agribusiness did its share to contribute to these objectives, and internal markets were privileged. The overall strategy for post-WWII capitalist expansion consisted in encouraging the region's agricultural production, regardless of productive models, and this meant essentially agribusiness or peasant farm styles of production. In this context, the Green Revolution Technology Package (GRTP) could not have come at a better moment.

Deployed via public policies for agricultural development and with Mexico as its pioneering country, the GRTP spread throughout a large swath of the country's deeply rooted peasant farming sector. This entailed an extensive basic grains production plan based on the use of land and labor, the two abundant resources of the region. The model was intensive for its time in the use of agricultural technology.

The scientific backbone of this productive plan relied on an adequate combination of supplies, agricultural techniques, and mechanization of agricultural work with the use of heavy machinery, mainly tractors. Among the strategic inputs figured varieties of seeds selected for high performance corn, wheat and rice; water, preferably from an irrigation system; and supplies of industrial origin, such as fertilizers, pesticides, and herbicides. Given its technological profile, it is generally said that this was the period in which industrial or modern agriculture had appeared on the scene (Pengue 2005).

The origins of this technology in the wake of the agricultural revolution midway through the 20th Century are to be found in the war industry that had developed towards the end of World War I, even though its expansion did not come until decades later. The basic science (in the area of chemistry, biology, and engineering) originally conceived for non-peaceful ends managed to find very promising and productive applications. But even when the selection processes of hybrid seeds were performed at research centers in Latin America, the scientific work that made it possible was funded and directed by North American capital and was subordinated to its needs.

In coordination with regional policies that had embraced the import substitution model, the public actions of rural promotion pointed to the GRTP as the answer to the food demands of a growing population with its spending power on the rise. The green revolution was taken to different types of producers through aggressive government intervention policies that included on-site training, teams of extension agents, financial instruments, and modernized

physical and institutional infrastructure. As implied earlier, this growth led to different sizes of production units that actively displaced traditional agricultural practices. While it is true that the GRTP, to some extent, adapted to regional characteristics, it can be seen in those parts of the world, where land or work limitations were reported, that actions to optimize these factors of production were taken. Since these factors in Latin America were in no shortage, this did not represent a problem. What also materialized, however, was an irrational use of inorganic inputs that would eventually result in a widespread degradation of soils.

On the other hand, peasant farmers who received the GRTP in the form of a subsidy became highly dependent on public resources since only in this way could the harvested crops be taken to the markets. The prevailing support policies for the peasant farmer-producer were very important at that time, both in terms of the amounts destined for the sector as well as for the deployment of efforts to revitalize this type of agrarian development. Essentially, this became widespread since, if producers did not move in that direction, their productive units could no longer be profitable.

The origin of the peasant farmers in underdevelopment, as I have discussed previously (Acosta 2003), is linked to population surpluses, given that capital in this context is unable to absorb these farmers as wage-earning workers. They consequently operate in accordance with a different rationality than profit that is based upon dynamics of subsistence. This implies that the material base in which they operate (land, inputs, traditional technology, empirical knowledge, etc.) either degrades gradually, is used up, or is surpassed. What is clear is that in their commercial transactions with other productive units, they remain permanently at a disadvantage. In that sense, the peasantry under capitalism is effectively doomed to disintegration and extinction right at the onset.[4]

From what was previously mentioned, we can observe that the deliberate effects of subsidies during the post-WWII era were to limit the systemic and destructive impacts upon the peasantry. If these supports were ever suspended, the deterioration of the peasantry would inevitably run its course. This whole process eventually intensified with the GRTP as the crops demanded inputs in larger quantities and costs began to gradually rise, while the prices of the basic grains follow their historic downward trend due to the development of productive forces and competition.

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[4] On the *decomposition process of the peasant* and the exposition of factors that lessened it during the time of substitution of imports, more detailed facts and arguments can be found in Acosta Reveles (2003).

Therefore, we may conclude that notwithstanding the macroeconomic accomplishments of the green revolution in terms of its impact on overall national supply, imports, hard currency, provision of supplies for industrial expansion, and keeping the price of the domestic food basket relative low—this technological package came up against the more salient limits of nature itself. The soil erosion, ecological degradation, and dependency on agrochemicals all resulted in damage to ground fauna, detrimental microbial activity, and the contamination of underground water supplies. There are also reports concerning the genetic degradation of seeds derived from their uniformity. The future prospects for suitable yields and product quality have become questionable and yields tend to drop.

With respect to its economic limits and contradictions, the technological dependency from overseas that the GRTP entails translates into a high economic cost. First, the phenomenon of regional de-accumulation manifests itself purely in the terms of exchange (capital assets for primary goods). Historically, this syndrome did not take long to weigh upon public finances and budgetary deficits, making state reforms broadly inevitable. In the broader context, the ongoing cycle of accumulation favors countries that actually create leading-edge technologies that allow them to pay for the research that positions them one step ahead. This obviously tends to consolidate the relatively disadvantaged situation of underdeveloped countries that are not producers of scientific work.

Towards the end of the 1960s, Mexico began importing foods, and this tendency has become accentuated over the years. For all that, the incorporation of the GRTP had no effect whatsoever on capitalizing farming and might have been the general rule for the rest of the countries in the region that adopted this technological package. What this signifies is that peasant farming did not evolve in its internal organization from work to wage-labor relations. In other words, business logic did not prevail over subsistence. The agricultural business sector itself became highly dependent on the state rather than becoming consolidated as an agricultural bourgeoisie per se.

In focusing on the family farms, we would like to emphasize that the technology that made the green revolution possible actually reached these farmers via the state, filtered through many mechanisms and without a right of return. It would not have been possible to do this via the market, given the general austerity of resources. The best evidence suggests that the technological revolution did not qualitatively change either their living standards or the sustainability of their production, since as soon as these resources were withdrawn the peasantry plunged once again into the logic of decline.

Put another way, the drain on public resources destined to family-based agriculture was exceptional for its magnitude and depth of institutional

support strategies, even though it barely managed to postpone the deterioration of rural households. Once state policies abandoned the subsistence sector and turned their attention only to the most efficient producers, the effects upon peasant producers were dramatic. Impoverishment, large-scale migration, and liquidation of small landholdings all begin to weigh down upon them. From that point forward, we can observe how resources become gradually consumed until they no longer provide a means of living. The crisis in the 1970s in Mexico is therefore the one we can identify with the general agricultural crisis of underdevelopment, that is, the crisis and eventual ruin of the peasant farming economy.

It is nevertheless true that peasant production remains important in both absolute and relative terms for Mexico, just as it is for various countries in Latin America. This is true despite the process of structural adjustment, the adoption of the *agro-export model* (Acosta Reveles 2006), the consolidation of neoliberalism, and the eventual distancing of the state from agricultural production units that are not competitive on the world market. The still numerous ranks of the peasantry typically insist on farming basic grains, fodder seeds, and tropical products such as coffee, but the fact is that their living standards generally seem to only get worse over time. It is a sector largely displaced from national markets, making their income a decreasing proportion of the overall economy.

When translated into numbers, the success of the green revolution in the region remained relative, since ultimately the gap in agricultural productivity between underdeveloped and more developed countries actually ended up widening. González (1987) details the limits of the application of these technologies by groups of countries during the 1955-1965 period. As agricultural productivity among developed and underdeveloped countries advanced, the annual rate of productivity per worker was 4.7% in developed countries while in the underdeveloped world it reached only 1.4% (González 1987: 17).

RRTP and *Agribusiness*

The case of Argentina is an exemplary one for grasping how agribusiness works in underdevelopment. Let us first recall that Argentina has a prominent place in regional agricultural production, given its long tradition of exporting a great variety of crops and livestock. This outstanding profile has survived through neo-liberal times, and this owes a great deal to the rich natural qualities of its national territory. The Argentine experience essentially constitutes a paradigm of rapid productive agricultural restructuring with rather appalling results in terms of social and environmental issues.

All across the pampas, it appears that the principle of the highest profit in the shortest amount of time has always prevailed. The restructuring that this involved significantly reduced the amount of land destined to produce wheat and corn in favor of shifting over to the soybean. Contrary to Brazil where the traditional soybean still predominates, Argentina has generally preferred a variety of seed offered up by the agro-transnational Monsanto Corporation. This variety of seed has been genetically modified to tolerate the Glyphosate[5] herbicide, commercially known as Roundup Ready (RR), from where it gets the name Roundup Ready Soybean. The Roundup Ready technological package (RRTP) includes direct seeding systems and fertilizers in its deployment.

The expansion of soy production in Argentina moved into areas previously dedicated to forestation, livestock, and natural reserves. There was open government support for agricultural export companies and for promoting various modalities of property transfer or agrarian usufruct in order to maximize soy production. Hence, we can observe that in the pampas region from 1988-2000, the number of farming units became reduced by approximately 60,000 while during the same period, the average farm size increased from 391.3 to 530.7 hectares (Terracini 2004: 22-23).

With the backing of the public sector and private capital, soybean turned into the most important crop in Argentina. Besides occupying the largest amount of arable surface, it is the agricultural commodity that contributes the most to the agricultural gross domestic product of that country (Paruelo 2006: 3). Moreover, this grain has led Argentina to become the world's third largest producer and the second largest exporter.

The rise of the genetically modified soybean in recent years was also made possible by the expansion of the agro-industrial oilseed complex that transforms seed into oil, flour, tablets, food substitutes for meat, milk, juices and many other derivatives. It can further be expected that demand for soybean production will continue to grow in response to *green* or *alternative* energy policies that utilize soy as a bio-diesel input. The area in Argentina that has most fully thrown itself into soybean production is the pampas region, since it is in this valley that the cost-return relation is so exceedingly positive.

The high technological content of this package is a guarantee of high productivity with a margin of controlled risk while the cost of production is low,[6] given the soil factors and prevailing wages. There is considerable time saving

[5] N-(phosphonomethyl)glycine.

[6] The average cost is higher in Argentina than in the south or north of Brazil. Nevertheless, it only represents 84% of the production cost in the United States (Terracini, 2004: 13).

since, on average, the conventional soybean production period takes 280 days while the transgenic variety is ready in about 180. This allows for the possibility of alternating the annual cycle with wheat farming in a double-cropping system.

One further advantage is that the product is exempt from paying duties on the continued use of the seed. Because the genetically modified soybean is autogamous, its own subsequent reproduction of seeds maintains its initial basic characteristics. Since the Monsanto Corporation did not specifically demand payment in Argentina for the use of the gene that becomes reproduced out of using the original seed, the growers were not obliged under Argentine law to continue to pay royalties after the original seed purchase. Making this kind of repeated use of seeds that result from genetically modified allogamous crops would not be possible.

The generalized introduction of RRTP across the Argentine countryside represents a reshaping of the rural landscape in productive and social terms. With respect to production, this innovation involves reorganizing the cultivation process in times and cycles, thereby altering the terms of agricultural work and the labor process itself in accordance with the changed conditions. This effectively translated into dispensing with a large number of workers. This was particularly true with the introduction of the *direct seeding system*, which substantially reduces or eliminates the need for tilling the land in the cultivation of grains, thus making the imbalance between labor supply and demand ever more evident (Neiman and Quaranta 2000: 13-14).

Direct seeding or *zero tilling* is generally speaking unattainable for producers on a small scale. But it has been well assimilated into medium-sized and large cereal and oilseed farming. Its biggest benefit is that it does away with the need to carry out traditional pre-seeding work (plowing and harrowing) through the use of specialized machinery that opens furrows and implants the seed with very minimal soil movement. The system of direct seeding of the Roundup Ready soybean eliminates the need to remove the previous crop stubble, but it in turn requires the previous and subsequent application of the Roundup Ready herbicide to control weeds as well as additional pesticides and fertilizers such as nitrogen, urea, and sulfur. The Roundup Ready herbicide is considered one of the most powerful and toxic on the market; hence its application is regulated and its use is limited internationally. The overall procedure is widely used in the United States and other South American countries, but nowhere is it more widely used than in Argentina.

Many advocates of this system praise it because it preserves the organic matter in the soil, thereby reducing the erosion that results from excessive tilling of the land. It also inhibits oxidation processes by not exposing internal

ground atmosphere to external environmental contact, and so the conservationist virtues are rather questionable if one weighs up the benefits and damages that the deployment of the technological package involves as a whole.[7]

What is unquestionable, however, is that the procedure is efficient in productive terms and that it drastically reduces costs both of labor as well as fossil fuel consumption. It has been calculated that in cultivation that resorts to direct seeding, the approximate savings are close to 35% on labor per year, 25% on machinery use, and 35% more on the use of the tractor (Neuman and Quaranta 2000: 14). This loss of jobs vastly increases the competition for available work. It is also true that the massive introduction of this machinery creates some new jobs, but they are few in proportion to those that become eliminated and generally require some sort of specific skill.

With the RRTP, the productive process remains subordinated from beginning to end to the technological factor. As the plant cycles through different growth stages, all of the factors that are to intervene in its development are marked by the genetic design of the seed. Even in its harvest and its subsequent handling, storage, and transfer, the machinery involved sets its own rhythm. The tasks performed by workers must necessarily adhere to the engineered process and product technologies suggested by the corporate provider, hence necessitating training in the use of pesticides, fungicides, and fertilizers while their traditional knowledge base becomes obsolete. Producers must receive the inputs as an integrated package accompanied by consulting services and precise instructions designed for optimal return. The company may offer a control and soil monitoring system for temperature, humidity, and nutrients so that additional inputs can be put into practice at the appropriate moment and with the precise quantities.

With the mechanization of the seeding, spraying, harvest, and post-harvest processes, the labor activity directly applied to the creation of a good is in this process reduced to a bare minimum, due to the introduction of more sophisticated machinery and tools of diverse power, capability, and versatility. It of course goes without saying that producing soybean with the RRTP involves a substantial investment in supplies, machinery and equipment, professional services, and so on; hence the majority of producers feel obliged to rely on contractors or opt to simply rent out their plots of land.

The contracting firms that get involved prefer to operate without investing in fixed assets in the form of agricultural land. Rather, they deploy liquid capital and a concrete technological design that combines machinery, equipment, tools, agrochemicals, biotechnological supplies, and other types of

[7] Guido Galafassi (2004) summarizes the state of the debate on the sustainability of this process.

equipment and supplies. They work with specialized personnel on the plots of land they use and employ farmhands often on a temporary basis (Binsang and Sztulwark 2006: 139). Their mobility is what sets them apart as they move from one farm to another across provinces and even neighboring countries, wherever their services may be needed. They can even operate in several areas at the same time (multi-local operations). Working this way reduces their risks and facilitates the disendowment of machinery in a relatively short time, which enables them to stay in the vanguard of innovations of every type.

In short, we can observe with great clarity in Argentina a number of core trends: increasing specialization by regions; uninterrupted assimilation of technological and organizational innovations associated with a greater foreign enterprise presence in the region; steady increases in work productivity; high profitability of agricultural businesses with foreign co-investors; and the consolidation of agro-industrial complexes that are integrated horizontally and vertically. Its dark counterpart is the greater private appropriation of natural resources or at least the indirect control of them by capital; the degradation of soil derived from the practice of mono-cultivation and the excessive use of agro-chemicals; an unrestricted exploitation of water, lands, and forests; radical changes in the use of cultivable lands; and a comprehensive neglect of food production.

In addition to the layoffs of workers, the RRTP process has stimulated the systematic displacement of peasant-farmers by entrepreneurs who aggressively produce on a much larger scale with little interest in conserving the soils being exploited. As lessees by preference, but also as owners, the agricultural industrialists have gained control of the best lands and continue to open fields for soybean farming at the expense of domestic food production. To grasp this trend as it unfolded in Argentina, we can see that from 1980-2004, soy production went from 17.2% to 56.2% of seeded cultivations while the area destined for the planting of wheat and corn diminished from 64.2% to 36.6% over the same period (CEPAL 2005: 87).

Parallel to this massive shift in cultivation, the RRTP has been efficient in displacing the rural population and sowing poverty among rural producers who had before contributed significantly to the agricultural wealth of the country. Across such a generous natural setting like the Argentine pampas, this represents a giant step backward in the social and political order. Paradoxically, this large-scale social exclusion coincided with the bonanza of agribusiness and represents a far-reaching leap in productive technology and a huge increment of investment in the fields. A major concern that emerged amidst this polarizing process is the environmental degradation and the intense pressure being placed on the soil as the scale of production continues to expand across new territories.

Technological and biotechnological progress has played a leading role in the expanding soybean agriculture of Argentina, but its social impact has not been socially positive. On the contrary, it has unleashed complex processes of social exclusion from labor markets and has altered the utilization of lands and productive inputs. This does not necessarily mean that technological assimilation is synonymous with social exclusion, the destruction of nature, or mass unemployment. It is instead a reflection of the underlying logic and social organization that governs the conception and deployment of these technological developments.

Conclusion

The lack of homegrown, domestically generated scientific production and technological development has been a steady constant in the modern history of underdevelopment. This central fact has been a determinant factor in placing limits to growth and preventing any eventual breaking of the underdevelopment cycle. In this study, we have seen how two important experiences with applied science in the agricultural sector that rolled out in the 20th Century confirm the impact of technological dependency and subordination. What is important to grasp from these processes is that while they have a certain positive effect for the underdeveloped world inasmuch as they favor a strengthening of the field of science and technology, they also heavily rely upon the importing of machinery and new production methods that translate into major de-accumulation and a growing imbalance in the labor market.

Additional effects such as the declining income for many residents in the rural environment and the concomitant decline in their living standards must be placed in the balance of analysis. Positive elements as seen in the yields of agricultural production and productivity are compromised by devastating social and environmental effects. There is no question that the two cases we have examined are not the only ones in the region but they are certainly important ones. Perhaps the common significance of these cases can be summarized with a reflection by Eliane Ceccon, who compares the more recent biotechnology revolution to the earlier "green revolution":

> *Despite the substantial differences in methodology and biological technology, both revolutions were launched with the idealized mission to put an end to hunger, which was, and continues being used repeatedly for its defense and justification. Today we know that the rise in food production per se does not guarantee its global and fair distribution, and in addition to that, the hunger problem has additional aspects of greater complexity associated with the real economy of the market, such as intermediation in its distribution and*

commercialization; or the lack of spending power of a large proportion of the world population, which prevents them from having effective access to food markets among others. There is, of course, a not so surprising similarity of economic interests on the part of those who have promoted these revolutions and their proven and potential consequences in the social and environmental order. (Ceccon 2008: 22)

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