

# THE CONCENTRATION OF CAPITAL AND THE INTRODUCTION OF BIOTECHNOLOGY IN LA LAGUNA DAIRY FARMING<sup>1</sup>



Casa abierta al tiempo

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## Resumen / Abstract / Résumé

65

Este artículo discute el reconocimiento entre el cambio de tecnología y las tendencias sociales. Se presenta un estudio de caso sobre el uso de la hormona transgénica (rBST) en vacas productoras de leche en la región de La Laguna del norte de México. Asimismo, se plantea que mediante la participación en el proceso de concentración, el cambio de tecnología contribuye en la expansión y desarrollo del capital. ©2000, UAM

Palabras clave:  
Biotecnología  
Granjas lecheras  
Hormona transgénica  
(rBST)

*This article argues that a recognition between technological change and social tendencies. A case study is presented here to illustrate this relationship, of a transgenic hormone (rBST) used in cows milk production in the La Laguna region of northern Mexico. By participating in the process of concentration, technological change contribute in the expansion and development of capital.*

Key words:  
Biotechnology,  
Dairy farming,  
Transgenic hormone  
(rBST)

*À l'aide d'une étude de cas sur une hormone transgénique (rBST) utilisée dans la production des vaches laitières de la région de La Laguna au nord du Mexique, cet article illustre la nécessité de reconnaître les dynamiques qui existent entre le changement technologique et les tendances sociales. En favorisant un processus de concentration, le changement technologique contribue à la expansion et au développement du capital.*

Mots clefs:  
Biotecnologie  
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hormone transgénique  
(rBST)

## Introduction

After years of being kept in the dark, biotechnology has finally come under the scrutiny of public opinion and academic research. The lines of debate mostly relate to environmental, health, food safety, and ethical issues. A more marginal field of inquiry and debate concerns the relationship between the

use of the technology and processes of social change, and more particularly with the process of development. There has been a growing concern to shun a technological determinist interpretation of the technology, according to which technology is a deus ex machina causing all ills and all goods alike. This article builds on this concern, based on a dialectical interpretation of social change and development, according to which technological change

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is both a product of the socio-economic environment in which it emerges and a factor of change of that environment. A case study will be used here to illustrate this basic insight, of a transgenic hormone (rBST) used in cows milk production in the La Laguna region of northern Mexico<sup>2</sup>. The socio-economic environment there is marked by a concentrating dynamic of the dairy capital used to produce the milk, which gives rise to specific issues regarding the use of rBST and its relationship to processes of development. This article will first introduce a summary of the arguments about rBST and development. Then, the political economy of dairy production in La Laguna will be analysed, paving the way for the third section, where the use of rBST in regional dairy production is examined, leading to conclusions about technological change and development.

### The rBST claims to development

rBST is a recombinant analogue of a naturally occurring bovine hormone, already identified in the 30's as a growth hormone that could increase milk production (Butler, 1999). Its extraction from the pituitary glands of dead cows was however too costly for the hormone to be used, until the use of recombinant DNA (Desoxirribunocleic acid) led in the early 80's to a synthetic version that could be produced industrially.

This transgenic hormone is a particularly strong contender in the biotechnology-for-development debate (see for example Borlaug 1997). Since it promises to increase milk production by 3.5 to 5.5 litres per cow per day (Elanco, 1999), it could, in countries with surplus production, allow to reduce dairy cattle herds while maintaining production levels. This could liberate land and resources for other purposes or prevent part of the environmental damage caused by cattle farming. In developing countries, it could allow to considerably increase the production of this relatively cheap source of animal protein, and thus diminish or eliminate the usual gap between consumption and production, there-

fore also mitigating balance of payments deficit problems. This is particularly true of Mexico, which is one of the largest importers of milk in the world, having imported, between 1990 and 1998, anywhere from 8% to 32% of all milk domestically consumed annually, adding \$250 million to its balance of payment deficit (SAGAR, 1999). In the case of many developing countries, this macro-economic promise has a very important micro-economic counterpart. Not only the price of milk should diminish with increased production efficiency, but also producers would be able to compete in an increasingly competitive and deregulated world market. This last point is even more vindicated in the case of Mexico. Since 1994, many Mexican dairy farmers are concerned with the commercial opening of the borders, which through NAFTA (North American Free Trade Agreement) will lead within three years (2003) to a fresh milk market completely free of tariffs. The perceived advantage of US producers over Mexican ones (conceived by La Laguna ganaderos to be caused especially by the availability of cheap credits in the US as well as much stronger and consistent government support) leads to fears of bankruptcy on the one hand, and on the other hand to renewed efforts to stay ahead of competition or gain competitive status in relation to their North American counterparts. rBST is often perceived as one of the main available tools for such pursuit. Moreover, it is said that the technology is scale neutral, allowing not only the largest producers to use it, but also smaller ones.

Another advantage that is not as often mentioned but that can be inferred from the properties of the hormone is that it leads to increased feed efficiency<sup>3</sup>, thus theoretically liberating land now used for feed crops to grow food crops or for other purposes. This increased marginal productivity of dairy cows also leads to the conclusion that less manure per units of milk would be produced, thus reducing the biological pollution derived from milk production. These environmental aspects would of course benefit both developed and developing countries. According to corporate studies, producers in the tropical and warmer regions of the world would also benefit with this product in times of severe heat

<sup>2</sup>The field study in La Laguna was performed during the months of October and November of 1999, which featured close to 50 semi-structured interviews on a variety of dairy farms and with other actors in the regional milk industry. It was part of a one year stay in Mexico to do field research towards my Ph.D. dissertation, titled "Agro-Biotechnologies and Development: the Case of Mexico".

<sup>3</sup> since the additional feed needed to produce the extra milk goes only towards that milk's production and not towards the maintenance needs of the cow (Fetrow, 1999).

and/or humidity, since the hormone also helps keeping production up and avoiding the seasonal fall in cow's productivity (Estrada et al.). This would in fact have particular relevance in a region like La Laguna, in the arid Mesa del Norte (Mexican Northern Plateau), where hot weather reigns from May to September<sup>4</sup>.

Despite numerous studies by the transnational corporation Monsanto –which has by far the largest share of the world market of the hormone and a monopoly in the US– that rBST is safe in every aspects, the product has been banned in the European Union since 1990 and in Canada since 1999 for animal and/or human health reasons (such as increased potential of udder infections in cows and increased risks of breast, prostate and colon cancer in humans). It is also banned in Australia, New Zealand and Japan. After hesitating, the FDA (Food and Drug Administration) finally approved the drug in the US at the end of 1993 and many other countries followed suit (including, among others, Russia, South Korea, Turkey, Algeria, South Africa, Colombia, Peru, and Costa Rica). Mexico quickly approved the drug in 1991, relying only on the company's documentation to do so.

The swiftness of the adoption of the drug in Mexico is testimony to two major problems affecting most developing countries when it comes to the adoption of a new technology such as rBST: 1- the lack of infrastructure and resources to offer an independent safety assessment of new imported products; and 2- a strong pressure imposed by the perceived need to introduce any new technology, especially one which can improve the yields of basic commodities for which domestic production is insufficient.

### Elements of the socio-economic context of technological change

In order to avoid the usual pitfalls of technological determinism, the debate over the potential of agro-biotechnologies to contribute to development must be grounded on an analysis of the socio-economic conditions in which the technologies are used. There are many ways in which this could be unders-

stood, and the most prevalent perspective bear an institutionalist focus, looking at the interaction of a number of formally independent institutional actors<sup>5</sup>. Though this type of analysis can offer rich insights into how a new technology can emerge and be adopted, it too often fails to recognise some of the compulsive dynamics at play in the political economy where the technology is developed or introduced, and leads to voluntaristic prescriptions for technological change and development. This article will present instead a critical political economy perspective, according to which the dynamics of capital are given epistemological priority to other social processes. Such analysis is particularly relevant in a context where market liberalisation is predominant, and hence where the dynamics of capital are more salient. Accordingly, this study of the socio-economic conditions under which agro-biotechnologies are used is focused on the conditions of agricultural production in La Laguna, and their relationship with the rule of capital.

### Concentration of La Laguna dairy capital

For a long time, La Laguna was essentially a cotton producing region. But a world market collapse of that commodity (due most importantly to the emergence of synthetic substitutes) from the mid-fifties, and a rise in the costs of production led, among other factors, to this activity not being profitable anymore, and abandoned by many La Laguna farmers. Milk farming, already practised at a small scale (a credit union of dairy farmers was founded in 1949), became one of the more profitable alternatives (García Hernandez et al., 1999). In the 60's, the switch to milk production started to be encouraged by government. This was done at a national level with the creation by the Ministry of Agriculture of new institutions, such as the National Cattle Council and its state delegations, with aims of promoting the establishment of specialised and high technology dairy districts, to further fodder cultivation, and to encourage dairy production with "soft credits". This scheme was financed with funds provided by international development agencies such as the Alliance for Progress, the World Bank, and the Inter-American Development Bank.

<sup>4</sup> While almost all cattle used in the dairy industry of La Laguna is of the Holstein race, which finds its optimal production temperatures between 13 and 18°C and has a "confort" zone between 5 and 25°C, temperature in La Laguna can reach 40°C at peak times during the summer.

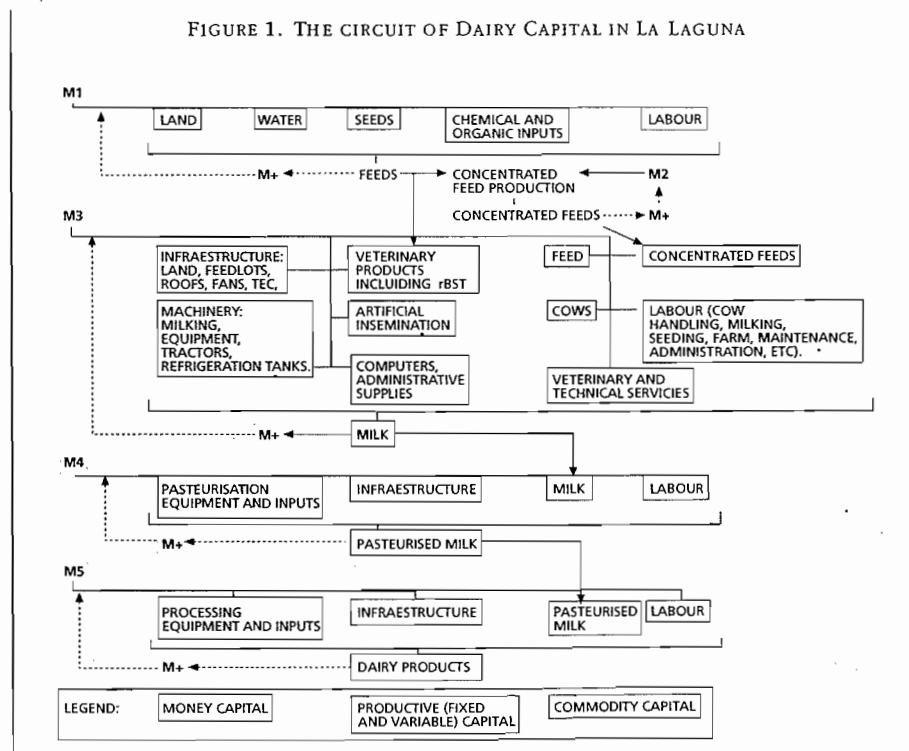
<sup>5</sup> Samples of this approach to the sociological study of biotechnology can be found in the first issue of the International Journal of Biotechnology.

Regionally, programs such as the "Economic Rehabilitation Fund for La Laguna Agriculture" were instituted, providing "soft" credits, implementing land redistribution, and extending irrigation capacities (essential for more intensive fodder production in such an arid area) (García Hernández et al., 1998). As a result of this and of other processes that will be explained in this essay, dairy farming became one of the most important agricultural activity in the region. In 1970, for example, the value of milk production had already reached 17% of the value of all regional agricultural production, a proportion that rose ever since to reach 37% in 1998 (Sagar-Laguna, 1998). The process of expansion of the dairy industry is characterised by the organisation of small producers into co-operatives, allowing many of them to successfully integrate capitalist methods of production into their operation and thus become progressively more productive. As a result, milk production in the region has for a long time been, and is increasingly characterised by the domination of the private sector over what is called the social sector (the small-herd, resource-poor operations often dependent on state support).

duction. What is represented here are the most important elements of an "extended" circuit of dairy capital. These elements are:

1. the production of fodder, which in a typical dairy farm in La Laguna in 1998 accounted for between 32% and 36% of all costs. While most farms endeavour to be auto-sufficient in feed provision, in order to save costs, the expansion of the herds and of their productivity led to a situation in which many of them need to buy from outside providers, often from neighbouring states. In 1998, FIRA (Trust Fund for Agriculture, a decentralised organ of the Bank of Mexico) reported a deficit of 30% in the regional production of feeds, which had to be compensated with imports from the neighbouring states Chihuahua, Durango and Tamaulipas.
2. the production of concentrated feeds, which accounts for another 25% to 37% of all farm costs. These are produced in industrial plants, and therefore always off farm.
3. Milk production as such, where the hormone is introduced.
4. and 5 The pasteurisation, and either distribution or processing of pasteurised milk.

Figure 1 outlines the main features of the regional circuit of dairy capital, typical of capitalist dairy pro-



Some of these elements might be integrated into one capitalist unit, such as feed and milk production (No. 1 and 3) on auto-sufficient farms; or such as feed, milk production, pasteurisation and dairy production (No. 1, 3, 4, 5) in the case of Chilchota Alimentos and Monica's Foods (these are two of the major local pasteurised milk and cheese producers, owning the largest farms in the region). The Lala group integrates all these elements in its activities, but milk producers (No. 3) are independent (at least formally, as will be explained later on). These examples of vertical integration give coherence to the many circuits of dairy capital and justify thinking of an "extended" circuit of dairy capital. Another factor that gives coherence to the concept is the financing of these dairy activities (M 1-5 on figure 1), common to all. Financing will be studied first, after which selected elements of the extended circuit of dairy capital will be presented, focusing on uncovering the concentration processes at play in that circuit.

### The financing of milk production

Many recent transformations at the global and national level since the end of the sixties have led to crucial changes in this aspect of the circuit of La Laguna dairy capital. One of the basic elements here is the structural crisis of Mexican capitalism from the end of the 60's. From then, and most markedly during the 70's, private investment started to decline, and was compensated for a time (especially with the oil boom of the end of the 70's) by heavy public investment schemes (Basave, 1996). In agriculture, the expansion of public financing led to expanded resources for the development banks (mainly Banrural, Banco Nacional de Comercio Interior, and Banobras). The mission of these banks was to provide "soft" interest rates loans (i. e. detached from market rates) for agricultural production in order to support small land-holding production. This rural finance system was also linked to the provision and dissemination of the Green Revolution package (improved seeds, chemicals, irrigation, technical support and education), subsidised or directly produced by the state, and in dairy cattle to the spread of a more intensive and specialised model of production (with the mechanisation of milking, the increase in number and the specialisation of dairy herds, etc.)

However, the unsustainability of the public financing scheme in the context of a global economy in crisis became apparent to all with the 1982 debt crisis. In agriculture, public financing started to decline sharply from 1989 on, when widespread and profound reforms of agriculture were starting to be implemented by the Salinas administration (Myhre, 1998). This implied two things. Firstly, the role of development banks such as Banrural declined radically, and a new scheme emerged, whereby FIRA offers discounted or low interest rates loans through the intermediation of commercial banks (Basave, 1996). And secondly, the lending criteria became more oriented towards market objectives rather than the once prevailing social ones. Soft loans disappeared and were replaced with market-based ones. This applied not only to the FIRA-financed commercial banks, but also to Banrural. There are thus two tendencies at play, one of partial privatisation of rural financing (with the inclusion of the commercial banks as intermediaries) and one where market orientation is given the primary role in the administration of loans. Together, these tendencies amount to a state supported integration of rural financing into an ailing capitalist credit system.

The regional trends are in line with the national ones. The regional branch of Banrural (the only remaining active development bank in regional milk production) has decreased its financing to La Laguna crop production by 77% in the last 10 years, entailing a drop from \$808 million in 1988 to \$187 million in 1998<sup>6</sup>. In the financing of milk production, this was reflected in a drop from \$54 million in 1989 to \$2.3 million in 1998. At the same time, FIRA has increased its participation in the financing of regional agriculture through its interest rate discounts. Its total resources for the region went up to a peak of \$1,607 million in 1994. However, here enters the macro-devaluation of 1994, the accompanying crisis of the bank sector, and the high interest rates imposed as a remedy to the economic ills of the country. Two main elements have followed from this. Firstly, the public financing system has been further "rationalised" and its resources cut. Hence, the total resources available for loan discounts by the regional branch of FIRA in 1998 were at less than a third of their 1994 levels. Almost the same proportion applies to interest rates discounts directed at the milk industry. Secondly, the high interest rates

<sup>6</sup> Unless otherwise stated, all monetary figures correspond to 1998 pesos.

have made commercial loans to producers out of reach for most of them<sup>7</sup>. Financing has thus been cut from all side, from both the public and the private sector, leaving the industry wholly under-financed (and the same is true for agriculture in general). This has meant that those able to expand do it at very high cost, with their own capital, or with informal forms of financing.

Myhre (1998) mentions types of informal financing: provision of inputs or services by the usual service provider to the farmer without upfront payment, but rather in exchange for the delivery of part of the resulting harvest; provision of finance by the agro-food firms usually buying the farm product, in exchange for an agreed upon amount and quality of product; financing by traditional local money lenders; and remittances from migrant labour.

Informal financing generally leads to a relative loss of independence of producers. When that financing comes from the processing industry or from the providers of inputs, what happens is often the loss of control by the farmer of the production process for the capitalist aims of the money lenders, therefore potentially leading to a virtual proletarianisation of the farmers.

Alternative forms of financing are also found to a limited degree in new government programs directed at agriculture, such as Procampo and Alianza para el Campo ("Alliance for the Countryside"). Instead of loans, these program provide cash reimbursement for specific productive purposes, such as buying cattle, building improved farm infrastructure, and new irrigation schemes for feed cultivation. Contrary to FIRA-financed commercial loans, these programs are meant to substitute the discredited development banks and their role of providing for the "social" sector as well as the private sector. Such programs have led, nevertheless, to an increase in the number of small producers in the region. There are therefore two diverging tendencies at play here, the main one strongly encouraging the concentration of dairy farm capital (only the strongest and most successful can survive in an envi-

ronment where credit is scarce), and the second one encouraging a limited proliferation of small and fledgling operations; in other words, encouraging polarisation among dairy farmers. The proclaimed aim of the direct payments programs is to facilitate the overcoming of the crisis of Mexican agriculture, by notably "contributing to the constitution of a rural, relevant, accessible and efficient financial system"<sup>8</sup>. However, the inadequacy of the amounts distributed and of the measures taken to end corruption in its distribution points rather towards the traditional political aim of cajoling the rural political constituency towards a renewed corporatism (or "to renovate the historic alliance between rural Mexico and the state", in ex-President Zedillo's own words (Zedillo, 1995), which had been rapidly eroding in the last two decades. What this section has shown, however, is that such corporatism would be based on a much weaker basis than the previous one.

### The provision of productive dairy capital

Among the panoply of inputs that go into milk production, only some of the most basic ones, i. e. cattle, water, and land, will be discussed here. Land, as the site and means of feed production, is probably one of the most crucial aspect of fixed dairy capital, with a heavy political background to it. With Salinas' agrarian counter-reforms of 1992, a private property regime was reinforced with the aim of boosting investment in the countryside. Though the reforms have apparently not led to the waves in investment that they were aiming at, a certain process of commodification of the land is under way, at least in regions where a capitalist agro-industry is expanding, as in La Laguna.

La Laguna had been one of the major focus of attention of the huge land re-distributions implemented by Cárdenas (SRA, 1998). As a result, La Laguna became one of the regions of Mexico with the largest proportion of ejido land. Still in 1989, 93% of all productive units and 76% of cultivated land in La Laguna belonged to the ejido sector<sup>9</sup>. But this is

<sup>7</sup> above 45% all through the 80s, then lowering to 20% just before the devaluation and then up again at 60% in 1995. The 1998 average lending rate was 29% (IMF, 1999).

<sup>8</sup> from President Zedillo's inaugurating speech of the Alianza para el Campo program (Zedillo, 1995).

<sup>9</sup> of a total of 46,330 units of production on 202,224 hectares, 43,711 units and 153,365 hectares belonged to the ejido sector (with an average of 4 hectares each) and the remaining 2,619 units and 49,859 hectares belonged to the private sector (denominated "small property", with an average land holding of 23.4 hectares) (García Hernández et al. 1999).

already in the process of changing. As the commercial farms have been expanding, their initial land holdings could not provide fodder for all the herd. Buying fodder is also more expensive than producing it on farm. Therefore, some did buy ejido land, available for sale since 1992. But the salient feature here seems to be the renting of ejido land and the use of the ejidatarios as labour. This is the solution used by most of the farmers interviewed to provide for the feed needs of their herd. It should be noted that the renting of ejido land is older than the reforms themselves, as it has been practised illegally and informally for a long time. Nevertheless, one can expect that the growing dynamism of the milk industry in the region will accelerate both the selling and the renting of ejido land. In sum, with some ejido land being bought by dairy farmers, with other being rented, and with the owners of the latter becoming virtual labour for dairy capitalists, one can conclude that land is in the process of being commodified in the region, and increasingly integrated into a capitalist circuit of dairy capital.

Water is another crucial input of feed production, relatively more so where it is scarce, as in La Laguna, and especially in period of extended draught, as in half of the last decade. One should note first of all that the water resources of the region have been directed ever more towards feed production: the proportion of irrigated land used for the production of feed crops rose from 12% in 1970 to 53% in 1998<sup>10</sup>. One can also differentiate between three forms of land holding in the region: non-irrigated, where little agriculture can be done, dam water irrigated and underground water irrigated. The advantage granted by the latter over the former form of irrigation is more flexibility and therefore potentially more intensity of production. The dams are controlled by government, and the irrigation periods are set, whereas the wells are private property (or collective property if on ejido land). Feed crops occupy a steadily rising and disproportionate proportion of the use of the latter, up to 70% in 1998. This points to a concentration of the best regional land and water resources towards milk production. The main feed crop used is alfalfa, which accounts for between 45 and 65% of all feed crops cultivated in La Laguna between 1970 and 1998 (Sagar-Laguna,

1998), and uses 22% of all underground waters used in the region (Aguilar y Luévano, 1999). This otherwise very advantageous and efficient fodder has a much higher water-to-product conversion rate than any other major crops cultivated in the region. It uses 279 litres of water for every kilo of fresh product, compared to 150 l./kg for maize or 134 for sorghum<sup>11</sup> (Aguilar y Luévano, 1999). Increases in the intensity of production and expansion of the dairy industry in the region have thus contributed to a situation today where underground water beds are used at a radically unsustainable rate. In the district of Matamoros, for instance (one of the districts with the highest concentration of dairy farms) underground resources are disappearing at a rate of 2 meters a year (Aguilar y Luévano, 1999). This has production costs implications, with deeper and more expensive wells having to be dug for irrigation, and more electricity required for the more powerful pumps used. Moreover, it can affect the health of the cows where the water becomes poisoned due to mineral imbalances in the soil. It also has agronomic implications, with the accompanying acidification of the land. The implications are also most tragically human, with arsenic poisoning not uncommon in some districts of La Laguna.

A third element of productive capital analysed here is cattle. Most of the dairy cows in the region are of the Holstein race. This is true even of most small operations, thanks to the government support mentioned in the last section. The prevalence of cows of Holstein stock contrasts with other milk producing regions of Mexico, where the Zebu race is more common, due to its better resistance to heat and diseases. The advantage of the Holstein is its high genetic potential for high productivity. In order for this advantage to be used, however, a host of factors must be considered. The milk yields of dairy cattle varies considerably from day to day, and is highly dependent on biological and environmental factors such as feed quality, absence of diseases, reproductive health, heat, dietary supplements, overall physical activity it is submitted to, handling during milking, etc. While any milking operation would try to control at least some of these factors, a capitalist mode of dairy production introduces the compulsion towards the most intensive control possible of

<sup>10</sup> Feeds do not entirely go towards cow's milk production, but also towards meat and egg production. Nevertheless, milk is the single most important product of animal farming in the region, oscillating between 34 and 47% of the value of all animal production in the last 20 years (SAGAR-Laguna, 1998).

<sup>11</sup> Maize is the second most important fodder used in the region, but by far the most important staple food in Mexico. Sorghum, in contrast, is marginal in terms of human and animal consumption, but is the most water-efficient fodder and food cereal.

all factors. In this process, the cows are reduced to the mere status of a difficult and fragile commodity, or in other words, of a sophisticated machine.

The provision of dairy cows in La Laguna is assured by either reproducing them on farm, through a more or less elaborated reproduction program (often with imported semen), or by buying them, often from abroad. Those who buy the cattle do so either because they cannot meet their replacement needs with on farm reproduction, or because they want to improve the genetic stock of the herd. Obviously, the genetic potential of each cow varies strongly, and is passed along through reproduction. This is why breeding technologies and records are so important in specialised dairy farming. Although the introduction of the Holstein race has been actively promoted by the Mexican government since the 1960's, with obvious successes in La Laguna, the same could not be said of breeding technologies and pedigree recording practices.

Only the largest, most advanced and best managed dairy farms in La Laguna can reproduce and maintain a high genetic quality in the herd. And only recently have companies started to emerge in Mexico offering services in this sector. As a result of this weakness, both farmers and government programs desiring to improve the productivity of the herds have had to rely on imports from the US or Canada. The number of cattle and semen imported annually varies greatly, and depends largely on cattle prices in the US and on exchange rates. This element is therefore likely, through competition, to lead to more polarisation among dairy producers, and to the process of proletarianisation already mentioned: only those with more resources (money or knowledge based ones) are able to increase the genetic quality of their herd, increasing their productivity and in the long term lowering the market price of milk, thus squeezing out the resource-poor and less efficient farmers.

### Divergent modes of milk production

The long history of milk production in the region resulted in a large variety of production patterns and of socio-economic conditions underpinning it. And

given the large number of factors which define a dairy farm, it is difficult to set categories. Nevertheless, one can vaguely differentiate between various types of milk production units in La Laguna. A starting point is FIRA's study of the regional milk industry, with two categories: family dairy farms and specialised ones. Family farms, on the one hand, number 187<sup>12</sup> in La Laguna, with a total of 12,365 dairy cows in production, and an average herd of 66 cows. In the specialised farming category, on the other hand, are 297 farms, with 152,803 dairy cows in production and an average herd of 514 cows. These categories broadly correspond to the capitalist and non-capitalist sectors of production. The first category, however, can be divided into three subgroups. Leaving the second category intact, we now have four categories.

There are, first of all, small independent producers with little resources (often referred to in the region as "traspatio" or backyard producers). The number of producers in this category has increased in recent years, due mainly to government support. Many are descendants of the first ejidatarios, but have never obtained ejidatario status and thus left with little resources. They typically have 5 to 25 cows, usually of the Holstein race and usually kept in rudimentary feedlots. These feedlots are often the only infrastructure they have, and many of them don't even have the land to grow their own feeds. In the context of what has been termed in interviews a feed crisis (little availability and high prices of feeds), the result is often poor nutrition of the cows and poor milk yields. Only a portion of these producers can afford concentrated feeds, nutritional or veterinary supplements, or veterinary and technical advice. Such farmer also typically lack the infrastructure to provide for shade, which leads to even poorer yield during the summer months. Moreover, only some of them have been able to introduce mechanical milking, and then only with one portable milking machine (hand milking can lead to cow health and milk sanitary problems). Finally, those who do refrigerate the milk of their cows can only do it through their participation in a co-operative usually set up for that purpose, pooling their milk with that of other members of the co-operative. The co-operative can also offer some inputs and services, but often have very limited resources.

<sup>12</sup> This number indicates either a farm or a number of farmers grouped together by a cooperative, where the milk is pooled in a refrigeration tank. The number of dairy farmers in this category in fact almost reaches a thousand (FIRA).



A second category is made of specialised or semi-specialised family farmers with more resources, typically with a longer history of dairy farming. The herd is small enough (up to 75 cows) to remain a family farm and to employ wage labour only marginally, but has been successful enough to provide for more sophisticated methods of production. These farmers typically will have mechanised milking, shade, will be auto-sufficient in their feed provisions, or have means to buy fodder, concentrated feeds, nutritional and veterinary products and services, etc. The larger ones will usually have their own refrigeration tanks, or else take part in the same cooperatives as the farmers of the last category. Of course, scale is important here, as the larger and more profitable the farm is, the more wage labour is introduced, the more the enterprise is dissociated from the family economy, and the more surplus is accumulated for further capitalist enterprises, bringing the farm ever closer to a capitalist mode of production.

Farms in the third category, the *establos ejidatarios*, can be quite sophisticated and well equipped. They are made of *ejidatarios* of collective *ejidos*, brought together into *grupos solidarios*, with equal shares in the control, operations and benefits from the farms. Most of them employ wage labour (with the *ejidatarios* actually doing little labour on the farm), but this labour is usually drawn from the families of the *ejidatarios* or from the *ejido* community. However, there has been a considerable decrease in their number, from a high of 78 fifteen years ago to 11 today. According to those interviewed on the matter, the reasons for this debacle include corruption, predatory appropriation of gains by managers of collective *ejido* dairy farms, structural inefficiencies, and so on. The main factor that sparked the debacle, however, is to be found in the switch already explained, from a rural finance system oriented towards the support of small holder and "social" agricultural production (and permissive of the ills just mentioned), to an essentially market based system, and the incapacity of *ejido* milk producing operations to survive in the new market-dominated context.

As for the fourth type of productive units, their numbers has remained stable in the last few years, and the few new commercial dairy farms being built belong to one or another of the largest dairy families of the region. Here are found the oldest dairy families of the region, and milk production today is

almost entirely dominated by this fourth category. The largest farms of this group will have the latest available technologies, full time veterinary doctors, dairy technicians and other wage labour, and so on, affording them ever more productivity. This category, according to FIRA, participated with 95% of all regional production, and has 92% of all the herd in production. This is the category of farms with the fastest growing herds, able for instance to finance trips to the USA or Canada to bring in good quality herds.

This article so far has identified sources of concentration of dairy capital in the unequal access to financing, in the unequal provision of dairy inputs, and in the unequal resources and methods of production used by farmers. It will become apparent however, that the most dynamic factors of concentration of dairy capital are to be found in the dairy agro-industries.

### Agro-industrialisation of milk

After leaving the production units, milk generally follows 2 main paths, either towards direct consumption, farmhouse cheese production, and "informal" distribution of what is called *leche bronca* ("raw milk", i.e. non-pasteurised), or towards pasteurisation, industrialisation as cheese or yoghurt, and consumption as pasteurised milk or industrialised products. It is estimated that the "informal" route uses 41% of all milk produced in Mexico, and the industrial one 59% (27% as fresh milk and 32% as industrialised dairy products). Generally speaking, the first path (un-pasteurised consumption and transformation) corresponds to small scale, non-specialised milk production, while the second path (pasteurised consumption and transformation) draws mostly from the larger family dairy farms and capitalist farms. In La Laguna, however, the integration of even some of the smaller dairy farms into the second, capitalist circuit is common. As the dairy agro-industry develops in Mexico, more small scale production should become integrated in the industrialised and capitalist circuit of dairy capital.

While the elements of the circuit of capital mentioned up to this point already tend towards concentration of dairy capital in the region, the most powerful process at play in this respect is the hori-

zontal and vertical integration of the dairy agro-industries. That concentration and control would happen upstream and downstream the production process is implied in the exposition on the process of penetration of capital into agriculture presented earlier. Only farming as such (No. 1 and 3 in figure 1) uses the natural processes already mentioned as slowing down or blocking the penetration of capitalism. But processing, distribution, inputs, as with any other industrial sector, can be appropriated by capital, and has been indeed (Lewontin, 1998). This is therefore the sector most likely to lead the concentration of capital in the dairy industry.

74

In La Laguna, this sector is under the incontestable leadership of the Grupo Lala, the largest Mexican dairy co-operative. It started in the forties as a farmers co-operative, the need for which was reinforced after new government sanitary regulations prohibited the sale of non-pasteurised milk. Small dairy farmers of La Laguna first joined together to form a credit union in 1949, with the funds of which they could then open the first pasteurising plant of the region in 1950 (García Hernandez et al., 1999). The transformation of the co-operative into the holding that it is today was given much impetus from the mid sixties on, when Lala started to go through different phases of geographic and corporate (horizontal and vertical) expansion. It now distributes milk and other dairy products to all regions

of Mexico, and even exports to Central America. The process of national expansion has received new impetus in the last few years: for instance, it bought 250% more milk from outside La Laguna in 1997 than in 1996, and in 1998 it acquired a pasteurising plant in Guadalajara, Mexico's second largest urban market (Aguilar and Luévano). The regional domination of the holding can be seen in the proportion of milk that it controls: in 1997, Lala controlled 63% of all La Laguna milk going towards industrialisation. Its share of the total has increased dramatically from the previous year, when it controlled 56% of it (table 1). The group has also vertically integrated ever more aspects of dairy production, including UHT pasteurisation, packaging, transport, yoghurt production, concentrated feeds, etc. Regarding the latter, the group has one of the most important concentrated feeds production plant in Mexico, which in 1998 provided 88% of all concentrated feeds used in La Laguna dairy farms. In contrast to many other regions, where feeds are sold by US corporations such as Anderson Clayton and Purina, in La Laguna these two companies had respectively only 6% and 5% of the market.

All these achievements of the Lala group amount to a bourgeois revolution<sup>13</sup> of sorts, whereby its members have increasingly acquired the means of accumulation of surplus value of dairy capital, and through vertical integration extracted ever more

TABLE 1: MILK DISTRIBUTION AMONG LA LAGUNA DAIRY AGRO-INDUSTRIES

	Millions of liters 1996	% share 1996	Millions of liters, 1997	% share 1997	% change
Grupo Industrial Lala	749	56	921	63	23
Chilchota Alimentos	145	11	162	11	12
Alpura	99	7	114	8	15
Monica's Foods	47	3	72	5	53
Pasteurizadora Lerdo	37	3	37	3	0
Others	272	20	155	10	-43
Total	1,349	100	1,461	100	8

Source: Sagar-Laguna, 1998; Aguilar y Luévano, 1999.

added value from the products. But at the same time, Lala is already far from being the co-operative of independent family producers that it once was. The reason for this are to be found in the same process of vertical integration just mentioned. Since only farming is at times non-capitalist, and since every step in the processing of milk and the pro-

duction of input is capitalist, the vertical integration process has meant that an ever greater proportion of the group has taken upon itself a capitalist outlook, farming as such being an ever smaller part of the added value appropriated by the group. There are also internal reasons underlying the change towards a capitalist enterprise. The 172 farms mem-

13 Following Henderson, who applies this concept to the formation of Sunkist and other Californian fruit commercialisation cooperatives.

ber of Lala include small dairy farms, but also almost all of the largest and most efficient dairy farms of the region. The only such capitalist farms not included in the group are those belonging to the competing dairy agro-industries (mostly Monica's food and Chilchota, each vertically integrated private companies with their own very large ranches providing for their milk needs, and Alpura, the second largest national dairy co-operative).

Moreover, membership in the group as well as decision making is based on a system of shares, which reflects the quantity of milk delivered to the group by each farmer and paid at the regular price. Any milk delivered beyond what the number of shares allows is paid at a lower price. Shares also drives the decision making process. This is most evident in the periodic shareholders assemblies, which among other things elect the executive committee and decide on major corporate changes. Decisions in such assembly are voted on based on the number of shares one holds, not according to the one person, one vote system. This skews the decision making process and the dynamics of the group towards the largest and most efficient capitalist farm owners, effectively integrating the smaller family farms into a capitalist logic of production.

Neither is the group open to the integration of more dairy producers. Since the amount of milk that the company can process and commercialise is limited, and since the group has grown so much in value, shares have become very difficult to obtain and very expensive to buy. In addition, when shares do become available (through the selling of those of an existing shareholder or through a new issuance), those with most shares get the first pick. This aspect is relevant since only those with new shares can expand their operation with a guarantee that the extra milk production will be bought by the cooperative at a good price. This system, by which the largest farms have the first and best opportunity to expand, leads to a highly concentrating dynamic. It explains the rise of dairy dynasties in the region, with the largest farmers having built new farms for their progeny, obtaining the necessary shares in Lala, while some other members of Lala have struggled for their farm to survive and have not been able to expand. All this lends the Lala group more the capitalist character of a shareholders enterprise than that of a farmers co-operative.

Moreover, as the Lala group expands horizontally, the concentration of regional dairy capital is also encouraged. Not only is Lala expanding nationally and even internationally, but its share of total production in the region is increasing dramatically. The concentration of dairy capital under the leadership of Lala, of its most powerful shareholders, and of other capitalist agro-industries can be seen in table 1. The table shows the distribution between regional dairy agro-industries of all milk produced in the region. In 1997, Monica's Food (which has the two largest farms in the region, with 4000 and 4500 cows each) and Lala saw their share of that total increase by 53% and 23% respectively. In contrast, the category "others" (which includes 15 other industrial and farmhouse transformation units) has seen a decrease of their share of the total of 43%. As smaller dairy processors and distributors scale down or are squeeze out of the market, the small producers of the first category and even some of the second category find it increasingly difficult to sell their milk, and sometimes have to do so in neighbouring states or at a much lower price. As pointed out by Heffernan, one way in which farmers loose their independence is exactly through the concentration and monopolisation of input and processing agro-industries, removing options for the producers. In a very competitive market with low profit margins, low and differentiated producer prices can also lead to the elimination of smaller producers from this economic activity.

The issue of quality is also an element of concentration of capital. As the dairy industry has developed, as consumption pattern have changed and as globalisation and liberalisation of the market have proceeded apace, product differentiation has become one of the main strategy to extract more value added from dairy products and to deal with increased competition. Associated to this is the fact that the standards of quality have been raised, and imposed by the dairy processors onto the farmers, together with the increased production costs this implies. The quality of the milk defines the price paid to farmers, with a system of premiums and penalties applied by the processing companies. One of the basic means to increase the quality of milk is its refrigeration as quickly as possible after milking. The imposition of stricter quality criteria has provided the impetus to organise small farmers into cooperatives mainly oriented to buy refrigeration tanks. It has often been imposed by the processing company itself, as a con-

dition to buy their milk, as is the case of Nestle in Los Altos de Jalisco, the second most important dairy region of Mexico (Rodríguez Gómez, 1999). In La Laguna, there are 24 such co-operatives, collecting milk in refrigeration tanks as well as offering various input services to their members. But even this type of organising has its limits. For example, access to Lala is not only limited by the number of shares available, but also by the minimum requirement that the milk be refrigerated on individual farms (García Hernández, 1998), in order to prevent the contamination of better quality milk from lower quality one. However, all farmers of the first category described earlier, when member of a co-operative, refrigerate their milk collectively.

76

In sum, what is painted here is an industry where there are strong tendencies towards concentration of dairy capital into the most powerful agro-industrial firms. Accompanying this is a polarisation among milk producers between a small elite of capitalist farmers with increasing control over the whole circuit of dairy capital, and a mass of small to medium family farmers increasingly under the control of the latter. Such control is implemented through a polarising share system as in the case of Lala, through increased quality criteria, or through differentiated prices paid to the farmers.

One could argue that even if this is so, Lala and dairy farming in general has led the region towards development and relative economic prosperity. Lala, as a local capitalist enterprise, has in fact managed to appropriate the increased value added to milk throughout the production and transformation process, and has largely allowed a number of dairy farmers to prosper without hindrances from monopolising practices of transnational corporations. This form of development has also allowed for most of the surplus value to be reinvested regionally. It has increased employment considerably. These are the advantages of regional endogenous capitalist development. Moreover, the region has recently become one of the major pole of maquiladora expansion, offering employment to those who might get squeezed out of dairy farming through the process of concentration of capital. But according to the analysis presented here, this latter point would only give more evidence to confirm the process of proletarianisation of dairy farmers already identified.

Moreover, all these elements point to the fact that the development at stake here is not the sustainable development that all development agencies are celebrating, but rather capitalist development, with the usual social polarisation, environmental non-sustainability, and exploitation it implies.

### Use of rBST on La Laguna Dairy Farms

La Laguna is where rBST was first introduced by Monsanto at the end of the 1980's (the official date, that of its registration with the Ministry of Agriculture, is 1991) and is still one of the very few milk producing regions that does use the technology. From the interviews conducted<sup>14</sup>, it appears that the general perception of the hormone is that it is an effective instrument to increase milk production and that it increases the profitability of farms of varying sizes, without leading to any problem for herd or farm management. There were, however, some dissenting voices, arguing that although the hormone does increase cows productivity, it can also disrupt their reproductive functions and shorten their productive life span. Some felt that it represents an addictive drug for the farm economy and that it is not necessary in order to improve cows' productivity. Some of these claims, as well as those mentioned in the first section on the potential of rBST for development, will be taken up here and integrated into what has already been said about the regional political economy of milk production.

All those using rBST said that with the recommended application of the drug, the yield of milk increased between 2 and 3 litres per cow per day (thus well below what the rBST distributor's pamphlet says, i.e. 3.5 to 5.5 litre/cow/day). A simple economic model can give an idea of how rBST can financially affect a typical La Laguna producer. According to FIRA data on the costs structure of dairy farming in La Laguna, and to interview data, one can calculate that the use of the hormone leads to additional revenues from the increased milk yield of \$2,440 per cow per year (an average additional 2.5 litres per cow per day, at \$3.20 per litres of milk paid by Lala in 1999, during 305 days, the average lactation period). The costs however are increased by \$2,370 per cow per year, which includes \$1,430 for the hormone

<sup>14</sup> Out of total of 300 dairy farms in La Laguna 30 were visited, with herds ranging from 5 to up to 4500 cows.

itself (\$55 per shot, applied every two weeks) and \$940 for the extra feeds given to the cow (increased by an average of 7.5% according to interview data, calculated on annual average feeds costs of \$12,537 per cow on a specialised La Laguna dairy farms<sup>15</sup>). The marginal profit yielded by the hormone itself is thus \$70 per cow per year. Beyond the regular application program of the hormone (injected once every two weeks in healthy cows for part of the lactation period), many producers also use the hormone in ways that might have other marginal positive impact on the profitability of production. It can be used for instance in cows that were sick, in order to help them to recover. Some also use it in cows in their last lactation or with reproductive or physiological problems, which in any case are bound for the slaughterhouse. Since the hormone not only increases production but also can maintain lactation to an affordable yield level for up to 1000 days (the regular lactation period is 305 days), it can grant a longer productive and profitable life to those animals.

Nevertheless, the marginal profit yielded by the regular application program is very slim. This is not that surprising if one considers that even in the US, the few ex-post studies that exist report only poor results on marginal profitability of the use of rBST (cf. review and study by Butler, 1999). In the context of Mexico and of La Laguna, these weak results should be considered with even more circumspection, as many factors make the profitability more unstable than in the US. For instance, the price paid for milk was at \$2.73 in 1998, diminishing (in the model presented here) the revenues from the increased milk produced to \$2080 per cow per year, and thus leading to a marginal deficit of \$290 per cow per year<sup>16</sup>. Moreover, another devaluation could increase the price of the drug and other essential inputs; more extreme heat could significantly diminish the extra yield conferred by the drug; a draught would increase the price of fodder and/or lower its quality; etc. And all this is exacerbated by the low level of government support relative to the US, and the low availability and high prices of credits.

Most literature on the topic (mainly in the context of the US) usually fails to deal with a host of other, perhaps indirect but nevertheless crucial, aspects of the use of the hormone. Some are specific to a developing countries such as Mexico, but some would also apply to many developed countries as well. For instance, the hormone can only be taken in optimal production conditions. Of first importance is the alimentation of the cows treated. But the whole management of the farm is important, from the milking process to the amount of shade the animals get during times of heat. If some elements are missing in this optimal management scheme, the hormone can reveal itself to be more destructive than beneficial. In a region like La Laguna, many factors make difficult this optimal farm and cow handling management: low availability of sufficiently skilled labour; the heat, as mentioned earlier, which in itself makes the region non-optimal for the use of the hormone; periodic or even chronic draughts, which leads to poor quality fodder and/or more expensive and more complicated logistics for fodder and feed provisioning; macroeconomic instability, which can drastically increase the costs of imported inputs necessary for such optimal management, etc. Regarding the heat, some interviewees decided to stop using the hormone in the summer, in periods of heat or when no fodder of good quality was available, as they had too many premature deaths or too many problems of fertility, which they associated with the application of the hormone. According to industry literature, however, the only consequence of less than optimal treatment of the cows is that it can lead to less efficiency of the hormone. According to their studies, it cannot have detrimental or destructive effects on the health of the cows treated, since the process of increased milk production also needs more nutrients to be triggered<sup>17</sup>. But even if the health of the cows is not impacted by the combination of heat and the hormone, the bottom line is that, given the small margin of profitability that the use of the hormone confers, less than optimal management of the farm and of availability of the necessary resources can easily lead to losses from the use of rBST.

15 There are no additional labour costs to apply the drug, as the distributors do it themselves. There might be increases of labour costs to monitor the cows, though it is suspected that it is the intensity of the same labour that increases instead of the costs of hiring new personal. Wages in this sector are seldom calculated on an hourly basis, but rather on a daily basis.

16 Of course, price changes can be affected both ways. For instance, a few years ago a competitor to Monsanto's Lactopropina<sup>®</sup> was introduced in La Laguna with a considerable price difference. Many producers switched to that new product, benefiting from more marginal profitability from rBST. But the price difference was only a marketing ploy, and it soon increased to par Lactotropina's.

17 rBST triggers an increased production of IGF-1 (insulin-like growth factor 1), which acts on the mammary cells, increasing their activity and thus milk. But more nutrients are also needed for IGF-1 production to be increased. It should be noted that the concerns over the human health impacts of the product are linked to this compound. While BST is different in composition from human growth hormones and therefore could not have any impact even if injected in humans, IGF-1 is identical to that found in humans. And a certain role is thought to exist for IGF-1 in prostate, colon, and breast cancer contraction.

One might wonder then why La Laguna dairy farmers continue to use rBST, even in the face of such low or even negative marginal profitability. The simple model presented above has certainly been considered by most farmers who have adopted the technology. One answer might be that dairy farming confers such low rates of profits that any means to increase them, even if hard to actually reach due to the number of conditions that go with them, is good enough to adopt. And rBST does increase production very significantly, acting on the most powerful of all criteria by which farmers assess each other, yields. There is also of course the pressure of the distributing companies, some of them in regular contact with the farmers for the sale of other veterinary products. These more subjective elements should not be underestimated, as those who reject the use of rBST are often subjected to subtle social pressure. But what sparks these subjective elements is a deeper process, that of the integration of La Laguna dairy farms into an ever wider and deeper circuit of dairy capital. This process, as emphasised in the last section, is led by a concentrating dairy capital, imposing cruder competition and higher entry barriers, and thus leading to the intensification of production as a means to counteract these tendencies. rBST is an intrinsic part of that process of intensification. While many farmers value the dairy cows they own as more than mere machines or dispensable commodities, and are therefore reluctant to treat them as such, most dairy farmers using rBST have no such qualms about their cows.<sup>18</sup>

But not only is the use of rBST problematic for the economy of many farms. Its role in intensifying production also has to be questioned. Even strong supporters of rBST would agree that more intensive production leads to a shorter productive life span for the cows (which can be cut almost in half compared to alternative modes of operation) and a decreased level of fertility (most of the energy of the cow goes towards milk production, with little left for reproduction). These two problems combined lead to the impossibility to be auto-sufficient in the provision of dairy cows, and to the necessity to buy calves, which is usually done from abroad (mostly Canada and the US). This practice is linked to go-

vernment sponsored programs of genetic improvement of the livestock, which pays a portion of the costs of the calves. But dairy calves cost some US\$1600 in 1999 (up from \$1200 in the previous year), having an important role to play in the cattle balance of payment deficit mentioned earlier, to which rBST can only contribute. The environmental problems associated with dairy farming in La Laguna, also mentioned in an earlier section (i. e. depletion of underground water resources) are also exacerbated with the intensifying of production.

Given the problems and weaknesses identified regarding the use of rBST in La Laguna dairy political economy (low profit margin, additional indirect costs, reliance on a foreign technology leading to instability of farm profitability), its potential use for "development" purposes is strongly challenged. First of all, the low or negative marginal profitability it confers combined with the clearly increased yields point to the fact that the pharmaceutical transnational corporations producing and distributing rBST<sup>19</sup> are extracting all the "rent" (Butler, 1999) (or in Marxist term the relative surplus value) associated with the hormone from the production process. In these conditions, even if rBST leads to an increase in milk yield, it cannot be said to help the farmers who use it to prosper and become more competitive. Only a few will be able to benefit from its use. Neither does it bring more wealth regionally, as all the extra wealth it produces is sucked back to where the product came from.

Secondly, the literature on the topic (corporate or academic) usually claims that this technology is scale neutral. From this it could be inferred that its diffusion should be more or less rapid and easy, and could benefit a host of small producers in developing countries. But even though the drug itself is scale neutral, everything else that is required to use it in an efficient and profitable way is not (infrastructure, specialised technical labour, quality feeds, monitoring, etc.). When one claims that the hormone has the same rate of return on herds of 10 or 10,000 cows, it is assumed that both herds are submitted to the same production conditions. But in the reality of most developing countries, the size of

<sup>18</sup> This does not mean that the dairy cow is not part of the capitalist farmers' personal or corporate identity. It might still be the most symbolic part of the farm economy. But then, the image of the cow often takes on a fetishised form, even sometimes humanised, hiding the actual relations of production in which they are involved.

<sup>19</sup> Two products are sold in Mexico: Lactotropina®, licensed by Monsanto to Eli Lilly, and Boostin®, produced by Lucky Star, a Korean pharmaceutical company, and sold in Mexico by the pharmaceutical giant Schering Plough)

the herd is often related to the sophistication of the technologies and infrastructure of the farms and of the resources available. Thus, a large farm might more easily get to the optimal conditions for the use of the hormone than a smaller one, and thus ripe more profit more easily from it. In this broader, non-reductionist sense, rBST is not scale neutral.

As a result, in most developing countries, a very large majority of dairy farmers are not even candidates for using rBST. Even according to those selling it to the farmers, a bare minimum for the use of the drug is adequate alimentation and some basic modern installations, the bottom line of which is often considered to be mechanical milking. But even at higher levels, there are many other priorities to increase productivity, such as alimentation, infrastructure and specialised technical consulting. This type of operation, however, which could not use the hormone, is the large majority of milk producers in developing countries, including Mexico. In La Laguna, among the four categories of dairy farmers described, it is mostly the fourth, capitalist one that uses rBST. But some farmers of the second and third categories are also starting to use it, both a symptom and a cause of their integration in the capitalist circuit of dairy capital, and of their tendency towards joining the capitalist category. In this situation, and in the current context of neo-liberal restructuring, deregulation of markets, and slashing of support policies to agriculture, what this technology is likely to be fostering is rather the increased polarisation between resource-poor producers and the more developed ones. It is true that it might foster more efficiency and competitiveness of the specialised and technologically developed dairy sector of a country like Mexico and thus might help it face the world market – though the limits of the contribution of rBST in this process should be clear by now. But the thousands of other producers excluded from that development face the alternatives of increased poverty; of becoming peons for large dairy producers; of joining the rural exodus towards employment in the emerging La Laguna maquiladora economy or unemployment and isolation in the cities; or of illegal emigration to the North.

The concentration of dairy capital and the adoption and use of rBST in La Laguna thus seem to reinforce each other. On the one hand, the concentrating and integrating dynamics at play in the circuit of dairy capital seem to motivate the use of rBST for some

producers, even when such use may not prove to be so profitable. On the other hand, the same dynamics prevent the use of the technology towards sustainable development, instead fostering and intensifying further concentration of capital and an environmentally unsustainable and socially exclusionary form of development.

## Conclusions

As should be obvious from the presentation of the main dynamics at play in the regional economy of La Laguna, technological change cannot be seen as determining the main tendencies presented here. But nor is technological change neutral. New technologies can take an active role in the process of change. The relationship between technological change and social change can be understood in a dialectical relationship: the technology itself is shaped by the tendencies at play as well as it can modify or reinforce those tendencies. The last section showed that the introduction of rBST in La Laguna was motivated and encouraged by many regional factors, the most salient of which is the concentration of dairy capital in the region. But the same technology also participates in that process of concentration by potentially encouraging the polarisation of producers. In many ways, what technological change brings about here is not a new society, but rather participates, as a capitalist technology, in the further expansion and development of capital.

This development, however, does not remain unchallenged. In the last two years, agro-biotechnologies have been placed at the centre of an intense political debate, to a degree that is rather unusual of new technologies. People have gone down on the street to attempt to fight what is often considered a ploy of transnational corporations to appropriate and control the basis of life itself. This is often linked to a struggle against the increasing power of these transnational corporations and their political institutions around the world, as the anti-biotech contingent in the Seattle protests in November demonstrated. Also countering the visions of technological determinists, therefore, is the fact that social agency, in what at times ends up being a fight against the increasing power of capital, is also part of the process. This keeps the future open, and makes the outcomes ever impossible to predict.

## References

- AGUILAR Viland Luévano G. A., eds., 1999, *Impacto Social y Económico de la Ganadería Lechera en la Región Lagunera*, 6th edition, Torreon, Coahuila, Grupo Industrial Lala, S. A. de C. V.
- BASAVE K., 1996, *Los Grupos de Capital Financiero en México (1974-1995)*, UNAM/Instituto de Investigaciones Económicas. México.
- BORLAUG, E. 1997, Feeding a World of 10 Billion People: the Miracle Ahead, Lecture presented at De Montfort University, Leicester (UK), May 31, <http://agriculture.tusk.edu/biotech/monfort2.html>
- BUTLER, L.J., 1999, The profitability of rBST on US Dairy Farms, *AgBioForum*, Vol. 2, No.2, <http://www.agbioforum.missouri.edu>.
- ELANCO, 1999, *Lactotropina = + Leche x Vaca*, Promotional pamphlet distributed by Elanco Animal Health, a division of Eli Lilly y Cía. de México, S. A. de C. V. México.
- ESTRADA, J. M. et al., (undated), *El estrés calórico y el uso de Posilac®, Somatotropina Bovina, en ganado lechero*, mimeo, St-Louis, MO, Monsanto Agricultural Company, Animal Sciences Division.
- FETROW, J., 1999, Economics of recombinant Bovine Somatotropin on US Dairy Farms, *AgBioForum*, Vol. 2, No. 2, <http://www.agbioforum.missouri.edu>.
- FUKUYAMA, Francis, 1999, *Second Thoughts: The Last Man in a Bottle, The National Interest*, No. 56.
- GARCÍA HERNÁNDEZ, L. A., et al. 1999, La Transformación de la Actividad Lechera en México en el Contexto de la Globalización y Regionalización Actual, in Estela Martínez Borrego et al., eds., *Dinámica del Sistema Lechero Mexicano en el Marco Regional y Global*, Plaza y Valdés/IIS/IE/UAM-Xochimilco. México.
- GARCÍA HERNÁNDEZ, L. A., et al. 1998, La Experiencia de Cooperativismo en el Subsector Lácteo. El Caso de La Laguna, presented at the Seminar Los Pequeños Productores Rurales: las Reformas y las Opciones, Colegio de México, México, September 10th.
- GOODMAN, D., B. S., and Wilkinson, John, 1987, *From Farming to Biotechnology: A Theory of Agro-Industrial Development*, Blackwell Cambridge.
- HEFFERMAN, W. D. 1998, Agriculture and Monopoly Capital, *Monthly Review*, July-August.
- IMF, 1999, *International Statistics Yearbook*, 1999, International Monetary Fund. Washington.
- INEGI, 1981-1998, *Anuario Estadístico del Comercio Exterior de los Estados Unidos Mexicanos, 1980-1997*, INEGI (Instituto Nacional de Estadística, Geografía e Informática). Mexico.
- LEWONTIN, R. C., 1998, The Maturing of Capitalist Agriculture: Farmer as Proletarian, *Monthly Review*, July-August.
- MYHRE, D., 1998, The Achilles' Heel of the reforms: the rural finance system, in Wayne A. Cornelius and David Myhre, eds., *The Transformation of Rural Mexico: Reforming the Ejido Sector*, Center for US-Mexican Studies, University of California. San Diego.
- REGÉ, J.E.O., 1995, *Biotechnology options for improving livestock production in developing countries*, Addis Ababa, International Livestock Centre for Africa (ILCA), [www.fao.org](http://www.fao.org).
- RODRÍGUEZ GÓMEZ, María Guadalupe, 1999, "Las Particularidades de la Globalización de la Leche: una Propuesta de Análisis", in Estela Martínez Borrego et al., eds., *Dinámica del Sistema Lechero Mexicano en el Marco Regional y Global*, Plaza y Valdés/IIS/IE/UAM-Xochimilco. México.
- SAGAR, 1999, *Situación Actual y Perspectivas de la Producción de Leche de Ganado Bovino en México 1990-2000*, SAGAR (Secretaría de Agricultura, Ganadería y Desarrollo Rural), Centro de Estadísticas Agropecuarias, México.
- SAGAR-Laguna, 1980-98, *Anuario Estadístico de la Producción Agropecuaria, Ciudad Lerdo (Durango)*, SAGAR, Delegación en la Región Lagunera Durango-Coahuila, Subdelegación de Planeación y Desarrollo Rural. México.
- SIC, 1971, *Anuario Estadístico del Comercio Exterior de los Estados Unidos Mexicanos, 1970*, SIC (Secretaría de Industria y Comercio), Dirección de Estudios Estadísticos. México.
- SPP, 1976, *Anuario Estadístico del Comercio Exterior de los Estados Unidos Mexicanos, 1975*, SPP (Secretaría de Programación y Presupuesto), Coordinación general del sistema nacional de información, México.
- SRA, 1998, *La Transformación Agraria: Origen, Evolución, Retos, Testimonios*, 2a ed., México, SRA (Secretaría de la Reforma Agraria), México.
- ZEDILLO, Ernesto, 1995, *Alianza para el Campo*, SAGAR, México.