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# *Agroecological technologies and opportunities for endogenous milk production in land-reform settlements in Rio Grande do Sul (RS) State, Brazil*

Flora Bonazzi Piasentin and Guido Ruivenkamp

ABSTRACT

This article gives an overview of the social construction of local milk production systems at land-reform settlements in Rio Grande do Sul (RS) State (Brazil). It analyzes the push towards an industrialization of local milk production systems, in which specific technologies developed by agro-industries played a dominant role. In contrast to the powerful mechanisms devised by industries to appropriate and substitute settlers' activities and products, generating exogenous styles of rural development, the article discusses local attempts to create social space for the development of agroecological technologies promoting endogenous milk production. Within the context of these two contrasting developments, milk production practices and technologies are analyzed at land-reform settlements in the State of Rio Grande do Sul in Brazil.

Key words: Industrialization of agriculture, agroecology, milk production, endogenous development.

## Introduction

In the globalizing economic space, multinational industries emerge as major driving forces behind the restructuring of transnational food chains (Bowler 1992). They do not only control the production of agricultural inputs but also control food processing, commodity trades, and agricultural research worldwide (Busch 1994). As a result, agriculture is becoming increasingly industrialized through its integration into global food chains (Ruivenkamp 1989, 2005).

Agro-industrial technologies have promoted the industrialization of agriculture through the processes of appropriation and substitution (Goodman *et*

*al.,* 1987; Ruivenkamp 1989, 2005). The process of *appropriation* refers to a gradually taken-over of some biological activities of farming such as soil fertility and the reproduction of plants through the supply of chemical fertilizers and hybrids, delivered by industries. The second ongoing process that stimulates the increasing industrialization of agriculture is the *substitution* of agricultural raw materials by industrial semi-products and synthetic products. These two historical processes (Goodman *et al.,* 1987) are strengthened by biotechnological developments leading to a qualitative shift in the social space of agricultural production within the social organization of global food chains (Ruivenkamp 1989, 2005).

The replacement of agricultural farming activities by industrial inputs weakens the constraints of nature on the agricultural production (Bowler 1992). The constraints of crop reproduction, land use, space, plagues, diseases, and labor are apparently solved by the deliverance of new industrial inputs such as hybrids, fertilizers, pesticides and machinery. However, the use of these inputs (contributing to solve the constraints of nature) also implies that "modern" agricultural production becomes increasingly dependent on the information brought into these new industrial inputs, delivered by the so-called "genetics supply industry". Biotechnological research by the genetics supply industry is not so much done to replace seeds and/or agrochemicals but first of all to modify these seeds and agrochemicals; to change the highly specialized packet of genetic information which controls how the plant will grow and respond to its environment. The possibility of intervening in this genetic program implicates that one can determine where, when and how the growers will sow, harvest and care for their crops. Companies, which control these inputs, are well on their way to control food production *at a distance* (Ruivenkamp 1987). In the longer term the yield of agricultural production will not be primarily determined by the natural specific environment (the constraints of nature, the soil conditions, climate, etc) but by the amount of scientific and technological information incorporated in the new inputs. Therefore, modern agriculture is (and will be increasingly) characterized by a dual process of solving the constraints of nature for agricultural production by disconnecting the agricultural production from its natural environment and simultaneously by making that production increasingly dependent on the specific information developed by the scientists in global knowledge networks (Ruivenkamp 1989, 2005).

The second historical process that is strengthened by biotechnological developments concerns the replacement of agricultural products by industrial semi-products and eventually by chemical and synthetic raw materials (Bowler 1992). This implies the qualitative shift that the linear organization of





food production - from a specific agricultural product to a specific food product - collapses. Basic nutrients as carbohydrates, proteins, fats and elements as amino acids or vitamins are extracted from a broad spectrum of agricultural crops and/or manufactured in industrial fermentation processes. This means that different crops as sugar and corn become parts of a new "sector" such as sweeteners and that crops such as wheat, soybean and (again) corn become part of a new "protein sector". The interchangeability of agricultural products as well as the fermentative production of food components will free the food processing industry from the constraint of the limited supply of specific (crop-based) agricultural products.

Agricultural products become basic raw materials to be used for a large spectrum of food components assembled by food processing companies. The separation of food and agricultural production implies a reorganization of the food chain in which the *interchangeability of products* becomes a central issue. Companies which develop the scientific and industrial capacity to reprogram microorganism and their enzymatic activities to extract food components from different commodities, have in their hands the mechanisms to divide and control the producers -- farmers and workers -- of these basic nutrients (Ruivenkamp 1987).

Thus, through the industrial processes of appropriation and substitution, a set of agro-industrial technologies are introduced into agriculture generating a re-organization of the food chain in which agricultural production becomes increasingly disconnected from its local environment and from the other stages in the food chain (Ruivenkamp, 1989; Ruivenkamp, 2005). As a result, an exogenous style of local development is built up, in which industries increase their control over farming activities while farmers become increasingly susceptible to industries' demands.

In opposition to this process of modern agrarian development within global food chains, efforts are made to install sustainable agricultural developments within local-specific food networks. Within these local food networks, agroecological technologies are developed, aiming to bring back activities under farmers' control and to promote endogenous developments. This style of technology development is closely connected with the social objectives of re-appropriating agricultural activities and products by farmers, and consequently with improving farmers' position within local food networks while opposing the re-organization tendencies of global food chains.

This article is based on a case-study carried out in three land-reform settlements in the Brazilian State of Rio Grande do Sul (RS), where milk production was an important economic activity. The article aims to compare the reorganization of milk production as a result of technologies pushed by global industries, appropriating and substituting agricultural activities and products by the global players, to the reorganization of milk production under influence of actors of local food networks, promoting locally-based (endogenous) developments.

The agroecological milk production was selected as a research topic because it was of great interest for the Landless Rural Workers' Movement's (*Movimento dos Trabalhadores Rurais sem Terra* - MST) State and local cooperatives. Furthermore, in RS State agroecological movements were fast spreading over the regional state and several associations of agroecological farmers emerged (Paulus 1999). Finally, there was a favorable political arena towards agroecology as well as to family agriculture in RS State which made this case an interesting research arena for studying the room for manoeuvre for tailoring techniques to agroecological developments.

The article is set out as follows: First, we examine definitions of technology and the social construction of technology in relation to endogenous and exogenous styles of development. Second, we describe the context of milk production in RS State and the case-study of the land-reform settlements. In the following sections, we analyze the mechanisms, policies and technologies pushing towards an industrialization of local milk production systems and how local actors responded to these mechanisms. The adoption of agrocecological techniques tailored to the conditions of small farmers promoting an endogenous milk production is considered in the following section. Finally, opportunities in different areas of milk production are mentioned for strengthening locally-based milk production by changing the technical codes of different techniques applied in the settlements.

**Technology and its social construction**

Major biotechnological developments have strengthened the structural development of separating farming from its location-specific, environmental links (Ruivenkamp 1989), promoting an agricultural industrialization of agriculture within global food chains. Agricultural technology here is considered in its broadest sense. It embraces hardware (e.g. machinery, seeds, vaccines), management practices and techniques (e.g. soil and water conservation practices, rotations, crop mixes), and increments in knowledge for resource management (Farrington and Bebbington 1993, p. 63).





As opposed to the technological determinism view that considers technology development neutral and following a single uni-linear development path, the social constructivist perspective sees technology development as resulting from negotiation processes between scientists and dominant actors in society. Through this lens, technology is considered a social construction (Van den Belt, s.d.), which may, however, largely be determined by the interests of the powerful actors in the political and economic arena, steering the negotiations. Therefore, a technology is not only the result of negotiations but also reflect the (unequal) power relations of the social context from which it emerges and therefore may also contribute to strengthen existing or even establish new power relations (Ruivenkamp 2005).

In the context of food chains, global agribusiness groups often play the dominant role in the development of agricultural technologies. On the other hand, farmers, who are the end-users of technologies, are usually excluded from the technologies' design process (van den Belt, s.d.). As a result, the technologies produced embody the interests of agro-industries by appropriating and substituting farmers' resources and generating exogenous styles of agricultural development. Therefore, technologies can be identified as "politicizing products" because they contribute to a re-organization of global food production that creates new relations among the different social groups (Ruivenkamp, 1989, 2005). An example of the new social relations created by an agro-industrial technology and the influence of the social context in technology development has been given by Kloppenburg in his analysis of hybrid maize seeds (Kloppenburg 1988 cited by Van den Belt s.d., pp.8-9):

> *"Combined with an increased input of fertilizers and pesticides, they (hybrid maize seeds) generated an enormous increase in yields. The new varieties had one disadvantage for the maize farmers: if he took seed from his own harvest, yields would drop dramatically in following years. Forced by this so-called 'economic sterility' he had to purchase his seed every year from the seed companies that kept the suitable inbred lines to themselves".*

However, the economic sterility of these seeds "was not merely an accidental side effect of a breeding strategy primarily oriented towards the goal of increasing yields. In fact, hybridization was not the only road leading to higher yields. [The alternative road] was characterized by the fact that it would not lead to 'economically sterile' varieties" and would, thus, not guarantee the profitability of the private seed companies" (Van den Belt s.d., pp.8-9).

Thus, by shaping the hybrid maize seed technology, the seed industrial sector reinforced its dominant position in the food chain by appropriating one essential element of maize production. On the other side, the reorganization in maize production caused by the introduction of hybrid seeds devalued farmers' knowledge related to maize breeding and decreased their autonomy over maize production. However, farmers are not always passive towards technology development and adoption. Farmers may challenge the "technical code of a technology" by reconstructing it to incorporate their interests or ideologies (Ruivenkamp 2005; Feenberg 2005). The technical code of a technology is defined as *"the realization of an interest or ideology in a technically coherent solution to a problem"* (Feenberg 2005). The embodiment of an alternative technical code, which is more responsive towards small farmers' needs, could offer opportunities for endogenous rural development. By endogenous development, we intend the types of developments in which poor-resource farmers exert greater levels of control over agricultural production, making use of the potentialities of the location-specific resources.

Based on that conceptual framework of endogenous developments (Van der Ploeg et al 1994) this article explores how settlers in land-reform rural settlements can be supported to develop and/or modify technical codes of technologies for endogenous milk production.

**The context of milk production in Brazil and in the Brazilian State of Rio Grande do Sul**

Brazil is one of the main milk-producing countries in the world (Marcondes, 2005). Among Brazilian Federal States, Rio Grande do Sul (RS) State ranks as the third major milk producer (Marcondes 2005, p. 22) (Figure 1). Milk production in RS State is of social and economic importance. It creates employment to those directly involved with the milk production and those indirectly involved with it in administrative, storage, transport, processing, and commercialization activities (Pedroso 2001). The milk production sector in RS is predominantly composed by small milk producers. In fact, this activity is one of the few economic alternatives adapted to the conditions of small farmers, given their limited land area and scarce resources (Pedroso 2001). As a result, milk production plays an important role for the maintenance of small farmers' families in the rural areas, contributing to reduce their migration to large cities and to develop the small municipalities in the countryside.





During the 90's the globalized context - resulting from the de-regulation of markets, which removed the commercial barriers between countries and cancelled the State control over milk prices - posed new challenges to the milk production sector in Brazil. Competition was intensified in all segments of the milk chain. However, the production sector was the most affected, due to the entry of imported dairy products at very low prices from neighboring countries such as Uruguay and Argentine (Pedroso 2001). Due to the greater geographical proximity with these countries, RS State milk producers were highly exposed to this competition (Pedroso 2001). Moreover, the new reality created by globalization stimulated the entry and expansion of milk processing multinationals in the State, who incorporated smaller national dairy companies (Homem de Melo 1999 cited by Machado 2001; Vargas 1999). As a result, the processing sector became increasingly concentrated in a few industries (Pedroso 2001). In 2002, only two processing industries were responsible for about 80% of the total milk processed in the State (Fonte et al., 1998 cited by Schultz, 2000).


Figure 1. Map of Brazil showing the political division in States. The South region is shown in a lighter color, where the State of Rio Grande do Sul is indicated with an arrow.

Because of their low production costs, small milk producers in RS State had been resilient to the falling milk prices, paid by processing industries. Nonetheless, given the increased competition and concentration in the milk chain, these producers were becoming increasingly susceptible to the demands of agro-industrial complexes requiring the industrialization (or modernization) of their milk production systems (Schultz 2000; Pedroso 2001) through the introduction of specific productive techniques.

**Milk production in land-reform settlements**

The production of milk in land-reform settlements managed by the *Movimento dos Trabalhadores Rurais sem Terra* (MST) was analyzed in this study. This grassroots' movement is the strongest social organization representing landless rural workers at national level. It organizes landless rural workers to implement the land reform - guaranteed in the Brazilian legislation - and once the rural settlements are established, to organize the agricultural production by setting up agricultural cooperatives.

Most settlers, who lived in the settlements studied, were either landless rural workers or sons/daughters of small family farmers from the North region of the State. This region concentrated a large number of small farms located on marginal lands. Settlers belong to a special category of small family farmers, who rely to a great extent on the labor provided by the family members and have most of their income derived from agricultural activities. Besides suffering from the poor access to technology, credit, and other production factors, these small family farmers (settlers) face additional difficulties related to the lack of agricultural knowledge and experience on the new local environment.

The first two settlements studied; Ceres and Rondinha, were located in the small rural municipality of Jóia in the Northwest region of the State. The third settlement Trinta de Maio was located in the industrial municipality of Charqueadas, closer to Porto Alegre, the capital city of the State (Figure 2). In all three settlements, milk production was seen as crucial for the economic survival of settlers, since it provided them with a regular income throughout the year. Besides, local extensionists considered milk production a safer source of income than the cultivation of agricultural crops because its production was less susceptible to climatic factors.





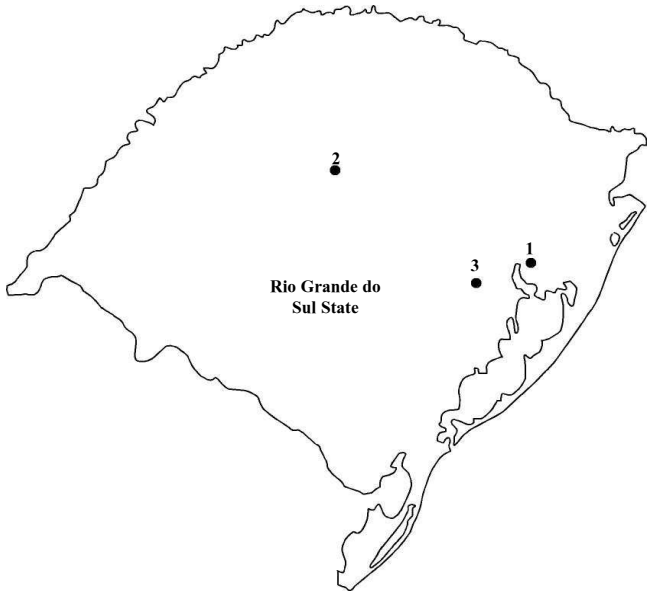


FIGURE 2. Map of Rio Grande do Sul State. Numbers indicate the localization of the land-reform settlements studied in respect to the capital city, Porto Alegre. 1: Porto Alegre 2: Jóia 3: Charqueadas.

The characteristics of the settlements studied in Jóia and in Charqueadas are shown respectively in TABLE 1 and TABLE 2.

TABLE 1. Characteristics of the settlements Ceres and Rondinha in the region of Jóia (MST, 2000).

| Name of settlement | Area (ha) | Total number of families | Average individual plots (ha) | Municipality | Year of foundation |
|---|---|---|---|---|---|
| Ceres | 2210 | 114 | 18 | Jóia | 1996 |
| Rondinha | 4125 | 233 | 13 | Jóia | 1995 |

The MST Central Cooperative of the Settlements in RS (*Cooperativa Central dos Assentamentos do Rio Grande do Sul* - COCEARGS), which coordinates all MST cooperatives in RS State, supported the local cooperatives in the MST settlements. The regional "Land and Life Agricultural Cooperative" (*Cooperativa Agrícola Terra e Vida* - COOPERVIDA) served the MST settlements in the region of Jóia, while the "Charqueadas Settlers' Agricultural Production Cooperative" (*Cooperativa de Produção Agropecuária dos Assentados de Charqueadas* - COPAC) assisted settlers in the settlement Trinta de Maio.

Both cooperatives organized the commercialization of the milk, produced by settlers, to processing industries. In the first two settlements, COOPERVIDA organized the sale of milk to a multinational processing industry. COPAC commercialized the milk produced in the settlement Trinta de Maio to a national milk processing industry. This cooperative was not only concerned with milk commercialization, but also with milk production. In this cooperative, the factors of production were owned collectively and the agricultural tasks were distributed among settlers' working groups. These cooperatives were administered by local representatives of settlers and coordinated by COCEARGS.

TABLE 2. Characteristics of the settlement Trinta de Maio in Charqueadas (MST, 2000).

| Name of settlement | Area (ha) | Total number of families | Average individual land plots (ha) | Municipality | Year of foundation |
|---|---|---|---|---|---|
| Trinta de maio | 950 | 46 | 20 | Charqueadas | 1990 |

The milk production activity in these settlements was assisted technically by agricultural extension organizations. In the region of Jóia, the "Cooperative for the Provision of Technical Services" (*Cooperativa de Prestação de Serviços Técnicos* - COPTEC), a cooperative of technicians administered by COCEARGS, provided the technical assistance to settlers. In the settlement Trinta de Maio, the official RS State´s Company of Technical Assistance and Rural Extension (*Empresa Estadual de Assistencia Técnica e Extensão Rural* - EMATER) was the extension organization responsible for assisting milk producers. Both extension organizations were engaged in stimulating agroecological practices in the settlements.





In contrast to the industrial model of agriculture that is based on the use of large quantities of pesticides, herbicides, chemical fertilizers and other agro-industrial inputs, agroecology's main focus lies on developing agroecosystems that have a minimal dependence on high agrochemical and energy inputs through changes in management that relies on local available resources (skills, knowledge, labor) and builds on ecological interactions and synergisms between biological components. Several authors consider agroecology as one of the forms of sustainable agriculture, most compatible with the conditions of small farmers, as it adopts local available resources as a starting point for generating local development and promotes technologies that are not only economically viable but are also culturally sensitive and socially just (Pretty 1994; Howard-Borjas and Jansen 1999; Altieri 2000).

The development and adoption of agroecological technologies could represent, thus, a potential improvement in settlers' positions by bringing back milk production activities and elements under local control. The introduction of an agroecological milk production system in MST settlements was, however, constrained by the mechanisms adopted by powerful actors to promote an industrialization of local production systems. These mechanisms will be dealt with in the following sections.

**Technological developments in relation to the globalization of the milk production chain**

Among the technologies, adopted by milk processing industries, the *Ultra High Temperature (UHT) process* has played an important role to strengthen an industrialization of the milk production chain. By adopting the UHT industrial sterilizing process, processing industries are able to obtain milk, deprived from all microorganisms. The absence of any living microorganism in the UHT milk, even the beneficial ones, combined with the aseptic package accounts for its greater durability (up to six months without the need of refrigeration), but also for a degradation of its nutritional quality. The UHT technology promotes a partial industrial "substitution process" by transforming an originally easy perishable product into a more 'industrial-like' product that can be stored for longer periods and traded over longer distances. Even though the UHT sterilized milk is of lower nutritional value in relation to the less industrialized types of milk (Ramos 2002), its future seems to be promising in the

country. In fact, the UHT milk consumption level is higher than that of other types of milk that contain a greater nutritional value (Ramos, 2002).

By allowing a long-period storage and long distance transport of milk, the UHT technology caused a reorganization of the global milk production chain that changed farmers' position within the milk chain. In fact, through the long-distance transport of UHT milk, competition among milk producers from geographically distant places of the globe was enhanced (Pedroso 2001). The UHT technology offered dairy processing multinationals the opportunity to search for the cheapest milk suppliers (Netto 2002) at a global basis, making milk producers in different regions of Brazil and even in the world interchangeable (Boletim do Deser 2000).

Another technological development that has contributed to the industrialization of milk chain is the sophisticated refrigerated transport equipment adopted by processing industries. It can be said that the development and worldwide adoption of the combined UHT milk and refrigerated transport technologies contributed to a globalization of the milk production chain. Indeed, the introduction of these technologies increased the separation between milk production and its consumption in the milk chain, reducing the perspectives for endogenous developments in the rural milk-producing sites (Pedroso 2001).

**The push towards an industrialization of local milk production and local responses**

Parallel to the above-described technological developments taking place in the milk chain at global level, local milk production units also followed a similar industrialization trend. Several mechanisms were devised by industries to create the necessary conditions for stimulating the adoption of other "politicizing agro-industrial technologies" (Ruivenkamp 1989,2005). For example, the milk pricing policy adopted by processing industries has been an important mechanism to implement specific production techniques within the local production units. The price policy followed a system of quotes in which the price paid to producers was *proportional to the volumes of milk* delivered. By adopting this policy, processing industries promoted the exclusion of thousands of small milk producers. This mechanism favored the process of concentration of the milk production sector in increasingly smaller numbers of large milk producers (Machado 2001; Kirchof 2001; Via Campesina 2001).





In Jóia, the majority of settlers, working individually and producing limited volumes of milk, had to adjust their production system in order to be able to reply to this pricing policy. The settlers re-organized themselves through their local cooperatives and set up a conjoint commercialization of their milk to the processing industry. Through this arrangement, settlers were able to receive higher milk prices than it would have been possible by selling the milk individually in view of the existing pricing policy. Thus, the social organization proved to be a good strategy for most settlers, in view of the limited possibilities of expanding their production through other means due to the non-specialized dairy herd, the limited number of cows, restricted adoption of productivity-enhancing technologies, and limited area.

While the Jóia settlers had to re-organize themselves the settlers in Charqueadas already worked and exploited their land collectively through the cooperative system, obtaining good milk productivities and fetching higher milk prices.

The emphasis put on productivity by the industries' pricing policy was reflected in the strong interest of most settlers in adopting agro-industrial technologies that could intensify their milk production systems. However, these same technologies also prepared an appropriation and substitution of their local activities and elements by industries. For instance, in Jóia, settlers were gradually replacing the traditional practice of promoting natural mating for the reproduction of the cattle with artificial insemination, using seminal matter provided by specialized multinational industries. Settlers "preferred" the latter technique because they could avoid the extra costs needed for maintaining the bull in the farm and because it was a cheaper way of obtaining cows that could deliver the required high milk production levels. However, the seminal matter-provided by specialized industries - originated from bulls located in distant sites, which did not always possess other genes required for an increased resistance to local diseases and adaptability to local feed conditions.

Some activities and elements related to the feeding of the dairy herd were also being appropriated by industries in the settlements at Jóia, although an agroecological practice relying on green pastures as cattle feed (rotational grazing) was also starting to be disseminated. Examples were the widespread use of high yielding hybrid maize and genetically modified (GM) soybean varieties used in part as feed for dairy cows. These agro-industrial products had to a great extent replaced locally-adapted soybean and maize varieties. The option for cultivating these crops reflected the assimilation by settlers of the productivist paradigm promoted by the industrial agricultural model.

Although hybrid maize seeds had to be inevitably purchased from industries at an annual basis, a subsidizing program devised by the RS State government facilitated the access of small farmers to this technology. As stated by settlers, for each kilogram of hybrid seeds obtained through the program, 11 kilograms of maize seeds (of second generation and thus of reduced vigor) were to be returned at the end of the harvest as the form of payment. This program promoted the widespread adoption of the high-yielding hybrid maize in the settlements, however, left unchallenged the biotechnology's intrinsic characteristics requiring the application of large amounts of off-farm inputs such as fertilizers and pesticides for a good development of the crop.

The struggle between the contrasting agrarian development models influencing agricultural production in the settlements took the shape of intense local conflicts over the use of GM soybean seeds. The conflicts arose from the disagreement between settlers' practices of cultivating GM soybean with the MST ideology, which was strongly opposed to GM products. For the MST organization, this biotechnology represented a new form of capitalist domination over agriculture, implying a loss of autonomy of small family agriculture and presenting risks to the environment, food security and human health (Movimento dos Trabalhadores Rurais Sem Terra, 2001). The majority of Jóia's settlers was believed to have had planted GM seeds. Being well aware of MST's position, no one would admit it openly. The seeds were entering RS State by being smuggled from Argentina, where their cultivation was legal (the cultivation of GM soybean seeds was illegal in RS state of Brazil in the year 2002).

In order to inhibit the continued adoption of this biotechnology in the settlements, the MST local representatives promoted several actions. For instance, settlers, who had planted GM soybean seeds, were denied access to resources controlled by the MST extension organization, such as the agricultural credit program subsidized by the RS State´s government. Furthermore, settlers, who exerted MST political roles within the settlements and had planted these seeds, received sanctions or were forced to resign from their roles.

Even though the MST attempted to repress the adoption of these seeds in the settlements, they were not able to offer economically attractive alternatives to it or ways to modify these products to fit settlers' conditions. Especially, because these seeds were industrial property and required modifications at gene level. The only alternatives available to GM soybean seeds were not other GM crops attuned to the settler need but only conventional soybean seeds, which were considered by settlers as less productive and, thus, less





profitable, and organic soybean seeds. Even though the cultivation of organic soybean seeds could become a profitable activity, settlers resisted it because it meant for them to 'go back' to their traditional practices of cultivating soybean without relying on chemical inputs but on their manual labor.

The persistence of the agro-industrial biotechnology in the settlements - appearing in the exclusive form of GM soybean seeds - however, seemed to be undermined not primarily by the political convictions of the MST organization, but most of all by technical factors. In fact, it was reported that the yield performance of GM soybean varieties on that year had been much worst than that of the conventional soybean varieties, which were more adapted to the adverse climatic conditions of RS State (Campanha Transgênicos 2002; Zero Hora, 2002). Furthermore, other initiatives were present in the settlements, which aimed to re-appropriate some farming activities, related to soil fertility, weeds and pest control in soybean production contributing to revalue local elements and knowledge.

Another example of the appropriation of local practices and knowledge, related to the prevention and treatment of cows' diseases, by industries is the adoption of veterinarian antibiotics. Phytotherapeutical treatments using locally- available plants were being experimented by settlers with the support of local extensionists. However, increasingly settlers relied more often on "the industrial antibiotics", especially when treating lethal diseases of cows, since the phyto-therapeutical treatments were considered not as fast and reliable as the antibiotic ones.

**The legitimation of exogenous styles of agricultural development**

A mechanism aimed at promoting the compulsory industrialization of all Brazilian milk production units was represented by a national legislation (*Portaria 56*) setting new norms on milk production. According to one of the norms of the new legislation, milk should have a temperature of 4 $^{0}$C, three hours after milking. The milk production systems of most settlers, however, where cows were usually hand milked and the milk was conserved in milk cans into domestic freezers or iceboxes, the milk temperature reached 7 $^{0}$C. The 4 $^{0}$C temperature standard could create serious implications for the continuation of a local milk production by most settlers, since in order to comply with this standard the settlers would have to abandon their traditional practices and adopt industrial on-farm refrigerated bulk tanks that had been not designed to fit small milk producers' conditions (Kirchof 2001).

Industries and the national government supported this legislation as a necessary step to improving the quality of the milk produced in Brazil and standardizing the Brazilian milk with international standards to enhance the international trade of milk. However, the on-farm tank technology, legitimated to society by means of the law as the only technical solution for enhancing the quality of milk in the country, embodied in its design the interests of industries in concentrating the milk production sector into a smaller number of large capitalist farmers and excluding small milk producers. Thus, this technology acted as a "politicizing agent" by benefiting capitalistic milk producers in detriment of small milk producers through its specific technical code.

As a result, the enforcement of the 4 $^{0}$C standard legislation was contested by organizations representing small milk producers. These organizations argued that the notion of quality as advocated by this legislation was connected to an industrial technology that was not adapted to the conditions of most small milk producers, who worked individually. In fact, these tanks required an almost six times greater minimum daily production of milk than their average milk production in order to compensate its costs (Boletim do Deser, 2000). Besides, the cost of this technology was not affordable to settlers, who in order to be able to purchase it would have to resort to credit, raising further their indebtedness level. This technology together with milking machines were already being pushed by processing industries in the settlements through specific quality programs that paid premium prices for the milk produced with these technologies.

The solution envisaged by organizations representing small milk producers to adjust to the 4 $^{0}$C norm was the organization of group-managed refrigerators to allow the use of the full capacity of the technology and the provision of subsidized government credit to facilitate its acquisition. Small milk producers, however, did not challenge the politicizing aspects embodied in the specific design of the proposed technology nor demand the design of an alternative cooling technology inclusive towards their needs.

In sum, specific technologies and policies have been pushed by industries into the settlements, creating contexts favorable for an increasing industrialization of local milk production systems. However, some local initiatives attempt to challenge the industrial model of agriculture and the incorporation of several agro-industrial technologies through the development of agroecological technologies that generated greater levels of local control over agricultural activities. These attempts are discussed in the next section.





**Tailoring technologies towards endogenous milk production**

Agroecological technologies present good perspectives for counteracting the exogenous developments promoted by the industrialization of milk production systems. One such technology, which was being stimulated by local extensionists in the settlements, consisted of a management technique called *rotational grazing.* This technique was already being adopted at the settlement in Charqueadas, while at Jóia, it was still in the process of implementation in settlers' plots.

In accordance to this technique, the management of the grazing ground is done by subdividing it into smaller plots or paddocks, moving livestock from one paddock to another. This simple practice allows the recuperation and good development of the pasture. Moreover, it relies on green pasture; a local available resource for settlers and one of the most economic feeds for dairy cattle (Blakely and Bade 1990). The State Foundation for Agricultural Research (*Fundação Estadual de Pesquisa Agropecuária* - FEPAGRO) in RS State, a research institute that developed technologies adapted to family agriculture, registered increases of 110% in the milk productivity of cows treated with this technique. The improvement of the milk productivity per hectare was related to the increase of the productivity and the biological value of green pastures.

By adopting this technique, several activities and elements related to milk production could be re-appropriated by settlers. For instance, the purchase or production of additional cattle feed could be considerably reduced or even avoided (Kirchof 2000). The application of off-farm fertilizers applied in the pastures could also be avoided due to the nutrients contained in the manure, naturally provided by the cattle. Fewer medicines were required to treat cows in this system, due to the improvements in the welfare of cows, which were for most of the part of the day not immobilized in stables and fed in a natural manner. This can be related to the principle that less stressed animals are less susceptible to diseases. Problems with ticks could also be reduced by transferring the livestock to new paddocks at determined periods, established according to the life cycle of ticks. For instance, when ticks would be on the larvae stage, the paddock would be left to rest for the necessary time to make the larvae of ticks present in the old paddock die for lack of food, represented by the cattle. At last, the labor required from farmers would be considerably reduced with this technique, as farmers did not need to cut pasture grass and fodder and carry it to the stables and had less labor when cleaning the stables.

This example illustrates how ecological processes concerning the growth of pastures, the nutrients contained in the manure and the life cycle of cattle parasites incorporated into agroecological technologies re-valued local available resources, reducing production costs and decreasing settlers' reliance on off-farm industrial technologies. Although initial investments and some capacity building is required, the correct application and dissemination of this technique could turn settlers again in "knowing agents" able to exert a greater degree of autonomy over their agricultural activities (Morgan and Murdoch 2000).

Another agroecological technology adopted by settlers and presenting a strong potential for improving settlers' autonomy over activities was the use of *phytotherapeutical veterinarian treatments using locally-available medicinal plants.* The high costs of antibiotics, combined to the restrictions of processing industries towards residues of antibiotics in the milk, urged settlers to further experiment with local medicinal plants to treat diseases and health disorders of the dairy herd.

Phytotherapy presented good results in treating a very common disease affecting cows; mastitis. Mastitis is a common bacterial infection of the mammary gland that influence the quality of the milk delivered to industries. Cows affected by mastitis produce milk that is acid and not accepted by processing industries (Schutz s.d.; Blakely and Bade 1990). Besides, mastitis gives other economic losses to farmers as it reduces the milk production and milking period of infected cows. It is also contagious and if a cow is too seriously infected it has to be replaced. The most widespread mastitis treatment adopted by settlers was *a balsam made with pig's fat and garlic* used to massage the cow's udder skin. Both pig's fat and garlic were locally available elements. Other local plant used to prevent this infection was the *carqueja (Baccharis genistelloides).* An infusion made from this plant was used to disinfect the cow's udder. Carqueja infusions were also used to treat problems of retained placenta in cows.

A wide range of alternative phytotherapeutical treatments was also being used to prevent and treat ticks (*Boophilus microplus*). Ticks may cause anemia in the dairy herd and losses in milk production. Furthermore, ticks can also transmit the agents that cause a lethal disease called tick fever. Some of the alternative measures used to prevent and control ticks adopted locally available plants such as *garlic, timbó* (*Ateleia glazioveana*) and *cidreira* (*Melissa officinalis*). The logic behind the functioning of these alternative treatments differed from that of conventional medicines in that it did not eliminate completely the ticks such





as conventional medicines did, allowing in this way the development of the immunity resistance of the animal against the disease.

The use of alternative veterinarian treatments using locally-available plants had a strong potential of dissemination among settlers given their easiness of adoption and low costs. Therefore, they presented an opportunity for promoting a re-appropriation over the activities, related to cattle health treatment. Yet, some attempts of the industrial capital to re-reappropriate this field were also present. At COPAC, industrial phytotherapeutical products were already being adopted.

In soybean production some isolated agroecological efforts, showing good perspectives for the production of endogenous development in the settlements, were identified. A technology that restored a greater level of local control over soil fertility was the use of *organic fertilizers,* commercialized by the COOPERVIDA cooperative in Jóia. Although still being an off-farm input, it had the advantages of being cheaper, having a better effect on soil structure, a long lasting effect in the soil and low environmental impact compared to chemical fertilizers. Another alternative practice adopted by some settlers consisted in substituting chemical herbicides by *mechanical weeding,* using a plough pulled by a horse. Locals provided this service, which was cheaper, besides, being more ecologically sound than the application of herbicides. The adoption of this practice also meant that more financial resources remained in the locality instead of going to global agribusiness firms. Another agroecological technique, being adopted by settlers, consisted of using a biological agent, the virus *Baculovirus anticarsia virus,* to control the soybean worm *Anticarsia gemmatalis,* a major pest threat attacking the soybean crop.

Thus, some agroecological techniques were being materialized in the locality, challenging the hegemonic productivist paradigm to agriculture and allowing settlers to re-appropriate some rural activities. Some activities in the areas of cattle feed and health were already shifting from the exclusive control of industries towards a greater degree of settlers' control. Still a greater dissemination of these agroecological techniques in the localities have been constrained. Not only due to the policies supported by industries to promote agro-industrial technologies but also because of the settlers' internalization of the productivist paradigm. The predominance of that paradigm among settlers and their organizations brought the settlers themselves to pursue efficiency and productivity in agriculture above other by importing into the settlements those agro-industrial technologies, such as off-farm inputs, intensive animal production, mechanization, leading often into an accelerated destruction of local nat-

ural resources and uniformization creating farmers' dependence to global, agro-industrial food chains.

**Opportunities for generating endogenous milk production systems**

During the analysis of the milk production practices and their different technologies within the land-reform settlements in the Rio Grande do Sul State in Brazil, it became clear that primarily agro-industrial technologies have been adopted. The push towards exogenous development was stronger than the one towards endogenous development in shaping the social organization of milk production systems in land-reform settlements in RS State. This may be connected to the fact that industries were also more powerful in influencing policy-making, leading to the dissemination of specific agro-industrial technologies within the settlements. Besides, settlers and their organizations have internalized aspects of the productivist paradigm to such an extent that the opportunities for re-shaping the technical codes of different technologies were often neglected. The analysis also revealed that some local attempts to promote an endogenous milk production have been initiated, but were still insufficient to predominate over the exogenous styles in milk production. This conclusion suggests that more should be done for developing and disseminating technologies tailored to local conditions and needs by the actors concerned with local agricultural research and extension.

In this final paragraph we will summarize the opportunities - already taken up by some settlers - to change the politicizing aspects of the agro-industrial technologies by modifying their technical codes in order to stimulate endogenous milk production practices. Settlers and their organizations could focus more on changing the technical codes of techniques applied in the following different areas of milk production:

In cattle reproduction:

- To promote the breeding of dairy herd for high milk productivities but also for genetic resistance to diseases and feed conditions encountered in the locality. In this way genetic material that is more compatible with local conditions can be obtained for artificial insemination.





In cattle health treatment:

- To enhance the effectiveness of the antibiotic properties of local medicinal plants by promoting related research;
- To promote the dissemination of phytotherapeutical treatments through courses and the implementation of medicinal plant gardens in settler's plot;
- To stimulate the development of new phytotherapeutical treatments through experimentation and research with the participation of settlers.

In milk refrigeration:

- To demand a (social) reconstruction of a cooling technology that meets the temperature standard required by the legislation and is tailored to settlers' volume capacities and investment levels.

In cattle feed:

- To improve the technical assistance and training courses for settlers on the proper implementation and management of techniques.

In soybean production:

- To promote the dissemination of the agroecological practices and products already being adopted in the settlements by some settlers (organic fertilizer, mechanical weeding and biological control of the soybean worm Anticarsia gemmatalis).

In maize production:

- To promote participatory breeding for selecting local maize varieties presenting high yields as well as low requirements in off-farm inputs.

The analysis of the activities of the settlers and their organization in the land-reform settlements has revealed that important initiatives do take place in challenging the predominance of exogenous milk production practices. Attention is being increasingly paid to the opportunities of changing the technical codes of techniques, applied in different areas of milk production. Technology is no longer considered as an inevitable and unchangeable entity

but increasingly as a negotiable domain in which specific social dimensions tailored to local sustainable developments can be integrated. However, the analysis also showed that critical reflection on existing experiences and creative imagination are still more needed to empower settlers' organizations in their efforts to steer and attune technological developments to the social interests of sustainable endogenous developments.

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