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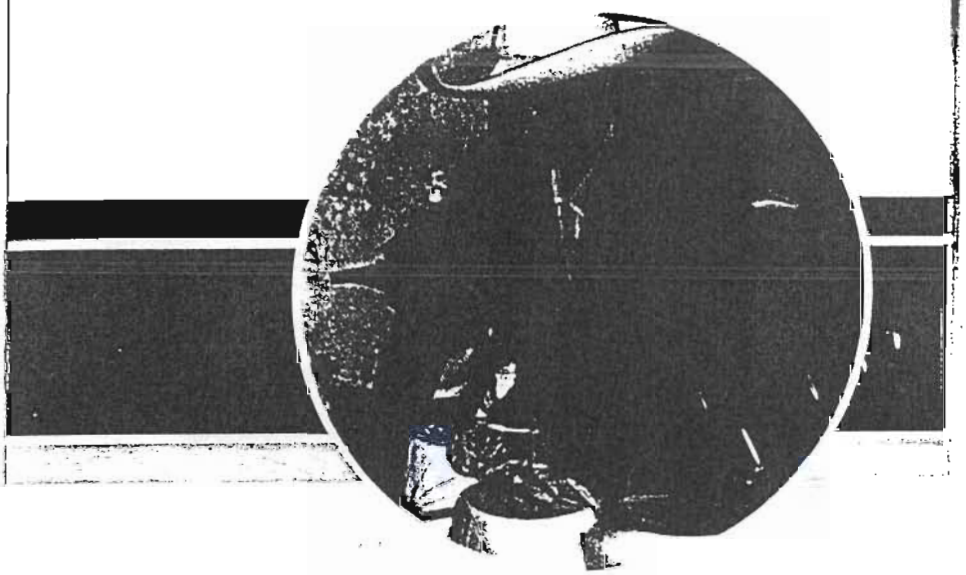

Ce cédérom rassemble l'ensemble
des communications présentées au colloque
« Systèmes agroalimentaires localisés »
tenu à Montpellier (France) du 16 au 18 octobre 2002.

This CD-Rom brings together all papers presented
during the seminar «Local Agri-food Systems»
held in Montpellier (France),
on october, 16th to 18th, 2002.

Este CD-Rom reúne el conjunto de comunicaciones
presentadas al coloquio
«Sistemas agroalimentarios localizados»
realizado en Montpellier (Francia),
del 16 al 18 de octubre de 2002.

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Université Montpellier 1

Editeur scientifique
GIS SYAL

Distribution
Cirad-Tera, TA 60/15
Equipe Qualiter - Programme AFM
34398 - Montpellier cedex 5
France

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SYAL

Local Agri-Foods Systems:
Products, Enterprises and the local dynamics

Montpellier, France • October, 16-18 2002

INRA CIRAD CNEARC AGROPOLIS MUSEUM UMR

Proceedings of the Conference
Scientific editor: Gis Syal
Design and realization : Cirad-Dist

Regresar a la lista

MILK PRODUCTION, REGIONAL DEVELOPMENT AND SUSTAINABILITY IN THE EASTERN BRAZILIAN AMAZON

SP 5339

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Abstract : Milk production is an important component of farming systems in the Brazilian Amazon agricultural frontiers. Developed mainly by smallholders, this activity appears as a promising alternative to improve sustainability of these regions development. More than on technological constraints, long-term sustainable smallholders milk production depends on the emergence of a local production and marketing milk chain. A comparative analysis of three contrasted regions in the Eastern Brazilian Amazon allows to underline the main determinants of such a chain development and to suggest some policies and support actions, which may favor sustainable milk production development.

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Introduction

Since the beginning of the 1990s, several important changes have occurred in the Brazilian milk sector: economic stabilization, import liberalization, changes in final demand patterns and new regulations have led to strong reforms in the sector (Jank *and al.*, 1999). Milk production growth has reached 38 % between 1990 and 1997 (Gomes and al., 1997, in Santos and Vilela, 2000) and new promising production basins have emerged in the Center-West region. National and international milk processing factories have followed this production frontier expansion particularly in Goiás, and are now setting up new production plants in the Amazon frontiers, currently in South of Pará and Rondônia.

Indeed, isolated from national trends, farmers of the Amazonian agricultural frontiers have spontaneously largely developed milk production, even in the most remote areas disconnected from national markets (Tourrand *and al.*, 1995, Veiga *and al.*, 1996). Smallholders are the engine of milk production growth in newly colonized regions but the overall regional dynamic of this sector has been very contrasted in the different regions, conditioned by their geographical location and by the strategies of the different agents belonging to the milk production and marketing chain. Since milk production is an important component of agricultural sustainability in these regions, these processes have been analyzed since 1995 by a research team composed of scientists from Embrapa Amazônia Oriental, UFPA and CIRAD. Parts of their results are presented here.

In the first section, the historical process that has led to the emergence of new milk production basins in the Amazon will be described (section I). Then, current patterns of milk production and marketing chain in three contrasted regions will be analyzed (section II). Finally, the consequences of the milk production dynamics on regional development and sustainability in the Amazon will be underlined (section III).

Section I – The emergence of milk production basins in the Amazon

Smallholder milk production increase

The last phase of the Brazilian Amazon colonization started in the middle of XX century with the penetration of pioneers in forest ecosystems for gold mining and timber extraction. At the beginning of the 1960s, the Brazilian government made this process official, building the road network and distributing land. Through these new networks, thousands of migrants, some of them experienced with milk production, arrived from other regions looking for a land and a way to improve their livelihoods in the agricultural frontiers of the Amazon.

For these new migrants, the first preoccupation was to find a land, to develop agricultural activities and to regularize their land tenure. During the first years, smallholders survived planting successively food crops using slash-and-burn practice, cultivating besides some perennial crops, when possible, or establishing pastures when they intended to raise cattle, mostly small herds (20 – 50 heads). In most cases, the individual herd started with the purchase of one or two dairy cows, in order to produce milk for domestic consumption.

The local experience shows that, under the context of diversified and little- steady agricultural systems in these pioneering regions, milk production is of variable importance, since the lack of infrastructures and the Amazon environment peculiarities lead to frequent changes in producers strategies.

The strong impact of public credit policies on the establishment of individual herds is also very clear. In the middle of the 1990s, a public financing program called FNO (North Region Constitutional Fund) was established, aiming at opening banking credit facilities for smallholders. This program allowed a family to buy around ten dairy cows and one bull. Despite some initial problems (solved later on), this program increased significantly the dairy potential in several agricultural frontiers, allowing smallholders to buy cattle and to enter the milk business. However, the bulk importation of low-quality cattle from other Brazilian regions had serious negative consequences on both herd and people health (Homen, 1999).

Production systems features

The features of milk production systems have been analyzed through a research program developed in the Brazilian Eastern Amazon in 1995 and 1996 (Ferreira 1995; Tourrand *and al.*, 1997). It reveals that milk production is a typical smallholder activity in frontier regions, since 90 % of the producers use only family labor and less than 10 % employ permanent workers. Most families live on their own property. The property area is generally made of one or two colonization lots, with a size varying from 25 to 100 ha, depending on the region. The farms are located near urban centers, at least when fresh milk is the commercialized output. Fifty percent of the surveyed producers had experience in milk production before their migration in the Amazon.

Milk producers are amongst the colonists who first arrived in the region, showing the positive effect of dairy production on smallholders farming systems sustainability. Moreover, milk-producing farms are usually more diversified, growing also both annual and perennial crops. The average herd size is 24 cows, confirming the family character of this activity. Milk productivity varies from 600 to 1500 liters by lactation of 6-7 months, resulting from a daily yield per cow of 4-5 liters (one milking usually done in the morning).

Herd feeding is based mostly upon Braquiarão (*Brachiaria brizantha)* and Quicuio (*B. humidicola*) pastures. A relatively adequate mineral mix is used as the sole feed supplementation in most farms. The herd genetic pattern is not well defined and dominated by a cross bred type of cattle, composed mainly of Holstein or Brown Schwitz, for European races, and Gir, for Indian races (Zebus).

The price of milk sold directly to the consumer varies between US$0.10 and 0.25 /liter, providing an average annual income per farm of US$1,000 to US$2,500 (average production of 18,000 to 20,000 liters/year). This income currently amounts to one to two minimum wages. Another important source of income is coming from the sale of calves to be fattened, which is equivalent or superior to income from milk sales. Calves sales income has the advantage of being relatively concentrated in one period of the year, allowing investments on the property, whereas milk income, spread during the year, is well fitted to cover daily domestic expenses. This complementary function by itself justifies the dual aptitude of cattle breeding in smallholder production systems (meat and milk). Moreover, milk production is an interesting alternative since smallholders are frequently exposed to great fluctuations of prices and yields of both perennial and annual crops. Thus, it is common to find smallholders choosing to invest in dairy cattle even without experience because of the lack of other safe economic alternatives.

Section II – Market insertion and contrasted regional dynamics of the milk production and marketing chain

Milk conservation and transport: a serious constraint

Market insertion constitutes the biggest challenge for the majority of milk producers of the Amazon. The network of milk processing factories is still in infancy in most regions and often, the producer does not find purchaser for his output. For instance, in the city of Uruará, in the Transamazon highway region, whereas 60 % of smallholders are producing milk, only 10 % of the production is commercialized in fresh milk or cheese (Veiga *and al.*, 1996). The transport issue is crucial because fresh milk is highly perishable in tropical climate. The precariousness of most road infrastructures in these regions reinforces bottlenecks in commercialization. Thus, almost all the producers selling fresh milk are living in the neighborhoods of the cities and their output is sold daily at consumers' doors. This activity is time consuming and is a serious constraint for production growth. Another option, to producers too far from the cities, consists into cheese production, weekly commercialized, which can be considered as a way to storage milk. But cheese production is time consuming as well and labor constraints may impede this second option.

The emergence of milk processing factories

Despite the fact that most producers are isolated, which makes difficult milk collection and distribution, urban growth in the Amazon since the 1980s has allowed the emergence of first milk processing factories, near large and medium size cities (Belém, Castanhal, Redenção, Altamira, Rio Branco, etc.). These factories owners are often themselves milk producers. They have perceived the increase of local demand, linked to urban population and economic activities growth, and/or they have faced serious labor constraints because of their growing production capacity[5]. Thus these small entrepreneurs have opted in establishing milk processing factories to process their own output and, in some cases, the output of neighboring producers. These producers have a small local markets share at the beginning, particularly because of the competition, on one side, with powdered milk, most demanded and sold by firms from the Southeast region (NESTLÉ, PARMALAT, etc.) and, on the other side, with small producers, staying in the informal sector and selling daily their output to the consumer, at a lower price.

Moreover, in the 1990s the FNO program has led to a strong increase of milk production potential in several regions and has stimulated the establishment of new milk processing factories linked to national or international firms. Original milk collection systems have appeared, as the use of small trucks entering daily in region through small roads in order to reach the producers, or the resorting to transport enterprises, as it has been found in Redenção, South of Pará. Because of this intense dynamic, banks start to support the establishment of new milk processing factories, as in Redenção, reinforcing the sector regional development.

One important difference between an agricultural producer and an industrial producer is that the former has to use a production factor fixed in space, i.e. land, whose location may not often be chosen or easily modified, whereas the latter has the opportunity to choose carefully the factory location. His final location choice depends particularly on the regional interaction

[5] For the same problem of conservation, fresh milk has to be sold early in the morning to the consumer. Since milking is manual in these regions, it can become rapidly difficult to produce and sell large volumes.

among distance[6] to raw material producers and to final consumers, local production factors availability, cost of inputs requirements, infrastructures development and economies of scale level in the sector (Beckmann and Thisse, 1986). This choice leads to contrasted structures of regional production and marketing chains that affect the whole regional dynamic of the sector. Currently, three schemes can be distinguished.

Regions connected to important national consumers markets

This first scheme prevails in the South of Pará, in the Eastern Amazon, and in Rondônia, in the Western Amazon. These regions benefit from the national sector dynamic, that comes favoring the emergence of new production basins at the peripheries, once these basins present stronger comparative advantages than the older ones. The Amazon comparative advantages for milk production are linked to specific agro-ecological conditions (high and steady fodders production during the year and favorable sanitary conditions) and socio-economic conditions (high regional production potential due to past colonization and credit policies).

Moreover, the national and international companies operating in the milk sector have been interested in establishing new plants in these regions because of the strong competition in the raw material market of other production basins, particularly during the *entre-safra (between-harvest)* season. Since these companies are controlling the biggest consuming markets, processing costs increases are mostly linked to raw material (i.e. milk) availability and price. The high process of concentration in the industrial milk sector leads to two options: reinforce this concentration with the others or decentralize plants in new production basins to escape from competition in the raw material market. This kind of dynamic has occurred in Goiás and, after a phase of strong competition, surviving firms have reached a consensus to share and demarcate each firm milk supply basin.

In the south of Pará, this process can be found at his initial step during which farmers can keep an advantage. Indeed, at the beginning of the process, new milk processing firms are dumping the price paid to the producer in order to increase competitors' raw material costs and to force older milk processing firms to close their own factories. This process leads to a spatial extension of these new firms, whose objective is to establish a network of factories to pick-up a sufficient amount of milk and reach production capacity, in order to take advantage of economies of scale and make more difficult the emergence of new potential competitors.

This process may lead in the long term to the emergence of a regional monopoly that will possibly act in the future against producers interests, as it has commonly occurred in others regions. Until now, the objective of spatial extension is so strong that firms are opening new plants not only around urban centers but also in the middle of remote production basins. This is reinforced by the fact that local consumption is small, so these firms are exporting a large part of their outputs to the South and Northeast regions. Thus, they do not need necessarily to locate near local demand. Since pioneering dynamic is very intensive in these Amazon frontiers, there is no doubt that more colonization of forested areas has the potential to transform these regions into large milk production basins, which justify investments made by these national and international firms.

On the farmer side, the openness of a milk factory allows him to milk and sell his production. In the long term, it may bring him to increase progressively his production capacity and to

[6] *Distance is the whole cost to transport goods between two locations. This depends on infrastructures quality,* transports means (road, river…),…and is not always proportional to the number of km between two locations.

become more specialized in milk production. This evolution is obviously supported by processing factories in order to increase their supplier's productivity and fidelity, which is a way to reduce the costs of access to the raw material. Thus, cars collecting milk at farmers doors are offering several other services as well, releasing farmers isolation and investment capital constraints: two major bottlenecks for smallholders viability in the Amazon. Transport of children to the cities, supply of agricultural and veterinary inputs, financing of improved cattle and of agricultural equipment are some examples of services provided by milk processing firms in these remote pioneering regions. This is giving an impulse to several processes of gradual regional living conditions improvement, contributing to smallholders' viability as well: openness and maintenance of roads, schools, electric network, etc.

The settlement of new milk processing factories in agricultural frontier regions has thus several positive consequences for smallholders, favoring people fixation on their land and sustainability of their farming systems. This process leads to the transformation of agricultural frontiers into milk production basins of growing importance in the national context. Some negative consequences may however appear in the long term, as it has already happened in others regions, when smallholders start to become completely dependent on industrial monopoly, which leads to a complete loss of their market power.

Regions isolated from important national consumers markets

In this second situation, the precariousness of road infrastructures hinders connections with national markets and potential national and international firms are not interested in investing in these regions. The cases of the Transamazon highway and the Tucuruí regions illustrate this situation. The emergence of milk processing factories, when it happens, is linked to local initiatives that face more difficulties because of smaller capital availability, weak accessibility to the market and lack in entrepreneurs skills. These factories are thus characterized by their small production capacities (maximum 2000 l /day), being exclusively localized in urban centers and processing the output of a small number of producers living near these cities.

Smallholders features are very similar with the case described previously, with a great production potential but less valorized. The lack of an industrial network is a serious constraint for the producer and direct sale to the consumer usually does not satisfy him, because it is time consuming and because it does not offer any sales guarantee. This context may favor the emergence of collective structures, as association or cooperative, to establish a milk-processing factory with the help of external financial resources (loan, ONG...).

However, the lack of associative experience of most producers in these regions is in many cases an obstacle for the development of a processing factory. Moreover, internal and external road infrastructures precariousness limits the accessibility to consumers demand. Indeed, local markets are very small: local population is not so numerous, their consumption/ capita is rather small and fresh milk competes with powdered milk. In order to reach more distant markets, the only opportunity relies in the production of dry cheese (*type Mozzarella or Parmesan*) since there is no efficient refrigerated transport system, hindering fresh products commercialization. But these kinds of products, when reaching distribution networks in consumption centers, have to face competition with the same products coming from southeast large firms. These latter consider northern markets as a valve to sell their production when prices in the South are decreasing too much. This occurs generally during the rainy season in the Amazon (summer in Southeast), which is followed by a significant decrease of milk products prices. This underlines another aspect of the consequence of transport and

conservation in the milk sector: dry cheese or powdered milk production allows to counterbalance remoteness in the Amazon but sales are not always guaranteed, as large firms from the Southeast also can reach distant markets with these products.

Consequently, small local milk processing firms in remote regions of the Amazon have to face seasonal fluctuations that make even more difficult the management of their activities. In these regions, the establishment of milk processing factories can greatly improve smallholders sustainability, all the more since the lack of such factories tend to favor a cumulative process of land concentration and rural exodus (see below). But they must face structural difficulties that push away potential investors from other regions and leave to the local actors all the responsibility to organize production, collection and sales. Public policies can greatly promote this process, by developing credit and improving road infrastructures. Moreover, research and development institutions and agricultural extension services are also fundamental for producers' collective organization and technical assistance, as it has already been observed in some regions.

Regions distant from national consumers markets but connected to large Amazonian towns

This last case is illustrated by the Bragantina region, near Belém, capital of Pará and by peripheral regions of Rio Branco, capital of Acre Brazilian State. On these markets, economic stabilization and supermarkets growth in the distribution sector have stimulated important changes in consumers' preferences. It has promoted the emergence of new products derived from milk as fresh cheese, yogurts, milk drinks and butter, that find more and more space in the shelves of supermarkets and bakeries. Local milk processing factories can easily supply these markets, taking advantage of their proximity. Southeast firms face more difficulties to compete on the fresh products market because of freight. Moreover, regions located near large size cities usually benefit from good infrastructures (road – energy).

But the principal weakness in this last case is found at farmer level. Indeed, the main factors that favor the emergence of processing factories, i.e. urban center proximity and good infrastructures, have negative consequences for milk production growth. Land and labor costs are higher. Smallholders are less numerous and a great part of available land is owned in fact by urban residents, as a form of saving, speculation or hobby farming. Some of them are producing milk but only to cover the sharecropper labor costs. Moreover, in these regions, opportunities for the agricultural sector are more diversified, as horticulture, fruits and perennial crops are more profitable. Milk production is thus less attractive than in remote pioneering regions. There are neither the same current regional production potential nor the same perspectives for the future. In this situation, the milk-processing factory has to pay more for raw material in order to incite farmers to remain in this activity. Some factories have even chosen already to work exclusively with powdered milk imported from others regions or from foreign countries.

As this last example shows clearly, the growth of local markets and the development of infrastructures are not always sufficient conditions to consolidate the emergence new milk production basins, particularly because of the competition with other agricultural activities. The influence of the milk sector on regional development and smallholders' viability is less significant in these regions.

This brief analysis of three contrasted milk production and marketing chain patterns allows underlining some major constraints and, conversely, pushing factors influencing the

emergence and consolidation of new milk production basins in the Amazon. Moreover it shows clearly that research and development institutions, public policies and others agents involved in economic development and sustainability in the Amazon, have to consider this regional dimension. The importance of milk production for sustainable regional development of agricultural frontiers will now be clarified.

Section III – The consequences of milk production for sustainability in the Eastern Amazon

The definition of a sustainable development has been much debated lately. One can define a sustainable system as one, which has the capacity to reproduce itself and resist to shocks and does not produce negative externalities. It has become clear from the different studies that several criteria had thus to be satisfied i.e. economic, social and ecological viability (Griffon 1999). The technological aspect of smallholder milk production sustainability can be inserted in the major context of sustainable development of pioneering frontier regions. Sustainable development of these regions can be defined as following: (i) there are processes of cumulative economic growth, (ii) the region is able to resist to potential economic and ecological shocks, such as sudden fall of markets prices or depletion of soils productivity, (iii) the regional development is not based on continuous depletion of natural resources, and (iv) there is a fair distribution of welfare. One will show here how milk production may allow to improve the sustainability of regional development in the Amazon agricultural frontiers.

Risks of cattle ranching for sustainability

Smallholders are considered as ones of the main agents affecting the pioneering frontiers of the Amazon. In some of these regions, large companies have also received land from the government, but most of them have given up in the 1980s and sold their land to farmers from the Southeast and State of Goiás attracted by the advantages of livestock in the Amazon.

Beef production and marketing chain efficiency in a pioneering environment explains why most capital was locally invested on beef farms. Moreover, many successful small colonists managed to enlarge their land and to consolidate medium and large farms, most of them dedicated to meat production. The less successful colonists migrated to more distant agricultural frontiers, went to urban peripheries or came back to their original regions. Thus, although most smallholders are still living in rural areas from agricultural activities, there is a strong process of land concentration in almost all regions of the Amazon. The evolution of land distribution projects managed by INCRA (National Institute for Land Reforming) also confirms this trend. The rural population density decrease leads to an auto-feeding vicious circle of rural exodus, a process that can be analyzed with multi-temporal remote sensing images. This process clearly acts against sustainable regional development.

Most of development actors and policy makers have considered livestock in Amazon as a uniform activity, without making any distinction between milk and meat production, both considered responsible for land concentration, rural exodus and failure of smallholder agriculture models in the Amazon. However, with a well organized milk production and marketing chain, milk producers strategies become very distinct from meat producers', leading to improve regional development sustainability.

Low technical constraints for sustainability

Technological constraints in milk production systems may all be solved, but some factors are limiting their sustainability. For the majority of these limitations, technical solutions exist whose adoption is linked to milk companies performances and to public extension service and involves labor training and technological transfer.

First of all, constraints on the feeding systems coming from problems of pasture management (overgrazing, lack of fallow and inefficient weed control) and of feed supplementation (low use of cut forage, by-products and minerals) put on. With respect to animal health, the prophylactic and preventive management, as well as available equipment are also deficient, in many cases due to the lack of information or practices unfitted with the Amazon environment (Laú, H.D., 2000). On the herd genetic side, there are also serious deficiencies. Through artificial insemination, which is still confronted to the problems of poor labor training and infrastructures, genetic improvement could be easily achieved with good results.

Markets structures and sustainability

Regarding to commercialization, the price paid to farmers continue to be a critical issue, varying from one region to the other. A research work carried out in the Southeast region of Pará showed that the cost of one liter of milk can reach US$ 0,04 – 0,05 (Machado, R.C., 2000). This explains why the milk factories, taking advantage of being very few to operate in the region (sometimes being even in a monopolistic situation), offer only US$ 0,07 – 0,08 /liter at the farm gate, and even so, do not encounter supplying difficulties. As an alternative to the abuse of this situation, some successful experiences have shown the efficiency of producers unions, as the cooperative of Tucuruí in the State of Pará. In other cases, the competition or the existence of other production alternatives at the farm level has forced the milk companies to pay up to US$ 0,18 per liter of milk. Besides the raw material low price, there are two other constraints: farmer payment delay and lack of confidence with respect to criterion for milk rejection at the platform factory.

More broadly, it has been underlined that smallholder milk production development in the Amazon region may be impeded by commercialization difficulties, which are the most serious obstacles to this production system viability. However, it has been analyzed that these difficulties has already been overcome in some regions (see section II)

The milk production has been considered as a sustainable alternative for scientists and policies makers, because of its few technical limitations and because of the following advantages:

- It allows to diversify activities at the farm level and thus decrease risk and opens paths to smallholder agriculture sustainability; this allows smallholders to better resist potential economic and ecological shocks.
- It leads to the integration of agriculture with livestock through the valorization of crops by-products for cattle feeding and of manure to increase soil fertilization, mainly for vegetable and fruit crops (ecological viability);
- Milk provides a regular, secure and reasonable income which guarantees to cover domestic expenses (economic viability);

- The dual potential of most milk production system (milk and meat) allows farms to be inserted in two distinct production and marketing chains, with complementary advantages (economic viability);
- Milk production allows smallholders to stabilize their situation at the frontier and may limit land concentration processes. This leads to a fairer distribution of welfare at the frontier and thus improves social viability.
- Milk production stimulates producers unions through associations and cooperatives because it needs a collective work to optimize milk collect, inputs access and producers training. This kind of unions improves as well social viability in the frontier.

Conclusion and discussion

Milk production, as an important component of the pioneering production systems since the beginning of the Amazon colonization, is a well-fitted agricultural activity to smallholders. From large urban centers up to the pioneer fronts, the milk production and marketing chain is supporting the process of regional development of agricultural frontiers, allowing peasantry survival in the Brazilian Amazon. Some aspects of the consequences of milk production on sustainable regional development of agricultural frontiers remain to be deepened (impact on deforestation, on long term economic growth...) but the first results presented here give already encouraging prospects. Moreover due to the big challenges it will face in the near future, mainly with respect to milk quality demand to be competitive in the market and its social role, this activity deserves a full support from different levels of public administration.

Sustainable development has to be fully appreciated by taking account for the long term. What was pointed out gives an idea of the dynamic of the milk production in the Amazon, analyzing how to improve this activity with positive consequences on the process of regional development and sustainability. Obviously, new constraints will appear in the future, probably bound to quality issue. Indeed, the National Program of Milk Quality Improvement is intending to establish new quality requirements and reforms in the inspection system, which indicates a stronger selectivity of the markets in the long term. These measures do not directly affect the milk chains of the Amazon because they trade with the Northeast region or with local cities, whose consumers do not still really take care of quality issues. Moreover, the lack of infrastructure creates difficulties for inspection services to act efficiently in the whole Amazon. But there is no doubt that, in the medium term, it will be necessary to improve the raw material quality in order to guarantee the sustainability of milk production in the Amazon. A quality diagnosis of milk straight from the cow was thus done in two milk basins of the state of Pará, Castanhal and Uruará, showing a good quality of physic-chemistry aspects (mainly in fat content), but a low microbiologic quality, due to some hygiene deficiencies.

Large farms may also enter the milk business in the future, attracted by improvements of the Amazon basins conditions. This will speed the technological progress with the support of the milk companies. More advanced technological packages, involving improved feeding and cattle genetics, mechanized milking... will become common practices, penalizing those who will not follow this evolution.

In the near future, one can say that the sustainability of smallholders' milk production will vary much in function of local marketing chain, but there will be no great technological constraints. Therefore, support actions will need to include:

At the producer level

- Extension actions for producers training
- Adaptation and diffusion among producers of improved practices and technology

At the processing factory level

- Actions to promote the development of cooperatives and associations;
- Fiscal and credit policies to allow the emergence of small milk companies;
- Policies to develop infra-structure inside milk production basins (roads and electric power) and link farmers to the market (good road conditions throughout the year, reduction of vehicles maintenance costs);
- Fiscal polices to avoid the emergence of regional monopolies.

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