



## The sugarcane-biofuel expansion and dairy farmers' responses in Brazil

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### A B S T R A C T

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The expansion of sugarcane for biofuels is a highly contentious issue. The growth of sugarcane area has occurred simultaneously with a reduction of dairy production in São Paulo state, the primary production region for sugar and ethanol in Brazil. This paper analyses different dairy farm rationales to continue dairy production in the context of a dramatically expanding sugarcane economy. Combining different data sets – semi-structured interviews with 34 farmers and baseline data from all members of a dairy farm co-operative – makes it possible to recognize different farm types. This heuristic tool is used to identify the various strategies regarding shifting to biofuel production or investing in dairy farming. The paper identifies labour availability, household resilience and technology introduction as key factors in the context of complex, multiple interactions between the biofuel sector and dairy production. We will argue that biofuel-sugarcane expansion not always pushes aside dairy farming. Those farmers that shift to sugarcane are not simply spurred by better prices, but mainly change as result of perceptions of labour constraints, risks and the opportunities offered by diversification. For farmers who totally quit dairy production the shift to sugarcane may pass the point of no return.

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### 1. Introduction

Embedded in a scenario of a world-wide growing energy demand and concern about global climate change requiring fuels from carbon-neutral sources (Thompson, 2008), sugarcane cultivation for biofuel production has become a new land use function. A lively 'biofuel debate' has crosscut a variety of areas including energy security, agricultural policy, environmental protection, transportation, bioengineering, and rural development (Borras et al., 2010; Mol, 2007; Leopold, 2009). This study examines how the dairy farmers in Brazil are reacting to the expansion of sugarcane production in their region. Brazil is the world's largest

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<sup>3</sup> About half of the total sugarcane production is processed into sugar and half into anhydrous ethanol (used for blending with gasoline) and hydrated ethanol (for direct use in flex fuel cars). Ethanol production reached 27 billion litres in 2010 (UNICA, 2011).

sugarcane-based ethanol producer with an impressive area of 8.7 million hectare<sup>3</sup> (IBGE, 2009). At least three different positions on sugarcane expansion in Brazil can be distinguished. The first group advances enthusiastically arguments in favour of sugarcane ethanol pointing at the huge availability of underutilized land (not competing with food production, nor promoting deforestation), the creation of jobs, more clean energy and the growing wealth of people, thus articulating a perfect win–win solution (Martines-Filho et al., 2006; Goes et al., 2008; Durães, 2008; Goldemberg and Guardabassi, 2009). A second group, less enthusiastic, point at some important constraints for the sustainable production of biofuel but consider that these could be removed by the introduction of best practices, technologies and new production processes (Smeets et al., 2006; Fischer et al., 2008; Wilkinson and Herrera, 2010). The third group consists of opponents to biofuel expansion (Gonçalves, 2005; OXFAM, 2008; Fernandes et al., 2010) who argue that the capitalist expansion of sugarcane area destroys peasants' territories, increases agrarian conflicts as a result of land concentration and will be detrimental to the cause of social movements. It is self-evident that different underlying perspectives on economy and politics would lead to a range of controversial positions about biofuels potential impacts. However, we also consider that the controversy persists because of limited insight

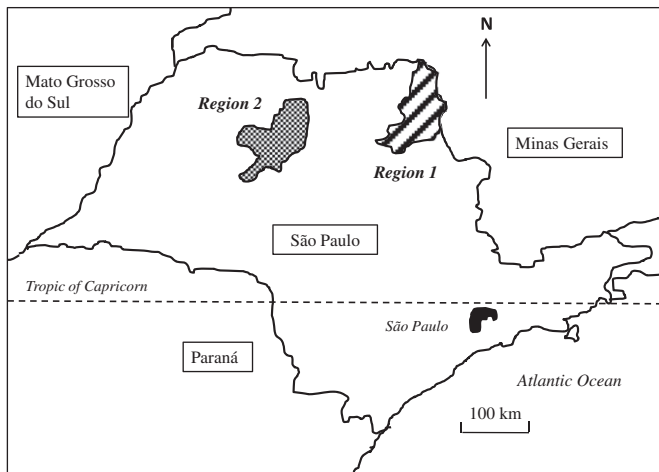


Fig. 1. Location of fieldwork sites, São Paulo state, Brazil, 2009.

into how sugarcane expansion interacts in multiple, complex, and uneven ways with other activities on the land.

In this paper we focus on the dairy sector in São Paulo state, the centre of Brazil's sugarcane production. Sugarcane expansion has preferentially replaced pastures in the Southeast region over the last decades. Beef and particularly dairy production are probably the most affected activities (Durães, 2008; Nassar, 2008; Novo et al., 2010; Rudorff et al., 2010). At the national level, milk production increased with 68% between 1995 and 2008 whereas in São Paulo state<sup>4</sup> milk production decreased by 11% (IBGE, 2008 in Milkpoint, 2008). In contrast with the highly efficient sugar and ethanol chain, dairy production is a family-based activity and demonstrates lack of competitiveness when compared to other relevant rural activities (Campos and Neves, 2007). Despite the growing literature on sugarcane and biofuels it remains yet unclear how the displacement of land for biofuels affects people at the farm level.

Previous studies have revealed competing claims on land between the sugarcane and the dairy sector at the regional level (Novo et al., 2010). Historically, government policies have supported the biofuel sector much stronger than the dairy sector. In the context of a strong and dynamic sugarcane economy and weak and less dynamic dairy chain, dairy farmers consider quitting farming and leasing their land to the sugar industry. Long-term contracts and monthly payments of rent make it an attractive option for farmers. A decision to lease the land is usually followed by selling the herd and equipment, dismantling the infrastructure and preventing the return to farming in the future. This study focuses more on the dynamics at the farm level and addresses the questions how farmers perceive the possibilities of dairy farming in the context of an expanding sugarcane business and how they make choices between shifting to sugarcane or investing in, or simply continuing, dairy farming. Compared to Novo et al. (2010) it provides more empirical detail about the potential benefits and threats of these choices and assesses them in relation to farmers' heterogeneity and their distinct operational logics. As we will show, different types of farmers have different rationales and strategies to adapt to the new constraints and opportunities resulting from the surge of a strong sugarcane business that has altered local demand for land and labour.

<sup>4</sup> São Paulo state, the main sugarcane region in Brazil, produced more than 80% of the ethanol production on 5.3 million hectare in 2010/2011 (UNICA, 2011).

Table 1

Shifts in sugarcane area in Franca and São José do Rio Preto, in thousand hectares, by administrative region (2003/4–2008/9).<sup>a</sup>

Administrative region	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	% increase 2003–2008
Franca	355.0	376.3	390.5	417.1	449.4	489.1	38
S.J. do Rio Preto	280.7	303.7	331.9	396.9	502.6	632.0	125
São Paulo state	3002.7	3165.4	3364.7	3661.2	4249.9	4873.9	62

(Adapted from UNICA, 2011).

<sup>a</sup> An agronomic year consists of the last six months of one year and the first six months of the next.

## 2. Methods

This study examines different dairy farmers in two regions in São Paulo state (Fig. 1). In São Paulo state, two sub-regions were selected as research sites with active sugarcane business and dairy production. In region 1, Franca, sugarcane was cultivated on 489 thousand hectares in 2009 (around 47% of the agricultural land). It is considered a traditional sugarcane region since at least four sugarcane mills were installed near Franca as early as the 1980s. In the past, coffee became an important crop in the region due to favourable agro-ecological characteristics as fertile soils and high altitude. Beef and dairy predominated on less fertile soils. After 1975, the sugarcane sector, supported by the “Proalcool” governmental programme, turned this region into one of the most important in sugar and ethanol production of the state (SEAP, 2007). Region 2, around São José do Rio Preto, represents the new frontier of sugarcane expansion (Table 1). The relatively flat landscape favours mechanistic harvesting, the sandy soils make high productivity possible and a vast area of pastures land is available. As agro-ecological conditions were less favourable to coffee cultivation, other agricultural activities expanded in this region (maize in the 1970s, citrus during the 1980s, beef and more recently, dairy, rubber and sugarcane) (IBGE, 2008). After the 1990s, when beef production became less competitive in region 2, mixed herds (dairy and beef) were introduced and São José do Rio Preto became the major milk producing region in São Paulo state. In both regions dairy and sugarcane clearly compete for land (Novo et al., 2010).

Below we will argue that the two main cities in each research site played an important role in shaping the surrounding rural space. The countryside cities in São Paulo have increased their relative share of the gross domestic product of the state over time and increased the demand for labour. While the growth of the big metropolis stabilized in the 1980s, an intense flow to medium size cities occurred (Cunha, 2003). Franca, the main city of region 1, has experienced high rates of population growth due to a dynamic industrial sector (around 500 industries of shoes and food industry, processing coffee, sugarcane, beef and dairy) and the expansion of commerce and services. A similar process of urbanization and industrialization took place in São José do Rio Preto (region 2). This city with currently 420 thousand inhabitants also demonstrates a growing economy, based on agro industries, furniture industry, and health and educational centres. Although city jobs often pay “rural labour” type wages, free time and quality of life factors are perceived to be better in cities than in rural work situations.

We interviewed thirty-four dairy farmers, with different farming systems and production goals, in eleven municipalities. The semi-structured, open-ended interviews focused on the complex interactions between dairy activity and sugarcane. Access to the farmers' profiles (with information on the size of the farm, family members, employees, average production) and the precise location of each farm was provided by local technicians of the governmental rural service (region 2) or by the technical staff of the

**Table 2**  
Average production, farm area, main occupation and educational level of the farmers in the COONAI dataset.

Production/farm (litre/day)	From 5 to 1350	Average: 158 SD = 186.8
Total area (hectare)	From 1.6 to 1305	Average: 88.7 SD = 145.1
Landowners' main occupation	74.4% were farmers 24.6% other activity <sup>a</sup>	31.6% of farmers are retired
Educational level	29.6% university level 14.0% high school 9.3% fundamental 46.8% basic/no education	2/3 of those who had university level are absentee

SD = Standard deviation,  $N = 438$ .

Source: COONAI, unpublished data.

<sup>a</sup> 18% works in the professions (lawyers, doctors, and dentists), 6.7% in commerce and 0.8% in the industry.

Cooperativa Nacional Agroindustrial (COONAI)<sup>5</sup> in region 1. Most interviews started with a joint study of the bookkeeping of the farm, collecting data about the farm history and shifts in household composition over time, including topics such as land use changes, changes in farming activities, and reasons for investments or disinvestments. Interviews with other actors complemented the farmers' point of view. The wide range of farm types interviewed (small and big farmers, professionals or settlers, peasants or absentees, amongst others), helped to identify the main factors that have been affecting dairy farmers' decisions over time.

Complementary data was collected to obtain evidence regarding the nature of dairy activity in both regions. In region 1, a database of COONAI provides data on a set of milk producers in several municipalities where the cooperative collects raw milk. The resume of some indicators from the dataset already gives an impression of the wide heterogeneity of farm types (Table 2). The high standard deviation and extremes indicate a wide heterogeneity among the cooperative members. First, there is a massive variation in farm size, ranging from peasants to large landowners. Second, almost one quarter of the cooperative members has other income generating activities in the city and farming (particularly dairy) is not their main job. Third, large differences exist in the educational level and, fourthly, one third of the farmers are retired.

Many researchers develop a farm typology not as strict classification schemes but as a tool to discuss the variety of socio-economic circumstances and how this affects farmers' management attitudes and behaviour (Emtage et al., 2006; Howden and Vanclay, 2000; van der Ploeg et al., 2009; Toleubayev et al., 2010). Whatmore et al. (1987) and later Landais (1998) put forward that typologies are potentially an useful methodological tool as they link theory and practice, but should not be used as ends in themselves. Our use of a farm typology does not aim to be absolute or to classify all the existing ways of farming but as way to reflect on recurrent farmers' behaviours and perceptions. In interviews we tested to what extent farmers identified themselves with the various types or could recognize other farmers (Burton and Wilson, 2006; Vanclay et al., 2006).

### 3. Farm types

In this study we identified five farm types among dairy farmers in São Paulo. A short characterization will be helpful for our discussion below of differential responses to sugarcane expansion.

<sup>5</sup> Local dairy farmers founded COONAI in 1941 in order to organize the collection and sale of raw milk. During several decades, the company was associated to a central cooperative and the pasteurized milk was the main product. Errors of strategic judgement on investments and expansion plans in the 1990s, led COONAI to sell the plant, the industrial equipment and others assets. Nowadays the cooperative collects only 10% of the average amount of milk collected twenty years ago.

#### 3.1. Farm type 1: retired farmer

Farmers classified as retired receive a monthly off-farm revenue, mostly by the governmental social security wage<sup>6</sup> and/or leasing of part of their land to the sugarcane industry or farmers of other crops. They continue farming even though in a smaller area than before. In general, the stable and safe monthly income has reduced the necessity to raise high revenues from farming. Therefore, farming profits have less importance than before the retirement (though are desirable to complement the income).<sup>7</sup> Other factors that will influence the rationale of this farm type are the age of the farmer (advanced life cycle) and the absence of sons/daughters to help with daily farm tasks.

#### 3.2. Farm type 2: family farmer

In contrast to type 1, family farmers do not have any external source of income and farming is the only source for making a living. Farm type 2 is also characterized by labour relations based on family labour; compared with type 1 and this is mainly possible because of a different position in the life cycle. Usually the whole family carries out the daily farm tasks (totally or partially) thus making possible an intense activity such as dairy production. The size of the farm is usually relatively small, less than 20 ha. To a limited extent this type hires temporary or permanent labour. Mostly the land has been received as inheritance; in our sample three farmers received land as land reform beneficiaries.<sup>8</sup>

#### 3.3. Farm type 3: absentee farmer

Characteristic for this farm type is that the main economic activity of the farmer is in the city. These farmers run the farm for other motivations than generating profits. Buying land and investing in farming is based on several reasons, including capital protection (land value used to increase over time and is considered a safe asset to invest money earned in urban business), social recognition (to pursue a farm is a clear sign of wealth to the urban society), leisure (weekends and vacation activity) and nostalgia. Owners use to spend very little time on farming activities (usually less than 40% of their time) and the respective revenues only contribute a small share of the household budget. The purchase of land was the most common form of acquisition.

#### 3.4. Farm type 4: entrepreneurial farmer

The identification and characterization of this farm type resulted from discussions with technicians and knowledgeable actors. They argued that, despite the small number of large, professionally managed farms, they represented an important segment of the dairy industry because of the high volume of production.

<sup>6</sup> After the age of sixty, farmers receive from the state a retirement pay equal to the minimum wage around R\$ 500.00/month (about US\$ 290.00). People with health problems may retire at a younger age. Retirement of other family members may complement the family income.

<sup>7</sup> According to Delgado and Cardoso Junior (1999), the regularity, safety and monetary liquidity from social service payments not only influence family strategies and adaptive behaviour in rural areas but also in small cities.

<sup>8</sup> Dairy production is actually an important source of income to land reform beneficiaries, called 'settlers', who similar to other family farmers sell their surplus to cooperatives or other commercial companies. The literature has discussed extensively the key role of the Movimento dos Trabalhadores Rurais Sem Terra among settlers in reframing political identity and agrarian citizenship (e.g. Wittman, 2009, see also Wolford, 2010) and linking the issue of access to land to alternative views on agrarian modernization and general changes in society (e.g. Welch, 2009). For an analysis of the birth of the MST see Fernandes (2000).

**Table 3**  
Distribution of farm types in the COONAI dataset.

Criteria						
Farm type	Family labour	Hired labour	Retired	Time dedicated to farming	N	Farmers producing extensively within type <sup>a</sup> (number)
Family	Yes	–	No	>40%	102	5
Retired	–	–	Yes	–	61	5
Absentee	–	–	–	<40%	130	20
Entrepreneurs	No	Yes	No	>40%	31	2
					324 <sup>b</sup>	32

<sup>a</sup> Extreme low productivity (less than 400 kg of milk/ha/year).

<sup>b</sup> Not all farmers from the initial data from COONAI had the comprehensive information to be shared in farm types.

Furthermore, it could be hypothesized that they would have rather different reasons to invest, either in sugarcane or milk production. This farm type is characterized by the professional management (the owner is always present), the farm is conducted as a company, uses hired labour, and produces on large scale in very large areas (in the sample from 300 to 5300 ha). Inheritance was a major form of land acquisition, but frequently additional areas have been purchased in the recent past.

### 3.5. Farm type 5: extensive farmer

The use of extensive areas of grazing land and low animal capacity has been the preferred way to produce milk in many regions in Brazil (Faria and Martins, 2008; Gomes, 2006). Farmers and technicians recalled histories about the “traditional” farming system with the use of very large grassland areas, beef or mixed herds, high number of cows per farm and low or no use of technology. During our fieldwork, however, we did not find a farmer that “matched” with the traditional/extensive characteristics. Below we are going to discuss some possible reasons for the absence of this type. For conceptual reasons we keep this farmer in our typology, as it is both a point of reference for our informants as well as for our analytical discussion.

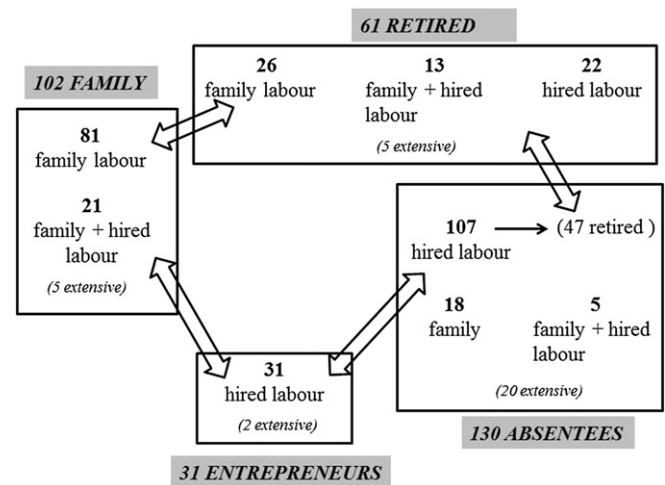
To get an indication of the presence of each farm type, we selected three criteria of distinction, based on our first analysis of interview data<sup>9</sup> and theoretical reflection on farm typologies, namely type of labour force (family or hired labour), retired (or not) and time dedicated to farming. Using these criteria we analysed the COONAI database (detailed information of 324 milk producers in region 1). All farm types became visible across the data, suggesting that the classification reasonably represents the farm types present in that particular region (Table 3). It is possible to figure out the overlapping feature of classification exposing the high complexity of interactions among them (Fig. 2). For example, using a productivity index to define the degree of “extensification” (kg of milk/ha/year), gives an idea of how many farmers of each type apply an extensive system. We selected the 10% least productive farmers in the COONAI dataset and found out that they were spread within each farm type, with the highest presence in the absentee farmer type.

## 4. Availability of labour: the major challenge to dairy farmers

In the interviews farmers<sup>10</sup> considered the organization of labour a key issue for shaping the viability of production systems.

<sup>9</sup> From the sample eleven farmers were classified as retired, thirteen as family farmers, seven as absentees and three as entrepreneurs.

<sup>10</sup> Fifteen farmers perceived increasing problems with labour law. They were spread in different farm types (5 absentees, 4 family, 4 retired and 2 entrepreneur) and had larger areas (on average 282 ha). However, changes in labour law were not identified as relevant by 19 farmers (4 absentees, 1 entrepreneur, 9 family, 5 retired), mostly family farmers with smaller areas (on average 47 ha).



**Fig. 2.** Farmers' distribution across and within types with overlapping characteristics.

At farm level, dairy production is one of the most labour demanding activities and it requires daily and year-round labour input so that labour shortage will directly affect land use decisions. The reduction of dairy production in São Paulo state may partly result from the relatively increase of labour costs. Carvalho and Carvalho (2010) show that in 1991 a farmer needed to sell 202 L of raw milk to pay a monthly wage of an employee (without taxes). This value had climbed sharply to 706 L in 2009 (milk lost 33% of its real value while the minimum wage increased with 133%, discounted the inflation). Each employee had to produce three times more than twenty years ago, otherwise the farmer would lose.

At the time of this research two processes were changing old patterns of labour organization. Firstly, the competition for labour between agriculture and the urban labour market increased. Secondly, the recent changes in labour law and its enforcement influenced decisions of large and small labour employers in agriculture. The labour law is the same for urban and rural space and adapted to the industrial sector, and therefore does not consider the particularities of agriculture, e.g. the seasonality of agricultural production and the continuous (all days of the week) and special working hours (early morning, evening) in dairy production. Since the ratification of a specific normative instruction regarding safety and health in 2005, Brazilian labour laws (more than nine hundred articles) are considered among the most severe of the world (Pires, 2008). Fifteen of the interviewed farmers (of different farmer types) recognized the changed situation and the implications of it for contracting labour while for others it seemed not a very relevant topic. Furthermore, a concern about changing legal context of contracting labour does not necessarily mean a change in previous practices. One interviewed lawyer stated that “Farmers are unaware about the risks of facing problems in labour court” since they still continue previous patron–worker relationships (labour lawyer, personal communication, 2009). Field observations show that many local practices deviate from what the labour law allows. For example, farmers (n.3, 12, 24 and 33) required workers to do the feeding of the herd and the milking of the cows on the resting days of the worker. Increasingly, however, different actors (in our sample the executive board of the dairy cooperative, extension service technicians, a director of a sugarcane mill and local politicians) consider that this new situation of a perceived increase in the rigor of the labour court has put pressure on the agricultural sector (it even reached the columns of *The Economist*, 2011). It results from our study that many farmers feel that hiring an employee has become more complex. First, because the small scale of milk



production, the majority of the farmers cannot pay an attractive wage nor the taxes related to the registration of an employee (including social security, annual extra salary, and the fee to an accountancy office). Second, dairy activity conflicts with the labour regulations about holidays and free hours to the worker. Third, housing for workers on the farm has to be arranged as the average distance to the city was around 15 km. For family farmers who intend to contract a labourer it is a big investment to build another house (while there is also a risk that they cannot find a labourer who then would live there).

These external conditions interact with the internal labour dynamics on the farms and farmers take them into account when considering alternatives such as renting land to sugarcane, moving to the city, or investing in the intensification of dairy farming. For the retired farmer and family farmer types, the dynamic of labour availability in the household is crucial and involves a modern version of a Chayanovian life cycle-land use relationship. For the retired farmer decisive factors are his/her age and the absence (or presence) of sons or daughters. Young family members went out seeking jobs in the city motivated either by the lack of farm income to support a second family or better opportunities in urban areas. A consequence was that less people on the farm means less need for a higher farm income. This makes a farm household based on retirement payment and some modest farm production viable. Retired farmers furthermore referred to the 'lack of strength' (or weak health) that has made it difficult for them to keep on farming the way they used to do. One interviewed farmer (n.1) stated: *"Dairy is a good business but a very exhausting activity, and I have lost my strength to handle it by myself...and I do not trust to have someone else to do the job, I do not know what I am going to do after my son goes to the city..."*. This reference to a diminished physical work capacity touches upon the topic of the drudgery of labour which we also found in the reasoning of family farmers. Also decisions of family farmers regarding investments in intensification of dairy production or leasing land to the sugarcane industry reflect the labour availability in the household and consideration about the drudgery of labour. Though a larger family would provide more labour, more expenses are in fact expected, as nowadays children study longer.

Why do farmers not quit dairy activities, lease land to sugarcane industry and search jobs in the city? One reason is the small size of the farm, usually less than 30 ha, which is not enough to get a valuable monthly income from renting to sugarcane. Farmer n.16 stated: *"...in a small farm like this (8 ha) if we decide to rent to sugarcane it would be impossible to make a living, if you have a family...then you would need to find jobs in the city for the whole family if you want to survive. With dairy and cheese making we can keep on living here..."*. Farmers also refer to the relative low level of urban wages for those with a low educational level (the majority of family farmers): *"before investing in dairy, I considered to work in the city, but what kind of job should I have there? I have no high education at all..."* (farmer n.22). The question then becomes if further intensification would be economically competitive and able to reduce the labour constraints.

The case of this farmer (n.22) shows that relatively high incomes are possible even on a small farm (8 ha). He could get a loan, intensify production and reach high productivity and profit with dairy. He reached the limit of the family labour force even using a lot of technology. Despite excellent profits with dairy (around five times the average sugarcane renting value) he could not use all his area for dairy production due to labour constraints. He invested in a house in the farm for an employee. His decision about hiring someone was however mainly driven by the drudgery of the dairy activity. He said *"I've never earned so much money in my small farm as when I reached 500 L/day, but there was no life, though! I'd rather*

*not to earn so much and hiring someone I could have a break and enjoy a weekend with my family"*. The intensification process of the dairy production resulted in high income and the farmer choose to reduce the labour load to his family by hiring external labour. By doing so, this family farmer became inserted in the local labour market and faced similar problems as other farm types that base their dairy activities on hired labour.

These latter problems are felt even more strongly by the absentee farmer type. The very existence of an absentee farmer turns farming highly dependent on workers and managers. The primary objective of hiring a worker, commonly accompanied by his entire family, is to have someone who maintains the house, garden, orchard, and so on, thus reducing the risk of thefts. Absentee dairy farmers then consider milk production as a means to pay the monthly expenses of the farm. The employee for the dairy and the milking could take care of the farm as well. In these situations, the main objective of milk production is not to provide enough income to survive, nor to complement the retirement, but just 'to help' to pay for the wages and other expenses of the 'caretaker'. The relationship between an absentee farmer and employees is a continuous source of conflict. In interviews, several absentee farmers attested a high turnover of employees, for example farmer n.4 said: *"I gave up dairy production first because labour constrains...during the last ten years, twenty two different employees passed through my farm...I was very dependent on their work and they took advantage of this..."*. Similar to six other absentee farmers interviewed, he never did any kind of farm work despite his countryside origins in the past. Besides this type of dependence, lack of control of the workers' performance may also lead to a low efficiency of the labour force in this farm type. Usually employees take daily decisions over processes without any control by the owner. For example, one absentee farmer (n.7) did not know how many employees he hired for milk production and what their tasks were. The conflictive character of the relationship between workers and absentee farmers also results from the nature of dairy farming as a continuous activity. Absentee farmers are not able to hire more than one worker-family and since many owners do not know nor want to learn how to deal with cows, they are not capable to replace workers during the weekly resting day or vacation. The consequence is a high turnover of employees due to conflicts, low efficiency of the labour force and, in many cases being involved in labour court processes. The problem to organize labour even made some absentee farmers to rent land to the sugarcane industry. This practice seems to go against the objectives of leisure and social appreciation of farmers for whom high revenues are usually not as important as a beautiful view in their fields, grasslands and grazing cows, calves and horses. In fact, leasing to sugarcane production would deeply transform the landscape of their dreams. The presence of strangers and heavy traffic (tractors, trucks, harvesting machines) surrounding a leisure farm is mostly considered undesirable. Nevertheless, we observed four out of seven absentee farmers (n.6, n.7, n.15 and n.32) partially renting land to the sugarcane mill. Among the expressed reasons was the felt need to avoid problems with the labour force. Renting out part of the land also provided extra capital for running the rest of the farm. Those with a large farm were able to locate sugarcane production at some distance from the main leisure house. It was also mentioned that renting to sugarcane producers carried less risk of non-payment than leasing land to small local tenants. Let us now turn to labour issues in the entrepreneurial farm type.

Large scale production makes it possible to hire more than one family and consequently to better follow the regulations of the labour law regarding free days and holidays. In their farms the turnover of workers was relative low. However, the three interviewed entrepreneurs mentioned that the labour law was unfair

since it makes labour too costly with, in fact, low benefits to employees. We initially supposed that workers would stay longer in this sort of farm because of the higher wages paid, but that was not found in the sample. There must be other reasons for the low turnover. Interestingly, entrepreneurs strictly follow the laws and regulations, thereby supported by offices and lawyers that control the bureaucracy involved in registration of the workers.

Above we have explored different labour issues for each farm type that influence decision-making about investing in dairy farming or leasing to sugarcane producers. This allows us to identify a range of relevant mechanisms, beyond the more direct costs and benefits of dairy or sugarcane production, that are of varying importance for the different farm types: family labour dynamics, age, perceived attractiveness of urban jobs, drudgery of labour, labour law regulations, and absence of knowledge to practice farming without hired labour.

## 5. Farmers' strategies and the economic environment

The Brazilian sugarcane industry is considered one of the most efficient agro-businesses in the world and highly competitive in prices (Bake et al., 2009). It can make relative good offers for long-term leasing contracts, usually displacing land from less competitive activities such as beef and dairy systems (Novo et al., 2010). Nevertheless, if the biofuel economy is so attractive, and dairy so problematic, why do not all farmers quit farming and rent land to the sugarcane? This question implies that simple short-term profitability analyses do not fully reflect the core reasoning underlying farmer strategies. In this section, we explore some other elements of the complexity of farmer strategies (Jansen, 2009) seen as non-linear farmer responses to economic circumstances and technological options, which interact with the labour situation discussed above.

### 5.1. Technology selection

Currently, there are technologies available, not yet used by all dairy farmers, that could be invested in to modernize production processes (Manzano et al., 2006). In the interviews it appeared that farmers make investments in dairy technology for distinct reasons, not only to increase milk production or to reduce costs. For example, retired farmers not just continue with older technologies. Some are introducing technologies such as buying a milking machine, aimed first to reduce the drudgery of the work and only secondly to get an extra income. For absentee farmers technology introduction, besides increasing output, meant also social recognition (show off behaviour<sup>11</sup>) and the need to exercise better 'supervision' over the employee. By hiring a technician to track the introduction of the new process they get information about the behaviour of the employee.<sup>12</sup> However, the success rate of technology introduction by absentee farmers is low due to the weak management of the farm and the explained constraints of labour availability. On family farms, technology introduction has generally the objective to increase the production and revenues in small areas, aiming for a better life of the family. Entrepreneurial farmers

<sup>11</sup> Farmer number 15 was highly enthusiastic about the regional milk tournaments that he had won in the past. In his perception, this 'important' prize demonstrates to the urban society how skilled he is and able to uphold the 'name' and reputation of his traditional family. During our visit to his fields, however, the spoiled silage into the troughs, dead cows with no clear explanation, and skinny heifers attested that he had farm management problems due to the lack of owner presence.

<sup>12</sup> In Patrocínio Paulista (small city near Franca) the local technician related that more than 75% of all farmers that requested her attendance to technology introduction, which means regular farm visits, were absentee farmers.

reach with new technologies high productivity, mainly based on the owners' presence and the professional way of farming. These farmers can afford one or more private professionals to supervise technical issues to train the staff.

Not only selection of new technology is an issue, but also strategizing with existing technology. By doing this farmers increase their flexibility. Risk aversion (in particular for retired farm and family farmer types) and concerns about large price variations of raw milk and the price drop relative to input prices<sup>13</sup> induces farmers to avoid investments. On the other hand, farmers adapt to the unstable economic environment by acting strategically when prices increase, using their resources opportunistically. For example, when milk prices go up, they immediately initiate the second milking, reduce the amount of milk destined to calves, provide some concentrate to fresh bred cows and several others activities that have quick response and increase product sales without long-term investments, loans or capital. Such strategies can be interrupted at any time, without major consequences to the cash flow of the farm and this flexibility is an important characteristic of the farm economy.

### 5.2. Resilience and cattle as savings

Despite the problems to mobilize household and hired labour as mentioned above and the presence of the alternative to lease the land to the sugarcane industry, some farmers remain in dairy activity because they valorise milk production as a way of obtaining a monthly income from the herd. At stake here is the issue of a resilient production system. The tendency to keep a relatively large number of cattle might have its roots in the long period of extreme high inflation (IBGE, 2010) and the unstable national economy from the 1960s to 1994. In this economic context an extensive system of cattle raising (farm type 5) flourished. In an era of high inflation and geopolitical interests to reclaim new spaces much capital was invested in cattle raising with relatively low risks (Hecht, 1985, Hecht, 1993). In this context, however, technology introduction and intensification were considered highly risky by farmers. A similar idea of cattle as savings, instead of only maximization of profits, we still find today. Interviewed farmers explained they aim at a better liquidity position with a large herd, which they consider crucial in crisis moments. Farmers reported several cases of selling all the cows to pay loans (in case of an extreme climatic event or bankruptcy) or the medical expenses after health problems in the family (n.11), or debts generated by other activity (n.19), or to build a house for the family, to give to a married son (n.1) or even as a strategy to buy more land (n.11). The "buffer" effect of cumulating capital in cattle may partly explain why not all farmers rent land to sugarcane industry, even when the short term monetary value is higher than the milk activity and given the problems with organizing labour for milk production.

While this idea of cattle as savings is still prominent among contemporary producers, we see that this no longer leads to the extensive farmer type (type no.5) at least in São Paulo state. The combination of a stable economy since 1994, labour constraints (by labour law or life cycle), increasing land values and opportunities to rent land to sugarcane may have caused that the extensive farm has almost disappeared within São Paulo state. Farmers selected for the case study as extensive farmers were already intensifying their production system or renting out land, partially or totally, to

<sup>13</sup> This phenomenon takes place on a global scale over the last decades (Koning and van Ittersum, 2009).

sugarcane<sup>14</sup> Farmer n.12 (classified as retired) mentioned that extensive cattle raising was the only way to earn money in his three-hundred hectare farm until 2007, but due to labour constraints, economic reasons (large variation of prices plus the opportunity to rent land to sugarcane for a good price) and social aspects (his three teenage daughters were studying in the city and had to travel 20 km daily) he had started to lease land to sugarcane producers. Another farmer (n.32), referred to by his neighbours as a reminiscence of the extensive system, had recently intensified dairy production by using rotational grazing, maize silage and concentrates. He used to farm extensively, in the same style of his father and grandfather, until 2008, but the retirement pay and changes in his family structure<sup>15</sup> led him to change farming strategies. With his basic maintenance guaranteed and living alone, the farmer took loans in the bank and invested in technology in order to reduce his labour load while still earning some money. It is possible to observe different reasons across the two study cases that justified their option to the sugarcane leasing or to intensify dairy production. Factors such as (family) labour supply and non-farm income might be the explanation why it is difficult to find a typical extensive system farmer within the boundaries of the most developed state in Brazil.

### 5.3. Dairy and sugarcane as diversification alternatives

We have started this paper with reference to the literature that documents the replacement of dairy by sugarcane at the regional level. However, there are situations in which sugarcane makes the continuation or even intensification of dairy farming possible at the farm level. In all the three visited entrepreneurial farms, both sugarcane and dairy had been introduced several years ago (from 4 to 10 years) in order to diversify the scope of agricultural alternatives.<sup>16</sup> In the sample, the proportion of sugarcane varied from 10 to 25% of the available agricultural area and at least three agro-ecological and logistic factors supported the expansion of sugarcane across the entrepreneurial farm type. First, sugarcane demonstrated a more stable production than soy or maize when extreme climatic events take place (e.g. droughts, delays in the rainy season) and this characteristic may improve the stability of the total revenue of the farm in the long term. Second, as a semi-perennial crop, sugarcane demands less agricultural operations (no need for annual ploughing, no seeds to buy, and less diseases control activities). Finally, some farmers with large farms (n. 07, 12 and 31) have developed an interesting logistic strategy to place sugarcane in more distant fields, reducing the transport of inputs and machinery. On the other hand, dairy is still an option in fields with less favourable topography, not suitable for crops. Interviewed entrepreneurial farmers also appreciated the monthly revenue of dairy which provides them with enough capital to run the farm while waiting for the most opportune moment to sell the harvest of, for example, soybean, maize or coffee, which considerably fluctuate in prices over the seasons.

<sup>14</sup> As said, we could not find extensive farmer to interview in our case study locations, even though local people pointed at their presence and referred to particular farmers. Furthermore, the selection of farmers may not have been comprehensive enough since extensive farmers may not be keen to technical innovations and consequently are “unknown” by the extension service staff.

<sup>15</sup> Just after retirement of the couple, when his wife (who was responsible for milking the cows) gained her own income with the pension, she asked for a divorce.

<sup>16</sup> Diversification into dairy and sugarcane makes sense due to large variations in commodity prices (e.g. for soy or maize) and yields (e.g. diseases or extreme climatic events). All entrepreneurial farmers had used cheap feedstock from residues of soy and maize, thus significantly reducing production costs (concentrates are usually a major cost item in dairy production; Rennó et al., 2008).

## 6. Discussion

The two previous sections discussed crucial factors that have shaped farmers position regarding the intensification of dairy production or shifting land use to sugarcane production. Constraints on labour supply and the preference for more resilience, for technologies to relieve the drudgery of labour and, in many cases, for diversification have supported intensification in dairy farming, but in some cases also a diversification into sugarcane. Realizing that the complexities on the ground are much larger, we have summarized in a very schematic way the historical line of each farm type in the model of Fig. 3. It represents how farmer types have changed over time within the context of historical changes,<sup>17</sup> including the sugarcane expansion (which expanded twenty times in area), the political-economic context (e.g. inflation rate) and labour demand in the cities (where population increased over ten times).<sup>18</sup>

In this model the role of the development of medium-size countryside cities comes to the fore. Strong urban influence over the rural space has become an important feature within the boundaries of São Paulo, the most developed state in Brazil (Jacobs, 1984; Abramovay, 2000; Graziano da Silva and Del Grossi, 2001). Due to migration to the cities, the total rural population and the labour force decreased between 1986 and 2008 (Alves and Marra, 2009), reflecting the worldwide capitalist-driven tendency of decline of agricultural labour in favour of urban wage employment (Bernstein, 2010). This process influenced the nature of the rural household life cycle. We have seen above that the strategies of some farmer types, in particular the retired farmer and the family farmer, are interwoven with the life cycle of the household (Inwood and Sharp, 2012), an idea associated with a Chayanovian model of the rural household economy (Thorner et al., 1966). Basically, the economic model of Chayanov considers that households develop their production system based on the amount of available family labour, which makes the demographic structure (the rate between workers and non-workers in the family) fundamental to farming decisions. For example, we described cases of retired farmers who after migration of the sons to the city behaved with a drudgery-averse mindset that avoided intense labour activities.<sup>19</sup> By the same logic, the many labour related strategies of family farmers are consistent with the model (increasing number of family members provide extra labour force to dairy production processes along with the need of a higher income to support the larger family). However, in many other aspects the situation in Brazil differs from the Chayanovian model. In particular, the presence of a formal labour market interacts with the household economy. In many cases farmers hire employees to run dairy activity. Moreover, the influence of attractive alternative sources of work and income, mainly originating in urban centres shape the employment of rural labour, including the labour from family farm members. They also consider the trade-offs between, on the one hand, intensifying dairy farming and, on the other hand, seeking wage jobs and leasing their land to the sugarcane industry.

Does this model of land use changes help to say anything conclusive about the future interaction between dairy farming and sugarcane expansion? Without pretending to be able to predict the future economic, social, and technical dynamics, it is possible to

<sup>17</sup> Interviewed farmers described former land use between the 1930s and the 1960s when sharecropping was a usual practice (the landlord allowed family farmers to cultivate the land against 50% of the total production).

<sup>18</sup> The rural population in São Paulo state decreased from 37% in 1960 to 4% in 2010 (IBGE, 2010).

<sup>19</sup> Farmers number 1, 2, 11, 12, 14, 19, 23, 25, 27, 32 and 33.

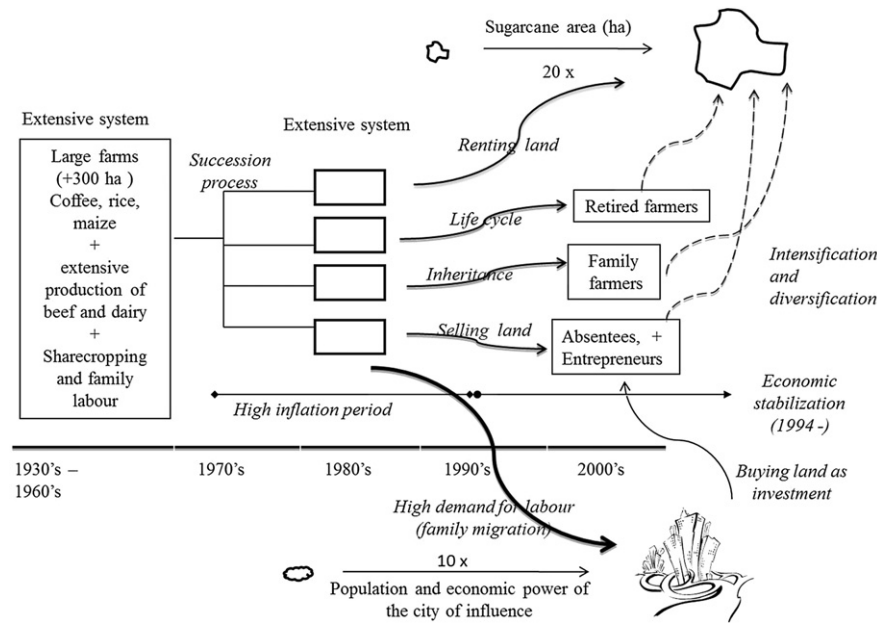


Fig. 3. Time line model of land use changes.

point at certain relevant processes and conditions that will shape this interaction. In some case indeed, the opportunity of leasing land to sugarcane responds to some mayor expressed needs of farmers: labour alleviation, 'safety', monthly payment among others. In many situations the shift to sugarcane will be a 'one way street' where farmers cannot return to their former business due to the total pull out of the herd, machinery, electricity and fences as well as the abandonment of buildings (barns, corral and houses) (Sparovek et al., 2010). After six or seven years, at the end of the sugarcane crop cycle, the lack of the large amount of capital required to remake the entire infrastructure will block the return to dairy. Therefore, no other alternative will be left but to renew the renting contract for another six years period.

In general, however, the effects of the expansion of sugarcane will be more uneven and contradictory. As we have described, in some cases sugarcane production prepares the conditions that make intensification, or at least continuation, of dairy farming possible. As a form of diversification it offers a guaranteed extra income, fitting the rationale of resilience and lowering risks and uncertainties. It has the potential to add value to available "under exploited" or underutilized areas on farms.<sup>20</sup> For example, interviewed family farmer (n.27) intensified dairy production on a small part of his land thereby creating enough room to rent area to sugarcane production. The sugarcane revenue provided enough capital to invest in technology for dairy activity and one year later, the high income obtained with dairy (that reached 900 L/day) made possible to hold the maize and coffee harvesting in storage, seeking better prices out of the harvesting season. Hence, in contrast to the first process (to quit production and totally rent the farm), the presence of sugarcane can be part of a strategy of intensification and diversification, enhancing stability and resilience for farmers in São Paulo state.

The question can then be raised why some farmers turn to leasing land to sugarcane instead of following other forms of

diversification? Fruits and vegetables, for example, could be economically feasible because of price relations and the presence of a consumer market in the surrounding cities. When farmers were interviewed about these and several other agricultural products as alternatives they presented their perception of involved risks. The recurrent testimonies from interviewed farmers (sixteen cases) referred to non-payments during the commercialization phase, bankrupts of agricultural industries and thefts of assets. They mentioned many cases where farmers generated very high profits with producing fruits (avocado, mango, pineapple, watermelon) but all of them ceased fruit production mainly because of one reason: non-payments of intermediate dealers. Traders used to pay correctly until they got the confidence of the farmer, then collected a big load and disappeared without payment.<sup>21</sup> The same process has happened in the past with citrus and coffee dealers, poultry integration companies and beef slaughter houses but during the interviews these were less reported cases. In this sense, the characteristic of dairy production, selling the raw milk and receiving the payment every month, reduces the risk of losing a large amount of money when a dairy industry goes bankrupt. Furthermore, the capital reserve in cattle could supply some money when an unexpected similar situation – non-payment of milk – takes place.<sup>22</sup> Non-payment by the sugarcane industry may also be possible, but is much less frequent due to the well-structured market of sugar and ethanol and the presence of an established long term contract that increases the confidence of farmers in this transaction. The governmental enthusiasm to support ethanol as a worldwide commodity and to use it as diplomatic tool also enhanced farmers' perception of the economic stability of sugarcane mills in the future. Even in moments that sugarcane and dairy are not necessarily the best profitable use of land, farmers identify

<sup>20</sup> This refers to areas with degraded grasslands and low fertile soils, and consequently low animal capacity. It also could be farm fields not used because of labour constraints or lack of capital to invest in technology.

<sup>21</sup> These intermediaries usually pay higher prices when buying "unofficially", i.e. without transaction records or invoices, based on oral agreements and trust. Once deceived, farmers cannot file a lawsuit as they have no proof of the loads collected.

<sup>22</sup> Farmers also reported some cases of thefts of cattle and machinery and a local newspaper headline (Diário da Franca, 2010) reported on the problematic situation near big cities. However, this does not seem to paralyse dairy farming.



them as a “safe” option in a context of weak market institutions. It increases their resilience.

Taking this consideration into account, what could be the future of sugarcane and dairy in Brazil? Assuming a scenario of high energy demand, locally and worldwide, the sugarcane industry has invested in further expansion. At the time of writing at least fifty new mills were being built in Brazil and the governmental support does not seem to cease. Each mill requires at least ten thousands hectare of sugarcane plantation so this industry will remain one of the main drivers of land use shifts in the Southeast of Brazil.

The future of dairy production is more complex to grasp but based on our interview material we can conclude that many farmers succeed in intensifying their dairy production, even on small plots of land. Hence, there seems to be room for an increasing production. It is possible to foresee that smallholder dairy production may grow in regions where land is cheaper, where the opportunities for labour for alternative jobs are weak, and where there is no sugarcane competition yet. In the Southern region, for example, the family-based agrarian structure offers conditions to increase milk production as well. In frontier areas some promoting factors are also present. The dairy industry has an interest in the North-Western and the ‘Cerrados’ (Brazilian savannahs) regions (motivated by the options offered recently with UHT technology, sufficient available areas for pastures and the shift from beef to mixed herds. Novo et al., 2010). However, the same drivers that have modified the São Paulo landscape are becoming more important in some regions of the ‘Cerrados’. In Mato Grosso and Mato Grosso do Sul e Goiás not only the sugarcane planted area is growing fast (from 320 thousand ha in 1996 to 1.2 million ha in the 2010) but also the urban population is increasing (shifts from 68% in 1980 to 88% in 2010) (IBGE, 2011). Therefore, the agrarian dynamics may be modified by a similar substitution process of the highly efficient sugarcane industry for less competitive activities. On the other hand, some very successful cases of intensification and diversification processes reported in this paper indicate an interesting opportunity to farmers when aiming to reduce risk, better resilience and high income generation even when inserted in a competitive and unstable environment as observed in São Paulo state.

## 7. Conclusions

This study looked at the dynamics of dairy farming in relation to an expanding sugarcane sector. It explored how farmers interpret the trade-offs between shifting to sugarcane, which in most cases means renting out the land to the sugarcane industry, or investing in, or simply continuing, dairy farming. As an heuristic tool the development of a farm typology turned out to be useful as it helped to transcend the often used dichotomy between smallholder-family farms and large scale-business farms. In particular the categories of retired farmers and absentee farmers turned out to be relatively large in number occupying a considerable aggregated land area. The typology helped to explore more in-depth the diversity of factors that influences farmers’ strategies. In particular expectations about short and long term labour availability shape investment and land use decisions. These interact with preferences regarding resilience, reduction of the drudgery of labour and diversification. For some farmers this meant diversification into sugarcane production. Other farmers were prone to rent out land captured by attractive economic offers by the sugarcane industry. This study suggests that profit maximization (particularly the higher values from sugarcane) is not always the farmers’ main goal. Other factors such as risks perceptions and the constraints on organizing labour are also decisive for farm development. Many dairy farmers choose to continue milk production even when

inserted in a capitalist context of strong competition such as observed in São Paulo state.

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