What are the strategies and steps to build-up a dairy system in a harsh environment? The case of smallholder dairy farmers of Unaí – Brazil.

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Abstract

In the district of Unaí (Minas Gerais, Brazil), smallholder farmers face numerous challenges such as restricted access to land, capital and labor, weak collective organization and climatic constraints. Yet, they are eager to access local markets to sustain their livelihoods and are ready to adapt their production systems in different ways to overcome the above constraints and achieve their place in existing productive supply chains. The dairy sector offers them a unique opportunity to achieve their goals. To understand how small holder farmers in Unaí took their place themselves in the dairy sector, we interviewed 24 smallholder farmers that deliver milk for the local cooperative. Our aim was to analyze the trajectories they followed from installation up to now in order to build specialized dairy production systems. Trajectories differ in terms of the feeding strategies and sources of feed for cows in the dry periods; of the breeds used for milk production; of the sources of financial resources for investment in the production system; of the relative synchronization of milk production in dry and wet periods, among others. This variability is related to how much smallholder farmers try to provide security to their systems, and in doing so, decrease its vulnerability both to internal and external events.

Introduction

The dairy sector is marked by a significant degree of volatility, explained by the low level of world-wide supplies and interchanges in terms of low production and consumption in general (Belhenniche et al., 2010). The fluctuation of the prices of milk market and the economic output can be harmful to the farmers who are still in the process of building their production system. This increases the economic risk for the family, with a bigger sensitivity of the system to the risks when the goals according to system specifications are not yet reached.

The present paper deals with the different ways smallholder farmers use to cope with risks and uncertainties (Darnhofer, 2010) in a context where there are no public policies offering them a safety net to correct damage caused by an unpredictable event such as droughts, drops in milk prices or increases in input prices.

Our study focuses on the trajectories of dairy production systems being developed by smallholder farmers in the Unaí district, located in the Cerrados region in Brazil. Analyzing trajectories in our case consisted of reconstituting the history and the logic of the evolution of the farming systems and their relations with an organized and competitive local milk cooperative.

Originally the region of Unaí was occupied for a vegetation type 'cerrado' and 'field cerrado' which covers 24% of Brazilian land. Currently, the open pasture meets restricted to the top, under form of 'capoeiras' or secondary bushes. For the most part of the region, the original vegetation was substituted by the pastures and the agriculture that today predominate in the landscape. Milk, as an alternative of production and generation of income for a significant number of smallholder farmers of the Unaí district, is associated with a series of propicious agronomic, agrarian, economic and social characteristics in the region (Gregolin, 2004).

Smallholder farmers involved in the milk supply chain differ one from the other in several aspects, including the characteristics of their production system (land, capital, workforce, sources of income) and the relationships they develop with the others smallholder farmers, the market, or technical assistance. To build their dairy production system, smallholder farmers in Unaí rely both on their empirical knowledge and on the technical dairy package, or components thereof, promoted by the local milk cooperative (Bernard et al., 2010). The socio-economic environment in which they operate is marked by the absence of, or a restricted access to, measures and safety devices typically found in developed countries, such as public technical assistance, insurance devices and supportive public policies.

The aim of the present study is to generate decision support and tools that may help smallholder farmers to choose and follow accurate strategies for the development of their dairy systems, based on a better understanding of the consequences of alternative choices along the trajectory (Branch, 2010). It may also help the local milk cooperative in formulating policies better suited to small holder farmers, who represent an increasing fraction of the cooperative membership and milk production.

Our main research question is: "What are the strategies and the corresponding practices of the smallholder farmers which aim to give safety to the dairy production systems they are developing?"

We use the concept of vulnerability as part of our theoretical background. Vulnerability can be defined as the degree to which a system is susceptible to and is unable to cope with adverse effects (Adger, 2006). The key parameters of vulnerability are the stress to which a system is exposed, its sensitivity, and its adaptive capacity. By focusing on these three aspects, three kinds of risk have to be taken into account: (1) risk of exposure to a crisis; (2) risk of incapacity to deal with the stress, crisis or shocks; and (3) risk of severe consequences, in the form of crises, risks or shocks (Hogan and Marandola Jr, 2005). A system can be vulnerable to certain disturbances and not to others (Gallopin, 2006). What is vulnerable in one period is not necessarily vulnerable (or vulnerable in the same way) in the next period, and some exposures and sensitivities may develop slowly over time (Smit and Wandel, 2006). The concept of vulnerability appears especially relevant to analyze the situation of dairy farming systems which are under construction in a highly unpredictable context (social, technical, economic).

Material and Methods

For this study, we interviewed 24 heads of families (both husband and wife). The initial population was constituted by 340 smallholder farmers who were selected randomly among the 4.000 smallholder farms existing in the district of Unaí, as part of a diagnosis study carried out by Embrapa (Brazilian Agriculture Research Corporation) in 2010. The first criterion for the selection of the 24-farm sub-sample was to have milk production as the main economic activity of the property, which applied to 184 smallholder farms of the initial sample. We then used a cluster analysis to identify homogeneous groups of smallholder farmers based on variables related to productivity level, i.e. milk production per ha, milk production per cow, and milk production per worker. Four groups were thus identified (Table 1), mostly related to relative level of milk production per unit of land (which we assume to be related to the relative vulnerability of the system). We then selected randomly six farms per group in order to make a detailed qualitative analysis of securing/safety trajectories and smallholder farmer's strategies (Rueff, 2011).

Table 1 – Cluster analysis of smallholder farmers, based on Variable Milk Quantity (liters/month).

Variable	Cluster (Groups)			
	1	2	3	4
Milk Quantity (liters/month)	6300	3100	1500	500
Number of Properties	6	23	48	107

Successive interviews were conducted in each farm. The first interview aimed at building an initial reconstitution of the trajectories over time. The beginning of a trajectory was taken as the moment of installation of each family farmer on the property. The second interview consisted mostly of a discussion with the smallholder farmers about a simplified representation of the trajectory we had formulated after the first interview. The discussion focused on confirming the main events, collecting missing information and identifying moments of greater difficulty small holder farmers had perceived during the trajectory. The description of those moments was for us a way to assess the sources of vulnerability of the system, from the smallholder farmer's point of view.

Three groups of variables were used to represent in a visual way the simplified trajectory of a given farm (Figure 1). The first group centers on work related variables such as availability and use of family labor on and off farm. The second group includes variables related to the use land and functioning of livestock system (farm size, area under different crops or land uses, size of the herd and levels of milk production). The third group consists of variables linked to capital and investments in the milk production system (products, credit and equipment).

After developing visual representation of the 24 individual trajectories, we analyzed and compared them one with another. We also took advantage of quantitative data from the milk cooperative about the monthly milk deliveries, the milk quality and prices paid to the smallholder farmers, which are available for most smallholder farmers from 2005 to the present.

Results and Discussions

The structural characteristics of the 24 small dairy production systems are diversified (Table 2). Different strategies can be observed among the 24 smallholder farmers with respect to increasing the size of their herd, and as a consequence, the pace at which they increase milk production over time. There is also a link between this latter and the use of specialized dairy breeds.

Table 2 – Diversity of 24 smallholder farmers in Unaí.

Small holder farmers	Years[1]	Surface (hectares)			Number of cows		Milk production (l/d)		
		Total	Cattle[2]	% Cattle[3]	Beginning[4]	Today[4]	Beginning	Today	
								Rainy[5]	Dry[6]
1A	4	7,5	6,0	80	4(4)	10(10)	25	100	90
1B	19	17,0	13,0	76	3(3)	23(12)	10	100	100
1C	25	5,0	3,5	70	2(2)	18(12)	4	110	110
1D	7	30,0	21,0	70	30(25)	42(34)	300	600	600
1E	5	33,0	32,0	97	30(20)	50(35)	250	650	550
1F	17	30,0	23,0	77	10(7)	50(38)	60	500	600
2A	10	29,0	19,0	65	10(10)	35(13)	70	250	90
2B	13	27,0	24,0	89	10(5)	15(10)	100	150	150
2C	10	27,0	23,0	85	3(3)	17(17)	45	350	200
2D	17	59,0	40,0	68	4(4)	42(34)	15	590	590
2E	9	57,0	39,5	69	2(2)	12(10)	16	150	150
2F	3	28,0	23,0	82	8(8)	24(20)	70	300	300
3A	10	17,0	12,0	70	5(2)	11(10)	10	95	80
3B	11	19,5	17,2	87	2(2)	17(11)	15	80	50
3C	15	28,0	27,0	96	3(2)	17(12)	10	200	110
3D	22	56,0	55,8	100	6(6)	18(14)	20	220	220
3E	8	30,0	26,5	88	7(5)	22(13)	18	230	230
3F	25	21,0	16,5	79	9(5)	20(18)	10	130	130
4A	10	22,0	21,2	100	8(2)	16(6)	15	60	30
4B	19	25,0	24,0	96	5(3)	10(8)	10	100	60
4C	14	17,0	16,5	97	6(4)	4(1)	20	16	16
4D	8	24,0	6,2	26	1(1)	6(5)	9	60	30
4E	43	26,0	16,5	63	2(2)	15(13)	8	70	70
4F	34	63,0	38,0	60	2(1)	24(13)	5	200	140

1 – Number of years since installation on the current farm.
2 – Hectares used for livestock production.
3 – Percentage of the farm area dedicated to dairy production.
4 – Total number of cows (number of lactating cows)
5 – Rainy season (usually between October and March).
6 – Dry season (usually between April and September).

The proportion of the farm area dedicated to milk production does not have much relation with the amount of milk produced (Table 1 and 2). This is because smallholder farmers use different strategies for feeding their herd during the dry season, when feeding is a major constraint. While every farm surveyed use pasture during the rainy season, during the dry season, some smallholder farmers rely on sugar cane while others rely on silage of maize or sorghum.

The feeding strategy during the dry season depends on the availability of workforce and on the size of the herd to be fed in the dry season, as well as on the financial resources available to covers the cost of making silage. The advantage of the silage is that it has high protein content and it is easy to distribute to the cows to compensate for the lack of grass. The disadvantage is the high cost required for its preparation over a very short period, especially for those (the vast majority) who need to hire silage equipment or tractors. For its part, the use of the sugar cane is much cheaper than silage, but requires much labor for cutting, milling and distributing to the cows. The diversity of those feeding practices during the dry season can be the relied to speed of increase of the herd size, in relationship with the availability of workforce in the farm as far as level of equipment.

The sources of vulnerabilities identified by smallholder farmers during the second interviews (Table 3) are also diverse: they related to factors linked to the family, to the initial installation on the farm and also to the gradual structuring of the production system. At the time of installation, the vulnerability of the system is due mainly to the lack of everything, and the organizing of the priorities for the temporal structuring of the production system, as many structural elements are missing. For example, smallholder farmers invest heavily in terms of labor to create or improve pastures, but they also have to sell their workforce off farm to compensate for the limited income they can generate through milking a few cows which they may have difficulties in feeding. This same dilemma applies to the following stages, during which smallholder farmers try to structure their system step by step, until a "threshold" corresponding to a whole system from a qualitative point of view is reached, even if the quantitative objectives in terms of levels of milk production are not yet reached.

Table 3 – Sources of vulnerabilities identified by smallholder farmers, as related to installation, structuring of their production system and family.

Groups	Sources of vunerabilities
Establishment of the system of production	Lack of physical infrastructure for the family and the flock
	Sale of workforce
	Lack of water for the flock
	Lack of financial resources
	Loss (death) of cows
	Lack of workforce
	Lack of monthly income
Structuring of the system of production	Lack of technical assistance and equipment (such as tractor, milk tank…)
	Insolvency
	Lack of water for the flock
	Reduction in milk production during the dry season
	Difficulty to engage workforce
	Investment in the purchase of land
	Low prices of milk low and high prices of inputs
	Difficulty for repayment of loans
	Lack of resources and machines for formation of pasture
Family	Sickness of the husband
	Sickness of the wife
	Lack of water for family (for washing, cooking)

Figure 2 represents the monthly milk production over the period January 2005 (or January 2006) to today for 2 contrasted farms. In each case, it was used as a didactic resource to discuss with the farmers the evolution of their milk production. For farm 1D, there are two distinct periods according to the milk production: (1) from January 2005 to May 2008, with a low and rather steady monthly milk production around 6 000 liters per month (200 l/day); and (2) from May 2008 until now, with high but very oscillating monthly production around 15 000 liters per month (500 l/day). For farm 2D, the evolution of milk production is less drastic, with an increase in production from 2010, which coincided with the purchase of 10 specialized dairy cows.

Overlapping Figure 2 with the trajectory of the system of production described in Figure 1 shows that the increase of the herd size and of the area under pastures explains well the evolution of the milk production.

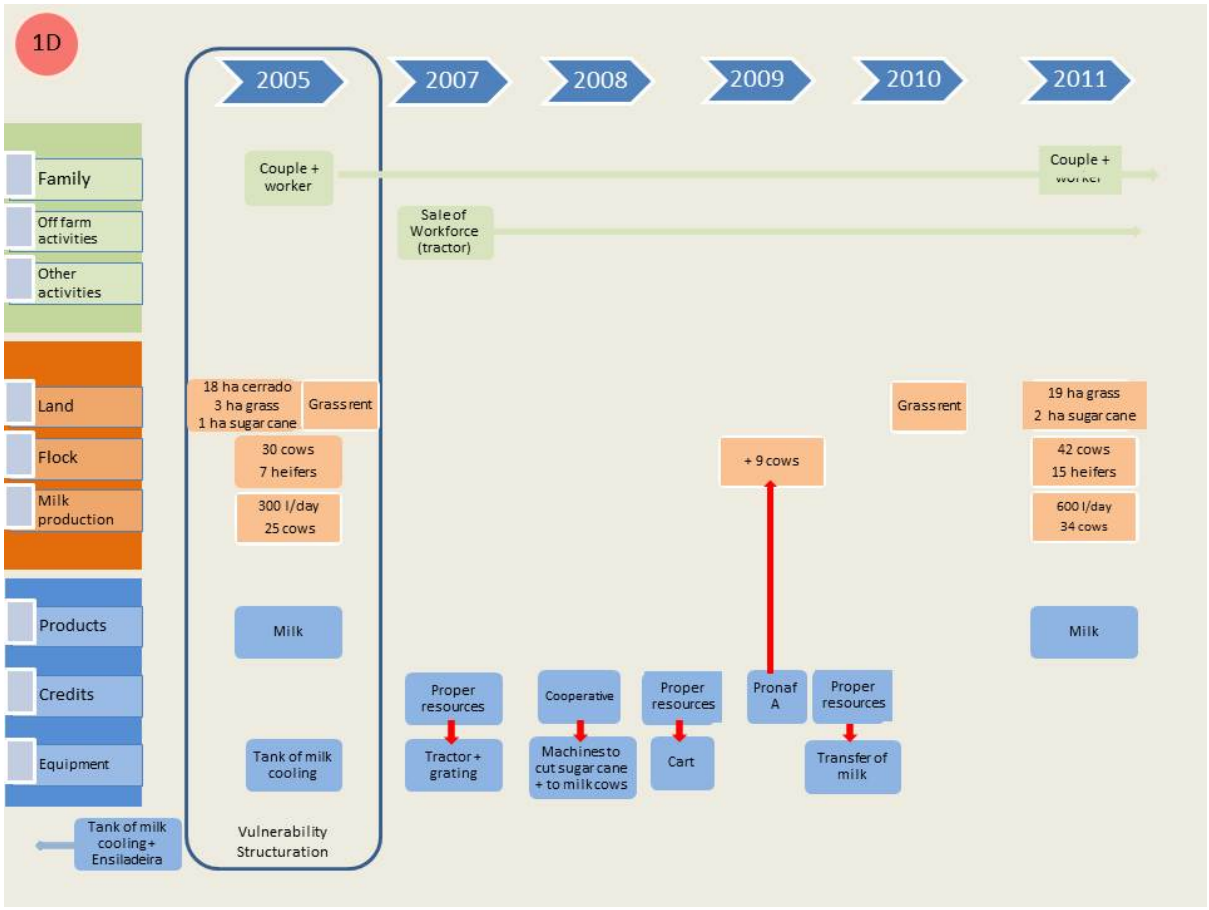

Figure 1 – Representation of the trajectory of the production system for farm 1D, since the moment of its installation in 2005.

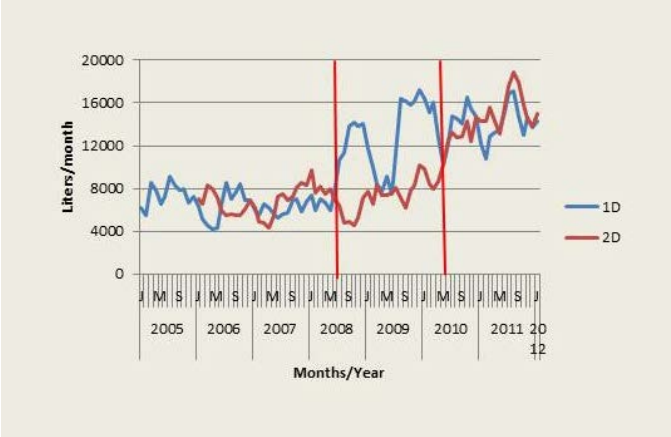

Figure 2 - Milk production of small holder farmers 1D and 2D, since 2005.

Sources of vulnerability for Farm 1D include the current quality of the pastures given the size of their herd. However, sugar cane can be used when the amount of silage is not sufficient. Another source of vulnerability corresponds to two periods of drought (October 2007 and January - February 2011), which coincided with a decline of the milk production. This same factor applies to farm 2D.

Conclusions and perspectives

Our study shows that smallholder farmers in the Unaí district have been developing their dairy production systems starting with contrasted states of the production structure and levels of production at the time of their installation. In a majority of cases however, the first steps in building up a dairy production system are to increase the herd size, increase the area under pastures and improve pasture quality. Changes in land use mostly aim at improving cows' feeding during the dry season. These developments are crucial to ensure an attractive level of milk sold – for the smallholder farmer and the cooperative – and with a relative regularity over the year. Acquiring specialized milking equipment and improving the genetics of the herd seem to be a second fundamental step, but in relation with family workforce or capacity to employ workers.

Over the years smallholder farmers faced several difficulties which can be considered as sources of vulnerability for the production system: they include trade-offs in the use of the workforce, challenges in accessing credits, or difficulties in feeding their herd during droughts. Despite those difficulties however, they moved forward, and almost all the 24 smallholder farmers interviewed wish to keep increasing their milk production and become even more specialized.

The next step of the study is to confront our interpretation on what are both the causes and the solutions for the different sources of vulnerabilities that we identified, as well as the relation between speed of changes, specialization and emergence of vulnerability. We then aim to validate, in a conceptual modeling approach, different pathways to build small dairy systems. This will allow us to assess the best ways of minimizing the risk of vulnerability throughout the trajectory by taking into account specific situations (workforce, status of the system when an unexpected event occurs, among others). We also intend to discuss our results within focus groups made of the 24 smallholder farmers involved in the study, as well as with the technicians of the local cooperative and other smallholder dairy farmers, not included in our sample.

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