

Do political changes regarding livestock farming, beef supply chain and Amazonian forest protection, contribute to ecological intensification?

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Keywords: livestock farming; local alternatives; ecological intensification; political support; Brazilian Amazon.

Abstract

Since 2008, Amazonian agriculture has been faced with radical changes in Brazilian policies regarding agricultural land use and the preservation of forest areas. The viability of livestock systems is threatened, revealing the emergency for technical, organizational and social alternatives which could bring about a sustainable development of agriculture in this region. Alternatives are experimented by public extension services and private operators in order to find an outcome. In this context, how do these alternatives contribute to put into debate what is ecological intensification? Ecological intensification, defined as an ecologically friendly agricultural development, is envisioned as a possible way to conciliate the existence of the beef supply chain and the protection of forest ecosystems in this region. Taking the examples of three municipalities of the Pará State, the authors analyze the points of view of different categories of actors involved in livestock farming and beef supply chain. The results show that the alternatives often deal with classical ways of intensification, which are hardly affordable to small farmers, and put forward other kinds of ecological risks and damages.

Introduction

In Brazilian Amazon, development is emblematic of the current issues facing agriculture worldwide regarding the reconciliation between production goals and environmental conservation. Indeed, population projections for the coming decades show that we'll have to produce more food - and share it better - while reducing negative impacts on the environment and producing environmental services (Hubert et al., 2010). Searching for ways of intensifying agricultural production systems that are more sustainable is then at stake. Part of the scientific community calls this trend "ecological intensification", but the conceptual and operational meanings are very different according to the authors (Doré et al., 2011). The Amazon region is a "hot spot" of biodiversity and its conservation is considered essential for the control of greenhouse gas. But at the same time, economic growth in Brazil is mainly due to agricultural production and exports. Since 2003, the country is the world's largest exporter of beef meat. Currently, nearly one third of the national herd is located in the Amazon region with 70 million head of cattle (IBGE, 2010). Livestock farming, jointly with the exploitation of timber and minerals, is an essential component of agricultural colonization in the Brazilian Amazon, and most of the time, ensure the maintenance

of many family farms in the region (Carvalho, 2011). Livestock farming systems is economically viable and profitable on agricultural frontiers, and as a matter of fact, one of the main drivers of deforestation (Poccard-Chapuis et al., 2005). But since 2008, a consortium of federal government administrations is coordinating to control and stop deforestation. A "black" list of municipalities where deforestation rates are the most important is annually edited, characterizing an area called "arc of fire"; creation of protected areas is accelerating; regularization of agricultural surfaces becomes obligatory for obtaining bank loans or for animal sales for slaughterhouses; application of labor law is strengthened. Facing strong policies and measures affecting all stakeholders involved in livestock farming systems and beef supply chain, ie much of the rural population of the region, alternative ways of producing and organizing production are urgently requested.

In order to help define the possible scenarios for agricultural intensification, and more precisely for livestock farming systems, the authors carried out a study in three contrasting municipalities in Amazon¹. A previous publication pointed out territorial dynamics in relation with livestock farming and beef supply chain (Vaz et al., to appear); the present paper focuses on the alternatives pointed out to develop livestock farming without deforesting. The first part explains the role of public policies concerning livestock farming and the colonization of the Amazon, and how the transformations required for this activity can be contemplated through the idea of ecological intensification. In a second part, we present the three municipalities of the study and the multidisciplinary methodology employed. Then we show the results and discuss them regarding the meanings of ecological intensification.

1. Meeting production and conservation: the case of Brazilian Amazon

1.1. The role of cattle in the economical development of Amazonian region

Various authors have shown that livestock production fulfills several functions aiming at stabilize the economy on the agricultural frontiers (Poccard et al., 2005; Tourrand et al, 2002). We refer in particular to providing a secure income; building up riskless savings for any investment; valorize areas with low fertility; occupying the land and mark the property (Vaz et al., to appear).

Thus, livestock production for meat was one of the driving forces in the advance and consolidation of agricultural colonization, from its beginnings in the 50s. Being a federal objective, with the creation of trans-Amazonian roads and the city of Brasilia in 1960, the agricultural colonization has nevertheless been poorly planned. Until recently, land was not a limiting factor for extensive livestock production practices (0.8 Animal unit / ha), based on the regular cutting of forest areas, and *slash and burn*, in order to implement and fertilize pasture, as well as to control weeds. Moreover, the lack of federal and local administration's actions - to apply law as well as to ensure the basic services such as hospitals, schools etc. - encouraged *slash and burn* beyond the legal proportion of 20 to 50% of the farm's area. Indeed until 2008, 50% of the farm's land had to be cut off to legitimate the appropriation. The rest, called the legal reserve, had to be preserved as primary forest area without being explored. In 2008, the proportion of legal reserve passed from 50% to 80% of the farm's area in the legal Amazon. At the same time, the federal government created the CAR (environmental land register) to regularize the situation or at least to have an initial state of land use. Without this CAR, livestock farmers can no longer sell animals to slaughterhouses nor contract bank loans. In parallel, a consortium of federal agencies operate a strong and repressive command and control policy. Livestock farmers, from big ones to small, are placed in a situation of deadlock. How can these stakeholders, who represent the majority of the

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Research project MOUVE ANR-10-STRA-0005

rural population, change their practices quickly, profoundly, and in a sustainable way? Are the existing alternatives contributing to precise the debate on ecological intensification?

1.2. Renovating the links between livestock and forest: toward ecological intensification?

The history of agriculture in temperate regions shows two periods marked by profound changes in techniques that occurred in order to increase production volumes - per unit area, animal, or work - and that were necessitated by a significant population increase. The first one deals with reducing fallow periods and replacing them with artificial grassland (XVI and XIX c.). In a second step, the industrial revolution has enabled the development of mechanization and use of mineral fertilizers in agriculture (Mazoyer and Roudard, 1997). The second period marked the beginning of genetic selection practices, regional specialization and supply chains, and the "rationalization" of production (Vissac, 2002). Nowadays, some researchers in agronomy put forward the concept of ecological intensification as a desirable way to transform agriculture. But the concept embraces a diversity of meanings (Doré et al, 2011), ranging from a declination of Organic Agriculture referring to Agroecology (Altieri, 2002), to a new way of producing that takes more advantage of the functioning of ecosystems in order to furnish ecosystem services, such as soil conservation or water filtration (Hubert et al, 2010). The most flexible meaning refers to the objective of increasing production yields while minimizing negative impacts on the environment (Cassman, 1999). Overall, the operational aspects of ecological intensification movement are still largely unknown and are the subject of current researches (e.g. MOUVE project).

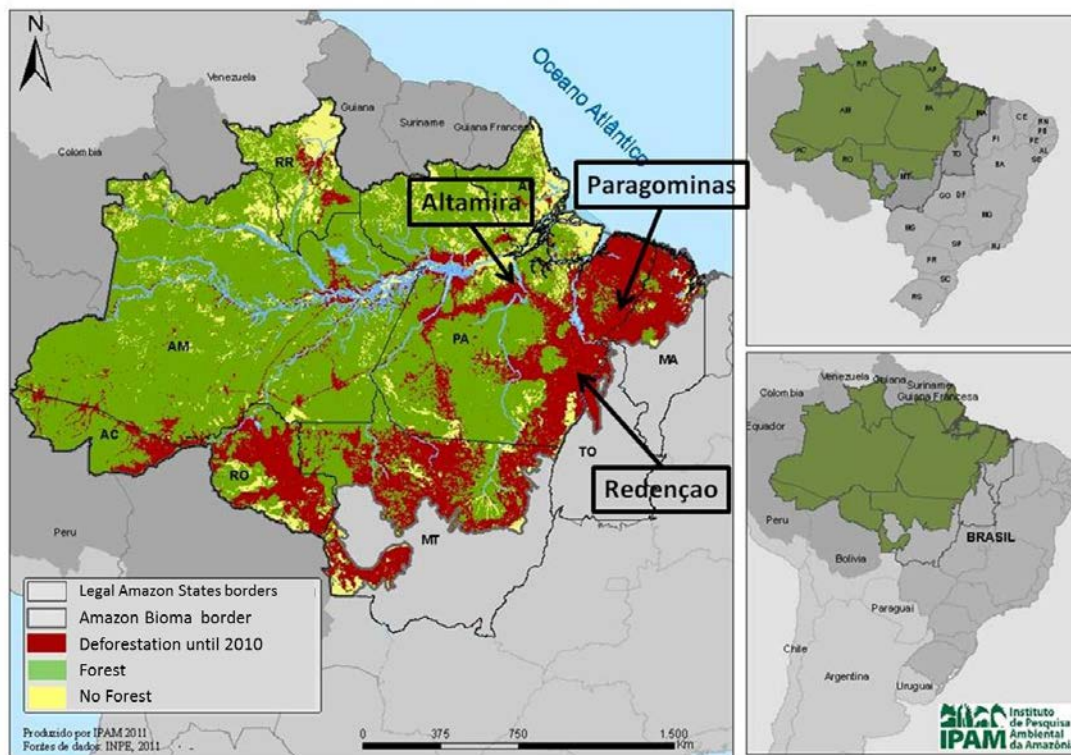


Figure 1: Deforestation until 2010 in Legal Brazilian Amazon (source: IPAM, 2011)

The Amazon represents an exemplary case of what could be a movement towards ecological intensification: to shift from a dominant model of ranching or mining (exploitation of the forest), to

an intensive model which preserves the forest ecosystem. We seek to understand how, in practice, this movement can emerge or has already started and what kinds of alternatives are put forward by the actors themselves in order to find out an income.

2. Method: a comprehensive approach of local dynamics

The choice of contrasted municipalities within the same region allows taking into account local specificity of livestock production's dynamics and global events, in our case the federal public policies aimed at stopping deforestation. We therefore chose three municipalities, Altamira, Redenção and Paragominas, located in the State of Pará in different places on the agricultural frontier (Figure 1). Table 1 shows the rate of deforestation and the number of cattle in the three municipalities, and in a few neighboring municipalities that are under their influence. Indeed, Redenção is now a predominantly urban municipality (and very small area). In contrast Altamira is still rural, although the urban area is growing fast. Almost ten times Paragominas' area, Altamira is the largest municipality in Brazil, and its area is about one third of the French territory. Altamira represents an illustration of the Integrated Plan of Colonization with distribution of 100 ha pieces of land and a few of 500 ha, unlike in the two other municipalities which counts with huge farms of thousands ha. Country planning has never been achieved and has let the region in an isolated situation. Low deforestation rate for Altamira (4%) is due to the total area of the municipality. However, deforestation's rate in neighboring municipalities does not exceed 40% of the land; number of cattle is very important, of half a million heads. In the region of Redenção, the deforestation's rate of most municipalities is far above the 20% imposed by the Forest law and the 50% allowed (between 60 and 80% for the given examples). Reported to the deforested area, cattle density is close to the average animal unit per hectare found in the region. This shows the specialization in cattle (Poccard-Chapuis, 2004). In the region of Paragominas, deforestation is advanced too, but does not exceed, or little, the 50% allowed in the state of Pará (between 44% and 65%, cf. Table 1). The low cattle density per unit of land points out a diversification in land use (crops and forestry).

Table 1: Forest area and livestock in the three study areas

Municipality	Total area (km ²)	Deforested area (%)	Deforestation per year (%)	Cattle (2010)	Cattle density (nb/ha deforested)
Paragominas	19452	44.2	0.35	315720	0.37
Rondon do Pará	8286	65.4	0.64	349871	0.65
Tome Açu	5168	56.9	0.71	116021	0.39
Redenção	3830	69.4	1.1	204296	0.77
Santana de Araguaí	11607	60.9	0.35	545523	0.77
Cumaru do Norte	17106	41.12	0.25	638983	0.91
Rio Maria	4123	81.66	0.1	299016	0.89
Altamira	159701	4.27	0.12	555324	0.81
Brasil Novo	6370	39.73	0.79	206099	0.81
Medicilândia	8271	23.5	0.57	103939	0.53

Source : INPE – PRODES – IBGE, 2010

A multidisciplinary team of researcher composed of agronomists and livestock science researchers, geographers, and historians disciplines, interviewed a diversity of key informants

belonging to "critical" groups of stakeholders involved in livestock farming. These critical groups are: 1) medium and large farmers, named as "rural producers"; 2) family farmers (less than 220 ha in Paragominas, 300 ha in Altamira and Redençao); 3) supply chain actors (traders, slaughterhouses etc.); 4) associations of producers, cooperatives, unions; 5) federal government and territorial administration (including technical assistance); 6) banks of the rural sector; 7) NGOs and service providers involved in livestock farming. The same interview was conducted for all people in the different groups of stakeholders: the technique of redundancy and triangulation (Copans, 1999) was used to determine the total number of surveys (between 12 and 15 per locality).

The methodology used was to conduct open interviews aiming at gathering information on five general questions formulated apart by the group of researchers. These five questions are: 1) What were the steps in the interactions between livestock farming development and country planning? 2) What functions livestock farming assumes in the territory? 3) What are the new technologies or changes in livestock systems in use, which correspond to an intensification of production? 4) What factors promote or impede the intensification of livestock production? 5) What are the scenarios for the development of livestock farming in the territory?

A total of 41 interviews have been conducted in the three municipalities, between June and September 2011. The data were compiled by all team members at the end of the interviews and at the final of interviews sessions, in two forms: i) a report for each interview; ii) a synthetic document for each municipality. These data were then analyzed collectively by the team during workshops in order to publish the results.

3. Alternatives to deforestation tested by local stakeholders: nature and scale of action

In the three study areas, all categories of stakeholders interviewed agree that livestock farming can no longer rely on the opening of new spaces; the message "zero deforestation" is now accepted by all, even if it will take time to change mentalities. To ensure a future in the Amazonian region, livestock farming has to change profoundly, at the technical level as well as at the organizational level on the farm scale, within the supply chain and the territory. Although all stakeholders point out the lack of research, training, technical and institutional support, some alternatives are regularly cited as enabling the transformation required for livestock farming.

We classified the alternatives in three categories, depending on their nature and the scale of actions that are concerned.

Conventional and punctual alternatives to increase livestock productivity

These alternatives are conventional and take place at the plot or the animal scale; they deal with the level of production system.

The animal scale: it deals with classical genetics which seeks to increase the carcass weight or milk-production potential within specialized breeds.

The pasture scale : it deals with technical renewal of pasture including soil preparation and sowing, which are mostly based on grass *Brachiaria bryzantha*, although this cultivar faces serious and recurrent problems of pests, as mentioned in the interviews.

These alternatives are all based on an increased use of chemical inputs and equipments to improved biomass production and weed control.

Alternatives to increase overall farm viability and efficiency

These alternatives occur at the farm scale or a group of farms, and affect the organizational level of the system of activities. They refer to different forms of farm diversification, from intermediate crops entering the livestock system feeding to activities relatively disconnected, and deal with varying degrees of forest ecosystem or natural resources' uses.

iLPP (AIEF) : Technical and organizational, that alternative integrates the management of crops, livestock and forestry. *iLPP* is a Brazilian research program involving various laboratories and universities (Santos et al., 2010); When maize is the main crop, it can be harvested as grain or silage. This ultimate case corresponds to an intensification of cattle feeding system that allows the improvement of quality and availability of food (especially in the dry season). This technique is particularly important in dairy production, because it can enhance and stabilize the volumes produced. The *iLPP* also allows pastures renewing by introducing an annual crop for the production of grain or silage, and the introduction or maintenance of economic trees in pastures to provide shading etc. This package aims at increasing land productivity (fertility, cash crops) and animal productivity (feeding system).

Balde Cheio (full bucket) is a support program to the intensification of dairy production systems, which acts mainly through the improvement of animal genetics and the cattle feeding system. Thus, the two most cited focuses of the project *Balde cheio* are a combination of the two conventional axes of productivity improvement: herd genetics and hygiene rules for milking; pasture productivity with the introduction of daily rotational grazing. For the latter, the use of chemical fertilizers and equipments to cut off the clumps of grass unconsumed is commonly recommended. The implementation of the alternative *Balde cheio* among producers is generally accompanied by an annual technical and economic diagnosis of the farm as far as economic viability of small farms (ten hectares) is at stake. Reconstruction of forest legal reserves and protected areas is also part of the project objectives (Camargo et al., 2006).

Agro-forestry systems (AFS): This alternative integrates a diversity of economical farming activities taking advantage of various tree species (cocoa, theca, pepper...) combined with livestock production, which remains the major activity in agricultural production systems in this part of Amazon. These systems are cited most of the time by small producers or technical assistance and administrative institutions that are dedicated to family farming. AFS is conceived as an opportunity to increase the global farm income and to take advantage the forest ecosystem. Indeed, the species used could enter the species authorized to reconstruct the degraded or protected forest areas, depending on the current negotiations on the Brazilian Forest Law.

Alternatives between stakeholders to increase supply chain or territory's efficiency

Certification is a quality initiative from the industry to ensure a "green" image to the product (eg. slaughterhouses in Redenção, Paragominas and Altamira). This alternative set various key actions according to supply chain's specifications, which are a combination of the previous alternatives. In the case of livestock, aspects considered are: i) Compliance with environmental certification on the use of the farm land (CAR); ii) improvement of carcasses' weight (genetic); iii) cattle feeding system through the introduction of fodder for dry periods and for fattening; and iv) through the improvement of rangeland management.

Green Municipality: Paragominas as a proactive, dynamic agricultural region.

The experience called "*Green Municipality*" is a local initiative to support current agricultural dynamics. The initiative consisted of co-ordinating actions of local institutions, especially municipal secretaries for agriculture and for the environment, the livestock farmers and their unions, and an international NGO, TNC (the Nature Conservancy) which has been contracted in

order to implement the Environmental Certification (CAR) of the farms over 300 ha (excluding family farming).

Technically, the initiative consists of implementing the *iLPFs* by combining the actions at three scales, i.e. the plot / animal, the farm and the municipal territory (Vaz et al., to appear). At the territory scale, farms, which are mostly very large, organize themselves spatially, in order to specialize in livestock farming, crops or forestry. The introduction of *iLPFs* takes place according to the potential of soils for crop production, which relegates livestock production systems in areas of low agronomical potential. This alternative is concentrated near roads to facilitate storage and transportation of grain. This last aspect puts into questions the feasibility of *iLPFs* in remote areas such as Redenção or Altamira. *Agro-ecology* refers more to a movement for small farms' autonomy, on the basis of organic agriculture and principles that are: i) poverty alleviation; ii) food security and self-reliance, iii) ecological management of productive resources, iv) empowerment of rural communities; v) establishment of supportive policies (Altieri, 2002). *Agro-ecology* is actually mentioned only by the technical assistance institutions and supported by local NGOs in Altamira. Indeed, the strong isolation of the area has marked the population thinking and the territorial dynamics in a favorable way for autonomous agricultural models. This alternative is not really collectively implemented and is mainly viewed as a desirable agricultural shift for the future of family farms.

Finally, the description of these alternatives shows that the main concern of all stakeholders related to livestock farming focuses primarily on intensification, i.e. increasing the productivity per unit area or animal (a little concerning workload in the case of milk production). Stakeholders appear very little concerned about ecological aspect actually, the forest's area preservation excepted.

4. Discussion: how these alternatives refer to the ecological intensification concepts?

At the plot or animal scale, there is no control or enhancement of ecological processes; alternatives are standard, without taking into account family farms difficulties in terms of knowledge required for the use of chemical products, economic viability and the consequences on work load. In the Brazilian literature, experimental organic alternatives for pasture management are conducted, but there were not cited during the interviews. Is there a problem of access to information? Are research advances strong enough to be promulgated?

At the farm level, alternatives show different relation with ecological processes or use of forest ecosystems. Within *iLPF*, techniques mentioned are not always inspired by ecological processes (use of chemical inputs, conventional techniques). But it increases the diversity of crops and land use as much as the time of rotations (annual for crops, multi-year for pasture and trees). It also uses technique of conservation agriculture in order to manage soil fertility and to protect it. Alternative *Balde cheio* uses conventional techniques with chemical inputs and equipments; research programs in organic production are in progress, but are not known by the stakeholders. Agroforestry systems include activities that are related to the use of the forest ecosystem, but it does not guide technical alternatives for the livestock system in the farm. Moreover, development of agroforestry puts into question family work load and market opportunities that have difficulties to emerge in remote areas (Carvalho, 2011).

At the territory or supply chain level, the focus of the alternatives is to provide a collective picture of a livestock activity which preserves the forest ecosystem by respecting the law. Initiatives then rely on alternatives based on conventional techniques which little build on ecosystems functioning. Thus, in general, most alternatives are rather in the spirit of the lightest meaning on

what ecological intensification can be. That is to say most of the time, the objective remain on limiting the negative impacts on the environment. Very few alternatives, such as direct seeding, which may itself be an element of *iLPF*, partly use natural ecosystem processes to improve production efficiency. The alternatives mentioned by the stakeholders which are more in line with a better integration between production and preservation of the ecosystem, are agro-forestry systems and agro-ecology. For some stakeholders, the latter corresponds more to a vision of agriculture on the territory than a concrete shift in the farms (apart relatively isolated experiences).

Conclusion

Amazonian colonization was allowed by the development of very extensive cattle on rangelands after deforestation. Today, this model of agriculture is challenged by various sources of pressure (government, supply chains etc.) which converge towards the principle of "zero deforestation". It is urgent, for livestock farmers and local stakeholders in relation with meat supply chain, to change their practices and in particular to increase the productivity of their production system. The paths to livestock intensification they envision seem to correspond mostly to classical techniques to increase productivity, coined during the "green revolution". However, we witness a rediscovery of the value of crop rotation, management of soil fertility thanks to the fallow and pastures, the diversification and the relative autonomy of farms, the ecological and economical role of traditional systems such as agro-forestry. Public policies achieved in changing mentalities respecting deforestation, but are still inefficient in order to stimulate new livestock practices. Even in this region where both agricultural development and forest conservation are very sensitive issues, the links between intensification and ecology, between livestock and forest, are still to be constructed.

References

- Altieri, M. (2002) Agro-ecology: the science of natural resource management for poor farmers in marginal environments *Agriculture, Ecosystems and Environment* 93: 1–24
- Camargo A. C. De, Noaves, N. J., Novo, A. L. N., et al. (2006) Projeto Balde Cheio: Transferência de tecnologia na produção leiteira. Embrapa : Comunicado Técnico, 73.
- Carvalho, S. (2011) Entre opportunisme et persistance. Quelles dynamiques et perspectives d'évolution pour les exploitations laitières familiales de la Transamazonienne ? Th: AgroParisTech, Paris.
- Cassman, K.G. (1999) Ecological intensification of cereal production systems: yield potential, soil quality and precision agriculture. *Proc. Natl. Acad. Sci. U.S.A.* 96, 5952–5959.
- Copans, J. (1999) L'enquête ethnologique de terrain : l'enquête et ses méthodes. Paris, Armand Colin (128)
- Doré, T., Makowski, D., Malézieux, E., Munier-Jolain, N., Tchamitchian, M., Tittonell, P. (2011). Facing up the paradigm of ecological intensification in agronomy: revisiting methods, concepts and knowledge. *European Journal of Agronomy*, 34: 197-210.
- Hubert, B., Rosegrant. M., van Boekel, M.A.J.S., Ortiz, R., (2010) The future of food: scenarios for 2050. *Crop Science*, 50: 33–50.
- Mazoyer M., Roudard, F. (1997) Histoire des agricultures du monde. Paris : Seuil.

- Poccard-Chapuis (2004) Les réseaux de la conquête. Filière bovine et structuration de l'espace sur les fronts pionniers d'Amazonie orientale brésilienne. Th : U. Paris X-Nanterre, Paris.
- Poccard-Chapuis, Thales, M., Venturieri, A., Piketty, M.-G., Merte,s; B. Veiga, J.B. da, Tourrand, J.-F. (2005) La filière viande : un levier pour contrôler les dynamiques pionnières en Amazonie brésilienne ? Cahiers Agricultures, 14 (1) : 53-58
- Santos, L.D.T, Sales, N. De L.P., Duarte, E. R., Oliveira, F. L. R. De, Mendes L. R. (orgs) (2010). Integração Lavoura-Pecuária-Floresta: alternativa para produção sustentável nos trópicos. Montes Claros : Instituto de Ciências Agrarias da U. Federal de Minas Gerais.
- Tourrand J.-F., Piketty, M.G., Oliveira, J.R.D., et al. (2002) Elevage bovin, déforestation et développement régional : le cas du Sud du Pará, Amazonie brésilienne. Bois et Forêts des Tropiques, 280 : 5-16.
- Vaz, V., Carvalho S., A. De, Barnosa, T., Thales, M. C., Mourão, M., Cialdella, N., Poccard-Chapuis, R., Tourrand, J.-F. A pecuária na agenda ambiental da Amazônia brasileira: percepções e representações dos atores locais. Redes Rurais (to appear).
- Vissac, B. (2002) Les vaches de la république. Paris : INRA Editions.