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Introduction

1 This study examines how ranchers of the Pantanal in western Brazil became interested in alternative beef production systems and considers the environmental, economic and social potentialities and constraints encountered in adopting this new productive system in a wetlands setting. Alternative stocking-raising is exceptional in Brazil, where cattle ranching is increasingly dominated by conventional beef agribusiness and organic and agro-ecological rural activities are usually employed by small holders producing fruit and vegetables. Even if restricted to a small number of ranchers in the Pantanal, this study of beef production using agro-ecological methods provides a useful example of sustainable cattle raising appropriate for the large holders of this ecologically important biome.

2 The objective of the research undertaken in the Pantanal was to understand: 1) the process of technical innovation and the building of new alternative stock-raising networks in a region dominated by conventional large-scale agribusiness and 2) to determine if agro-ecological stock raising is viable and represents a transition to sustainable food systems which promote environmental conservation, produce quality food and improve rural livelihoods. Does agro-ecological cattle ranching actually attain the main goals of sustainability in the nexus of production, environmental

conservation, quality food for consumers and health and quality of life for working families?

3 The research was undertaken in the Pantanal wetlands located in the state of Mato Grosso do Sul, an important farm state of the Central West Region. The Central West is the most important beef producing region in Brazil and supplies domestic and international markets. The region has two biomes: savanna on the Central Plateau and savanna and swamp vegetation in the Pantanal floodplain depression[1]. Over the last three decades agribusiness expanded on the plateau where it encountered ideal conditions for the production of commodities using ultra-productivist methods. This was not so common in the Pantanal where extensive areas of permanent swamp and seasonal wetlands predominate.

4 For centuries the adverse environmental conditions for most agricultural activities in the Pantanal has limited land use to extensive cattle ranching practiced in a less domesticated landscape. Human population density is low, less than one inhabitant per square kilometer in many places, and high diversity of fauna and flora still exists throughout the biome. This has made the Pantanal an object of ecological interest and a number of private and public conservation units have been set up over the last four decades, some of which have attained the status of World Heritage Sites[2]. Despite this, the biome is not well known outside Brazil and only made international news in 2019 when large-scale fires raged across parts of the biome[3].

5 Today the Pantanal occupies a marginal position in regional agribusiness and the rise of agro-ecological ranching represents a way of transforming and aggregating value to the historic extensive cattle raising methods by producing quality beef with regional identity of origin which highlights environmental conservation and traditional ranching culture. The historical system of cattle raising and current agro-ecological systems are intimately related to the annual cycle of seasonal floods and dry season availability of pasture which imprint a distinctive character to ranching activities. In this study relational theory and methods are used to understand the transition to agro-ecological stock-raising in process.

Theory and methods

6 Productivist conventional and post-productivist farming systems are usually treated separately. The first uses a structuralist political economy approach which emphasizes production-driven technical impositions that are forced on distant urban consumers and the second uses a cultural framework which focuses on how consumer demand for food free of agrichemicals and for benign ecological and social impacts at the site of production drives technical change in a sustainable direction. Against this bifurcated way of investigating food systems Goodman *et al.* (2011) and Marsden and Morely (2014) advocate a relational approach which bridges the two and permits understanding how transitions from one system to another occur. These authors identify the proliferation of alternative food networks as one of the most vibrant trends in rural research today because these networks require theory and methods which transcend analytical binaries such as nature-society, urban-rural, conventional-alternative, production-consumption and private-public interests.

7 The agro-ecological stock-raising system which arose over the last twenty years in the Pantanal wetlands of western Brazil presents such a case which can only be properly

understood with a relational network approach in which economic and social elements are intimately interwoven with natural resources and the local environment. A structuralist approach would only focus on technical relations for comparing traditional extensive stock raising, modern intensified conventional beef production and organic beef production. This kind of analysis could yield interesting economic insight into how some ranchers changed to alternative systems in order to supply a market for organic beef. A culturalist approach, which highlights the influence of reflexive consumer demand and the regulatory power of corporate processors and retailers, on the other hand, would evaluate how the rise of a market for quality and chemical-free meat influenced ranching methods of the Pantanal.

8 The relational approach used in this study goes beyond factors of change in productive system and markets to also embrace judgment of values and quality of food, local environments and social behaviour entangled in actor networks. Such an approach to alternative food networks focuses on production-consumption interaction and 'foodscape' rather than 'system' and 'regime'. This permits a more complex understanding of the entire process, involving a chain of actors spanning the ranchers located far away from the consumer markets and the various marketing, research, farm extension, input suppliers, meat processing firms and political agents located in between (Goodman *et al.*, 2011; Marsden, Morely, 2014; Morgan *et al.*, 2006). In Latour's (2013) way of expressing it: all of the actors in a chain of relations must be investigated, no more, no less. This includes non-human actors as well, which in our case would include domestic and wild animals, plants, insects, floods, swamp, dry land, etc. For example, agro-ecological concerns with farm animal welfare and conservation of wildlife are best interpreted in a hybrid light whereby relational authors like Descola (2013), Latour (2013) and Whatmore (2002) would consider them to be actors in their own right in order to overcome the artificial separation of nature from human society.

9 Sustainable food systems often use separate marketing networks/chains situated parallel to productivist agribusiness marketing chains that supply large volumes of mass produced, ultra-processed food for global markets. Agro-ecological systems by contrast stand in opposition to large-scale agribusiness production of cheap foodstuffs using conventional farming systems that cause environmental degradation, health risks to workers and consumers. Productivist systems also concentrate income, consolidate different links of the marketing chain and accumulate political power to the point of taking command of national food policy (Schutter, 2018).

10 Sustainable food systems go back to the basic objective of agriculture, namely the production of food involving the sustainable use of natural resources in the planning and management of the efficient use of land and water in such a way as to integrate environmental and socio-economic services (FAO, 2007, 2014). Integrating environmental and socio-economic services guarantees standards of sustainable production and consumption and achieves food security, improved nutrition and promotes sustainable agriculture, basic objectives of Agenda 2030 (United Nations, 2017). Different fields and research initiatives consider the transition to sustainable food systems to be one of the greatest challenges of the 21st Century (Frison, 2016; Ipes-Food, 2015; Marsden, Morley, 2014; Schutter, 2018). Alternative stock-raising in the Pantanal is one way of meeting the challenge of promoting sustainable food production in this case of meat.

11 According to Marsden and Morely (2014), attempts are being made to accommodate conventional agriculture to new agendas by reducing its ecological impacts. Discourse is offered about low carbon emissions and minimal use of agro-chemicals, which is achieved through the use of genetic biotechnology applied to plants and animals. This is merely rhetoric if current levels of synthetic input use continue to rise as well as practices that cause loss of soil and biodiversity and degrade water resources, exactly the basic natural resources necessary for agricultural production. Agroecological systems go beyond merely creating natural and economic capital in order to promote environmental conservation but are also concerned with social issues about meaningful work, quality food and dignified livelihoods for all actors in the food system.

Research procedures

12 One of the first research procedures for identifying alternative rural producers was to determine whether the ranchers studied followed organic or agro-ecological protocols which distinguish these systems from the conventional productivist methods used in agribusiness production of beef. Organic food production must obey norms and guidelines established by their country which usually follow recommendations made by international institutions such as the United Nations and the Food and Agriculture Organization as well as by national and international organic certification organizations.

13 Specific Brazilian legislation defines an 'organic system of cropping or stock raising as a farming system that uses specific methods that optimize the use of the natural and socio-economic resources available (...) with the objective of achieving ecological and economic sustainability and maximizing social benefits' (Brasil, law nº 10.831.2003, *translated here*). In Brazil, organic methods of cattle raising must follow norms established by the Ministry of Agriculture, which our study used to establish parameters for comparing and contrasting organic stock raisers with conventional beef production. The parameters concern animal nutrition, pasture management and modes of confinement, acquisition and selling steers, reproduction methods, veterinarian treatment and issues concerning animal wellbeing, all of which constitute the relational nexus between soil and water conservation and human and non-human welfare (Table 1).

14 Interviews, questionnaires and primary data collection in the research were conducted using these parameters and variables which organic ranchers have to follow and adapt to the socio-ecological conditions of the Pantanal wetlands. An assembly of partners from state and national research centres, extension and sanitary agencies and universities as well as from beef processing, marketing and animal pharmaceutical firms all contributed to creating the alternative methods and representatives were also interviewed.

Table 1. Selected requirements for organic beef production in Brazil*.

Normative Parameters	Variables for identifying and characterizing organic cattle raising		
Nutrition and watering	sufficient amount of native and organic planted pasture for the number of steers	supplements limited to organic fodders, hay and silage with natural fermentation	mineral supplements without contaminant residues; clean water without chemical and biological contamination
Range and confinement	free range pasturing with adequate space for grazing, animal sociability, free mobility, rest and reproduction functions	semi-intensive system respecting animal quality of life and no restrictions to normal animal movement	intensive systems prohibited as well as any method involving harnessing animals in place or in small stalls
Animal reproduction	natural method of animal reproduction as part of social life and well-being	artificial insemination can be used but with semen from animals raised under organic systems	embryo transfers and in vitro fertilization prohibited as well as any artificial hormonal induction
Veterinarian treatment	homeopathic treatment only, allopathic drugs may be used in extreme cases but not in a preventive manner	mandatory vaccines and other national sanitary requirements must be followed	electrical stimuli, allopathic tranquilizers and hormones prohibited
Acquisition and discharging steers	preference for acquiring animals from organic producers; animal life span at least 12 months under organic system	animals from conventional systems must remain separate during the period of conversion to organic stock raising	buying or discharging calves at an age when they no longer need their mother
Animal well-being	animal social life and instincts respected; painful and stressful transport and slaughter avoided	no mutilations such as horn removal, castration or branding	nose ring and any kind of mutilation not allowed

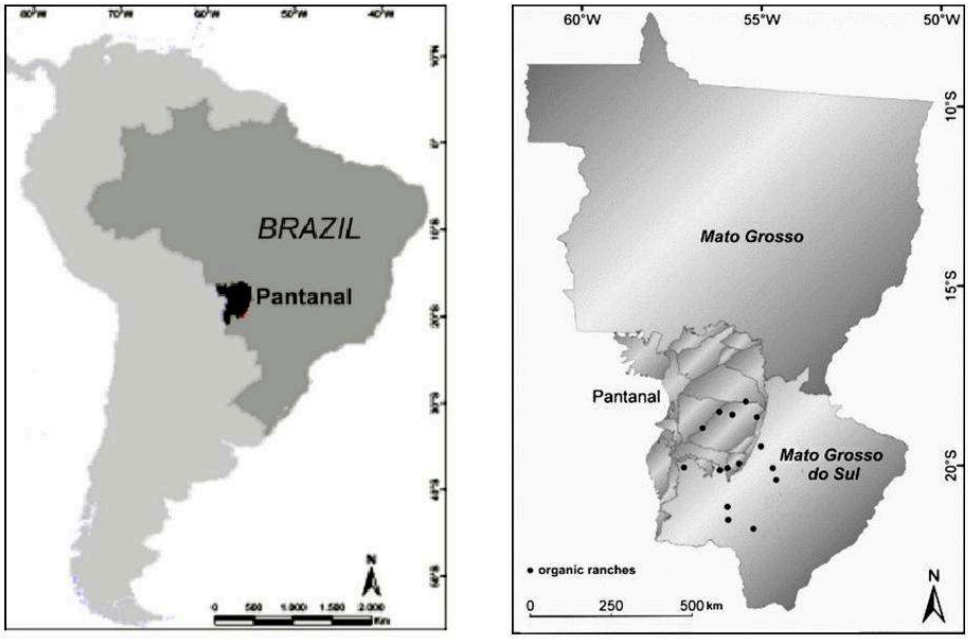
*Methods selected that are relevant for organic stock raising in the Pantanal.
Source of information: Brasil/MAPA (2008)

15 General information was obtained for the universe of the fifteen alternative ranchers who are members of the Brazilian Association of Organic Producers of the State of Mato Grosso do Sul (ABPO) and detailed questionnaires concerning the production system, personal motivations and the transition process were applied to the eight members who own ranches in the Pantanal (Figure 1). Even if fifteen alternative ranchers may seem to be a limited number of producers researched they have about 80,000 certified animals in agro-ecological systems and attain a commercial scale (ABPO, 2017b).

16 In order to compare and evaluate the new alternative cattle raising system to historic and ultra-productivist systems in the Pantanal results from previous research undertaken in the region since the early 2000s are reported when deemed appropriate (Araújo, Bicalho, 2010; Araújo *et al.*, 2014). This long period of undertaking research in the Pantanal permitted observing and accompanying the shift from one system to another as it happened in an incremental fashion.

17 The rise of an organic stock-raising system had its origin in the efforts of some ranchers who were searching for agro-ecological alternative methods in contraposition to the conventional intensive and semi-intensive cattle raising systems based on synthetic chemicals, preventative antibiotics and hormones. Ranchers were aware of the fact that the use of these inputs caused residual chemicals to accumulate in meat and from there be transmitted on to human consumers. Another motive for adopting agro-ecological methods was to avoid the environmental degradation caused by more intensive forms of stock raising. With these concerns in mind the ranchers contacted regional farm researchers and together with them began to build a network of organic beef producers in the Pantanal.

Figure 1. The Pantanal region and organic ranches studied.



Source: Authors elaboration

18 The creation of this system of stock raising represents one point in the link of an alternative network articulating human actors, in the form of the accumulated local knowledge of the ranchers over generations and the scientific knowledge of farm researchers, with non-human actors, in the form of their animals, different kinds of seasonal prairie and swamp subject to annual flooding. This represents a relational/hybrid approach to the Pantanal which does not separate nature from human society in the way that Descola (2013), Latour (2013) and Whatmore (2003) criticize. Other links of the agro-ecological assembly investigated are related to a chain of actors who articulate production and processing of beef to marketing chains and ultimately to consumers, so uniting production and consumption in the way discussed above with regard to Goodman *et al.* (2011), Marsden and Morely (2014) and Morgan *et al.* (2006).

19 To investigate the overall actor-network, interviews were undertaken with representatives of the Brazilian Association of Organic Producers of the state of Mato Grosso do Sul (ABPO), with managers and technicians of organic beef processing and commercial firms, with agronomists and veterinarians of the EMBRAPA Pantanal (a federal research institution working with cattle raising in the wetlands), with technicians representing private ranching technical support firms and with representatives of federal and state regulatory and inspection agencies, respectively the Ministry of Agriculture (MAPA) and the Animal and Food Sanitary Control Agency of Mato Grosso do Sul state (IAGRO/MS)[4].The objective was to obtain information concerning the active participation of these public and private institutions during all phases of the transition and specifically their active contribution in adapting and creating research, processing and marketing structures for a novel organic product in a potentially hostile encompassing region of ultra-productivist commodity agribusiness.

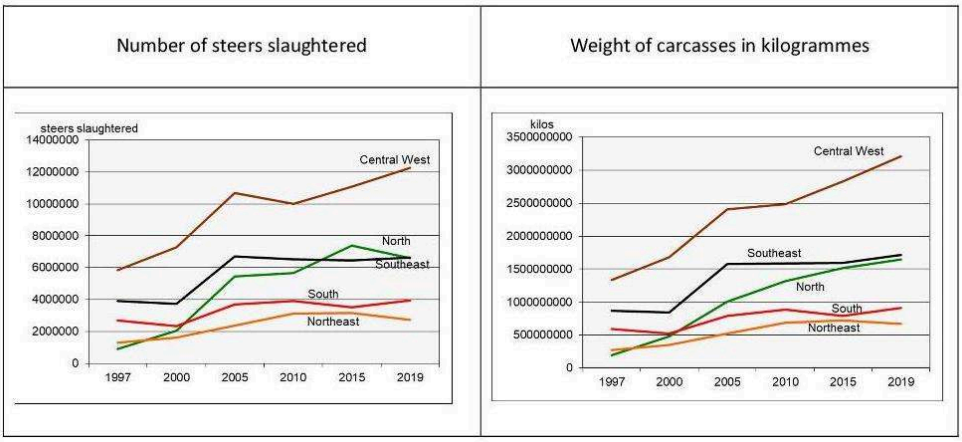
20 In the next section, our case is placed in the national context of beef production. Using secondary statistical data, the Pantanal is positioned within the Central West and the importance of this region within the overall Brazilian beef sector is highlighted. In the two sections that follow after that, in one, the alternative organic system is compared and contrasted to the productivist system and, in the other, the organic stock raising network of the Pantanal is presented in its complexity.

Brazilian beef production and global exports

21 With the phenomenal expansion of an agro-industrial complex on the Central Plateau of the Central West region, Brazil has become a major producer and global exporter of key farm commodities, especially soy and beef. Globally, this was part of a process in the late 20th Century whereby intensive productivism was relocated to the South and to newly industrialising countries like Brazil (Marsden, Morely, 2014).

22 Within Brazil from 1970 onward beef production shifted up country, initially advancing into the Central-West and from there into the North region. Between 1980 and 1985 the number of steers in the Central West became on par with the number in the South and the Southeast regions. Since then cattle raising in the Central West has surged to 35% of all cattle in the country by 2017. The expansion into the North region grew markedly in the 2000s to the point that 20% of all cattle were being raised there by 2017, particularly in the east of Pará state, an area of older settlement located in the Eastern Amazon. However, the Central West still dominates cattle production in Brazil and differently from other regions it is specialized in beef production. This region stands out in the number of slaughtered animals and meat produced in comparison to the other regions (Figure 2). The meat from the Central West supplies both domestic and export markets.

Figure 2. Brazilian beef production by region, 1997-2019.



Source of data: IBGE (1997-2019)

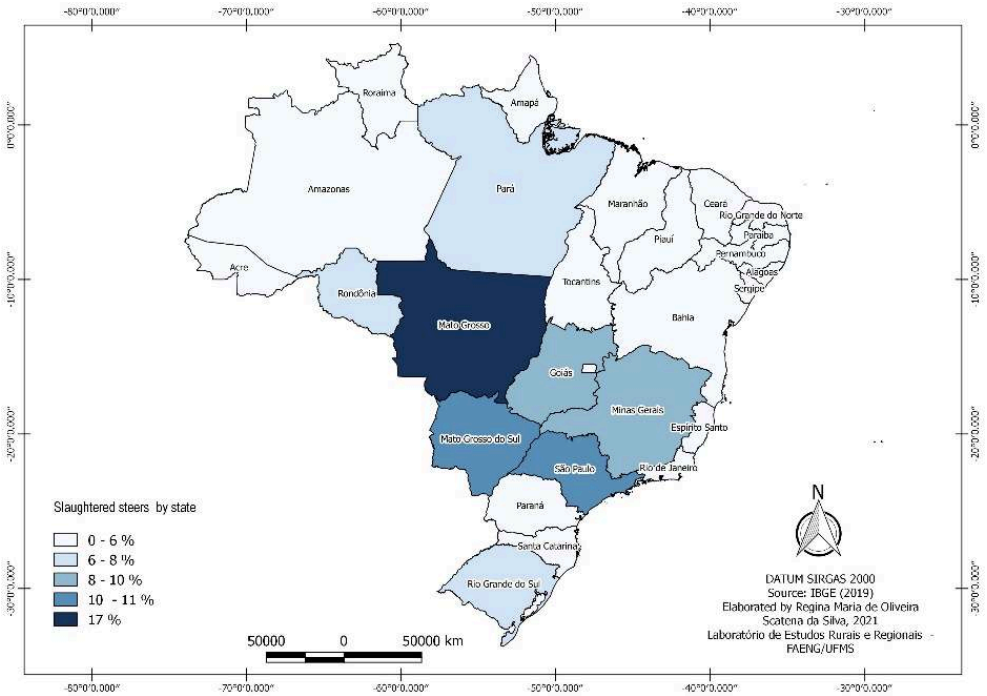
23 At the state level, Mato Grosso is the most important beef producer, followed by Mato Grosso do Sul and São Paulo (Figure 3). The first two are located in the Central West while São Paulo is located in the Southeast. From year to year Goiás state of the Central

West oscillates in position with São Paulo as does Rio Grande do Sul of the South region with Minas Gerais of the Southeast.

24 The continual increase in cattle raised in Brazil over time was accompanied by the growth of Brazilian exports to international markets. Brazilian beef exports increased from nearly 152,000 tonnes in 1996 to over 1,600,000 tonnes in 2018 and value soared from US$ 473 million in 1996 to over US$6.5 billion in 2018 (ABIEC, 2019a, 2019b) (Figure 4). Exports increased steadily and value grew exponentially from the early 2000s onward as fresh beef and special cuts for quality markets became the main products and were responsible for aggregating greater value. By 2018 fresh beef represented more than 75% of all beef products exported.

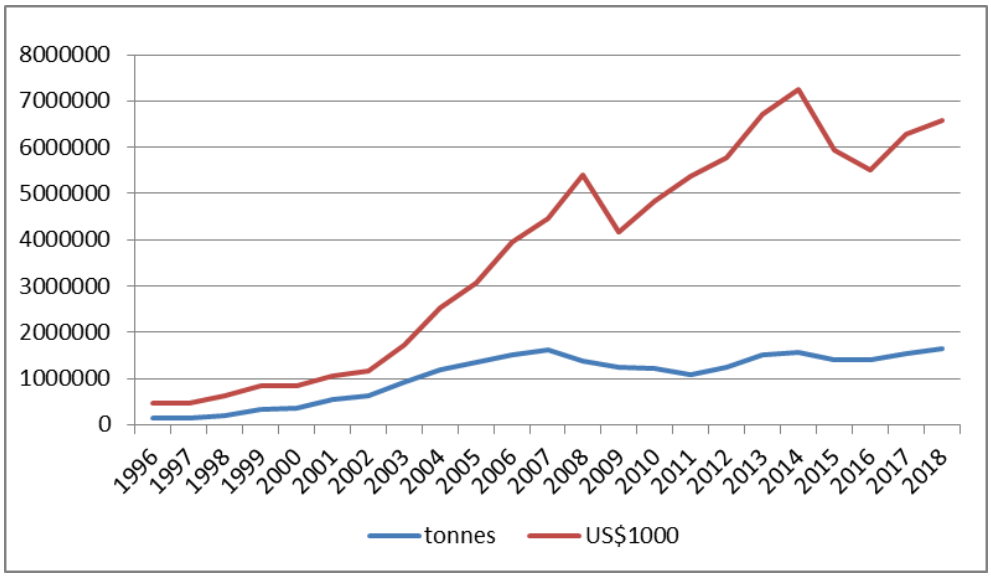
25 Global demand for more 'natural beef' was crucial for fuelling the growth of quality beef in Brazil. Europe was historically an important market but has drastically reduced beef imports from Brazil over the last decade. Selling beef to the European market still is a long-term goal for natural and quality beef producers of Brazil but today in terms of volume of production Asian and Middle Eastern countries consume most of the Brazilian beef exports.

Figure 3. Main beef producing states in number of steers slaughtered in 2019.



Source of data: IBGE (2019)

Figure 4. Brazilian beef exports (tonnes, US$1000).



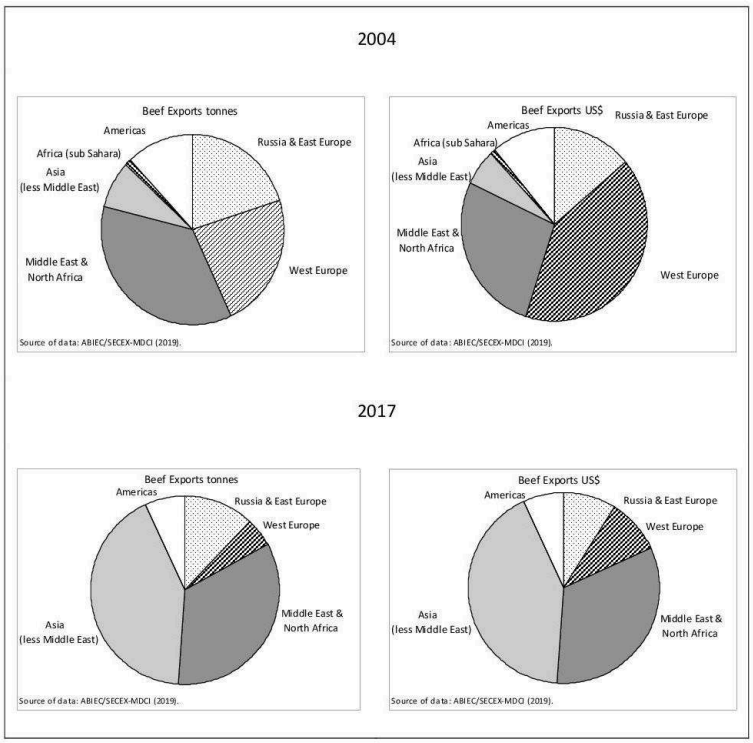
Source of data: ABIEC/SECEX-MDIC (2015, 2019)

26 Over time oil-rich countries of the Middle East and recently industrialised countries of Asia became important markets. The case of Hong Kong which imports Brazilian beef for the booming China market is instructive. During the 2000s Hong Kong's position shifted from the twelfth largest importer of Brazilian beef to third and then in the 2010s it became the most important market, followed by continental China in second position. East and South Asian markets now take 42% of Brazilian beef exports while Middle Eastern and North African countries consume 34%. During the same period exports to European markets fell drastically from 23% of tonnes of beef exported and 41% of the value of exports to merely 5% and 9% respectively (Figure 5). Within the European Union, Italy and the Netherlands still buy large amounts of Brazilian beef and at the level of specific countries are among the top 10 importers. Hong Kong, China, Iran, Egypt and Russia are the top five buyers and each of them imports over 140,000 tonnes of Brazilian beef annually.

27 The growth of Brazilian beef exports was made possible by public and private strategies to improve quality and food security through more stringent sanitary control and traceability. New kinds of breeds were introduced and developed which were increasingly in demand internationally, particularly in Europe. Lately with the increase in meat consumption in Asian countries, especially in China, Brazilian producers have taken greater notice of market developments there, even those ranchers engaged in organic beef production.

28 Over time basic quality of beef was guaranteed by sanitary measures and control of preventative diseases. During the 1990s a specific demand for quality 'natural beef' arose in Europe where consumers were keen to buy meat produced from agro-ecological pasture-fed cattle. To meet this demand some Brazilian ranchers started marketing 'natural beef', 'pasture-fed animals' and 'green steers'. Over time 'green beef' evolved into the sustainable organic stock-raising now encountered in the Pantanal and these ranchers still have the intention of exporting to Europe as well as entering this high-income niche in China.

Figure 5. Brazilian beef exports by world regions.



Source of data: ABIEC (2015, 2019).

Paths to alternative stock-raising in the Pantanal

29 The Pantanal is a traditional beef producing area located in a low-lying quaternary sedimentary basin. Rivers drain into the depression and form alluvial fans subject to extensive seasonal flooding during the rainy season between October and March (Assine, 2004). During the rains and floods the Paraguay River overspills up to twenty kilometres from its margins and blocks the out-flow of tributaries so increasing the area flooded. As the floods reside during the dry season extensive areas of native pasture become available for grazing.

30 Ranchers of the Pantanal have always had to adapt their activities to an environmental context of ecological limitations imposed by the seasonal floods which require them to take animals to higher ground during the rainy season. As land remains under water for months at a time an extensive land use system was developed that is still in place today. For conventional intensive beef production the local environmental conditions were long perceived to pose a serious barrier to developing modern stock-raising methods in the Pantanal but the extensive stock-raising practices proved to be advantageous for shifting directly to ‘natural beef’, ‘pasture-fed animals’ and ‘green steers’ and from there to alternative organic and sustainable stock-raising. Consequently, these non-productivist ranchers jumped directly to post-productivist alternative stock raising and so did not have to go through the prolonged and expensive process of decontaminating land in which productivist methods had been used.

31 In the extensive ranching system large areas remain in the native vegetation of seasonally flooded savannah land which can be inundated for up to six months of the year. Consequently, Pantanal ranchers have lower productivity than ranches located outside the biome. Given this economic disadvantage for extensive stock-raisers of the Pantanal the idea of earning more income per 'green steer' was an attractive proposal. In 2001 the first alternative beef marketed was a veil with regional branding, VITPAN (*vitelo do pantanal*), which was certified by Ecocert. Calves were raised with a combination of organic and conventional methods and slaughtered at the age of 7 to 12 months old when they weighed about 180 kilogrammes. Twenty-one ranchers were involved in this experiment with alternative ranching.

32 'Green beef' soon evolved into the sustainable organic stock-raising now encountered in the Pantanal. Sustainable beef production was first distributed to select domestic markets which could pay the higher prices. But given the limited nature of these markets, ranchers turned to global markets (ABPO, 2018a). In the early 2000s some organic meat started to be exported to European countries and the European Union became the target market for quality meat of the Pantanal.

33 Beef production on these ranches has now made the full transition to organic methods and ranches have been certified. The transition occurred together and in parallel to establishing norms for the Protocol of Sustainable Beef of the Brazilian Association of Organic Producers in the State of Mato Grosso do Sul (ABPO, 2017a). The protocol adheres to the Brazilian organic legislation and is adapted to the conditions and specificities of stock-raising in the Pantanal wetlands. The ABPO Protocol now guides certification of ranchers, slaughterhouses and the marketing chain. Certification, identity and traceability were key practices for Pantanal Sustainable Beef to enter organic markets.

34 In the new system great attention is given to pasture which in the national requirements for organic systems encompasses variables related to the parameters of nutrition, range and animal wellbeing. Management of pasture and feed in organic cattle raising in the Pantanal is treated first and then variables concerning animal care of the adapted and improved cattle breeds of the Pantanal, reproduction control and methods, phytosanitary conditions and veterinarian treatment.

35 All of the ranchers interviewed in this study are members of the ABPO, half of them fully organic and half sustainable. Ranchers certified as organic must follow all of the appropriate rules for this kind of production or risk losing certification. Presently the ABPO organic ranchers using the 'Brasil Orgânico' label are certified by the Associação de Certificação Instituto Biodinâmico (IBD), which was formally a part of the Demeter Institute. Members of the ABPO who do not have the 'Brasil Orgânico' label have not fulfilled all of the necessary requirements for organic certification and market their output as 'sustainable beef', which guarantees use of agro-ecological production. Several of the sustainable ranchers are in transition to the organic system.

Pasture and feed

36 Pasture management in the Pantanal is based on accumulated traditional knowledge of local natural environments and seasonal variation in level of flooding. As the annual floods rise cattle are moved from lower to higher terrain within a ranch or from ranches located in the low Pantanal to those situated in the high Pantanal or to ranches

located on the surrounding plateaus. Stock-raising has always been based predominantly on the use of native pasture even if some exotic grasses have been planted. A number of different local grasses used for raising pasture-fed animals became the basis for agro-ecological systems which seek economic and environment sustainability.

37 Important differences exist with regard to pasture and feeding methods used in conventional and organic systems (Table 2). Both systems use the same type of native grazing pasture and exotic planted pasture introduced into the region in the 1970s and 1980s. Today organic and sustainable ranchers recuperate degraded areas of native pasture; they have stopped using the old practice of burning pasture as a means of eliminating weeds and promoting regrowth of desirable pasture; experiment with the potential of different native grass species; manage pasture through planned limited trimming of grass, bushes and trees, which maintains edible species, soil covered and local biodiversity (Figure 6). Exotic species predominate in conventional pastures. These were originally introduced into the Pantanal together with Nelore cattle.

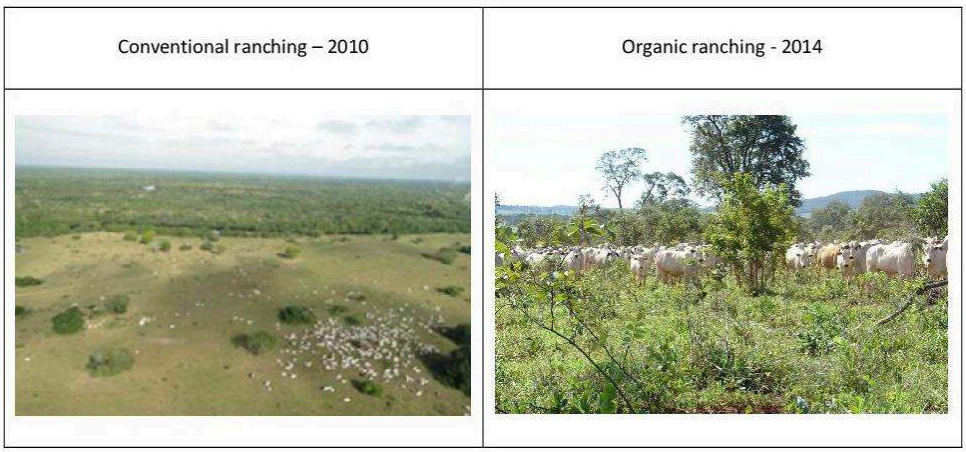
38 The Brachiaria group of grasses is the most common exotic pasture planted in the Pantanal and includes a number of varieties: *Brachiaria humidicula, Brachiaria decumbens* and *Brachiaria brizantha.* Common native grass species used on organic ranches are: *Axonopus purpusi* (capim mimoso) and *Mesosteum chaseae* (grama-do-cerrado). Ranchers have tested the nutritional value of these native grasses and praise their exceptional quality for producing good beef and leather. However, the carrying capacity of the native pasture is lower than that of exotic species. As a result, organic ranchers carefully manage the rotation of pasture controlling the number of cattle per area, place animals in harvested fields to eat crop residues and use and fodders, all organics. Normally, there is no need for feeding cattle with fodders but some ranchers can utilize these organic supplements.

Table 2. Pasture and feeding methods used by ranchers according to system in the Pantanal.

Pasture	Conventional	Sustainable/Organic
Native and exotic pasture	Extensive areas of 100-500 ha 60% native, 40% exotic	Sustainable: mainly native pasture, gradual substitution of exotic pasture Organic: 100% native pasture commingled with savannah vegetation
Pasture subdivision and rotation	25-100 ha subdivisions	Large subdivisions with 100 ha or more
Special pasture for calves	Creep grazing - 25 ha areas Creep feeding - 10-12 ha areas	Creep grazing and feeding - 100 ha areas
Planted fodders	Use of fodders	Occasional use of organic fodders
Supplements	Mineral salt, urea	Non-iodine salt, no urea

Source: Araújo and Bicalho (2010); Bicalho and Araújo (2018); field research, 2013-2014

Figure 6. Contrasting landscapes of conventional and organic pastures in the Pantanal.



Source: Authors, field research, 2010, 2014

39 Water is plentiful in Pantanal but not always of good quality, so water tanks are built to provide clean water for the animals. Clean water is especially scarce during the floods when local vegetation decomposes in the water making it improper for human and animal use[5]. Pasture and water care was never an important concern for ranchers in the past so this represents a significant innovation that organic ranching has introduced.

40 The size of pasture enclosures is another expressive difference between the two systems and one that interferes directly in the freedom of movement of the animals. Larger pasture and rotation areas of at least 100-hectare parcels are present on alternative ranches regardless of the stage of growth of the animals while in conventional ranching larger steers are placed in 25-hectare enclosures and calves in 10 to 12-hectare areas.

Animal care and well-being

41 With regard to animal genetics and health care the two systems use the same climatically resistant Nelore breed of cattle while some conventional modern ranchers have introduced the Brangus breed in order to sell higher-priced tender meat (Table 3). The Nelore breed was developed in Brazil from crossbreeding different types of zebu cattle, which resulted in an animal that produced more meat and was well adapted to the different environments of the country, including the Pantanal. However, new hybrids cattle such as the Brangus have being introduced and tested in agro-ecological systems.

Table 3. Animal care used by ranchers according to system in the Pantanal.

Animal care	Conventional	Alternative/ Organic
Resistant breed	Nelore	Nelore
New breed for tender meat	Brangus crossbreeding	Some Brangus crossbreeding
Reproduction control methods	Artificial insemination, controlled mounting, FIV & embryo transfer	Only controlled mounting
Animal life cycle spent in Pantanal	No rule	1/3 of life
Slaughter age	36 months	36-48 months
Early slaughter	12-18 months	12-18 months
Phytosanitary treatment	Vaccines, allopathic drugs	Mandatory vaccines, homeopathic drugs
Traceability	Use	Use

Source: Araújo and Bicalho (2010); Bicalho and Araújo (2018); field research, 2013-2014, 2018

42 Reproduction control is radically different between the two systems. Only controlled mounting according to the fertility cycle and reproductive instincts of the animals is practised in alternative methods while ultra-modern ranchers use an array of intrusive methods of genetic control, such as fertilisation in vitro and embryo transfer. Alternative ranchers also insist that a steer pass at least a third of its life cycle in the Pantanal. This became a requirement for ranchers who want to use the Pantanal Beef

label for enhancing market appeal by associating distinctive environmental and cultural elements to their product which are well known in Brazil.

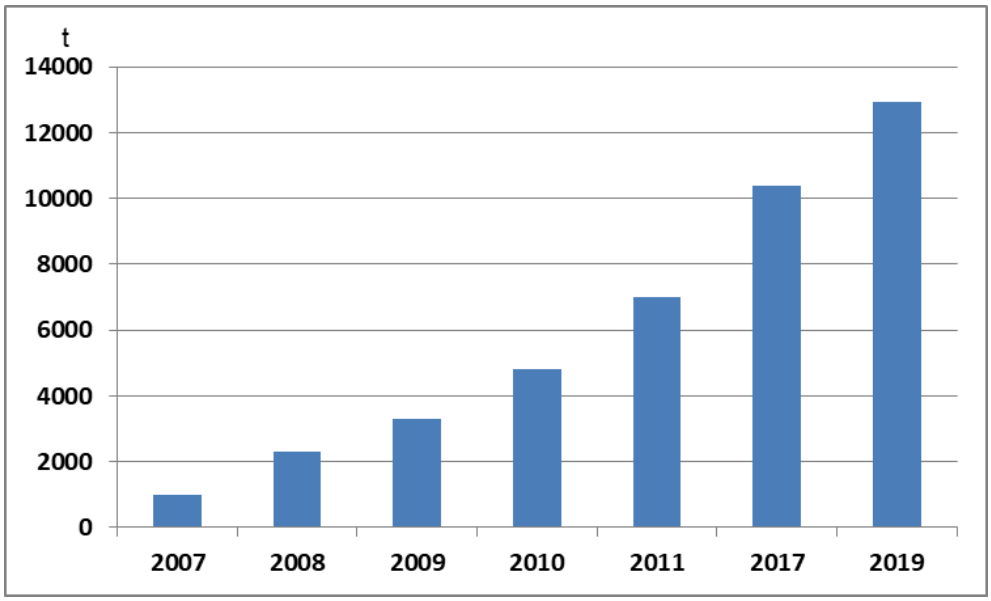
43 Normal slaughter age can be a bit longer in the alternative systems but early slaughter to ensure tenderness takes place at eighteen months in both systems. A number of vaccines and allopathic drugs are used in conventional ranching often in a preventative manner while in alternative ranching mandatory rabies and foot-and-mouth disease vaccines are administered and homeopathic drugs are used to treat animal ailments. Traceability is necessary for both types of ranching as it attests to animal quality and animal sanitation care.

44 Other researchers present similar findings. Neves (2012) in a study comparing methods used before and after the transition to organic cattle raising highlights animal welfare issues involved in feeding methods based on grazing pasture, fewer animals per area and shorter distances to water. This author also observed the same differences involving sanitary control and homeopathic treatments that we did but does not comment on animal reproduction. Resende *et al.* (2005) studied this dimension and found that while reproduction methods should be through natural mounting artificial insemination is permitted. Banned are fertilisation in vitro, cloning and embryo transfer, which are common practices in ultramodern ranching operations on the nearby Central Plateau.

Economic viability

45 Production with the brand name 'Pantanal Sustainable Beef of the Brazilian Association of Organic Producers' has increased at a fast pace from year to year. In 2007 ABPO ranchers produced only 990 steers for the market but by 2011 this reached 6,000 steers and by 2019 attained 12,928 steers (Figure 7). In 2017 ABPO reported that 15 organic ranchers had a herd of about 80,000 certified animals and slaughter rates of 200 per week (ABPO, 2017b). The state government of Mato Grosso do Sul reported that in 2018 twenty-two organic ranchers slaughtered 12,000 steers and that this could double in few years due to the implementation of a new state programme promoting organic ranching (ABPO, 2018b; SEMAGRO, 2018).

Figure 7. Increase in ABPO animals slaughtered per year.



Source of data: ABPO representative, 2015; ABPO (2017b); Bereta (2020)

46 ABPO sustainable and organic beef production has considerable economic advantages over conventional production. However, the economic viability of the alternative stock-raising systems was an open question when first developed. Costs and returns as well as market acceptability were unknown. Ranchers thought that latent demand for their product existed but processing and marketing structures and channels were absent to get their beef to potential consumers. In practice, the initial cost of setting up the on-farm installations and the transition waiting period involved losses in the first years of operation but these progressively fell until low operating expenses were attained. At the same time, productivity increased at a fast rate so that profits were soon realized and increased rapidly after that, guaranteeing the consolidation of the systems and their continuity (Table 4).

Table 4. Investment and productivity per hectare for organic beef production over time.

years installing system	average investment per hectare		average production per hectare	
	R$/ha	% reduction	kg/ha	% increase
Year 1	1700	-	120	-
Year 3	1088	- 36,0	130	8,3
Year 6	627	- 42,4	250	92,3
Year 9	458	- 25,5	400	60,0
Year 12	358	- 21,8	750	87,5

Year 1 to 12	-	-78,9	-	525 %

Source: Field research, 2015

47 Today ranchers are confident that they have guaranteed markets and can further expand production by exporting to the European and Asian markets, China in particular. The success of alternative stock-raising attracted the attention of the government of Mato Grosso do Sul which created a special programme 'Sustainable and organic beef of the Pantanal' at the end of 2018. This programme focusses on encouraging more ranchers to go organic by reducing state taxes on sustainable beef by 50% and on organic beef by 67% (SEFAZ/SEMARGO, 2018). This benefit was added to the other advantages of alternative beef production *vis-à-vis* the conventional system, such as lower operating costs, higher productivity and higher prices received (Table 5). In addition to this, organic management practices create better pasture, recuperate degraded land and promote environment conservation in such a way that the land value of organic ranches increases.

Table 5. Advantages of alternative stock raising over conventional stock-raising systems.

Comparative advantages	Organic beef production
Production costs	20% to 30% lower
Productivity	30 to 40% higher
Price per 15k	10% to 18% higher
Government subsidy	50% to 67% tax reduction

Source: Field research, 2015; ABPO representative, 2015; SEFAZ/SEMAGRO, 2018

Building alternative beef networks in the Pantanal

48 According to Domingos (2005), contemporary organic stock-raising developed in reaction to the outbreak of *encefalopatia espongiforme* (vulgar: mad cow disease) in bovines in the United Kingdom in 1996. A number of rigid global controls and regulations targeting intensive practices were implemented in the principal beef producing and exporting countries. Brazilian farm policy was also influenced by the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 which promoted organic methods as economically and environmentally viable alternatives to intensive agriculture. Organic stock-raising methods were developed and officially validated by the National Forum of Stock Raisers in 1997. Domingos also states that in 1999 the Buiatrics Society of Mato Grosso do Sul organised a meeting on organic cattle raising which explored the possibility of introducing alternative stock-raising systems in the Pantanal.

49 Our research revealed that a few Pantanal ranchers began the transition to organic beef production in the early 2000s. First, they produced beef with differentiated quality for

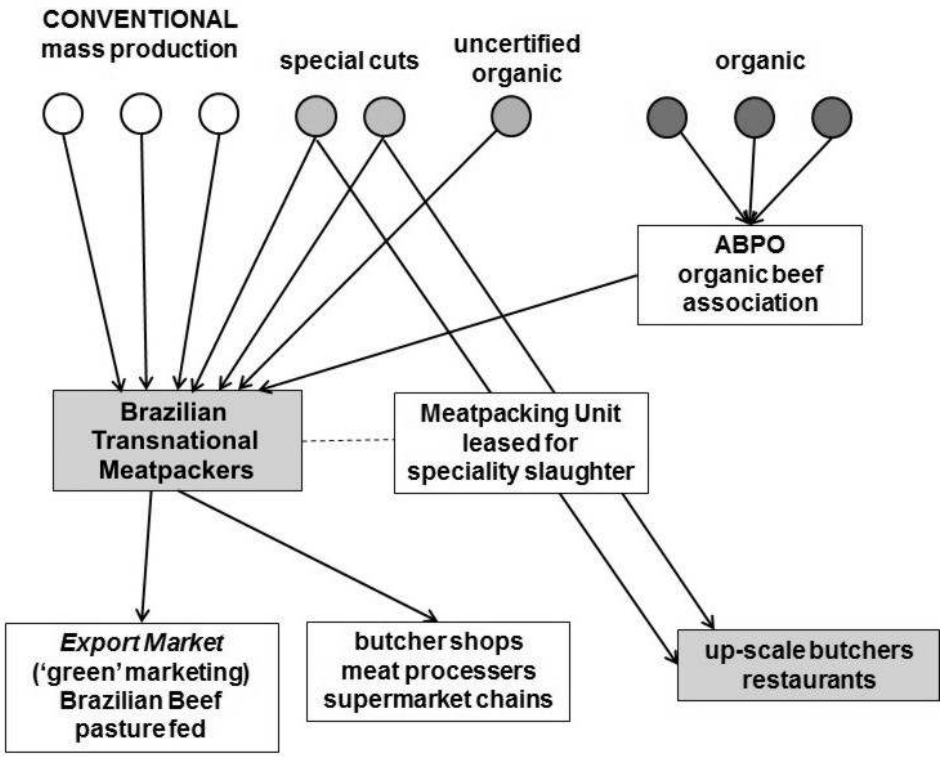
niche markets in order to meet demand from high-income domestic consumers as well as from global quality-food consumers. Special meat cuts were developed involving tenderness, usually veal, and animals that were pasture-fed and not stabled or confined in feedlots. Then in the mid-2000s an ecological concern was added with the employment of organic ranching methods. Organic beef production was also pasture-fed on land free of agro-chemicals, animals were not given hormones or antibiotics and were only subject to homeopathic treatment. Finally, in the mid-2010s regional identity was added to the ecological concern giving rise to the Sustainable Pantanal Beef brand name.

50 These changes required considerable organisation of ranchers into associations. In Mato Grosso do Sul state the Brazilian Association of Organic Producers (ABPO) was founded in 2001 and over the years the number of organic stock-raisers has varied from fifteen to twenty-three. The association also served as hub of connectivity with governmental and non-governmental agents which resulted in refocusing research at the EMBRAPA Pantanal Centre, the EMBRAPA Beef Production Centre and the local federal universities to their needs. As the Pantanal is a major nature area in Brazil and the largest wetlands complex in the world, the WWF Brazil was also keen on promoting research and connectivity between alternative ranchers and researchers so as to avoid the expansion of modern conventional ranching in the biome. Finally, the 2018 tax exemption programme for organic beef production expanded the role of the state government into the partner network.

51 In addition to change in the production methods, alternative processing and marketing networks had to be developed. This was not an easy task because the Pantanal is located within the Central-West region which has a significant agro-industrial complex for handling the processing and marketing of conventional beef products on a mass scale. Such a context is not necessarily receptive to marketing organic beef of limited scale which requires special methods for slaughtering animals.

52 At first, the giant meatpacker JBS-Friboi was the principal processing and commercial partner for quality meat from pasture-fed animals destined for the green-market sector and this arrangement was later extended to organic beef (ABPO representative, 2015). Steers were also sold to other important meat companies such as Marfrig and Minerva. For eight years JBS had an exclusive contract to sell ABPO organic meat, most of which was exported to Europe. The price paid to ranchers was from 15% to 18% above the price paid for conventional steers. Domestic distribution of the organic beef was handled via Wessel and two large supermarket chains in Brazil, Carrefour and Pão de Açúcar (acquired by the French Casino group) (Figure 8).

Figure 8. From conventional mass-produced beef to quality beef.



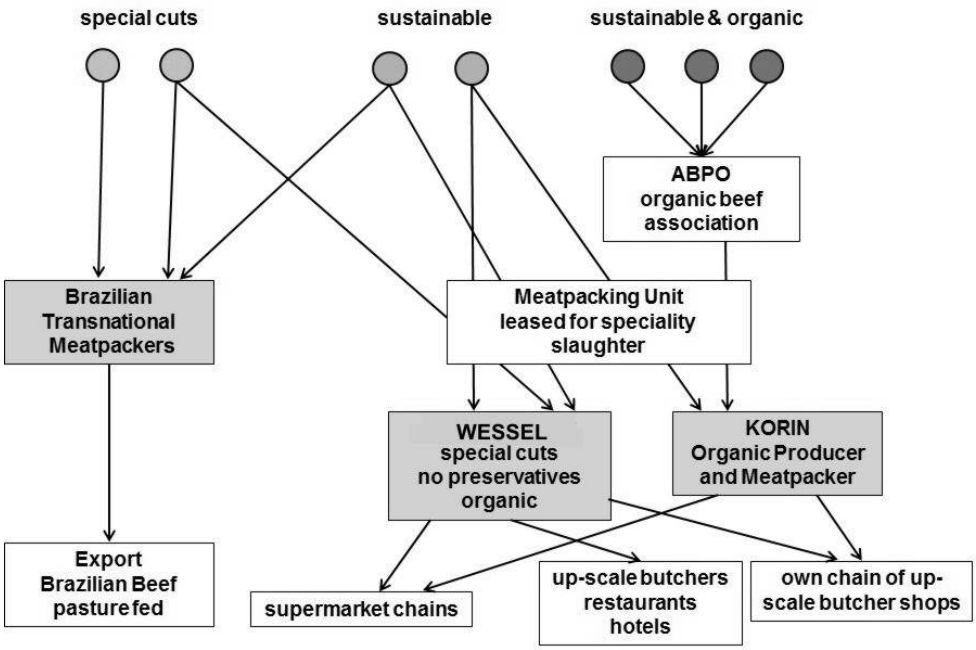
Source: Field research, 2013-14; Bicalho and Araújo (2015).

53 According to the interviewed ABPO representative, in 2015 JBS-Friboi decided to discontinue this arrangement under the pretext that the cleaning work necessary to prepare the line of production for just one day of organic processing was not worth the effort. This caused ranchers to develop new marketing channels with the organic and 'natural' meatpackers and distributers, such as Korin Agropecuária and Wessel. More recently, a Naturafrig meatpacking plant located in the Pantanal began processing ABPO's organic beef. Korin and Wessel still handle distribution of organic meat in wholesale and retail markets to upscale butcher shops, restaurants and hotels located in the rich Southeast and South regions (Figure 9).

54 The result was a shift from different kinds of quality meat to truly organic meat under the brand name: Sustainable Pantanal Beef. Exclusive selling contracts with JBS, i.e. dependency on a sole giant processer, were replaced by a more diversified relationship with smaller processers and distributers more attuned to the ranchers' interests, which permitted more direct access to new consumers. Consequently, the overall marketing network became more complex and denser.

55 Dense links in the overall network arose at the production end of the organic stock-raising assembly which were centred on the rancher association and formed an array of new partnerships for improving technical knowledge. This brought together organic producers, suppliers of organic inputs, the above mentioned processing and marketing firms specialized in sustainable or organic meat, the regulatory agencies of the Ministry of Agriculture, federal research institutions of EMBRAPA, the state regulatory IAGRO and the IBD organic certifier.

Figure 9. The complex marketing of agro-ecological beef.



Source: Field research, 2013-2014; Bicalho and Araújo (2015)

56 The retailers, restaurants, hotels and final consumers in the chain only buy produce and so participate indirectly in the network as a demand function and do not exercise direct influence in building technical knowledge. This constitutes a significant departure from the more active role of consumers in organic crop production in Brazil which can include direct contact between small sellers, who may also be farmers, and consumers near metropolitan areas (Bicalho, 2005). Beef logistics is more complex and requires specific structures and processes at the production end which exclude most retailers and consumers from the network. Finally, new international partnerships are being developed with the support of the state government and firms from Italy with the objective of making this country the principal point for distribution in Europe (ABPO, 2018a).

57 The social context of the Pantanal was crucial for developing the alternative beef network. Traditional social relations between families over generations provided the basis for the alternative rancher network of relatives and friends. The same social networks where mobilised to influence institutional research and policy related to alternative stock-raising. Regional identity and pride formed the basis for the Sustainable Pantanal Beef brand, which evokes images of ranching in traditional harmony with the wild nature of the wetlands. The association of all of these cultural images is also part of the creation of a new organic foodscape.

Conclusion

58 Environment difficulties present in the Pantanal wetlands meant that ranching systems historically have been land-extensive. Resilient breeds are used, cattle graze in large pasture areas and are not stabled. Ranchers mobilise traditional local knowledge of seasonal variations and micro-ecosystems to calibrate how many animals can be raised

and where to place them at different times of the year in order to avoid losing steers to predators, drowning and disease.

59 The traditional system now works to their advantage. In fact, ranchers say that they were already ‘green’, which is partially correct because ranching methods have always been land-extensive system and this eased the transition to organic stock-raising. They went directly from traditional systems which had taken on some conventional practices to alternative systems without the need to de-intensify and detoxify their land from a previous conventional productivist system.

60 But the seasonal floods still limit the availability of pasture during the year and favour growth-cycle specialisation between ranches. The land-extensive nature of Pantanal ranching also maintains traditional concentration of ranch ownership and social inequality, particularly when vertical integration is undertaken by firms.

61 Ranchers also must work in an economic context of realising profits in order to maintain their lifestyle. The global market potential for pasture-fed beef and organic consumer ideology created the market opportunity, which introduced the idea of ‘natural’ and organic stock-raising locally. However, global and domestic organic beef markets are still quite limited. Brazil only exports small amounts of organic beef to a few countries, mainly those located in Western Europe, and even then only in the form of special cuts. The domestic market is the main destination for organic beef but is restricted to informed middle- and mainly upper-class consumers of rich regions. Brazilians of all classes eat great considerable amounts of beef and according to Farmnews (2018) the country is ranked third in beef consumption in the world. However, our research undertaken between 2014 and 2020 at the consumer end found that the final price of sustainable and organic Pantanal beef is three to four times that of conventional beef and this obviously limits the number of consumers who can actually buy the product.

62 Ranchers adopted organic methods not only because they possess an environmentalist mentality of protecting nature. Ranchers have gone organic while maintaining a productivist mentality guided by considerations of market potential and production costs. This is a case of a productivist mentality taking advantage of post-productivist consumer attitudes and the result is a hybrid regime that combines both. Nevertheless, the urban consumers of distant markets do not interact directly with the production. The crucial mechanism for the rise of organic ranching in the Pantanal was the regional network between ranchers, their association and other institutions promoting sustainable practice which resulted in interaction and exchange of information in multiple connectivity between actors with the same mind set.

63 This network features the ABPO rancher association as a point of convergence of actions in the form of a star radiating influence in the analogy of the shape of networks proposed by Latour (2005). Therefore the existence of the exceptional case of organic beef production in the Pantanal demonstrates how a mosaic of productivist and post-productivist transitions is present across the Brazilian countryside, in accordance with the complex views of global agriculture proposed by Wilson and Burton (2015) and Woods (2011).

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NOTES

1. The Pantanal biome occupies a total area of 192,600 km^2 straddling the borders of Brazil, Paraguay and Bolivia, of which about 150,988 km^2 are located in Brazil in the states of Mato Grosso and Mato Grosso do Sul. Within Brazil 64.76% is located in Mato Grosso do Sul state (the study area). The Pantanal is the largest complex of wetlands in the world, which are situated on a huge floodplain within the Paraguay River basin. The Pantanal is surrounded by adjacent high plateaus from where rivers flow inland down into the depression and meander toward the Paraguay River before finally flowing south to the River Plate and out into the Atlantic Ocean.
2. In the Brazilian part of the Pantanal, 87,749 km^2 of the biome is situated in conservation areas, which corresponds to 58.1% of the total area. One of the most important nature area is the National Park of the Pantanal of Mato Grosso, which occupies an area of 1,355.52 km^2 and has been recognized as Natural Patrimony of Humanity by UNESCO. In addition to private and public conservation units, all rural establishments are required to maintain a minimum of 20% of their land in native vegetation, which considerably increases the amount of protected land.
3. The years of 2019 and 2020 were exceptionally dry in the Pantanal. In 2020 a savannah fire of great proportions swept across 26% of the biome. The fire started in Mato Grosso state and spread to Mato Grosso do Sul. Large-scale destruction of ranches, conservation units and indigenous lands occurred. Fauna and flora were decimated and the human population took refuge in the cities which were overtaken by a dense cloud of smoke and hot air.
4. ABPO - Associação Brasileira de Produtores Orgânicos; EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária / Brazilian Agricultural Research Corporation; MAPA - Ministério da Agricultura, Pecuária e Abastecimento; IAGRO - Agência Estadual de Defesa Sanitária Animal e Vegetal de Mato Grosso do Sul.
5. In the beginning of the flood period rivers flow over the levees and on to the floodplain, cover the vegetation present which decomposes and contaminates the water. The lack of oxygen in the water in turn kills fish, which further worsens water quality.

ABSTRACTS

The development of alternative beef production systems in the wetlands of western Brazil is treated here. This study contributes to the literature on alternative production systems of an organic and agro-ecological nature, which are not usually employed by large-scale farmers and ranchers. The rise of an alternative foodscape in the Brazilian Pantanal is shown to be rooted in generations of local knowledge concerning extensive cattle-raising in the wetlands that has been mobilised to develop an organic system of beef production appropriate to this biome. The study uses a relational perspective to understand how new production functions were developed and how ranchers of the Pantanal built a dense alternative technical and marketing network to provide support for organic beef production as part of new sustainable food systems. First, the larger context of agribusiness beef production in Brazil is presented. After this, organic stock raising systems are analysed and compared to conventional stock raising systems of the Pantanal. Then, the formation of organic actor-networks spanning production to consumption is treated. The sustainability of the organic stock raising in the Pantanal is highlighted and its potential for expansion evaluated.

Cette étude, consacrée au développement de systèmes alternatifs de production de viande bovine dans les zones humides de l'ouest du Brésil, apporte une contribution à la littérature sur les systèmes de production alternatifs de nature organique et agro-écologique, qui ne sont généralement pas employés par les grands agriculteurs et propriétaires de ranchs. L'essor d'un paysage alimentaire alternatif dans le Pantanal brésilien s'enracine dans des générations de connaissances locales concernant l'élevage extensif de bétail dans les zones humides qui ont été mobilisées pour développer un système biologique de production de viande bovine approprié à ce biome. L'étude utilise une perspective relationnelle pour comprendre comment de nouvelles fonctions de production ont été développées et comment les éleveurs du Pantanal ont construit un réseau technique et marketing alternatif dense pour soutenir la production de bœuf biologique dans le cadre de nouveaux systèmes alimentaires durables. Premièrement, le contexte de la production agroalimentaire de viande bovine au Brésil est présenté. Après cela, les systèmes d'élevage durables et biologiques sont analysés et comparés aux systèmes d'élevage conventionnels du Pantanal. Ensuite, la formation d'acteurs-réseaux organiques allant de la production à la consommation est traitée. La durabilité de l'élevage biologique dans le Pantanal est mise en évidence et son potentiel d'expansion évalué.

INDEX

Keywords: organic beef production, agro-ecological stock-raising, alternative food networks, Brazilian Pantanal wetlands, western Brazil
Mots-clés: production de viande bovine biologique, élevage agro-écologique, réseaux alimentaires alternatifs, zones humides du Pantanal brésilien, ouest du Brésil

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