Cattle ranching, conservation and transhumance in the Brazilian Pantanal

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Beef cattle production is the main economic activity in the Brazilian flood plain called the Pantanal, the world’s largest freshwater wetland. Though cattle have been raised on an extensive basis for more than 250 years, the Pantanal is considered the most conserved ecosystem in Brazil, still dominated by native vegetation though 95 per cent of the region is made up of private ranches. Seasonal flooding leads to cattle movement from low to high grounds, involving huge herds of cattle walking hundreds of kilometres from one farm to another. Flooding at different intensities also causes wide variations in native pasture support capacities, leading to animals being sold to farms outside the Pantanal for fattening at specific times of the year. Cattle marketing is commonly on foot, with herds taking on average 11 days to cover 230 km to their destinations. These activities have economic repercussions on the population of the Pantanal, not only affecting sale price of the animals, but also leading to tourism niches for local farmers.

Keywords: beef cattle, flooding, Brazil, South America, wetlands, zebu

Introduction

Brazil has the largest commercial cattle herd in the world, with 200 million beef cattle (Instituto Brasileiro de Geografia e Estatística – IBGE 2008). It is also the world’s largest beef exporter (Mariante et al. 2008), followed by Australia, India and Argentina (which has the fifth largest herd in terms of cattle numbers). This is the result of 225 million hectares of pastures in Brazil, leading to a production of 8.7 million tonnes of beef carcass equivalent. The centre-west region of Brazil, of which the Pantanal is part, has the largest cattle herd in the country, with 68 million beef cattle (IBGE 2008).
Extensive rearing of beef cattle is the principal economic activity in the Pantanal region.

Brazil has six distinct biomes, each with environmental characteristics which leads to different economic occupation of each territory, with different impacts. The six continental Brazilian biomes are: Amazonia, Savannah (Cerrado), Caatinga, Mata Atlantica (Atlantic Forest), Pantanal (wetlands) and Pampa. The Pantanal occupies 176,496 km² which is 1.76 per cent of the total Brazilian territory.

Pantanal region ecology, conservation and colonization

There are no roads in the Pantanal except for the Transpantaneira, a raised dirt road that runs for 145 km from the town of Poconé to Porto Joffre. The extension of the road was limited by lack of finance, technological problems as well as ecological considerations. The road from Campo Grande is paved for most of the distance of 400 km, although parts can be potholed and in general poor condition.

The Pantanal is the world’s largest freshwater wetland, a seasonally flooded plain fed by the tributaries of the Paraguay River, with 65 per cent of its area in Mato Grosso do Sul (MS) State and 35 per cent in Mato Grosso (MT) State (UNEP 2007). The lowlands known as the Pantanal are divided into various regions, called ‘panatanais’. The Pantanal is a huge gently sloped basin that receives runoff from the upland areas (the Planalto highlands) and slowly releases the water through the Paraguay River and tributaries which is a result of the large concave pre-Andean depression of the earth’s crust. It constitutes an enormous internal river delta, in which several rivers flowing from the surrounding plateau merge, depositing their sediments and erosion residues, which have been filling, over the years, the large depression area of the Pantanal. This area is also one of the distinct physiographic provinces of the larger Parana-Paraguay Plain area. During the rainy season the water in the Pantanal basin rises between two and five metres and over 80 per cent of the Pantanal floodplains are submerged during the rainy season.

The direct distance from the municipality of Cáceres, in the extreme north, to the Apa River in the extreme south is approximately 680 km. The greatest distance in the west-east direction from the Bolivian frontier to the central highlands is approximately 300km. The Pantanal can be divided into eleven distinct sub-regions caused by differences in hydrological, soil and vegetation characteristics: Cáceres, Poconé, Barão de Melgaço, Paiguás, Nhecolândia, Abobral, Aquidauana, Miranda, Paraguai, Nabileque and Porto Murtinho (Silva and Abdon 1998).

The climate in the region is hot, with a dry winter. Frost may occur in July or August. Rainfall varies between 1,000 and 1,400 mm per year. About 80 per cent of the rainfall occurs in the summer, between November and March, most occurring in December and January. The region is very flat, which
contributes to water retention at the soil surface due to flooding caused by rivers and rainfall. Many rivers can be found in the region, with the Paraguay River being the most important. This river, which flows in a north-south direction over the whole region, is 2,730 km in length from its spring to where it meets the Paraná River at the Argentinean-Paraguayan frontier.

The soils in the Pantanal are developed on young sediments which may be sandy or clayey in origin, alternating or in discontinuous bands. The most fertile regions are in the clay phase which occurs in the low Pantanal region, but overall the sandy phase predominates.

The vegetation in the region is varied and defined as ‘Pantanal Complex’ (UNEP, 2007), which encompasses different phyto-physionomas. In the region the following plant systems can be found: savannah, open fields, ‘dirty’ fields (with many small trees and shrubs), swamps with hydrophilic vegetation, tropical pluvial subcaducifol forest, among others. There are diverse vegetative communities to be found in the region where a clear dominance of one species leads to the denomination of the community e.g. caronal (Elyonorus muticus + savannah species), carandazal (Copernicia australis + Paspalum simplex), paratudal (Tabebuia caralba + P. hydrophilum or Andropogon hypogynus), canjiqueiral (Byrsonima orbignyana + P. pantanalis), etc.

Studies indicate that during the dry season, organic matter accumulates on the soil surface (Nunes da Cunha and Junk 2004, Nogueira et al. 2002). When the flood season begins, an accelerated decomposition process starts and, consequently, nutrient liberation occurs. These studies also indicate that plant material decomposition during the flood season transfers nutritionally rich organic debris to the pastures, keeping them fertile during the dry period. Furthermore, the aquatic plant community becomes terrestrial throughout the flood pulse, which refers to the fact that the flood plain is made up of a number of landscape units, subject to flood pulses with variable intensity and regularity. There are permanently flooded, sporadically flooded, and periodically flooded areas (Nogueira et al. 2002).

**Cattle and conservation**

According to the vegetative cover map of Brazilian Biomes from the Environmental Ministry (MMA), the Mato-grossense Pantanal is considered the most conserved ecosystem in Brazil, with 86.8 per cent native vegetation cover and 11.5 per cent of the area affected by anthropic action. Nevertheless, practically 95 per cent of the region is made up of private lands, of which 80 per cent of the area has been used for cattle production for more than 250 years. The first official register of animal production in the region dates from 1737, which may have led to the Pantanal becoming an area with marked anthropogenic action.

So how has the region, which is the largest flood plain in the world, with an economic activity for almost 300 years, come to be considered the most conserved ecosystem in Brazil? The answer involves several important social,
environmental and economic aspects but there is a tendency towards a negative correlation between poverty and ecological disequilibrium, which means that greater poverty in a certain region leads to greater pressure on natural resources in general. Human population densities inside Pantanal are very low, at around 30,000 people, with towns located at the border of the plain.

Beef cattle production has enriched and conserved the Pantanal (Barros Neto 1979). Therefore, the goal of Pantanal conservation depends on the strengthening of traditional cattle production in the region (Abreu et al. 2000, 2001, 2006a, 2006b). The sustainability of this economic activity guarantees the conservation of the region. Usually beef cattle production is considered to have a strong negative environmental impact on the regions where it is practised. Generalizations are dangerous and, in the case of the Pantanal, the opposite happened, where extensive beef cattle production guaranteed, and continues to guarantee, the conservation of the ecosystem. There are fears that removing cattle will increase risk from fire as grasses grow taller and dry dead foliage accumulates.

The origin of cattle production in the Pantanal goes back to the 17th century, with two important periods being identified in relation to cattle type. Before the 20th century the ‘Pantaneiro’ cattle breed was dominant, these being small animals of *Bos taurus ibericus* origin. The second period began with the substitution of the Pantaneiro by zebu (*Bos taurus indicus*) cattle in the 20th century. The effective occupation of the region occurred due to the introduction of cattle within the Pantanal from north to south. This activity underwent various economic cycles over this period including:

a) 1775–1864. Development of huge private farms such as Jacobina and Piraputanga. These farms were given to their owners by the local government agent in exchange for favours and were mainly used for cattle production.
b) 1879–1914. Occupation of new areas of the Pantanal in the southerly direction;
c) 1914–1923. Development of dried meat industry with foreign capital (especially English and South American);
d) 1923–1929. Development of dried meat industry with regional capital (from Pantanal);
e) 1936–1950. Increase in dried meat production with regional capital due to exportation during Second World War and following recession;
g) 1994–2000. Increase in the efficiency of the production system with specialization in calf and heifer production;
h) 2000 to date. Identifies a need to add value to the production system and increase multifunctional use of the property, directing the work to strengthening the sustainability of the production system.
In the 1890s, the largest ranches ranged between 100,000 and 400,000 hectares. By the 1970s, 70 percent of all properties ranged between 1,000 and 10,000 hectares. Thus the average size of properties has decreased. Conversely, since the mid-1800s the number of cattle grazed in the Pantanal has increased. In 1920, a Brazilian census estimated there were about 700,000 cattle in the Pantanal. By the early 1970s, the number had increased to over five million. Since that time, because of market conditions and periods of extreme flooding, the number has decreased somewhat. Therefore, considering cattle ranching throughout its history in the Pantanal, there have been two general trends: more and smaller ranches and increasing numbers of cattle.

Current cattle ranching in the Pantanal floodplains

At present, cattle production with a herd estimated at four million head, is the main economic activity in the region characterized by large properties. About 12 per cent of these properties have an area greater than 10,000 hectares, corresponding to 56 per cent of the total area of the Pantanal. Farms ranging from 1,000 to 10,000 hectares make up 69 per cent of the number of farms, and 43 per cent of total area. Small farms (< 1,000 hectares) make up only one per cent of the Pantanal area. Independent of the different environmental conditions, calf rearing predominates. Cattle fattening is uncommon and depends on various factors such as price and abundant pasture availability especially in zones where heavier flooding occurs. Sixteen of the twenty Brazilian municipalities with the highest cattle population are in the states of Mato Grosso and Mato Grosso do Sul, with several of these being inside the Pantanal (IBGE 2008), such as Cuiabá with the highest cattle population of 0.9 per cent of the national herd.

From October to April, heavy rains cause the Paraguay River and its tributaries (such as the Sao Lourenço, Cuiaba, Taquari, Miranda, Negro and Aquidauana) to overflow. The flooded area is almost ten times the size of the Florida Everglades in the USA. The Pantanal can be classified into three subregions according to the degree and duration of flooding (Alho et al. 1988):

a) Alto Pantanal, relatively higher ground where about 20 per cent of the area floods to depths of 30-40 cm for two to three months of the year; b) Medio Pantanal, a mid-lying area where widespread flooding lasts from three to four months; and c) Baixo Pantanal, low-lying very flat areas with almost complete inundation to depths of 3–4 m during the rainy season. A detailed evaluation of this phenomenon can be obtained in ANA (2004).

Cattle farmers, depending on where their property is located, use native pastures in three ways: (1) the cattle stay on the pastures year round. This occurs where flooding is caused by rainfall alone; (2) Farmers need to relocate from low to highlands during floods and vice-versa when floods recede. This
occurs where farms are cut by streams and rivers while flooding is caused by rainfall and river flooding. (3) cattle graze during the dry season and are removed before the low lying plain is flooded by large streams and rivers. These areas have excellent pastures and cattle may be fattened on them. In this last case farmers have two distinct properties, one low lying and the other in the highlands. The cattle are driven on foot by mounted cowboys and the journeys across the flooded areas can last weeks. In the sub-region of Poconé most of the farmers use the third system, having two properties, one in the lower regions of the Pantanal and the other in the high region. In 2009 an estimated 528,000 head of cattle will temporarily leave the Corumbá region – more than half of the cattle population in the region – as an estimated 45 per cent of the grazing lands are submerged during the floods. The annual floods can also drive part of the rural population to cities and towns until the waters recede, which can also cause social problems both in rural and urban areas.

Most cattle production in the Pantanal is therefore extensive calf rearing on native pastures (Bliska and Gonçalves 1998). This occurs on large properties where management is directed by the flood regime. In this system, the animals receive little care and are kept almost exclusively on native pastures on the extensive sandy plains with few sub-divisions. On average there are approximately 8 pastures per farm, each of 1,700 hectares on average. Most pastures are continually grazed when cattle are present. During the flood season, cattle movement depends on the intensity and duration of the flood, the timing of which varies between subregions. This movement may be within the same farm if there are areas free from flooding. If not, then the animals are sold or moved to other farms. In general, some farmers defer the use of pastures so that feed is available for some categories of animal such as yearlings. Other practices, such as rotational use of pastures, are not frequently used, but are on the increase due to favourable results found with both native and exotic pastures. These large paddocks also allow the animals greater freedom to select the plants they want to eat, and also use of drinking holes. Where sub-divisions exist, the fences are built parallel to the rising water so that the animals are kept away from the flood water. Depending on the part of the flood cycle, animals are driven to the higher lands. This movement between two or more farms composes an integrated management system, where different groups of cattle are to be found in each farm at different times of the year.

There are two main periods of feed limitation: from the height to end of the floods (February to May), and the other from the middle to the end of the dry season (August to September) (Pott et al. 1988, 1989). Basic feed is almost exclusively from the following forage species: mimosa grass (*Axonopus purpureus*), *Mesostem loliiforme* and carandazal grass (*Panicum laxum*), depending on the region and flood status (Table 1).

In the Pantanal, the carrying capacity of the land is evaluated subjectively by the farmers. The stocking rate (area/herd size) for the Pantanal depends on farm size and can be grouped depending on soil quality which is reflected in
pasture quality: Farms > 4,000 ha have a stocking rate of 3.4 to 4.2 ha/head, while those < 2,000 ha have a rate of 2.5 ha/head. Estimates are one animal unit (cow + calf) on three hectares in the central part of the region and on five hectares in the east, where soils and pastures are of poorer quality (Comastri-Filho and Pott 1994). As environmental conditions are variable, there are

<table>
<thead>
<tr>
<th>Vegetation Unit</th>
<th>Topography/Slope/Flooding</th>
<th>Phytophysionomes and main plants</th>
<th>Use by Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usually humid</td>
<td>Lowest part of the region (border of lakes/bays and river banks). Usually stays with moist soil and becomes submerged when floods occur</td>
<td>Generally clean fields, but some trees and shrubs may appear. The most important plants are: Scleria, Cyperus, Reimarochloa brasiliensis, Heliotropium filiforme, Leenis hexandra, Hymenachne amplexicaulis, Caperonia castaneifolia, Ludwigia sp., Panicum laxum, Eleocharis sp., Axonopus purpusii</td>
<td>Used generally in the dry season as preferred grazing or in the absence of flooding. Open fields generally have more palatable species such as A. purpusii, which are preferred by the cattle.</td>
</tr>
<tr>
<td>Usually seasonal</td>
<td>Intermediate region (between low and highlands) and temporary bays. Area of greater soil moisture variation throughout the year, being dry for part of the year and wet for the other part.</td>
<td>Both clean fields and woods or shrubs. Main plants include grasses (Poaceae), especially Axonopus purpusii, Andropogon bicornis, Mesosetum chaseae, Waltheria albicans, Melochia simplex, Setaria geniculata, Richardia grandiflora, Paspalum vaginatum, Cyperus brevilflorus, Hyptis brevipes, Andropogon Sellowanus, A. Hypoginus, Reimarochloa brasiliensis and Cynodum dactylon</td>
<td>Used and preferred during both rainy and dry seasons, but with limited areas during the floods. May have a greater number of species used by cattle in wetter years and after long flooded periods. The preferred type is where A. purpusii with Mesosetum chaseae while the least preferred is A. bicornis</td>
</tr>
<tr>
<td>Usually Dry</td>
<td>Highest parts of the region (hill tops and their borders). Floods don’t reach here.</td>
<td>Predominated by shrubs and trees in the higher parts and herbaceous plants in the lower parts. Main plants are: Scheelea phalerata, Bromelia balansae, Copernicia alba, Waltheria albicans, Richardia grandiflora, Veronica scabra, Mesosetum chaseae, Anadenanthera acrocarpa, Byronima orbignyana, Sapium haematoporum, Tabebula sp., Cecropia pachystachya.</td>
<td>Used during flooding of humid and seasonal fields. Preferred species include: Mesosetum chaseae.</td>
</tr>
</tbody>
</table>

Source: Rodela (2006)
many doubts about true carrying capacity. For example, the true capacity for wintering on the Nhumirim farm (experimental farm for the federal agricultural research company – Embrapa – in the Pantanal), in the Nhecolândia sub region was estimated taking into consideration phyto-physionomy of the vegetation eaten by the animals. The carrying capacity varied by month and year and depended mainly on monthly rainfall as well as intensity and duration of flooding. Generally carrying capacity, in terms of available dry matter, decreased in August and September (end of dry winter season) and during the rainy season while it decreased in quality terms (protein level) from April to July.

Traditional cattle production in the region is marked by two main yearly periods of management: in May or June and November or December. These periods include branding new calves, castration, vaccination and other management activities which depend on the individual farmer. Traditional production indices are low compared to national averages, with birth and weaning rates around 45-60 per cent and 35-50 per cent. This is mainly due to irregular native pasture on offer which means that frequently the herd has inadequate nutritional levels. On the other hand, this low input system is an important factor for conservation of the environment and the pacific co-existence with the fauna and flora over the whole region.

Economic and environmental analysis of herd production

Although there is a great deficiency in information on cattle production in Brazil, its importance for the country’s agribusiness is evident. At present, Brazilian beef production accounts for about 47 per cent of total meat production in the country, developed nationwide in different production systems and production levels. Its contribution to Gross Domestic Product (GDP) is greater than three per cent. The central focal point in the beef chain is the biological production system including different stages (calf, growth and fattening) in different combinations around which the farmers are grouped.

In the Pantanal, the farmers concentrate on calf production, with mainly substitute heifer rearing in the growth phase. The main products of the system include weaned calves, growing heifers, yearling steers, culled bulls and cows. Using the optimization (Data Envelopment Analysis – DEA) of a mathematical model (Abreu et al. 2006a, Abreu et al. 2008) it was shown that the productive region of the Pantanal, due to the extensive production system (almost totally based on native pastures), and given economies of scale (mean farm size around 4,000 hectares), shows the lowest cost for the farmer in Brazil although it is the largest area destined for beef production. A positive correlation was found between low annual costs and the cost of the calf and growth phases. This is in accordance with the tendency to put these activities in low cost areas, large properties, far from slaughter and consumer regions. In the higher regions, especially on the border of the Pantanal where
cultivated pastures were introduced, the production system is more intensive and cattle are fattened on farm. Calves produced inside the Pantanal are fattened on these farms.

Environmental potential is the basis of the Pantanal production system, with native forages the main support for the cattle. The wide variety of environments mean that a broad range of vegetative species are available (grasses, legumes and cyperaceous plants), which favour beef production, leading to greater selectivity of pasture. This also means that native pasture management is complex and difficult. Huge open fields, few sub-divisions, changing environments, low stocking rates and a large number of plant species available for selection mean that pasture usage is low, with usually 75 per cent of the forage available going uneaten.

The spatial and temporal variability of the phytophysical systems in the Pantanal means that a single management plan cannot be adapted for the region. Due to pasture dynamics that exist, the ideal situation would be that management strategies adapted to the region and forage resources would be developed. As such, there is a need to map the different types of native pastures according to their function in quality and quantity, which varies between and within years (Santos et al. 2008). The strategic use of cultivated pasture (mainly *Brachiaria* spp.) has been suggested to reduce seasonal effects on certain sensitive categories of animal such as growing females and recently calved heifers as well as young bulls for breeding and bulls after breeding.

The implementation of technology is a dynamic process. Researchers, farmers and farm workers need to work together to increase herd production efficiency in the Pantanal, to guarantee sustainability of the process which is vital for the conservation of the region. At present a protocol is being developed for the Pantanal using biophysical, economic and social criteria to evaluate the sustainability of management practices used by the Pantanal farmers. Associated with these criteria, systemic simulation models will be developed to evaluate the use of alternative management practices and their impacts on the farming system and the environment (Santos et al., 2008).

**Movement and marketing of cattle from the Pantanal**

The movement of animals due for sale from the municipality of Corumbá (steers both fattened and for fattening, culled cows and bulls, and calves) uses several means of transport (on foot, river, railway and road), generally in combinations, depending on local conditions and animal condition (Cavidad Garcia, 1982, 1985, 1986). Most cattle commerce occurs between October and March, with peaks between December and January (64 per cent). Temporal variations can be observed depending on the production characteristics of the Pantanal region involved.
Figure 1. Cattle grazing in the floodplains in the Pantanal

Figure 2. Transport on foot in Pantanal: crossing the Taquari river
The destination of these animals includes the States of Mato Grosso do Sul (63 per cent), São Paulo (20 per cent) and Mato Grosso (14 per cent). First the animals walk, in groups of 900, approximately 230km to a river or road collection point. The animals walk on average 21 km/day resting after 12 hours. These rests occur at night. On average there are 5.6 men per animal group and 2.3 per cent of the animals are lost due to accidents and fleeing etc. Recently, animals from the margins of the Pantanal have been transported by truck rather than on foot, as more roads have been built, but some estimates show that the cost of transport on foot is approximately one third of that by truck although the journey takes much longer. During this time, which may take months, the drovers (almost all men) stay with the cattle. Salaries are around US$2–3 per day. After reaching their destination, they leave the cattle and return to their families.

These same families are also in constant movement, from small communities on the river banks during the dry season to larger towns (Pignatti and Castro 2008). They stay in the houses of relations or even temporary accommodation until the water evaporates. The Pantanal has one of the lowest HDI (Human Development Index) in Brazil and many of these migrants find it difficult to arrange temporary employment, with 97 per cent of the men of economically active age surviving on temporary jobs with no formal contract. The population that stays in the Pantanal is cut off from other regions. Transport during the floods is by boat or horse-back (on Pantaneiro horses adapted to long treks in flooded regions) or even by plane and communication is by radio.

Cattle production development based on the special characteristics of the region cannot be met without improvement of the commercialization systems, as inefficiencies in these systems lead to lack of stimulation for production and thereby hindering whole system development. The cattle producer, usually limited by resource availability (pasture, cash, flooding, etc), is pressured to sell in unfavourable conditions. Due to the flooding cycle and reduced nutrient availability and therefore the reduced capacity to maintain his animals on farm during the height of the floods, there is a large offer of unfattened steers and calves in those seasons. The producer therefore accepts the transfer – at low prices – of the potential weight gain of the animals to other regions. This, along with a lack of bargaining ability, lack of information on the market and reduced prices when calf offer is high, means low profits for calves and unfattened steers in the region. The animals are sold in groups and evaluated subjectively. If a better system of specification was available, where age, animal type, traceability, among others, were available the price could be improved. Market organization by farmers could also improve demands for infrastructure, including roads and collection points, as well as credit for commercial and market information.

Commercialization is considered an important phase in the production of cattle as it involves not only production activities but consumer activities. The organized flow of goods and services is dynamic and changes with...
technology, social-economic structures, institutional changes and market trends. In each commercial system there is a coordination mechanism which varies between systems but always includes three important points: price level (including price formation and means of payment), collection agents (collection in concentration areas and movement to consumer which may be another farmer for fattening, slaughterhouse or final consumer) and objectives of elements of the system (variation in accordance with farmer or buyer interest, product type and physical condition of the product).

New and potential eco-markets
More recently, some cattle farmers have diversified their activities to include tourism, offering horseback treks accompanying cattle movement, among other attractions. The transportation of cattle from ranches to regional trade centres along the perimeter of the Pantanal is normally executed on foot, but may involve small barges or trucks, depending on ranch location. The only paved road in the region connects the three main trade centres and runs along the southern, eastern and northern perimeter of the Pantanal. This also makes farm access for tourists to the farms in the Pantanal more difficult. As discussed above, although cattle ranching is the main economic activity in the Pantanal, it has a weak economic base compared to the industrialized production in other regions of the country. This leads to smaller farmers selling their unfattened calves at low prices, with low productivity and per hectare profit. Farmers with larger farms have been buying up these smaller farms and earn profit on the basis of scale. More recently, the natural beauty of the landscape and its diverse flora and fauna in combination with traditional extensive ranching has become attractive for different forms of ecotourism. Large-scale marketing campaigns for local ‘green’ products such as for beef with a recognized label of ‘free roaming sustainably managed Pantanal cattle’ could increase the profitability of the ranches.

Conclusion
The Pantanal traditional cattle production system is now under threat due to several economic, social and environmental factors. Actions such as intensified cattle ranching, large-scale road construction and flood control to improve access, and increased industrial production by the construction of large hydroelectric power plants, canalization of the Paraguay River for large ship traffic, and other measures to improve infrastructure could have serious negative effects on local productions systems if not carefully planned. For example, the construction of the Transpantaneiro highway in the 1970s led to a change in water distribution in the region and thousands of cattle drowned, as the highway was built in a straight line separating MT and MS states, instead of following the tracks used for decades by the cattle drovers. Therefore many small traditional farmers were forced out of the business and
their land bought by larger farmers, leading to changes in the traditional system (Seidl et al. 1998).

Most rivers draining into the Pantanal have their sources in the surrounding highlands. The Brazilian government has been subsidizing intensive agricultural operations in these areas since the early 1970s. The flood water therefore brings with it pesticides, herbicides and fertilizers from the highlands, and poor soil management along with deforestation has led to silting up of rivers in the region.

In the past, low-intensity cattle production, including seasonal herding of cattle between regions of the Pantanal, has proven to be a sustainable management approach that maintains structures, functions, biodiversity, and the beauty of the landscape that has made the Pantanal what it is today. Environmental sustainability is founded on knowledge of the processes which control the dynamics of production systems in a specific region or locality. The search for sustainability is a constant challenge and this is the principal focus for researchers and decision-makers working in the region. Only through the monitoring of agro-ecosystems in the region and the use of adapted technologies will it be possible to replan farm management, conserve biodiversity and optimize the use of natural resources in the Pantanal in a sustainable manner.

References


