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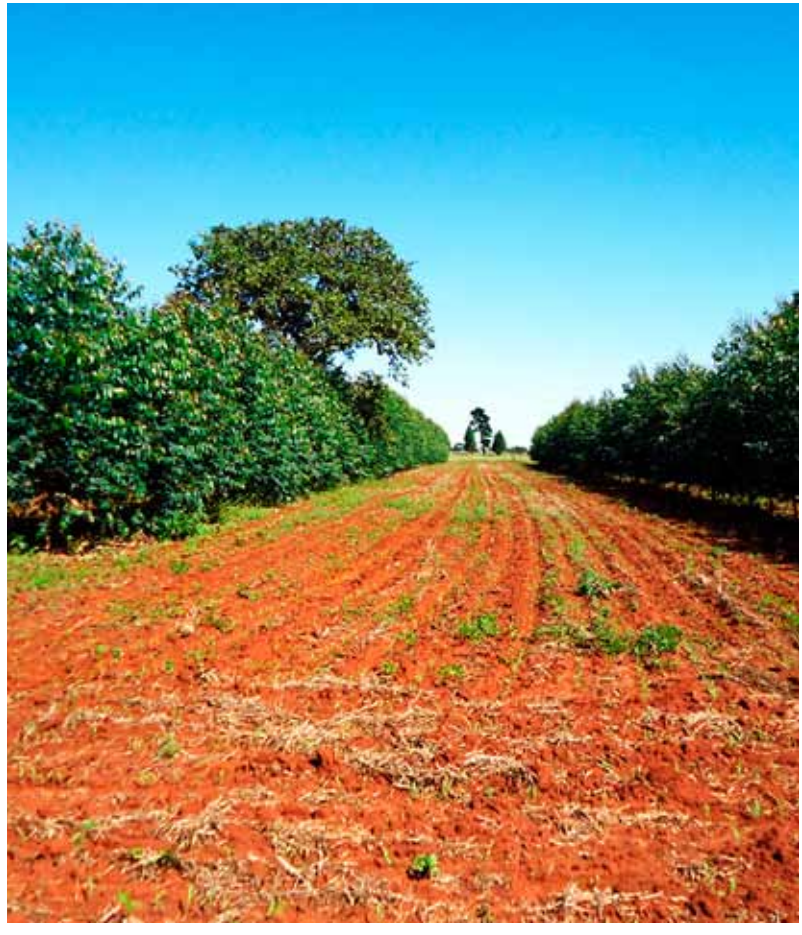

Water and soil conservation

Beef cattle production in the Cerrado

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1st Edition

WWF-Brazil

Embrapa Beef Cattle

WWF-Brasil

WWF-Brazil is a Brazilian non-governmental organization dedicated to preserving nature by harmonizing human activities with the conservation of biodiversity. It also promotes the rational use of natural resources in benefit of today's citizens and future generations. WWF-Brazil was created in 1996 and is headquartered in Brasilia. It develops projects all around the country and is a part of the WWF Network, the largest independent network for nature conservation, with operations in more than one hundred countries and the support of more than 5 million people, including members and volunteers.

Embrapa Beef Cattle

Founded in 1975, Embrapa Beef Cattle works to facilitate sustainable technological solutions for the beef cattle production chain. It is one of the many units in the Brazilian Agricultural Research Corporation (Embrapa), an organization founded in 1973 and affiliated to the Ministry of Agriculture, Livestock and Supply, which works on the creation of solutions based on research, development and innovation for sustainable agriculture, in benefit of the Brazilian society.

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Beef cattle production in the Cerrado

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Build dams to keep the forests in their natural environment and use canals, pumps or pipelines to supply cattle with water as well as other uses

1 Introduction and background

This document is the product of a joint effort made by Embrapa Beef Cattle and WWF-Brazil, providing procedures to be adopted by cattle farmers in order to generate positive outcomes for their production and the environment. These practices will help to improve beef cattle production, favoring environmental preservation, especially in the Cerrado.

These recommendations were listed in a workshop held on September 30th and October 1st, 2009. Among the participants were WWF-Brazil, WWF-Bolivia, Embrapa, Pró-Carnívoros Institute, Agrosuisse Consulting, Biodinâmico Institute, The Wildlife Conservation Society, the Brazilian Association of Organic Farming, Ministry of Agriculture and Livestock of Paraguay, International Center for Tropical Agriculture, Guyra Paraguay and the Private Natural Heritage Reserves Owners Association of the Mato Grosso do Sul, Pantanal of Nabileque Producers Union, Mato grosso Cattle Producers Association, Mato Grosso State Agriculture and Livestock Federation, National Rural Apprenticeship Service, and the Mato Grosso do Sul Secretariat for Agrarian Development, Production, Industry, Trade and Tourism.

The representatives of these public and private institutions and the civil society have recommended a series of practices that will make beef cattle farming more sustainable. Without being repetitive, this publication is dedicated to exposing techniques that aim for the protection, conservation and restoration of soil fertility. It also offers recommendations on the access of cattle to rivers and water bodies, pasture management and restoration as well as systems that integrate the production of crops with livestock and forests. Enjoy your reading!

Manage, decompact and apply fertilizers on the soil, control ants, termites and competing plants

2 Water and soil conservation in beef production

Developed some ten thousand years ago, agriculture is a revolutionary achievement of mankind. It allowed for the settlement of populations, made urbanization possible and is the basis of many economies around the world.

At the same time, it generates environmental impacts, such as the replacement of forests and other phenomena caused by the cultivation of a few selected species, including pasture used as livestock feed. However, agricultural and livestock production is not necessarily incompatible with environmental preservation and restoration.

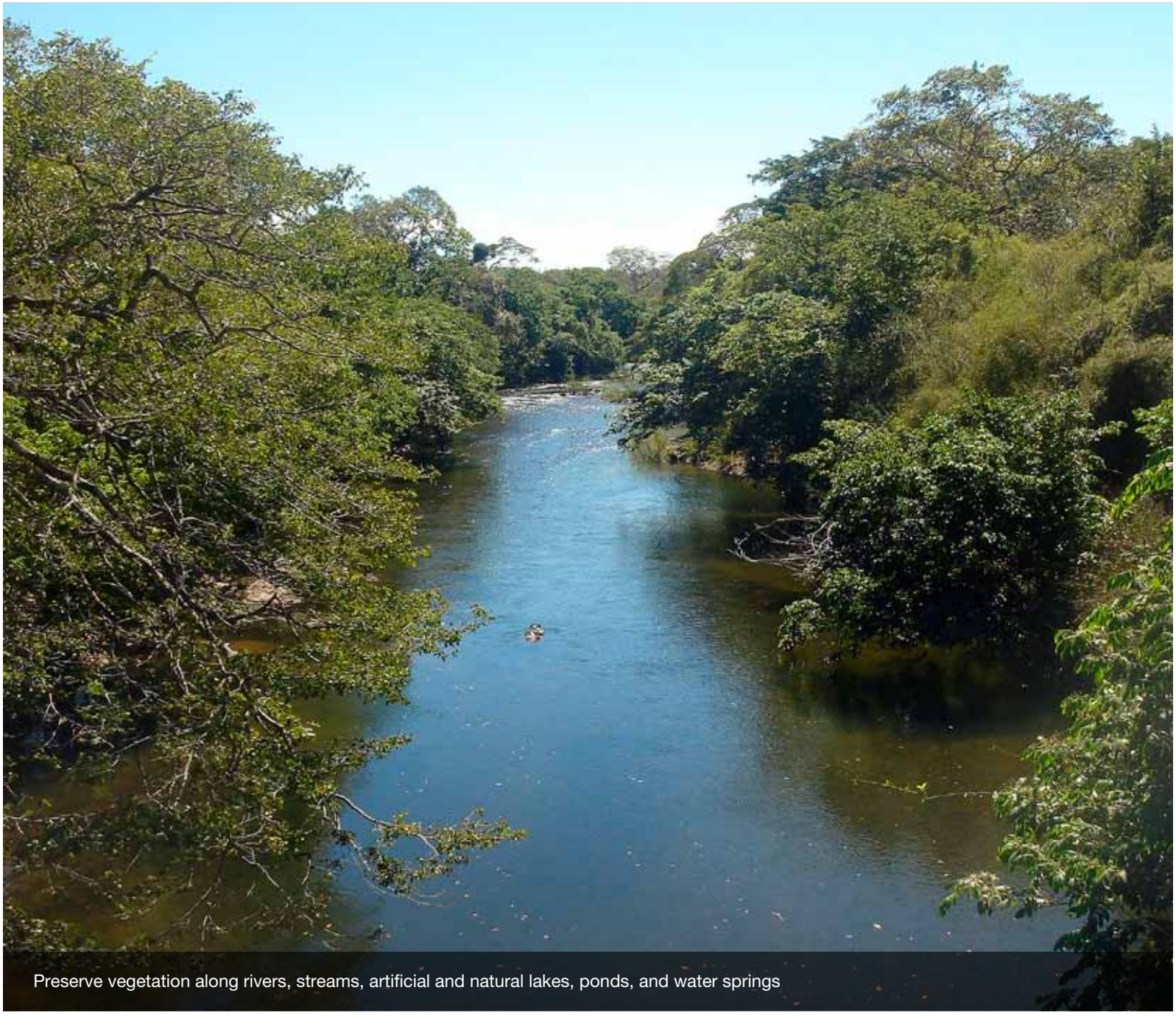
Water and soil conservation is critical to rural properties and other economic activities, ensuring human livelihood and improving the quality of life of people living in rural areas where production is carried out in accordance to sustainable criteria.

The conservation of natural vegetation on the side of water springs, rivers and streams as well as hilltops, helps in curbing erosion and floods. It purifies the water consumed by people and cattle, facilitates pollination of crop fields and keeps the soil rich in nutrients. It also forms important ecological corridors for the survival of native fauna and flora. Moreover, sustainable properties are more resistant to the effects of climate change.

These benefits, caused naturally by preserving such spaces, are called ecosystem services. Well managed properties make use of these natural mechanisms and reduce their production costs through agricultural practices that conserve the soil, water and pastures. They also reduce problems caused by pests, diseases, and excessive utilization of agrochemicals, among others.

Preventing degradation and the waste of natural resources in these properties is also key to opening up space in increasingly demanding markets, both in Brazil and abroad. After all, an environmental approach in livestock breeding, building and maintaining ecosystem services, adds value to farms and their production.

Therefore, there is a wide opportunity for revisiting traditional ways of cattle production which are in harmony with the preservation and restoration of natural environments, in benefit of all Brazilian people.



Preserve vegetation along rivers, streams, artificial and natural lakes, ponds, and water springs

3 Good practices in beef cattle

3.1 Water use and conservation

Rodiney de Arruda Mauro
researcher at Embrapa Beef Cattle

The permanent supply of water depends on the characteristics of each region and how it is used. In Brazil, rivers and streams are the main water sources, while wells are more expensive and require licensing of environmental agencies. Hence, preserving vegetation on the side of rivers, streams, artificial and natural lakes, ponds, and water springs helps to protect these sources and maintains the quality and quantity of water used in properties.

Building dams correctly can provide good quality water for livestock and other uses on farms and ranches. However, these water sources need vegetation as well as fences around them, preventing the herd from having direct access to these water bodies. Drinkers and water troughs must be filled by canals, pumps and pipelines. In order to increase infiltration of water in the ground, it is important to build harvesting dams for capturing rain water, with leveled broad-based terraces following the contour of the land and deeper canals at the upper levels. This practice also helps preventing erosion and damage to rural roads.

Farmers can also “produce” water, by using smaller dams for instance. The *Barraginhas* Project, developed by Embrapa Maize and Sorghum, in Sete Lagoas (state of Minas Gerais), harvests rainwater, preventing erosion and flooding. It therefore restores the soil and revitalizes streams and rivers in rural communities. Cattle farmers who make best

use of water resources in their properties will benefit economically by adding value to their properties, as well as environmentally by preserving soil quality and improving the health of their herd.

In many countries, rural producers share the amount of water available in each region through concessions given by the government and the payment of fees. In Brazil, these concessions must be requested whenever large volumes of water are used or when dumping sewage and other wastes into rivers, streams or lakes. Any doubt about the need for such concessions can be clarified by environmental agencies.

Generally speaking, Brazilian legislation regarding water resources is quite modern. The 1988 Federal Constitution establishes that both surface and underground water should be managed by state governments. However, if such water bodies are shared between at least two states, or in case they serve as natural borders with neighboring countries, they must be managed by the federal government.

The Water Act (9.433/1997) implemented measures in Brazil similar to those in countries with highly sophisticated water management policies, such as the water basin management approach when planning multiple uses of water resources. It also recognizes water as a finite and vulnerable resource with economic value and defines regulations for a decentralized and participatory management of water resources.

Avoid deforestation beyond limits established by law and do not carry out open burnings, control cattle trampling and movement of machinery and vehicles

3.2 Soil conservation

Mauricio Sarto
Agronomist, lawyer and rural producer

If pastures and soil are not managed carefully, farms can face problems with surface runoffs, floods, soil depletion, water scarcity in springs, rivers and streams, and even extinction of animals and plants.

When soil is washed away by rain and wind, large-scale erosion might occur (gullies). They degrade the soil and cause enormous damage to properties, silting rivers and streams, contaminating them in case pesticides and fertilizers are washed in by rainfall. This all generates devaluation to these farms.

Sandy soils are more easily swept away by floods, while clay is more resistant. Some producers make things worse by cultivating crops not adapted to the land characteristics, planting them incorrectly, leaving the land unprotected by excessive deforestation, not controlling cattle trampling and the movement of machinery and vehicles and burning vegetation.

The steeper the terrain, more intense will be the floods. However, when the land is well managed and protected by vegetation, rainfall is buffered by leaves, falling gently on the ground and being absorbed by the soil.

In order to prevent or control erosion, one must choose the appropriate crops for each type of soil and land, plant in contour levels, use terraces, protect springs and waterways, and replant native vegetation.

On steep areas and hilltops, one should preserve original vegetation or plant trees, preferably native species. On slopes and less steep areas, the land can be covered with pasture or semi-permanent crops such as coffee and fruit trees, to lessen the effects of floods. The flat parts of the property are ideal for annual and semiannual crops. To impede surface runoffs, one should cultivate crops “downhill”. Planting lines should always follow the level contour. Keeping native vegetation around springs and waterways will protect them from the soil washed away by rains and mudslides. There are also other techniques to preserve and restore the soil and maintain

property value, such as planning the pathways leading to the fields, preventing damage to the soil and unnecessary costs having to change the routes. One should follow the natural aptitude of each type of soil for each region and prepare the land in a manner which is less aggressive, since excessive harrowing causes degradation and increases production costs. It is important to use hardy plant species that grow quickly in areas subject to erosion and grow plants that cover the areas during rainy season, using lime and fertilizers if necessary.

It is also important to focus on crop rotation, avoiding planting a single species in a large continuous area. Burning the harvest remains should be avoided. This material will help plants grow, giving a better yield in the following season.

Carry out crop rotation, avoid planting a single species in a large continuous area and do not burn the remains after harvesting

3.3 Pasture management

Rodrigo Amorim Barbosa
researcher at Embrapa Beef Cattle

The correct management of pastures extends its life and provides more forage for animals. Therefore, it is important to adjust the size of the herd to the capacity of the pasture area, in any type of management adopted. Animals will be ready for slaughter earlier when managed at proper stocking rates. These facts are often not taken into account by farmers, since eight out of ten pastures in South America have too many animals for their optimal production capacity.

The supply of forage will vary throughout the year in terms of quantity and quality, therefore, stocking rates must be adjusted according to these limits. Fertilizers and supplements should be applied on pastures at strategic times. Nutrients should be replaced according to soil analysis, in order to use the correct products and the right amounts, avoiding waste.

Open burning of pastures for restoration is still common in some regions of Brazil, but it may cause harmful impacts on air quality. It also reduces soil fertility and favors erosion. There is also loss of nitrogen and sulfur, among other nutrients that are released into the atmosphere or washed away by rain into rivers and streams. For all these reasons, open burnings require previous authorization from environmental agencies and should be done only in specific cases.

It is also essential to control harmful weeds, because they indicate pasture degradation, generally when inadequate or poorly managed forage is used. Avoiding excessive grazing and applying fertilizers will help preventing these problems. The use of pesticides is expensive and often times do not give the expected result, since in Brazil, a large number of different weed species can be found in a single area. Thus, herbicides will be partially efficient and commercially valuable species will be put under risk.

Today, the welfare of livestock herds is increasingly valued by producers and consumers, not to mention that healthy animals produce more and better. It is essential to provide them with clean water, high quality nutritional supplements and distribute water sources throughout the pasture to facilitate their access, avoiding long walks. Besides that, it is necessary to provide shade for livestock, in both extensive and intensive production systems.

Applying fertilizers and supplements on pastures, after carrying out soil analysis, helps preventing degradation of pastures

3.4 Restoration of degraded pastures

Ademir Hugo Zimmer and
Manuel Claudio M. Macedo
researchers at Embrapa Beef Cattle

Pasture degradation is a major problem in the Brazilian cattle industry, which directly affects the sustainability of the production system. Due to the large area occupied by commercial pastures, the impacts of their degradation cause loss of soil and affect the quality and quantity of water available and also reduce the ability of carbon sequestration and conservation in the system. Livestock production is less efficient in degraded pasture, thereby increasing the final amount of gas emitted per kilogram of beef produced per hectare every year. This generates unnecessary greenhouse gas emissions, which cause global warming.

The degradation process begins with the loss of pasture vigor and a decline in the amount of forage produced, reducing the stocking capacity of pastures and the weight gain of the herd. After that, infestation by weeds and pests starts, followed by soil degradation.

The main causes of pasture degradation are excessive stocking rates and incorrect pasture management, open burnings, lack of soil correction, no nutrient replacement, inadequate species or species not adapted to the climate and soil type. Pasture degradation results in reduced forage production and decrease in animals' weight gain. In more extreme cases, it can result in soil and environmental degradation. Burning pasture can generate losses of more than 50% of its production capacity. Inadequate soil preparation, lack of conservation practices, use of improper planting techniques, and use of poor quality seeds of unknown origin at the start of pasture formation can result in rapid degradation.

Restoration must be preceded by a technical evaluation that will indicate the practices to be adopted after a diagnosis

of the property and the winter quarters that take into account aspects of soil, pasture and the animals themselves. The restoration can be carried out directly by applying lime and fertilizers on pasture surface, or indirectly, by cultivating annual crops such as millet, grazing sorghum, oats, etc. Another possibility is the cultivation of grain crops such as rice, corn, grain sorghum, soybean, etc. These crop-livestock integration systems result in high-yielding pastures, with high animal performance and benefits in grain production. After restoration of grazing pastures, it is important not to make the same mistakes that led to its degradation in the first place. In most situations, only pasture restoration is not enough to maintain productivity. There is therefore the need for periodic maintenance fertilization in order to maintain levels of soil fertility. Moreover, it is extremely important to manage each forage plant correctly, observing grazing height according to their growth habit and the management system to be adopted. For example, the Marandu, Piatã and Xaraés grasses should be kept at a size between 20 and 35 cm. *Brachiaria decumbens* should be between 15 and 30 cm and *Brachiaria humidicola* as well as Tifton grass should be between 10 and 25 cm. As for the Tanzania grass, it should always be managed between 30 and 60 cm and Massai grass between 25 and 40 cm.

More specific information on ideal grazing height can be obtained directly at Embrapa Beef Cattle or technical assistance institutions. With proper management, more forage will be produced and grazing areas will last longer, generating better weight gain.

These actions will decrease losses of soil and water, protect water springs and add value to properties. It is important to note that well managed pastures increase their capacity for carbon sequestration, due to more organic matter being available on the soil. Besides that, improvement in animal performance results in reductions of methane emissions by their organisms, thereby contributing to minimize the effect of greenhouse gases.

Adjust the size of the herd to pasture capacity for all types of management

3.5 Crop-livestock-forest integration

Roberto Giolo de Almeida and
Valdemir Antonio Laura
researchers at Embrapa Beef Cattle

The growing global demand for food, timber and biofuels, as well as restrictions on opening new areas for livestock farming and the prevention against deforestation of native forests all indicate a trend of crop fields and planted forests occupying pasture areas, especially the more degraded ones. In this context, emphasis has been given to the development of crops-livestock integration systems and, more recently, crop-livestock--forest integration (CLFI).

Due to its greater complexity, before implementation it is essential to assess the conditions of the regional and local production system and market regarding the availability of inputs, machinery, manpower, services and trade possibilities for products, especially forestry ones.

However, with proper management techniques, these systems are extremely efficient in the use of land and resources available.

Therefore, crops should be chosen based on their importance and suitability to regional climate and economy. Other important factors when choosing crops are the local cultivation traditions, availability and cost of seeds and seedlings. Trees to be planted should be well adapted to local conditions, showing quick growth, quick enough to have treetops out of animals' reach within two years of planting and enough trunk girth as to resist mechanical damage.

Tree rows should be organized to favor soil and water conservation. Trees should be placed in contour levels and, if necessary, terraces should be used, planting in their lower third to avoid root damage and allow for water infiltration and free movement of animals. On flat areas, trees can be planted in single, double or triple rows and should be set in east-west direction.

Larger spaces between tree rows favor forage development allow for timber production at a larger scale. It also makes intercropping with other crops easier and longer, since there is less competition for space, light, water and nutrients. The soil must be well managed, with proper decompaction and fertilization of planting lines as well as control of ants, termites and competing plants.

The removal of lateral branches is important and should be performed before animals are introduced in the system. The selective logging is intended to reduce costs, increase the entry of light for forage and crops and improve tree growth.

Selection of forage for the CLFI systems should be based on their tolerance to shade. As for livestock, it will depend on the livestock system to be recovered or intensified. Animals of more productive breeds are recommended, keeping in mind that they should be well adapted to the region.

The main barriers to the adoption of CLFI for beef production are the high initial investment costs, especially for producers without access to credit, and the lack of knowledge on the part of producers about the benefits that planting forests can provide to their properties. Demonstration units of CLFI systems in use can be visited at Embrapa Beef Cattle, where experts are available for further information on the system. More information can be found at other units of Embrapa, following the link provided in section 5.

4 Summary of good practices

Water conservation	Preserve vegetation along rivers, streams, artificial and natural lakes, ponds, and water springs
	Build dams to keep the forests in their natural environment and use canals, pumps or pipelines to supply cattle with water as well as other uses
	Build wells and leveled contour terraces to ensure rainwater infiltration
	Build smaller dams to harvest water from rainfall
	Require environmental licenses to use water from rivers and wells
Soil conservation	Using crops adapted to each type of soil and plant them correctly
	Avoid deforestation beyond limits established by law and do not carry out open burnings, control cattle trampling and movement of machinery and vehicles

Soil conservation	Preserve vegetation in very steep areas and hilltops, cover slopes and less steep areas with pasture or semi-permanent crops
	Plan and maintain pathways leading to the fields, follow the natural capacities of each soil type and each region and prepare the soil in a less aggressive manner
	Carry out crop rotation, avoid planting a single species in a large continuous area and do not burn the remains after harvesting
Pasture management and restoration	Adjust the size of the herd to pasture capacity for all types of management
	Apply the adequate supplements and fertilizers in the proper amount, after soil analysis has been carried out
	Do not push for pasture restoration through open burnings
	Control and avoid the introduction of invading weeds, preferably without chemicals
	Distribute water sources, nutritional supplements and shading throughout the pasture, avoiding long walks

Crop, livestock and forest integration	Choose pastures, trees and animals according to the local and regional market and production conditions
	Plant trees in leveled terraces on steep areas, and on flat areas, plant trees in single, double or triple rows
	Manage, decompact and apply fertilizers on the soil, control ants, termites and competing plants
	Remove lateral branches and carry out selective logging
	Chose forage according to its tolerance to shade and chose animals according to the breeding system

5 Legislation and links

Integrating Livestock-Crop-Forest Programme (Embrapa)
http://ilpf.cnpms.embrapa.br/template.php?idcategorias=2

Brazilian Water Act (Law 9.433/1997)
http://www.planalto.gov.br/ccivil_03/Leis/L9433.htm

Regulation nr. 25, dated July 23, 2009, from the Ministry of Agriculture
http://extranet.agricultura.gov.br/sislegis-consulta/consultarLegislacao.do?operacao=visualizar&id=20542

Regulation nr. 56, dated November 6, 2008, from the Ministry of Agriculture
http://extranet.agricultura.gov.br/sislegis-consulta/consultarLegislacao.do?operacao=visualizar&id=19205

Guiding Principles of the World Organisation for Animal Health (OIE)
http://www.oie.int/es/

Brazilian National Water Agency (ANA)
http://www.ana.gov.br

Use crops adapted to each type of soil and plant them correctly

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