



Animals need shade trees to feel comfortable. Photo: Ana Primavesi

Optimising climate-soil-pasture-cattle interactions in Brazil

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In nature, nothing functions in isolation; everything depends on the other factors present. In animal production, to optimise the performance of cattle, it is very important that management practices try to enhance the ecological functioning of the web of living organisms within the production system - climate, soil and soil life, vegetation and cattle - by influencing their interactions. In this article we look at some of these interactions and how, in Brazil, they can be optimised in an ecologically sound way.

Adapting pasture to the soil and cattle to the pasture

Cattle breeding is a very expensive activity when the breed is selected first, then the pasture suited to that breed and finally the soil is corrected with lime and fertiliser to make the pasture grow. This order has to be reversed. The pasture has to be adapted to the soil and the cattle to the pasture, and all of it has to fit the climate. In the tropical climatic zone, European breeds should be used only for crossbreeding with zebu cattle. It is not the most productive breed that will give the best performance, but the breed that adapts best to the existing ecological conditions, climate, soil and pasture.

Increasing water availability for plant growth

Forage yields depend strongly on the availability of water. Especially in the dry areas of Brazil, improving permeability and the storage capacity of the soil can increase water availability. Covering soils with vegetation and its residues allows for better infiltration of rain water, improves the soil structure, and thereby increases its air and water circulation and storage capacity necessary for plant metabolism and efficient plant nutrition. In a well-structured soil, roots are able to explore

a larger soil volume for more water and nutrients. Plants can, therefore, develop better and faster and will be less affected by drought. Integrating deep-rooting crops and trees into the pasture system will further increase the production of biomass and the overall performance of the system.

Plants absorb water from the soil and transpire it. When the air is saturated with water vapour, plants cannot transpire any more. But when the wind carries it away, they absorb more water from the soil and transpire more water into the air, thus drying up the soil. In Brazil, in one year, wind can carry away an equivalent of 750 mm of the total rainwater. Planting of shrubs and trees as windbreaks can strongly reduce the transpiration of pastures and hence increase the available water for plant growth.

Enhancing micro-climate for comfort

When the surface temperature of tropical soils is higher than 33° C, plants cannot absorb water and nutrients any more. Deep rooting trees can act as air humidity and temperature regulators, pumping water from the subsoil, and releasing it through transpiration. Therefore the shade of trees is cooler than for example, the shade of a dry leaf roof.

An animal is not a machine into which forage is put in and milk and meat comes out. It is a living being that needs to be comfortable to produce well. Shade trees provide comfort to cattle. In the colder season it is 3 to 4° C warmer under the trees and in the hot season it is 3 to 4° C cooler. Pastures with at least 50 shade trees/ha allow a yield increase of 15 to 30% milk and around 20% meat. It is not only the quantity of fodder quantity or the energy consumed or the digestibility of the forage that matters; it is also the comfort that makes cattle produce well.

In Brazil, there is an increasing tendency to establish wind shelters and small shade forests to avoid water losses by wind and to improve animal comfort. In extensive systems with

cerrado (savannah) vegetation, the bushes and trees provide additional advantages, like the supply of forage and increase of biodiversity of forage species. This allows for better animal weight maintenance and even an increase, compared to monoculture grassland, also in the dry season. When new pastures are opened, with maintenance of bush and tree strips of the original “cerrado” vegetation, the grass grows faster and the productivity is higher, due to wind protection. *Embrapa Agrobiologia*, the Brazilian research centre on agrobiologia, near Rio de Janeiro, has developed an easy way to establish legume trees even on very degraded pastures, by inoculating the seedlings with *Rhizobia* and *Micorhizae* and adding a little phosphorus to the substrate. Organic matter production and accumulation in these soils is surprisingly fast. This works well as a pre-treatment for establishing forage plants

Grazing rotation instead of fire

The division of pastures into smaller sub-units for grazing rotation is fundamental to prevent grassland being destroyed by cattle. In native grassland, cattle always first eat the plants it likes most. The plants that are not eaten get old, hard and are not tasty. The eaten plants sprout again and are grazed on another time. This goes on until these palatable plants disappear. But the less appreciated plants continue to grow and multiply and with time the entire pasture gets hard, rough and has little nutritive value. Then the ranchers set fire to the pasture. Many plants die, and only those that can protect their growing points against fire survive. Thus the pasture becomes worse and the forage volume smaller. Eight consecutive years of burning, with one fire per year, is enough to decrease plant production to 25% of the initial. As only the hard, less palatable plants that cattle eat only when very tender are left, farmers burn the pastures up to five times per year. Thus all organic matter that nourishes soil micro-organisms is burned out, resulting in their death. The soil compacts, water runs off and the vegetation gets scantier.

All perennial plants need a rest period to recover the reserves in their roots, which are needed for re-sprouting. Forage plants and weeds recover their root reserves only when they bloom. Grasses need to bloom and form seeds once a year. This makes pastures more resistant to droughts and low temperatures and warrants vigorous re-sprouting. Ranchers say: “rest for a pasture is as good as irrigation”. Forages cannot always be grazed when it is best for the cattle. Sometimes they have to rest to recover their forces. In Brazil, rotative grazing is getting more common under better-controlled conditions, using electrified fences, sometimes powered by solar energy.

Integrating leguminous forage plants

In Brazil, 70% of the pastures are of *Brachiaria* (*decumbens*, *brizantha* or *ruziensis*), and 80% of the cattle are improved *Bos indicus*, this is zebu, mainly of the Nelore breed. *Brachiaria* is an African grass with very active *Micorhizae* fungi on its roots which give it a high degree of adaptation, productivity and efficiency of phosphorus absorption and use. The main problem is that it is planted in monocultures. In more fertile soils, *Cynodon dactylon* cv. Coastcross and Tifton, and different cultivars of *Panicum maximum* (Tanzania, Tobiatan) and *Pennisetum purpureum* (Elephant grass) are used.

Grass-legume mixtures are rare because the tropical grasses are very aggressive when supplied with nitrogen. Pasture with soybean rotation is more common. After 3 to 4 years of *Brachiaria brizantha*, soybean is direct seeded into the desiccated pasture. The nitrogen input by soybean improves the growth of *Brachiaria* grass, allowing an increase of the stocking rate from the national mean of 0.5 Animal Units (AU)/ha up to 3 AU/ha. Nitrogen-fixing legume shrubs and trees like *Cajanus cajan* or *Leucaena leucocephala* and other fast growing species are introduced in semi-intensively managed pastures for protein rich forage.

Eliminate nutrient deficiencies

Tropical grasses have a very high biomass production potential, but need a good water and mineral supply. But cerrado soils, for example are acidic and poor, especially in calcium, magnesium, phosphorus and potassium. The major nitrogen sources are nitrogen-fixing leguminous plants, cattle manure and synthetic nitrogen fertilisers. Small doses of phosphorus (35 to 42 kg/ha P_2O_5) are needed to guarantee the development of forages. Phosphorous-deficient, decumbent grasses like *Brachiaria*, don't form stolons, have a shortened vegetative cycle, bloom early and produce little biomass.

Cattle also need phosphorus. Insufficient phosphorus in the pasture lowers milk and meat production and makes cows sick. It happens specially when pastures have old, dry forage, or when the soil is compacted by overgrazing and forage roots cannot penetrate the surface layer of the soil. It can be completely avoided by applying phosphate fertiliser or giving cattle mineral salts.

There also can be other nutrient deficiencies, which affect animal health, like that of calcium causing a kind of “grassland tetany”. This can occur especially in *Brachiaria humidicola* pastures, but also in young, vigorously sprouting grasses or in very compacted soils.

Magnesium-deficient zebu cattle are very nervous and aggressive and the heifers do not develop well. Cobalt, extremely deficient in the Amazon region, is the mineral which is most lacking in Brazilian grassland. Young animals are meagre, gloomy, without appetite but gnawing at tree barks; they lose the hair from their tails and have a scrubby hide. In all cases mineral salts are very important to compensate for the mineral deficiencies and to keep the animals healthy.

Parasites and diseases

One of the biggest problems in tropical cattle breeding is parasites, mainly worms, ticks and bots. The horn fly becomes an increasing problem in flogs treated against parasites with injectable *Ivomectin*. This is because the beetle that eats the larvae of the fly in the cattle excrements is also killed. With rotational grazing and a pasture with 20-25 % legumes, the worm problem can be practically controlled. Tick attacks are mostly seen in European cattle that have a thinner hide. Zebu cattle are rarely affected. The problem of bots can be resolved by selecting the bot-resistant animals and selling the affected ones. Normally, “sweepers” (animals with no respect for fences, grazing anywhere) never have bots.

Towards “green meat” and “green milk”

To prevent ‘global climate change’ by ‘greenhouse gases’, it is important to reduce methane emission by cattle. This obliges farmers to speed up animal production per unit area and to reduce the slaughter age to get a lower ratio of kg methane/kg animal protein (meat). The use of grains for animal feed has to be reduced as well, giving priority to human consumption. This then increases the dependence on forage. But, as grass cellulose is the main source of methane emission, management practices that contribute to an increase of forage yield per unit area and maintain stocking rate without weight losses, all year long, are needed. Profitability, competitiveness and sustainability of the production system will be thus increased whilst reducing the negative impact on the environment.

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