Global Agenda for Sustainable livestock production

Restoring value to grassland

Rogerio M Mauricio

Case study - Natural regeneration of native trees for the implementation of silvopastoral system for cattle production in Brazil

Introduction
In north of Brazil, following deforestation and pasture seeding and establishment, different types of trees or bushes regenerate from seedbanks that remain in the soil after deforestation or even through wind or animal seed spreading. There are several trees and also bushes that can grow together with grasses. Essentially the success of this natural regeneration process depends on the shape and density of the canopy of trees. If the canopy does not intercept all of the sun light (less than 50%), the resulting mix can be useful for the grass and cattle. Therefore, the first step to start this system, is to identify those trees species that allow for an open canopy. Secondly, a change in the pasture management is required to allow growth of young trees and bushes. Normal or traditional practice is for farmers to cut all of the young trees and bushes to leave the grass as a monoculture. After some years, selective cutting of some trees or bushes in densely planted areas is often necessary.

Local situation
The Mona Lisa farm has 3.000 ha, dedicated to the production of beef cattle maintained on silvopastoral system composed by native trees, shrubs and grasses. The Mona Lisa farm is located at the west of the state of Maranhao, 45 km from the city of Imperatriz, Brazil (latitude -5.214593º and longitude -47.400311, elevation 320 m). The tropical climate is classified, according to Köppen and Geiger as Aw (tropical climate, savannah, rain season is concentrated during summer). The average rainfall in 2016 was 1230 mm, with the rainy season from October to April, reaching the top in the first three months of the year, being 240 mm per month. During the dry season the minimum precipitation reaches 8 mm. The average annual temperature was 26.4º C with variations of 1.3º C.
Implemented actions
Our objective is the development of sustainable livestock production in the state of Maranhao/Brazil using natural regeneration of native trees for implementation of silvopastoral system. Already regeneration has occurred on around 800 hectares and is adding value to the livestock system. This natural regeneration process is applicable to small or big scale operations according to the capability of the farmer.

![Natural regeneration process (2005 to 2016)](image)

Results
Since the silvopastoral practices was adopted at Mona Lisa farm, the profit from the livestock system has steadily increased in comparison with traditional monoculture systems based exclusively on Brachiaria. The resulting high biodiversity, fauna and flora from silvopastoral practices has positively changed the farm landscape, which has enhanced soil conservation, forage biomass and animal comfort. These are the facts that push farmers for the silvopastoral practices direction.

Social – one important point is related to the happiness and enthusiasm of the farmworker due to the higher biomass produced in the silvopastoral system which gives security for cattle nutrition, an important value. The better income promoted by the silvopastoral system also gives financial stability to the farmer and consequently to the farmworkers which promotes a better social security.

Economic – if there is a system that promotes greater forage biomass production throughout the year, the economic stability is improved and also the profits. In practical terms, silvopastoral system allows higher stocking rates and more beef production per hectare compared to monoculture forage system. This system can provide opportunities for economic diversification (e.g. wood, carbon and also tourism).

Environment – the environment benefits generated by silvopastoral system are related to: higher biodiversity that provides the service of increased biological control of insects (e.g. spittlebugs) and enrichment of fauna and flora; and increased carbon sequestration by trees. In addition, the shade from the trees provides a reduction in temperature (3-4 degrees lower on the tree shade) which is important for animal welfare allowing thermal cattle comfort in the tropics and higher productivity. Trees also provide a natural source of organic matter, phosphorus and potassium which reduces the need to use chemical fertilizer for grasses. These environmental services could be quantified to inform policy in development of payments for economic services.
Mahanarva spectabilis before and post fungus parasitism (fusarium genus)

References


REIS, Guilherme Lanna; LANA, Ângela Maria Quintão; MAURÍCIO, R. M.; Lana, Regina Maria Quintão; Machado, Rodrigo Matta; BORGES, Iran; Neto, Talmir Quinzeiro . Influence of trees on soil nutrient pools in a silvopastoral system in the Brazilian Savannah. Plant and Soil (Print), p. 111-117, 2009.


VIANA, V. M.; MAURÍCIO, R. M.; MATTAMACHADO, Rodrigo; PIMENTA, I. A. S. . Manejo de la regeneracion natural de especies arboreas nativas para la formacion de sistemas silvopastoriles en la zonas de bosques secos del surestes
1. Helping you think more holistically about the design of your case: could you give us an example and results of how you have done this.

Background - This case study started around 15 years ago when a group of farmers from the north of Brazil attended a lecture which silvopastoral system was explained for them by myself. One of the farmers invited me to visit his farm (Mona Lisa farm) and at the end of the 3 days he decided to start a silvopastoral system. However, our approach was not based in tree seeding which is expensive and high labour demand, we decided to develop a natural regeneration of native trees in most of the pasture lands. Why? Because it is easy to do (just do not cut most the young tree plants) and cheaper (no seedling). In 2011 during “The Brasilia Consensus” and the “First Global Multi-Stakeholder Meeting on Sustainable Livestock” I presented the results from Mona Lisa. I believe that is was the beginning of my thought to design our case study for AN2.

After our participation during the model concept and development workshop (CIRAD Montpellier) I realized how important is the model to consider all the dimensions that are involved in grassland system. Surprisingly I also accomplished that I already had thought of these dimensions in the last 15 years ago as described above. As a conclusion, the model reinforced the importance of thinking in 4 dimensions and that silvopastoral system could be one important approach to fulfil these dimensions.

2- Working team

We start the work including a farmer (veterinary) and myself (agronomist & animal scientist). However, as science naturally involves different areas of knowledge other colleagues came to the team (Biologist & entomologist). Even that, as the results started to appear, we are realizing that we need to add people from other areas as modelling, economic and social science.

3- Adoption of some of the indicators Indicators from my study case

In this section I identified several “holistic” indicator from our case study that could describe the impact of changes to the working practices of the farm during the years of work. Sometimes they are reflecting our “holistic philosophy” and consequently the importance of each one. We clustered them according to the four dimensions:
### Social dimension
- Farmer & farm worker happiness
- Succession (father to son)
- Culture values

### Environment dimension
- Biodiversity (fauna & flora)
- Land degradation
- Water use
- GGE from cattle

### Local development dimension
- Farmer income
- Distance to the town

### Production dimension
- Animal production (Milk yield & Calf production/year)
- Biomass production & quality

However, there are other indications that can describe the synergies between and among dimensions that we are identifying and could be included in the list:

- Number of visitors that came to visit the farmer; this indicator reflects the interface between Production (high beef production that attracts farmers), Local development and Social indicators.

- Payment for environment services; this indicator is not only related to the environment but also to the whole farm (Production, Environment and Social dimension).

- Number of research studies or interface between farm and universities; this indicator could relate Production and Environment according to the approach used in each study.

4- Also you thought it would help you with analysis of your case data again please provide an example and results.

Even if the model is an important tool to analyse the impact of grassland system in each dimension in future or even now the model could analyse the interface or synergies between dimensions. These synergies should be included in our next analyses to maximize the use of the model.

5. The development of a simulation model was also another way of using the ontology to test impact of grazing system changes. Please if you could explain why you think a simulation model would help you and for what purpose.
Why a simulation model could be used to test grazing system? I will explain using examples:

- In our case one important output after implementation of silvopastoral system in the farm was the increasing amount of forage biomass, including grasses, shrubs and small trees used for cattle nutrition. In this specific case, the model can demonstrate that if we take out the bushes and trees from the system (as usually farmers do in South America) immediately the feed available for cattle will be reduced, the livestock liveweight gain decrease and also farmer income. In addition, the synergy of this action will impact the CO₂ and CH₄ emissions which will increase in response to the “deforestation” process. On this example not only the four dimensions are impacted independently by this action but also clearly will see interactions between dimensions that can upgrade the results in different ways.

- The welfare concerning are increasing around the world. If we take out the trees from the grassland system described above, we can increase the temperature in 3 to 4 degrees which impact the thermal animal control and losses of metabolic energy and low liveweight gain and income. Therefore, it is other example that could be taken from the model in terms of dimensions impacts.

- The model using four dimensions amplify the perspective of students regarding to the values and impacts of grazing system in terms social, local development, production and environment. I also think that it could be applied by local the extension services which has interface with the University. I would like to arrive at police makers level to demonstrate how the rules/laws could be enhanced according to the impacts on the four dimensions. However, it has long way to be achieved.

6. We also thought the ontology would be useful to share with others who are not familiar with grazing livestock systems. Could you tell us whom these people might be and how you plan to work with them using the ontology.

Firstly, the environmentalists or people in charge of environment protection (governmental agencies and people in charge of land policy) who does not know that we can conciliate animal production and environment services in the same farm or landscape. How to plan to work? Answer: workshops (academic or not), meetings (key persons) and as a member of GASL and representing Brazil (it is part of my responsibility to transfer the views/ideas from the GASL to Brazil). I have on May at the Ministry of the Environment and could be one opportunity.

Brazil and other countries have a strong agribusiness enterprise which sometimes are not familiarly with secondary impacts of the activity (e.g. negative impact on the
environment). Therefore, before any governmental credit or even technical benefits (e.g. extension services which do not consider the impacts of agro techniques on the livestock sustainability principles) the availability of then (money or technique) should be linked to the positive or negative outputs in the four dimensions. In this specific case the model would be extremely helpful to preview interactions and scenario.

7. Finally it was noted that this would be a good tool for teaching students. Could you please give examples of how you might introduce this into a curriculum or teach.

As a lecturer on sustainable ruminant/livestock production in the tropics, the simulation model would be an important tool to explain the interactions of grazing systems with the four dimensions. In Brazil, in most of the university courses (vet or zootecnists) lectures are based on techniques to improve animal production (milk or beef) and they are not too much concerning about the interactions with society or environment. However, the model clearly state the importance of interactions which are related to the main world problems like climate change, food security and environment conservation.

Acknowledgements:
Global agenda for sustainable animal production
Agriculture research for development - CIRAD
Agresearch
Research center for sustainable agricultural production systems - CIPAV
Federal University of Sao Joao Del-Rei - UFSJ
Brazilian sponsors: FAPEMIG-PPM, CNPq, CAPES
Brazilian and international farmers