

The Savanization of Brazilian Agriculture!

perceptible everywhere, a limitation to good management

No matter where we are, there is always a 'problematic tropical grass', competing with our cultivation, costing effort and money. This grass did not always exist, but it was arriving and changing the "face" of our landscapes, occupying a space that would be of other plants. Here we will examine this forthcoming and some consequences of it.

1. Initial warning: the focus is local, regional - NOT "macro"!

The focus given by biology/ecology to the concept of Savanization is "macro", evolution, involving the physiognomy of large landscapes, with a special look at the biomes. In these sciences, Savanization refers to the substitution of forests by a vegetation of low size due to major events: a prolonged exposure to fire, year after year OR major changes in the climate regime, forcing the regression of the forest to savanna.



macro mapping: biomes/old

The focus given to the Savanization of Agriculture is "on my fields" and tangible, is the daily agriculture. In a smaller context than the previous one, it refers to the introduction of forage grasses mainly from the African Savannah, for pasture planting. Species that generate a profusion of seeds and rhizomes and that make these efficient weeds, **invasive plants** of all crops. It is necessary to understand the concreteness of the arrival of these "savanizing invaders" and how they begin to inhibit and replace a set of spontaneous plants (the broadleaf weeds), composing the agricultural landscape with savanizing monocultures and reducing agrobiodiversity.



Green panic grass in the agriculture school ART

Glossary:

Grasses = plants of the family of Poaceae, *sprawling* monocots that propagate spontaneously, invading the "biological emptiness" that remains after the removal of the forest. Efficient in the formation of pastures, however of great aggressiveness in the invasion of crops.

Broadleaf weeds = plants of several botanical families, dicotyledonous, endowed with excellent multiplication strategies, however inhibited by grasses. Essential part of the desired regenerative agrobiodiversity.

Biological emptiness = great loss of biological diversity in microbiology or landscape.

Agrobiodiversity = Biodiversity of the agricultural system. Including plants, animals, microorganisms and human action. It is obvious that plants take on a central role, from the 'cornerstone' to animal biodiversity, microbiology and human activities. That's why they're such key partners.

2. Forests in Brazil: (most) landscapes and biomes were non-savannah!

The Brazil discovered by the Portuguese was mostly forest, as described by Geraldo Leme da Rocha, from the Animal Science Institute.

"The vegetation of Brazil at the arrival of the white man at the end of the fifteenth century was characterized mostly by forest formations. These, in their different climax manifestations, make up about 89% of the national territory, thus divided: forests 61% (equatorial, tropical and subtropical), cerrado (declining forest by yearly fire) 20% and caatinga (semi-arid biom) 8%; the remaining 10% approximately, were occupied with grasslands formations (39)", (Rocha, G.L. da, 1988). In this beautiful work of rescuing the history of the arrival of grasses, Geraldo Leme da Rocha quotes and describes the arrival, one by one, through facts and dates that have some record for each species of grass.

[Link to full text:](#)



mata ciliar Araguary 1906. Source: Family file

<https://www.scielo.br/j/aesalq/a/6qLk6WsPNPGsbzkqXmSXHyB/?lang=pt&format=pdf>

The weeds were arriving without any plan, first in the Slave Ships, by ways of this sad chapter of inhumanity, where they formed the bed in the basements of the ships, disembarking and disseminating with the people transported there. Then they were emerging in the farms of the Brazilian hillside as a spontaneous phenomenon, arousing the interest of the Portuguese landlords for its forage qualities. Finally they gained ground with the expansion of livestock, when they were replicated and intentionally replanted. In the deforestation that opened up the land for sugar cane and coffee, there was already talk of the 'pasture formation'. In the fields invaded by the grasses, these tenacious competitors were weeded.

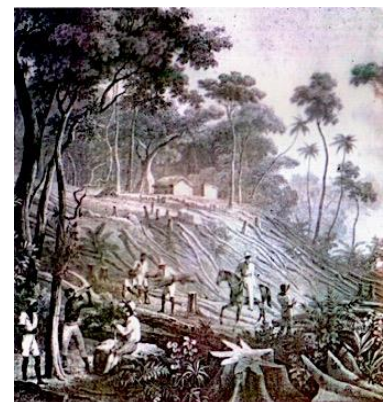
Spontaneous concept: savanization of productive areas = spreading of grasses, as pastures and as insistent invaders of all crops.

3. Felling of the forest: the first tillage over trunks

The felling of the forests was done "on the axe", followed by burning. Commercial crops (cane, coffee, cereals, cocoa) were planted on the ash of the stump swidden, reaching high yields for two main reasons:

a- Corrective effect and fertilizer of the ashes, leaving the soil with the availability of nutrients very high, but for a short time. Declining in the years to come.

b- Absence of grass, competitors of commercial crops. Crops could develop freely, without the effect of weed-competition and grass-inhibiting allelopathy on commercial crops.



swidden, Atlantic Forest, XVIIIth century.

Glossary:

Stump garden = open clearing in the forest, aiming at cultivation of cane, cereals, coffee, cocoa...

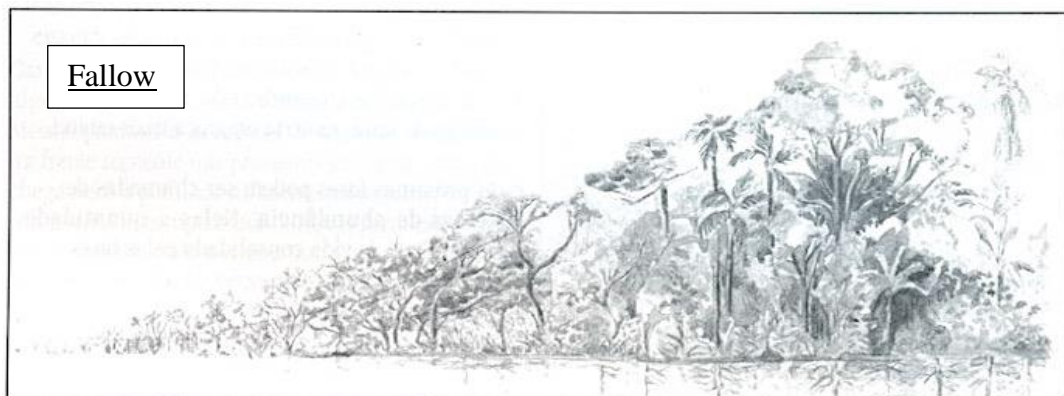
Weed-competition = **dispute** of production resources (water, nutrients, light etc.) between the commercial crop and the invasive plants. Usually overcome by the bush = grasses, the crop is only saved by weeding or the use of herbicides.

Allelopathy = biotic action of one living being on the other/ of one plant on the other, favoring (positive allelopathy) or unfavorably (negative allelopathy) its growth. Grasses inhibit the growth of commercial crops, and inhibit the growth of the broadleaf bush.

4. Evidence at the establishment of coffee plantations

Reports of the pioneering time of coffee are forceful: "it was planting and harvesting". "I didn't have that weeding". It was harvested from 50 to 60 bags of coffee!! Absence of grasses favored the cultivation of coffee, grown on "strong lands", recently deforested. When the lands became weak, they became "tired", the grasses were introduced to transform the plot into pasture. And the coffee moved, to be planted in another recently deforested land.

Fallow: as an alternative to pasture, the land was allowed to rest for 10 to 20 years, in fallow, regenerating a secondary forest, the return of the trees, and then felling, burning and starting another cycle. Also called "shifting cultivation", practiced by small farmers, squatters, and taught to them by the indigenous people of each region.



natural succession: protagonism of herbs, shrubs and trees (a way to ensure the return of trees)

Glossary:

Fallow = tired swidden was abandoned, for forest regeneration and overcoming of the savanna stage by natural succession. Like in secondary forests.

Shifting cultivation= Itinerant agriculture. It is the rotation of areas of cultivation with others in fallow, establishing a relationship around 3 years of cultivation for 9 to 12 years of fallow, sufficient to regenerate the soils and start another cycle of planting.

Return of trees = natural phenomenon of reestablishment of a forest by autodynamical process of reinstallation of trees of natural succession by seed bank in the soil or rain of seeds coming from nearby matrices.

5. Introduction of grasses by colonization

The center of origin of most forage grasses in Brazil is the African continent. From the detailed description that Geraldo Leme da Rocha does in his work, we will follow some steps, well summarized.

The felling of forests for the installation of pastures, provided for the exploitation of the area with the cultivation of cereals. It was up to the corn crop, for example, to provide protection against excess sun and rain for the newly planted grass seedlings. From February onwards, after the harvest, the corn withered and let in more solar radiation to force the grass.

As the felling of native vegetation for coffee plantations was often outsourced, it was provided a contract for the exploitation with cereals for a few years, while establishing the coffee culture. The cultivation of coffee followed for years until the land was "tired", being replaced by pasture for the cattle.

6. From grass to competitor, to aggressive weeds!

And that's how the grasses were taking over the Brazilian rural landscapes. One by one they were introduced and tested, allowing them to spread without limits, invading the crops, becoming competitors, allelopathic inhibitors of the crops. Biological vectors contrary to productivity, with high cost of elimination.

Eco-physiological concept = grasses protagonize the establishment of pastures = planted savannas = grasses are efficient invaders of cultivation areas = a nightmare to the farmer, a high cost of production!



looks like pasture, but is a tillage!

7. Species introduced "by chance"

According to the formidable *Geraldo Leme da Rocha*, 1988, we have 5 centuries of colonization that are so marked in relation to the introduction of African grasses:

"The grasses that predominated with almost absolute exclusivity until the 1930s and 1940s belong to the following species: molasses grass - *Melinis minutiflora*; "colonião", Guiné grass - *Panicum maximum*; Jaraguá grass *Hyparrhenia rufa*; Angola grass - *Brachiaria mutica*. The Kikuyu grass, *Penisetum clandestinum*, introduced in 1923 (46), would be restricted to sub-tropical/temperate regions."

The Guinea grass (*Panicum Maximum*) would have arrived in the middle of the eighteenth century to the Bahian slope, however there are reports of its presence already in the seventeenth century in Central America and in the mid-sixteenth century in Salvador, BA. Very early, then, we have to admit.

Capim-Angola (*Panicum purpurascens* / *Brachiaria mutica*) has arrival references at the same time as Guinea Grass, going from the mid-sixteenth century in Salvador, BA to the eighteenth century/ early nineteenth century in Rio de Janeiro.

The Jaraguá Grass (*Hyparrhenia rufa*) was introduced in time after the Angola Grass, already in the eighteenth century, coming from the coast of Angola, and endowed with noted aggressiveness in its establishment.

The fourth grass to land in Brazil was the molasses grass (*Melinis minutiflora*), dating the first safe descriptions of the early nineteenth century, in the estates of Rio de Janeiro and Minas Gerais.

8. Grass or Weed? The Protagonism is the same!!

Along with a fifth, the grass of Bermuda (*Cynodon dactylon*) these four grasses gave account of the first pastures of Brazil, also invading the crops and giving work in the "weeding" of them. More ahead would come others, even more efficient, giving even more work. And savanization expanded his repertoire, gaining all terrains.

9. Intentional introduction of new grasses

The so-called grass cycle, which began at the beginning of the 20th century, brought to Brazil the search for a miraculous grass that could grow in depleted soils and provide quality forage, saving Brazilian livestock.

In the 1920s, it was the turn of the Kikuyo (*Penisetum clandestinum*) and elephant grass (*Penisetum purpureum*) to arrive in Brazil. This last managed in zero-grazing plots.

In the 40s and 50s we had the introduction of Pangola grass (*Digitaria decumbens*), of good performance in the early years, but highly vulnerable to various pests.

In the early 60's it was the turn of the genus *Cynodon spp*, with the cultivars Coastal bermuda, Coast cross and star, very popular in Rio de Janeiro and the Paraíba Valley. All of them with a good vocation for dairy farming and also making hay. And terrible spreading weed!

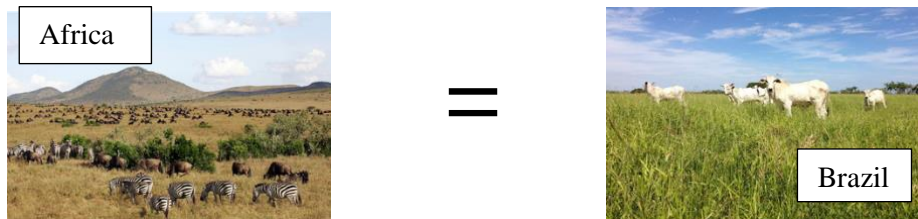
Perhaps the most notable introduction and of greater repercussion in all agriculture was the arrival of the grasses of the genus *Brachiaria spp*, in the 60's, 70's and 80's. Beginning with *B. Decumbens*, then the genus *B. ruziziensis*, *B. Humidicola*, *B. brizantha* and *B. arreata*. The *B. Humidicola* was nicknamed *Kicuyu of the Amazonas* and settled very well in the humid lowlands. All *Brachiarias* brought the capacity for good growth in soils with short, fixed, unavailable phosphorus, our typical tropical soil. But they also responded well to pasture reform by multiplying the supply of forage to cattle. They were protagonists in the introduction of several rational management systems, from the "rotated in wide pickets" to the *Voisin* Grazing Method.

10. Arrival of grasses in each crop = savanization!

Procedural concept = the arrival of grasses allowed the expansion of pastures and the multiplication of herds. However, he brought to Brazil the savanization of farmland. It is necessary to examine the parallelism between the NATURAL = CULTURAL systems to understand the niche occupied by grasses in Brazil. See:

African Savannah Main Vectors:

- Seasonal rainfall regime, with a marked dry season (drought). Fire.
- Huge herds of ungulates (animals with hooves). Trampling of the soil.
- Intense trampling on tree-shrub seedlings. No forests, compacted soils.
- Grazing of tree-shrub seedlings, inhibiting the return of trees.



Main Vectors of Brazilian Pastures:

- Seasonal rainfall regime, with a marked dry/cold season (off-season). Fire.
- Huge herds of cattle, practicing overgrazing (excess of animal load).
- Intense trampling of the shoots of the forest. Compacted soils. Monoculture.
- Grazing/mowing of tree-shrub seedlings, inhibiting the return of the forest.

Systemic operational concept = grasses are very well adapted to:

- Soils of intense trampling, whether by hooves or by wheelsets (tires).
- Constant cutting of the aerial part, by an animal, a brush-cutter or by the herbicide.
- Soil depleted of organic matter and burnt frequently. In these soils the grasses find little broad-leaved bush and settle uninhibitedly.
- Deforested production systems, completely open, "full sun", no shade.

Systemic Result = The result of the combination of these factors is the rapid installation of a savanna, which then remains, resilient, for a long period, demonstrating the "savanic autodynamic" of stagnation at a low level of biological productivity! We must understand this inertia, which is no fatality.

11. Savanization = reduction of agro-biodiversity

The arrival of the grasses to the swiddens and crops, ends up decreasing the variety and presence of the so-called broad-leaf weeds. Grasses exert an inhibitory effect on spontaneous herbal and bushy plants, by the process of "negative allelopathy". Over some cycles, the grasses inhibit and muffle several species, in a context of successive reduction of agrobiodiversity, biological soil impoverishment, a classic reductionist process of conventional crop management.

12. Animals/competitors indicators of low agrobiodiversity

Nematodes (microscopic worms)

I know organic guava orchards, with the classic management of the "mowed street " by the tractor, which have serious problems with nematodes, serious pests of *guava* roots. The monoculture of grasses ends up conditioning the lack of natural enemies of nematodes, generating a competitor that did not exist before and that depresses the productivity of the orchard. Similarly, other fruits and vegetables may have the same problem with nematodes = a result of LACK of agrobiodiversity.

Solution? Cutting the bush/weed when flowering (higher), facilitating the arrival of broad-leave weed, as well as planting green manures in the middle of the "street" and projection of the canopies. This multiplies biodiversity by creating the natural enemies inhibited by the agricultural savanna.



Nematode trapped in fungus trap

13. Savanization of Agriculture: perpetual phase?

The agricultural savannah is maintained because of some trapped vital processes. We can call them savanna maintenance vectors or "savanna autodynamics". A comparison of the African savannah with the so-called "agricultural savannah":

Vectors	African Savanah	Agriculture Savanah
Vegetation?	Monoculture of grasses	"Monoculture" of grasses maintained by *management.
Soils?	Intensive trampling	Intense trampling (tractors), 2 to 4 times / year.
Seasons?	Rain / dry season / fire	Cultivation / offseason, spreading of grasses.
Fertility?	Manure + urine of animals	No regenerative fertilizers, only commercial ones.
Forest trees?	Few trees, full sun.	Cleared areas, monoculture crops, full sun.

*Management = mechanical mowing (brushcutters) or desiccation with herbicide.

14. Autodynamics, how it can be understood?

What comes to be "Autodynamics" of a landscape physiognomy, of a phyto - sociological set, of a predominant "team" of plants? I first heard this term from *Ernst Goetsch* in 1987. He was referring to the **autodynamics** acquired by his agroforestry: after a series of investments in the succession of pioneering, transitional (secondary), lignin accumulation and the luxury system (or climax) belonging plants, the "plants of the future" were implanted very early, a clear evidence of AUTODYNAMICS = the system needed few interventions to continue evolving, developed by itself. **Here the autodynamics favored the transformation, the evolution from one stage to the next.** As in natural forests.

Savannical Autodynamics even in Stagnation. Intuitively I understood this concept and realized over the years how much it was alive and true, even for systems that brought stagnation. As in the case of savannical agriculture, stagnant in an herbaceous *stratum*, less biodiverse and very costly for the management of agricultural crops. Here the savannical autodynamics favors the suffocating presence of savanna grasses in all crops, cultivated or abandoned (temporarily), determining just the opposite: a total lack of transformation and

evolution. Savannical Autodynamics = no matter how much it is fought, it remains, "*Brachiaria spp.* will be there", waiting for us in the next cycle.

15. Eco-physiological advantages of Grasses / ability to compete!

The phytosociological predominance of grasses has its reasons:

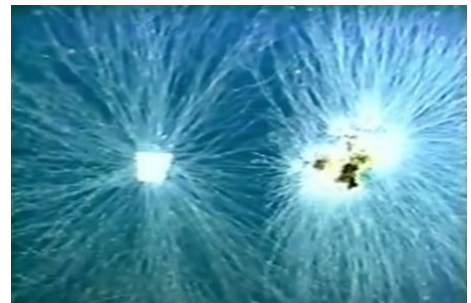
- First, the profusion of seeds, rhizomes, stoloniferous and others.
- A fasciculate and inhibitory root system, occupying a large volume of soil.
- The ability to live with low nutrient content (phosphorus unavailable, - Ca - Mg).
- Rapid growth, rapid regrowth in conditions of full sun (no shade).
- Excellent adaptation to the condition of drought, frequent water restriction.

OTHER INVASIVE SPECIES

We know that there are other species that are not grasses, native and also exotic, very difficult to control. An example is purple nutsedge (Cyperaceae), about which we already have experiences of weed-competition and suppression as well, it will be reported in another text.

16. Negative allelopathy, how does it happen?

There are several studies showing how allelopathy happens. One of the most classic is that of the two fungi, in Petri dish, establishing each one its zone of domain, limited by the zone of domain of the other. The "loud there" communication of each fungus is made by exudates released by the hyphae penetrating the agar mass and communicating to the other species that it will not be able to advance.



Two fungi: each one ends where the other begins

Similarly, plants share a volume of soil and can exert influence on each other through exudates of their roots, substances released into the soil that act on the other plant in the phytohormonal inhibitor mode: high there! Stop growing!! But where can we observe allelopathic inhibition?

Anywhere, when the grasses are allowed to grow freely, the broadleaf bush is inhibited and decreases proportionally, in size and occupied area.

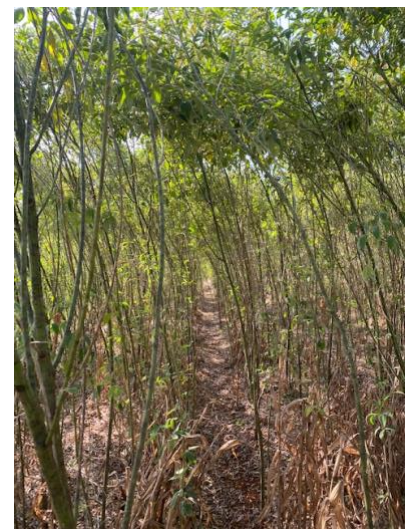
Opposite process: if, in a certain area, the grasses are weeded (selective weeding), immediately the broad leaf bush expands and multiplies. The removal of the grasses modifies all floristic composition of the site, which acquires a dynamic (phytosociological) shift. Soon there will be a new text on "dessafricanization".

17. Can the Agricultural Savannah be overcome?

At least partially, yes. As shown by several agroforestry systems, which demonstrate a significant decrease in the composition of their spontaneous flora. Or, we should say: they present a sensitive increase of spontaneous plants, the "broad leaf weed", dicotyledonous plants (also, broadleaf, shrub and arboreal) that prepare the return of the trees', but could be managed much shorter, remaining herbaceous.

The establishment of a spontaneous and biodiverse flora can be achieved by combining various anti-savanic management interventions:

- ✓ It practices selective weeding, eliminating the grasses and leaving the broadleaf bush (MFL).
- ✓ Application of regenerative fertilizers every year, green manuring/ * DGM, ** RCW and *** BLW.
- ✓ Shading management by green manures, providing green cover and mulch.
- ✓ Effective presence of trees in cultivation areas, agroforestry tracks (benefits):
 - the windbreak effect, balancing small droughts;
 - partial shading of the area, taking full advantage of the grass****;
- ✓ Not revolving the soil, exhausting the seed bank able to germinate.



*DGM with *Cajanus cajan*: efficient shading*

* DGM = dense green manuring;

** RCW = ramial chipped wood;

*** BLW = broad-leaf weed

**** Ecophysiological advantage: see above, item 15.

18. Final Conclusion

Savanization is a real process, visible everywhere.

It has acquired such strength that it has already been considered inevitable and unsurpassable.

However, nowadays it can already be considered a stage, only.

To overcome it, one must understand it as a dynamic process.

Let this text be a sincere attempt.

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