Regenerative livestock or sustainable livestock?

¿Ganadería regenerativa o ganadería sustentable?

Pecuária regenerativa ou pecuária sustentável?

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Abstract

Sustainability has been recognized as a fundamental principle of development so that humanity can survive on this planet. However, there are still difficulties in translating its philosophical principles into the ability to make concrete decisions for its consolidation. Three factors that determine growth on planet earth, directly related to agricultural systems, have been identified: agricultural production, management of natural resources, and pollution. Therefore, sustainable agriculture must consider them both for the management of plant and animal populations, since both modify the environment to adapt it to their requirements, thus regenerative practices arise to recover the ability of ecosystems to restore themselves. In that sense, it is intended in this review to elucidate how the concepts and principles exposed are translated into a regenerative or a sustainable livestock. To achieve sustainability, it is necessary and essential, an integral management of processes with a holistic vision of the system by farmers and technicians, leading human talents willing to learn different and new technologies, and motivated trained personnel in sustainable techniques that incorporate agroecological and regenerative practices, all on the basis of financial planning. Regenerative livestock *per se* as an emerging paradigm is very promising, but still requires local research. It is concluded that there is no single model of sustainable livestock, there are no recipes or technological packages, it is governed by the principles that aim at the balance of its dimensions (social, economic, environmental and institutional political governance).

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Resumen

La sustentabilidad ha sido reconocida como un principio fundamental del desarrollo para que la humanidad pueda sobrevivir en este planeta; sin embargo, aún persisten dificultades para traducir sus principios filosóficos en la capacidad de tomar decisiones concretas para su consolidación. Se han identificado tres factores que determinan el crecimiento en el planeta tierra relacionados directamente con los sistemas agrícolas: producción agrícola, manejo de los recursos naturales y contaminación; de manera que, una agricultura sustentable debe considerarlos tanto para el manejo de poblaciones vegetales como animales, ya que en ambos, se modifica el ambiente para adecuarlo a sus requerimientos, es por ello, que surge la necesidad de prácticas regenerativas que recuperan la capacidad de los ecosistemas de restaurarse. En ese sentido, se pretende en esta revisión, dilucidar cómo los conceptos y principios expuestos se traducen en una ganadería regenerativa o en una sustentable. Para alcanzar la sustentabilidad es fundamental una gerencia integral de los procesos con visión holística del sistema por parte de ganaderos y técnicos, unos talentos humanos líderes, dispuestos a aprender diferentes y nuevas tecnologías, con personal entrenado y motivado en técnicas sustentables que incorporen prácticas agroecológicas y regenerativas, todo sobre la base de una planeación financiera. La ganadería regenerativa *per se*, como paradigma emergente, es muy prometedora pero aún requiere investigación local. Se concluye que no existe un modelo único de ganadería sustentable, no hay recetas, ni paquetes tecnológicos, se rige por los principios que apuntan al equilibrio de sus dimensiones (social, económica, ambiental y gobernanza político institucional).

Palabras clave: Sustentabilidad, ganadería regenerativa, sistemas agropecuarios

Resumo

A sustentabilidade tem sido reconhecida como um princípio fundamental do desenvolvimento para que a humanidade possa sobreviver neste planeta; no entanto, ainda há dificuldades em traduzir seus princípios filosóficos na capacidade de tomar decisões concretas para sua consolidação. Foram identificados três fatores que determinam o crescimento do planeta Terra, diretamente relacionados aos sistemas agrícolas: produção agrícola, manejo dos recursos naturais e poluição; Portanto, uma agricultura sustentável deve considerá-los tanto para o manejo das populações vegetais quanto animais, pois o ambiente é modificado para adaptá-lo às suas exigências, assim surgem práticas regenerativas para recuperar a capacidade dos ecossistemas de se restaurarem. Nesse sentido, pretende-se nesta revisão, elucidar como os conceitos e princípios expostos se traduzem em pecuária regenerativa ou em sustentável. Para alcançar a sustentabilidade, uma gestão integral dos processos com uma visão holística do sistema por agricultores e técnicos, alguns talentos humanos de ponta, dispostos a aprender diferentes e novas tecnologias, com pessoal treinado e motivado em técnicas sustentáveis que incorporam práticas agroecológicas e regenerativas, tudo com base no planejamento financeiro. A pecuária regenerativa *per se* como um paradigma emergente é muito promissora, mas ainda requer pesquisa local. Conclui-se que não existe um modelo único de pecuária sustentável, não existem receitas, nem pacotes tecnológicos, ela é regida pelos princípios que visam o equilíbrio de suas dimensões (governança política social, econômica, ambiental e institucional).

Palavras-chave: Sustentabilidade, pecuária regenerativa, sistemas agrícolas

Introduction

Sustainability has been recognized as a development principle necessary for the survival of mankind in this ecologically challenged world which has caused serious climatic consequences. It is already on the lips of all those who proclaim the care of the environment and particularly, environmental sustainability, but this popularization of the term has not ensured that in our minds the necessary interacting conceptual elements are formed for a practical action in accordance with the consolidation of its benefits.

The term sustainable owes its wide acceptance in part to its ambiguity, since everyone agrees to reach it but few know what it is (Sarandón, 2002), the definition of the Brundtland report (WCDE, 1987), universally accepted, it has not yet managed to agree on the criteria and indicators to measure it in the complexity of agricultural systems.

An agricultural system is defined as a set of individual farm systems that have a similar resource base, business patterns, subsistence systems and constraints, and for which similar development strategies would be appropriate (FAO and WB, 2002). The agricultural holding (or farm system) is the economic unit of analysis in agricultural statistics, whether of crop, animal or forestry production, subject to a single management, comprising all the livestock contained in it and all the land dedicated totally or partially to agricultural production (Pedrero, 1998). Livestock production is a secondary trophic level that requires primary plant production for food, so that, the definition of sustainable livestock production goes through the concept of sustainable agriculture, since in both cases, plant and animal populations are domesticated and the environment is modified to adapt it to their requirements in order to satisfy human needs (Sarandón, 2020).

Although there is currently no discussion of the need to make efforts in pursuit of sustainable agriculture, the concept may remain at a declarative stage with little operability, due to the difficulty of translating the philosophical and ideological terms of sustainability into the ability to make decisions in this regard (Bejarano, 1997).

Thus, livestock farming based on regenerative principles arises, which reduces pollution levels by discarding the use of chemical synthesis products, fertilizing in an organic and natural way, enhancing photosynthesis in plants and favoring the soil-plant-animal-human relationship (Gosnell *et al*., 2020a), these effects require a particular management of grasslands and their diverse plant component to have an important impact on the conservation and recovery of soils.

However, in order to adopt regenerative principles and practices that point at sustainability, it is necessary to review its ecological impact and also analyze its implications in the economic and productive dimension, so that the key elements canbe exposed to understand it in practice. In this sense, the indicators reported for this type of livestock will be checked out and a review of definitions will be carried out with the aim of clarifying how the concepts and principles exposed can be translated into a regenerative or a sustainable livestock production.

Sustainability of livestock production systems

The concept of sustainability of agricultural production systems attends to systemic principles and complexity, due to the large number of variables and interactions that occur in them with directionality for food production (Chiappe, 2001). Likewise, It must also consider the commitment and intergenerational equity in the use of natural resources, with technologies and management practices that do not exceed the carrying capacity of the ecosystem, understood as the maximum number of individuals in a population that a habitat can support according to their resources, without adverse effects on that population or the environment (WCDE, 1987).

Sustainable agriculture prioritizes the ecological dimension by insisting on the good management and conservation of natural resources, so that technological and institutional changes must ensure the satisfaction of human needs continuously for present and future generations (FAO, 2015). The sustainable development (SD) must allow the conservation of soil, water, and animal and plant genetic resources without degrading the environment, being technically appropriate, economically viable and socially acceptable. Thus, three dimensions of SD are evident (social, environmental and economic) and additionally, Menéndez (2005), indicates that sustainability must also be treated from ethics and sustainable governance, coinciding with Sepúlveda *et al*. (2001), who develop a dimension referring to the necessary policies and institutions to carry out sustainable development processes.

In this sense, the sustainability of livestock production systems implies that the increase in animal productivity must occur in the context of a lower impact on natural resources, so that the carrying capacity of the environment is not exceeded. The application of good agricultural and animal welfare practices with adapted breeds and species, and the use of local resources for greater savings, translate into practice the principles of adaptability and resilience necessary to promote balance between its dimensions.

To take on this challenge, it is essential that a change occurs in farmers mentality, since nature must be understood as a living system, where human beings evolve together with the rest of the species, so that the impact on nature have to be minimal, the waste produced by the production process must be non-polluting and as possible, recyclable, promoting the circular economy.

The technology used for the pasture and animal management must favor the use of biological inputs and preventive practices, as well as soil conservation; the energy used must be clean, efficient, and available (solar, wind, biodigester). Known practices such as forage conservation (hay, silage and haylage) and the use of local resources (crop residues, industrial by-products, among others) support this sustainable vision.

There are two fundamental indicators that must be taken care of to promote the sustainability of agro-ecosystems, one is the reduction of the water footprint, understood as an indicator of the use of water based on consumption, that is, it refers to the total volume of freshwater used directly or indirectly in the provision of a product or service (Chenoweth *et al*., 2014). That is why irrigation systems must be efficient; flood irrigation must be avoided, without leveling and with large volumes of water, which are very inefficient in the use of water (less than 50%). Likewise, aquifers must be taken care and the minimum flow of rivers must be respected. Rainwater harvesting technologies in reservoirs (capture and storage) are also recommended for use in the dry season (FAO, 2013).

The other important indicator for sustainability is the one that measures carbon sequestration, a phenomenon that occurs when carbon is fixed from the atmosphere and its storage is greater than its release during a certain given time, this is known as endogenous carbon (Krna & Rapson, 2013). The carbon cycle occurs, when plants during the day absorb atmospheric carbon dioxide through photosynthesis releasing oxygen, which results in plant growth and increased biomass of microbes in the soil; then in the process of autotrophic respiration they release part of the carbon and the material thrown by the plants decomposes as organic matter, being able to remain stable in the soil (Jaramillo, 2004).

In consideration of this, livestock agroforestry practices are recommended, which substantially improve the environmental services of the farms (Murgueitio *et al*., 2013), promoting the use of shrubby legumes either as living fences or protein banks, or simply managing in a useful and efficient way the shade of the trees in the paddocks. The regeneration of the carbon cycle and other nutrients necessary for the restoration of ecosystem functions is also promoted with the application of organic fertilizers, since organic matter is a key indicator of its quality, both because it positively stimulates its agricultural functions (production and economy) as well as its environmental functions (carbon sequestration and air quality), since it is the main determinant of biological activity, by promoting the proliferation of fauna and soil microorganisms and greatly influencing its chemical (fertility, availability of nutrients) and physical (texture, structure) properties.

In this way, regenerative processes are promoted, which consist of the recovery of the vital processes of the ecosystem through its natural cycles: water cycle, nutrient cycle, energy flow and community dynamics, among others (Borrelli, 2016), which allows increasing and maintaining soil cover, stabilizing its surface avoiding erosion, increasing biodiversity, increasing carbon in the soil and consequently improving forage production and animal productivity (Gosnell *et al*., 2020a); but what makes this livestock so particular? What are its concrete sustainable impacts?

Regenerative livestock: definition, principles and agricultural practices

Regenerative livestock can be defined as an agricultural production system with grazing herbivores, which through natural and ecological management practices promotes the vital cycles of the ecosystem. According to Díaz-Pulido *et al.,* (2020); as a result, higher productivity, reduced costs and higher return on investment are expected. It is from understanding and optimizing the link between the animal, the soil and the pastures, that it is possible to enter in a virtuous circle of regeneration, productivity and profitability (Ovis21, 2021).

A fundamental principle of regenerative livestock is the valuation of autochthonous genetic resources, adapted to environmental conditions, both animal and plant, which requires holistic management, a principle promoted by Allan Savory, Zimbabwean biologist, ranger, politician and farmer, which is based on guiding values, land planning, pastoralism and finance for decision making. It arose from the need to restore the southern African savannah, degraded by inadequate grazing management (Gosnell *et al*., 2020b).

Savory & Butterfield (1999), consider the entire system, its elements and relationships, assuming the complexity of agroecosystems as bio-socio-economic systems. The holistic view allows making decisions that are simultaneously solid in the economic, social and environmental aspects, considering the

integration of natural processes in close relationship with man (Soil-plant-livestock-man relationship).

In the case of the animal component, it promotes the crossbreeding of rustic breeds and the development of those characters that determine greater ecological resilience. Likewise, it also promotes the culture of prevention rather than control, what has been called "green medicine" and alternative medicine: preparation of antipyretics, antidiarrheals and antimastitics, among others, as well as the use of biopesticides in the control of parasites and natural antibiotics, reducing veterinary costs.

Animals are selected for resistance to external parasites (without Ivermectins), biostimulators are used as strategic supplementation, mating and synchronization periods are established for births at the best calving season. Animals are also selected for functional efficiency, more fertile females and precocious bulls but not catalog features, although they have a good hormonal balance. In short, selection of cattle genetically adapted to the environment and the grazing system with the application of a vaccination program and minimal food supplementation.

In the plant component, the use of adapted species and the use of the diverse local grassland (polyphytic grassland) is assumed, that is, the valuation of what exists, with rational management of the varieties of grasses and legumes that coexist on the same surface of land, which can be biofertilized (*Azotobacter, Rizobium* and *mycorrhizae*), healed by means of biopesticides (*Trichoderma* and *Trichogramma*), biological control and integrated pest management.

Carbon sequestration is achieved through two strategies, the first is with the use of tree species; the second is with the grazing of the diverse grassland with high stocking rates in very short periods of use and long periods of rest in the small and numerous paddocks necessary to achieve this. The application of regenerative principles would make it possible to improve soil cover by increasing biodiversity, and by capturing atmospheric carbon, improve the organic matter concentration with a better infiltration and retention of water and nutrients, with the consequent increase in the response of the pasture and its productivity (Conant, 2010; Gosnell *et al*., 2020a)

Grasslands are the world's main carbon sink, taking carbon out of the air and storing it in the soil. The importance of the role of grasslands is beginning to be recognized, undermining the arguments that blame livestock for the evils of climate change. According to Borrelli (2016), regenerative livestock turns pastures into true "carbon bombs", he states that, if Argentina could regenerate 40% of its pastures, it could remove all of its net agricultural emissions from the air (0.16 GT).

In this way, regenerative livestock management (RM) is presented as an emerging paradigm in the face of climate change, it implies a holistic handling of grazing, beyond what is productive (Savory & Butterfield, 1999) because the animals are managed imitating nature. They are changes that aim at environmental, economic and social sustainability (Borrelli, 2016) and at the biological resilience of ecosystems, since they recover their capacity to restore species to their original state after having suffered disturbances due to human activity (Doak *et al.,* 1998).

Cuevas-Reyes (2010) states that an important attribute of ecosystems is resilience as a buffer against natural disturbances and as a factor in the regeneration of biological diversity; in this sense, RM makes it possible to restore ecosystem function and improve resilient biological capital by conserving native flora and fauna, forming microclimates for the evolutionary dynamics of the prairie and restoring the soil through natural succession. Thus, the management of the vegetal component is crucial in RM, in order to implement rational, rotational, intensive and non-selective grazing systems, where the first thing is to understand the concept of the polyphytic meadow since it is used to managing one or more few species of grass in the same pasture.

Polyphytic grasslands are those that are made up of several forage species, even from different families (*gramineae*, *leguminosae*, *asteraceae*, *brassicaceas*, among many others). This definition, together with the valuation of native plant resources, implies that the management of the diverse pasture for animal feeding must consider the existing species, including the arvense flora, since it is estimated that less than 20% of the species considered as weeds are toxic or have thorns (Viteri, 2020), consequently, their control would be localized, with non-chemical methods (biological or manual).

The idea is to take advantage of the adaptability of native species to existing microclimates or to differences in soil with the aim that they can express their maximum potential and offer quantity and quality of forage, with a varied diet for the animals; this means for the producer a new management based on techniques different from the traditional ones, but it also means a lower cost alternative with principles of sustainability in the medium and long term.

When planning grazing and calculating the number of paddocks, the duration of the dry season (period without rainfall) should be considered as rest days and not the natural period of recovery in conditions of adequate moisture (optimal conditions), this grazing involves the consumption by the animal of "past grasses", i.e. already flowering, with higher lignin content and lower protein content, but due to the diversity of species consumed, it is considered that it improves the animal's digestion by creating an optimal environment for the rumen (Cárdenas, 2013), since grazing is non-selective (high stocking rates in short periods) and because the stocking rate is a factor of great influence in the selection of the diet in a diverse pasture (Chávez *et al*., 2000).

This planning implies that a grazing lot requires many paddocks to be able for an adequate rotation (at least 61, if the dry period last two months), which implies a large investment in fences, aqueducts and drinking troughs which is why the use of mobile fences and drinking troughs is recommended before making the fixed investment; likewise, the use of trees to create pleasant microclimates for the animal.

As a result of these principles, a series of grazing models associated with regenerative livestock farming have been assumed, among them, the rational grazing of André Voisin (VRG), French biochemist, soldier and farmer, who formulated the four universal laws of grazing (Pinhero, 2013), whose purpose is to maximize the capture of solar energy as its main input. The soil-plant-animal complex is managed harmonizing the plant physiological response with animal needs. It consists of direct and rotational grazing, with high stocking rates, short occupation period, without fixed times and based on soil biology, incorporating agroecological management (Monteverde, 2018).

Another grazing associated with regenerative livestock farming is Ultra High DensityGrazing (UHDG) proposed by Johan Zietsman, a Zimbabwean rancher, whose principle is to place the largest possible number of animals on the smallest surface area possible and in the shortest possible time. They manage the maximum sustainable economic benefit per hectare (MBESH); to achieve this, they discard cows that do not respond positively to non-selective grazing, even

though they may be very good in selective grazing systems, to reduce costs and increase efficiency in a relatively small area (Ziestman, 2014).

The intensive rotational grazing (IRG) of Chilean producer, researcher and scholar Arno Kloker is also known (Sabino & Vanoni, 2007). This system is similar to the VRG because it is based on many divisions of paddocks, but it does not accept the four universal laws of grazing to the letter. At IRG, the animal harvests a healthy, clean and fresh grass on a daily basis. They are also given comfort and good treatment so that they can express their optimum production capacity.

Allan Savory's holistic management (HM) is managed by imitating the movement of large herds of wild ungulates in the African savannah, generating an exhaustive use in the ecosystem, a strong impact on grass and soil, followed by sufficient recovery periods. (GODEHESA, 2021) This management is continuously adapted through planning and permanent monitoring.

Despite widespread disagreement about the environmental and production benefits of HM, researchers on both sides of that debate, seem to agree that its emphasis on goal setting, complexity, adaptability, and strategic decision making are valuable. These ideas are shared by systems thinking, which has long been central to agroecology and recognized as a valuable tool for dealing with the different dimensions of farming systems (Mann & Sherren, 2018).

These grazing methods have generated controversy among farmers, technicians, and researchers, among some reasons, because they were developed in large areas such as the South African steppes (Savory & Butterfield, 1999; Ziestman, 2014). Doubts also arise with the VRG, since it originates from the management of short European grasses (with buds at ground level), when the typical tussock grasses of Latin America (buds 10-15 cm from the ground) do not respond equally to these grazing pressures; also, due to the high initial investment required.

Doubts arise fundamentally in the community of agricultural technicians, who were trained with the approach oriented to the stocking rate control and not in the management of pastures long rest periods with the consequent decrease in its nutritional quality, a situation that is not well managed, it can have both detrimental economic results on the farms that they advise and effects on soil compaction due to high instantaneous stocking rates. Some findings have shown that UHDG has a potentially negative impact on soil health and vegetation composition of South African mesic grasslands and particularly on compaction due to trampling on the topsoil below the shrub canopy and also in patches with vegetation (Chamane *et al.,* 2017).

A balance of articles that show how *Holistic Planned Grazing™* is managed, concludes that the use of planned holistic grazing cannot be ruled out, but it cannot be said that it will work anywhere. The analyzed studies cases show the positive effects of holistic grazing in terms of pasture and livestock productivity and soil conditions, superior to conventional or continuous grazing, but are quite limited in time, number of study sites and data. Although better grazing management can improve conditions on many degraded lands, the evidence reviewed indicates that holistic grazing could be an example of good grazing management, but nothing suggests that it is better than other well-managed grazing methods (Hawkins *et al.,* 2017).

The difficulty for its evaluation lies in the lack of agreement on the indicators that represent the HM, since it is a fluid and heterogeneous concept, which is difficult to define and evaluate (Mann & Sherren, 2018). On the other hand, these authors indicate that some achievements seem exaggerated, such is the case of the carbon sequestration indicator used by the Savory Institute to affirm that holistic grazing can reverse climate change, which is seven times higher than the rate of 0.35 $t.ha^{-1}$, known for pastures under conventional grazing (Nordborg, 2016).

Gosnell *et al*. (2020b) conclude, that the way to resolve this controversy is to investigate, in collaboration with farmers, the socio-ecological systems of grasslands in a more holistic way, this can co-produce new knowledge and contribute to social transformation and ecological transformation. The effective transfer of this technology, which is highly positive from an environmental point of view, requires that the indicators of the economic and productive dimension also be positive; an analysis of comprehensive evaluations would promote their proper acceptance.

Productive and economic indicators reported for regenerative livestock farming

The first concern for the producer is the initial investment, which can vary from 300 to 600 $\$.ha^{-1}$, considering the principles of VRG that is, it depends mainly on the type of grazing system, on the number of paddocks and the length of fences required, which can reach $1000\$.ha^{-1}$ with UHDG, this value includes the provision of solar panels with electric fences, rods and reels (Viteri, 2021).

An evolutionary case record (2019 - 2021), registered on the Loma Blanca farm in Uruguay, (Longo, 2021) reports an investment of only $\$100.ha^{-1}$, which includes a tank, drinking though, posts, stands or stakes and electrification equipment, since they used existing materials that were relocated, with this change they managed a total of 145.5 UG per year (one UG or livestock unit, is equivalent to a head of cattle in reference), with an instantaneous stocking rate of 291 UG on 5000 m^2, managing to increase the animal density 2.6 times (from 0.56 to 1.51 $UG.ha^{-1}$) as well as meat production from 161 to 245 $kg.ha^{-1}$ in the third year.

An evaluation carried out in different agroecological areas in the Argentine pampas (the central plateau of Chubut, the Subandean grassland and the humid Magellanic Steppe) and three modeled technological approaches (Traditional Management, Basic Model, and Holistic Management), reports that holistic management It turned out to be the most productive in all areas, and in the area with better humidity conditions it doubled the productivity of traditional management. In addition, it favored the increase in soil cover, the development of native legumes, and a reduction in the use of fire, which allowed grasslands to be kept green (Argyropoulos, 2014).

Another comparison of traditional management with holistic management, carried out in Corrientes Argentina, reports an increase in the gross margin per hectare (from 477 to 1049 $pesos.ha^{-1}$) with an increase in the stocking rate from 0.58 to 0.92 $heads.ha^{-1}$. The higher production of forage was the result of the regeneration of carbon in the soil. (Borrelli, 2016)

One of the major benefits reported by regenerative livestock farmers is the increase in stocking rate, with the reduction of costs and the consequent increase in profitability. Stocking rate is the indicator of grazing-based livestock systems that exponentially increases the profitability of farms through an increase in the gross margin per animal (Urdaneta, 2001). Therefore, if regenerative management has reported ecological benefits and can also mean better productive and economic results, it is imperative to strengthen the managerial dimension, so that in each circumstance, the producer can have the knowledge, skills and values necessary to holistically plan his production unit, including the financial production projection and

thus be able to make decisions that promote the integral sustainability of the system based on regenerative principles.

So is it regenerative livestock farming or sustainable livestock farming?

There are livestock production models that coincide in some aspects with the paradigm of regenerative livestock production, but that do not manage high stocking rates or grazing intensities, in these systems prevails the use of introduced pastures, even though they also manage small and uniform paddocks on a rotational basis, with rest periods of pastures that allow them to recover adequately, so that the land is always covered.They manage the stocking rate depending on the seasons (dry or rainy), maintain water in the paddocks and conserve surplus pastures, among many important practices for sustainability. These rotational grazing models have the great advantage that they have been tested and evaluated, their results have been scientifically published and they have proven to be useful in multiple circumstances; in regenerative livestock farming, a great deal of knowledge still needs to be formalized. There is still a lack of formalized knowledge since most of the information is found on social networks.

However, in these traditional rotational systems, the use of organic fertilization, biological control of pests and diseases and local and selective control of true weeds (reducing the use of chemicals) should be encouraged; as well as reducing the water footprint, avoiding flood irrigation and incorporating other regenerative practices to capture carbon. That is to say, sustainable livestock farming can be done by adapting the models to our conditions and incorporating regenerative principles; therefore, *regenerative livestock farming is not a single model of sustainable livestock farming.*

Sustainable livestock farming does not promote recipes or technological packages, it is governed by the principles that aim to balance between its dimensions, nor does it disdain knowledge, on the contrary, it integrates it and applies it according to the circumstance. Each farmer in his production unit must assess the quality and quantity of the existing biological assets (meadows, forests, pastures, animals) since *there is no magical variety or hybrid of grass or breed* for regenerative livestock farming or for sustainability. The farmer must value what is available, what is native, what is adapted (adaptation is saving) and incorporate agroecological and regenerative technologies for production, harmonizing animal requirements with the ecosystem and considering the infrastructure and equipment available to carry out the farming model that fits his possibilities and expectations, always within the framework of good environmental practices, it is a dynamic model. In all cases, it should carry out a financial planning of the decided model and train the necessary human talents to carry out the unpostponable task of sustainability.

Conclusions

In order to achieve sustainability, the change towards a holistic vision of the system by producers and technicians, with a comprehensive management of the processes, is essential. The leading human talents must be open to learning new agroecological technologies in the management of livestock farms, likewise, staff must be trained and motivated in these sustainable techniques incorporating regenerative practices, based on financial planning.

The possibility of at least doubling the stocking rate and the consequent gross margin per area unit, due to regenerative management, is a challenge and an opportunity that should not be underestimated, given the consequent economic response and ecosystem services that have been reported. However, research is still required in aspects of local regenerative management, which includes the evaluation of the animal response in polyphytic grasslands to at different stocking rates and occupancy time. There is also a need for evaluation of high-density intensive grazing in our conditions and evaluations of the stocking rate effect and the high concentration of manure on the soil.

Regenerative livestock farming is not a unique model of sustainable livestock farming; each producer must consider the available evidence, which allows him to decide the management approach and the most appropriate livestock biotype for his production objectives, always within the framework of the dimensions of sustainability, where regenerative principles play an important role.

It is essential to promote the role of universities and technology and research centers to strengthen the political and institutional dimension, promoting the construction of knowledge for sustainable production, together with farmers, and communicating the benefits of this management through extension and technology transfer. It is also necessary to formalize the regenerative livestock experiences that remain in social networks, which are still important and require support to systematize knowledge.

In the constructivist process of knowledge formation, ideas are discarded, incorporated and integrated to develop more evolved concepts due to their relevance to the prevailing conditions of the moment, such as climate change and the imperious need to take care of the environment; no knowledge is disregarded. Furthermore, the holistic conception does not disdain any paradigm, on the contrary, it integrates them into an increasingly complex and proper gnoseological syntagm to explain the multivariable and diverse phenomena characteristic of agricultural systems.

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