



The dynamic of Montado ecosystem

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Abstract

Agro-Silvo-Pastoralism integrates the knowledge and research of Agronomy, Forest and Extensive Animal Production systems where the soil is the common main factor and looks for application of new technologies on farming systems integrated as a multifunctional way. To improve soil capacity in Mediterranean environments the most efficient process is the improvement of Mediterranean Permanent Pastures and how higher the quantitative and qualitative production of pasture increase the level of Organic Matter in soil and the stocking rate. Also the increase of stock of water in the soil allows the enlargement of the annual cycle in pasture self reseeding plants which means higher biomass production. At some level of soil potential capacity the existence of perennial plants with summer dormancy becomes possible. This means the anticipation of the autumnal start of annual cycle of growth in pasture and decrease of forage supplementation according to the Feeding Scheme of Extensive Animal Production systems. The increase of stocking rates delay the regrowth of shrubs which means the enlargement of Montado Crop Rotation by the increase in variable n (years of pasture). This has positive effect on natural regrowth of tree component because of lower animal pressure and in the balance on vegetal stratus (*arboreus*, *arbustive* and *herbaceous*) with high levels of general biodiversity (animal, vegetal and microbioma). So, increasing the level of bioma in soil which has positive impact on the availability of nutrients and water for plants making easier the sanitary control of vegetal component and increase the general productivity of the whole system. The model of management and multifunctionality can be found in the project of conversion of Mediterranean forest in agro-silvo-pastoral system Montado by Potes et al (2021).

Introduction

Since the VI IRC in Townsville, Queensland, Australia 1999, the Montado ecosystem has been presented as an agro-silvo-pastoral ecosystem with a typical landscape which characterizes the Mediterranean region of Portugal in the Iberian Peninsula. It was built by Man and preserved among centuries by the control of shrubs and usage of natural resources within extensive farming systems. The extensive animal production systems evolved are based on pastures and forest by-products but need to be complemented with forage production and other supplements in order to adapt to semiarid environments to obtain high quality products.

Potes et al, (2021) presented the conversion of the Mediterranean Forest into a Montado ecosystem by the management of the Mediterranean environment focused on the recovery and preservation of the soil. As poor soils are generally dominant in these environments the increase of its potential productivity is essential for the development of distinct phases of the process that characterize the success of a working and balanced ecosystem.

The objective of this paper is to point out the correspondence of several papers submitted to International Congress's in the last twenty years concerning the different phases of implementation of the Montado ecosystem and show the dynamic of the management to achieve technical, environmental and economic sustainability.

Methods

The methodology used for the implementation and management of the Montado ecosystem it is the Agriculture of Conservation or Conservation Farming System which means the focus on the recovery or improvement of the soil. If the soil is considered the common base of any natural system of production in agronomy, animal husbandry or forestry, in the case of Mediterranean environments it is more important because of the level of degradation caused by human activity over plus the natural decrease in the potential productivity of the soil. So Conservation Farming consists in absence of mobilization of the soil, diversification of the rotational annual crops and the residues of crops remaining on the soil.

Results and Discussion

The first approach and identification of the physical and environmental characteristics of the farm is essential to establish the plan of the intervention regarding the stud of the status of the soil, the balance between vegetal stratus and infrastructures for animal and grazing management.

Looking for technical procedures Potes & Babo (2003) proposed the Montado Crop Rotation for combining operations as the mechanical control of shrubs (if necessary), forage crop and pasture improvement process. The implementation of the rotational interventions must be done in an appropriate plan of individualized parcels with easier access, water supply and surface according the level of stocking rates. This means the facility in animal and crops management and very importantly, the dilution on infrastructural investments along the cycle of the rotation. Such process of management is identified as multifunctionality.

The pasture improvement process was presented by Potes et al (2005) focusing on the importance of liming and P fertilisers to adapt the soil conditions to a balanced botanical composition of the flora which favours the increase of annual legumes of self reseeding. This botanical Family is the principal responsible for the increase of N in the soil with direct impact on the increment of levels of pasture biomass. The control and balance of the flora is highly dependent on the grazing management and is only possible with the adequate infrastructural plan of parcels or paddocks. How long the years of permanent pastures (n) decrease animal pressure and increase the regrowth of *arboreus* stratus mainly composed by *quercineas*.

The efficiency of the animal production systems adapted to the Montado ecosystem depends on the contribution of all natural resources for animal feeding and looking to minimize the outsourcing of the system. This is the base of extensive grazing systems which was presented by Potes (2008) as the Feeding Scheme of Extensive Animal Production Systems in the Montado. It shows the contribution of all vegetal stratus for the feeding supply and the irregularity of sources between each season of the year with impact on the different preferences that each animal species reveal for distinct products. The supplements of crop forage are the highest inputs of the scheme and can be reduced or decreased as the total natural biomass of the ecosystem increases and deeply adjusted to the stocking rate.

When the technical procedures are implemented and the dynamism of the process is guaranteed by the results the cycle of the Montado Rotation is closed and it can be possible to start de evaluation of environmental conditions or acquisitions. Potes (2011) discussed the effect of the proposed technical management of the ecosystem in the increase of level of Organic Mater (OM) in soil content and the positive impact of it in the structural and nutritional values. The consequence is the increment of level of water stocked in the soil which combined with more disponible nutrients for plants results in the increase of vegetal biomass. The cycle of water movement within the soil benefits from the distinct distribution of roots system of different stratus of plants (*arboreus*, *arbustive* and

herbaceous) and the increase of OM in the soil and biomass of plants reveals the increase of sequestration of C in soil which is a relevant environmental service delivered by the ecosystem. The fire prevention becomes as a natural consequence of the control of shrubs (the combustible for fire) by the mosaic disposal of forest parcels (*arboreus stratus*) which represents the main goal for the balance of flora and it's also an important environmental service. Finally the high levels of biodiversity are an instrument for managing the ecosystem because permanent pastures in Mediterranean environments are characterized by high numbers of species from annual plants of self reseeding reproduction which can increase with the longing cycle as consequence of availability of water in the soil. The improved conditions of the soil at some level can even increase the biodiversity of herbaceous flora by the appearance of perennial plants with summer dormancy. The improvement of soil means the increase of bioma in the soil for humification process so micro biota increase of biodiversity is needed for the chemical formation of the soil exchange complex. Concerning the biodiversity of the animal kingdom the use of all domestic species is required because of their distinct characteristics in grazing behaviour and combines with the variable presence of wild animals, reptiles, birds and insects which results in a high level of general biodiversity. In fact it is recognized as a high spot in terms of the world biodiversity.

The Montado ecosystem is a farming system allocated in a low productivity region recognised as extensive system of agriculture and so the economic balance is very hard to achieve if only based in the high quality products it offers to the global market. Potes (2016) presented the environmental acquisitions of the adequate management of the ecosystem with positive impact in soil, water, air, fire and biodiversity as environmental services provided to the society. This is the justification for the High Natural Value (HNV) of the Montado ecosystem. More important is the balance or reduction in sanitary problems in the whole system and so it must be evaluated and valuing looking for a proper payment. Until this mechanism is not offered to the farmers the economic sustainability of the ecosystem was presented as a result of conversion of Mediterranean Forest in the Montado ecosystem (Potes et al. 2021) and can be improved when the HNV would be properly recognized and payee. However the dynamic in positive sense described can be easily reverted by the human abandon that means the natural return to Mediterranean Forest.

Conclusions

The Montado ecosystem is a very successful and dynamic achievement of the human management and conversion of the Mediterranean Forest into an agro-silvo-pastoral system. Its HNV is justified for the technical, environmental and economic sustainability.

The dynamism of the process reveals its own fragilities and economic resilience.

Looking for valorisation of extensively (Potes et al, 2024) and environmental services payment it will be necessary for increase economic sustainability and present Montado ecosystem as a model of modern agriculture.

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