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Pasture and fodder crop as part of high natural value farm systems at Mediterranean dryland agro-ecosystems

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SUMMARY – European Mediterranean countries have the highest percentage of high natural value (HNV) farming systems and also the highest environmental risk areas. Portugal has the highest percentage of HNV farming systems, and also the highest risk area. From the HNV Portuguese farming systems – "montados", dry land extensive pasture systems, rangeland pastures, "lameiros" (irrigated permanent pasture systems at mountain), and "cereal pseudo steppe ecosystem", all contain pastures. The sustainability depends on the multi-functional role of farming systems, such as soil protection, landscape enhancement, biodiversity recover and enhancement, surface and ground-water quantity and quality, carbon sink, high quality production, and production diversity. Pasture systems could be one of the best agricultural systems to fulfill the sustainable conditions. Some examples of running LPN projects are discussed to support these multi-functional indispensable conditions.

Key words: High Nature Value farmland, multifunctionality, dry land, environmental risk, pastures

RESUME – *"Les pâturages et les cultures fourragères en tant que composante des systèmes agricoles à forte valeur naturelle dans les agroécosystèmes arides méditerranéens". Les pays méditerranéens ont le plus grand pourcentage de systèmes agricoles à haute valeur environnementale (HVE), mais aussi le plus grand risque. Le Portugal avait le plus grand pourcentage de systèmes agricoles à HVE et à risque. La plupart des systèmes agricoles portugais à HVE - systèmes agroforestiers ("montados" et "dehesas"), les pâturages extensifs, parcours ou "rangeland", les pâturages irrigués dans la montagne ("lameiros") et le système de steppes avec production de céréales, avaient toujours des pâturages. Le développement durable dépend directement des fonctions non supportées par le marché, les multi-fonctions, telles que la protection du sol, le paysage, la biodiversité, la quantité et la qualité de l'eau, la fixation du carbone, la diversité et la qualité de la production agricole. Les pâturages sont la meilleure forme d'atteindre la durabilité du développement des terres sèches. Sont présentés quelques exemples de projets en cours pour souligner l'importance de la multifonction.*

Mots-clés : *Haute Valeur Environnementale, multifonctions, terres sèches, risque environnemental, pâturages.*

Multifunctionality and sustainable development

Rural area, agriculture and forest uses, have functions that are not remunerated by the market, that answer to social claims. This multifunctional role include the maintenance and creation of cultural landscape, the improvement and maintenance of biodiversity, the protection of natural resources such as soil, water, and air quality, and the protection of natural disasters (Anonym, 2001).

Sustainable development depends on natural resources, and sustainable farming depends on air, soil, water and biodiversity resources. The great variety of habitats and species across Europe is also a vital natural resource (Hoogeveen *et al.,* 2004; EEAC, 2002).

Any form of agriculture which affects or substantially disrupts natural resources, either in short, medium or even long term, can be regarded as sustainable (EEAC, 2002).

European Mediterranean countries have the highest percentage of high natural value (HNV) farming systems and also the highest environmental risk areas.

Portugal with the highest percentage of High Natural Value (HNV) farming systems – 37% of agricultural land (Queirós *et al.,* 1999; Hoogeveen *et al.,* 2004), have also the highest environmental

risk area – forest and agricultural fires, soil erosion risk, desertification, flood risk, extreme drought, water scarcity and water quality degradation (Sequeira 1998a,b, 2001a,b; 2006, Sande Silva, 2007) etc.

Regional differing farming systems have led to a large variety of agricultural habitats and landscapes, that host a large number of plant and animal species (Hoogeveen *et al.,* 2004).

However, the biodiversity of farmland declines rapidly with the increase intensity of farming (Hoogeveen *et al.,* 2001).

In Portugal exists a strong relation between agro-forestry system and natural values. So 90% of Nature 2000 classified areas are in extensive farming systems (Lima Santos *et al.,* 2006). The agricultural abandonment or intensifying farming systems cause loss of biodiversity.

The sustainability depends on the multi-functional role of farming systems, such as soil protection, landscape enhancement, biodiversity recover and enhancement, surface and ground-water quantity and quality, carbon sink, high quality production, and production diversity.

Pastures as part of HNV farmlands

Pasture systems could be one of the best agricultural systems to fulfill the sustainable conditions, such as: good quality production; high man productivity extensive system; high multi-functional services and goods: carbon sink, soil protection, ground-water recharge system, high resistance and resilience to water scarcity, biological diversity improvement, specially in mosaic landscapes, decreasing forest fire risk, etc. are part of services and goods of the pastures:

(i) Pastures are part of most important classified habitats from which agro-forest dry-land system of "montado" with *Quercus suber,* and with *Quercus rotundifolia* (also with *Q. pyrenaica and faginea*) are the best examples (Lima Santos, 2006; Sande Silva, 2007c) of Iberian important agro-ecosystems of HNV. The maintenance of low-input farming system, and specially mosaic system (long term rotation) with cereal and fodder crop under canopy, and low stocking densities, with Mediterranean natural forest at step slopes as ecological corridors for mammals and prey bird refuge are one of the examples of LPN project.

Extensive animal production with pastures and forages integrated in multiple use of forest, rainfed and irrigated agricultural productions are part of sustainable rural development (Sequeira, 1997). These systems increase security against price change, increase farm income, employment stability and qualification, combat depopulation, and specially combat desertification.

This agro forest system also increase resilience against climate change, drought and forest fires (Sequeira, 2006; Sande Silva *et al.,* 2007 a,b);

(ii) Other important agro-ecosystem of HNV is the cereal pseudo steppe maintained in dry-lands by the long rotation of cereal with pastures, without trees. This very old system, thousands years old, allow the conservation in Portugal and Spain of threatened species of birds. However the traditional farming system cause heavy erosion, loss of soil organic matter by excessive ploughing, accelerated desertification process and low revenue. So, no tillage seeding, improved pasture management (Crespo *et al.,* 2004; Nogueira *et al.,* 2004), new methods of reclaim eroded soils by sewage sludge mud subsoil injection, retaining water runoff are developed to avoid erosion, fertility and water loss (Sequeira, 2002ab; 2004).

Improving a simple Sustainability Management System (extensity.ist.utl.pt/) (SMS) for agricultural farms, comprising environmental, economic, social, food safety and operational management, in conformity with the EMAS and HACCP standards, with specific criteria for the following agro-ecosystems: mountain, irrigated pasture, mixed olive groves with pasture / crops, "montado" and cereal steppe is a necessity.

The increase of soil organic carbon could be considered as a carbon sink, together with tree effect, increasing the stability of organic matter by the nitrogen coming from leguminous plants (bio-diverse pasture).

(iii) The improvement of mountain pastures "lameiros", irrigated or rainfed, pastures are also a HNV farming system, by improving biodiversity and also interrupt the continuity of burnable vegetation (pinewood, shrubs and eucalyptus). The mosaic of different forest, riparian forest, protection forest (with *Quercus*) and mono-specific production forest, with pasture and agriculture land increase the diversity of production, improve landscape, the biodiversity and also decrease fire risk.

Fire risk increases with climate change, imposing prevention measures to reduce forest fire propagation. Most part of these measures include landscape planning with the use of pastures (Sande Silva *et al.,* 2007b).

Examples of LPN projects with HNV farmland systems with pastures

Castro Verde Program - Soil recovery in a rural Threatened Ecosystem in Portugal

Objectives

Recover soil fertility, increase soil organic matter, decrease erosion process, reverse desertification process, increase rate of soil formation process (increase rate of rock weathering process), to increase ecosystem support capacity and farmer profit.

Campo Branco (or Castro Verde) is a rural area located in the South Portugal, semi-arid and sub-humid zone, especially threatened by soil erosion and desertification, where the economy is dependent on farming, mining and services. This area is recognized by Birdlife International as an IBA (Important Bird Area) and by the European Commission of the European Union as a Special Protection Area for Birds (SPA) in the Natura 2000 Network. It is also acknowledged as the most important area in Portugal (and one of the most important in Europe) for steppe birds such as the Great Bustard (*Otis tarda*) and the Lesser Kestrel (*Falco naumanni*).

The overall objective of LPN in Castro Verde is to achieve the conservation of the threatened cereal steppe ecosystem of Campo Branco through an integrated sustainable development approach, integrating land and soil protection, direct nature conservation actions, developing new farming practices, scientific research, environmental education and ecotourism.

Through the successful achievements of this project focused in soil resources and farming, including permanent and non-permanent pastures, we aim to replicate it in other rural areas, threatened by desertification and important for nature conservation in Portugal or in other Mediterranean countries.

Methodologies

(i) No tillage, rotation of wheat, oat, pasture (3 years), to maintain the steppe habitat.

(ii) Low stocking densities to avoid cattle treat on nests.

(iii) Increase soil infiltration rate, by contour ditches, sedimentation ponds.

(iv) Increase soil water holding capacity by no tillage, organic matter increase, sub-soiling and sewage sludge injection.

Results

Decrease erosion more than 90%, decrease fuel consumption more than 75%, maintaining cereal productivity, increase soil forming process more 50 times, increase water holding capacity, water infiltration ratio, and a strong increase in biodiversity.

From 1994 until 2007 the agro-environmental measure – Plano Zonal - application result in IBA result in the increase *Otis tarda* from 270 to 1 290, *Falco naumanni* from 150 pairs to more than 490, etc.

Conservation of the Iberian Lynx

Objectives

The Iberian Lynx is, nowadays, the world's most threatened cat. This project, in partnership with Fauna & Flora International (FFI), is the long term management of priority habitats of Iberian Lynx, such as patches of Mediterranean woods and shrubs of cork oak (*Quercus suber*), holm hoak (*Quercus rotundifolia*), strawberry tree (*Arbutus unedo*), etc. and pasture spots for the recovery of rabbit's populations (the Iberian Lynx main prey).

Also, the good pasture is a mean to increase the support capacity of the ecosystem and to manage fire risk. The management agreements with associations and landowners have as main purpose to allow the conservation of suitable habitats for the Lynx and at same time to promote the economical profitability of the land, and the sustainability of the farming system.

EXTENSITY – Environmental and Sustainability Management Systems in Extensive Agriculture (life Program)

Aims to create a cost-effective and simple Sustainability Management System (SMS) for extensive agriculture, comprising environmental, social and economic aspects, with successive levels of demand.

Develop an interactive approach to the SMS comprising, as possible intermediate steps, integrated farming/crop management, organic farming, certification of origin, green accounts, ISO 14001 and EMAS.

Obtain farm level sustainability indicators for the SMS by downscaling from the national and EU levels.

The SMS provides multiple economic benefits for farmers:

(i) Reduced implementation costs due to application to multiple farmers.

(ii) Reduce operational costs, through reduced resources use and improved technical management.

(iii) Ensure regulatory compliance.

(iv) Ensure better prices to the consumer.

(v) Improve agro-environmental subsidies through the use of the project's data to validate and valuate the environmental services and goods provided by farmers.

(vi) Ensure other profits resulting from other activities namely tourism.

Apply innovative aggregation methods (energy, ecological footprint, material input, and total economic value) to assess trade-offs between sustainability indicators. Contribute to a test of the applicability of these methods for the Resource Strategy of the 6th Environmental Action Program. Promote the economic viability of the SMS for farmers. Promote the SMS to consumers, increasing their awareness of and interest in sustainable products.

Conclusions

Pastures are central part of Mediterranean High Natural Value farming systems, contributing to decrease erosion, combat desertification, increase soil fertility, improve biodiversity systems so to the Sustainable Development, if with a sustainable management and integrated with an appropriate landscape.

However more research about sustainable management, stoking rates for each agro-ecosystem, landscape planning, interaction between managements and biodiversity, soil organic matter stability, water cycle effects, and fire risk control are needed.

The characterization, quantification and valuation of Services and Goods provided by agro-ecosystems with pastures needs more research to support agro-environmental EU Common Agricultural support, and other forms of payment.

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