Rehabilitation of degraded lands in Portugal

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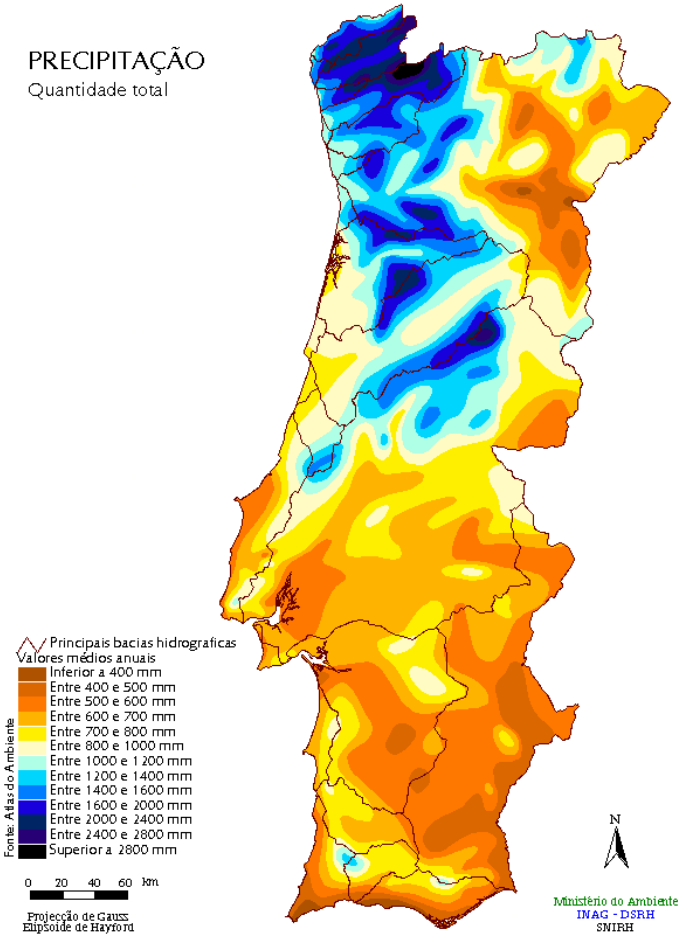
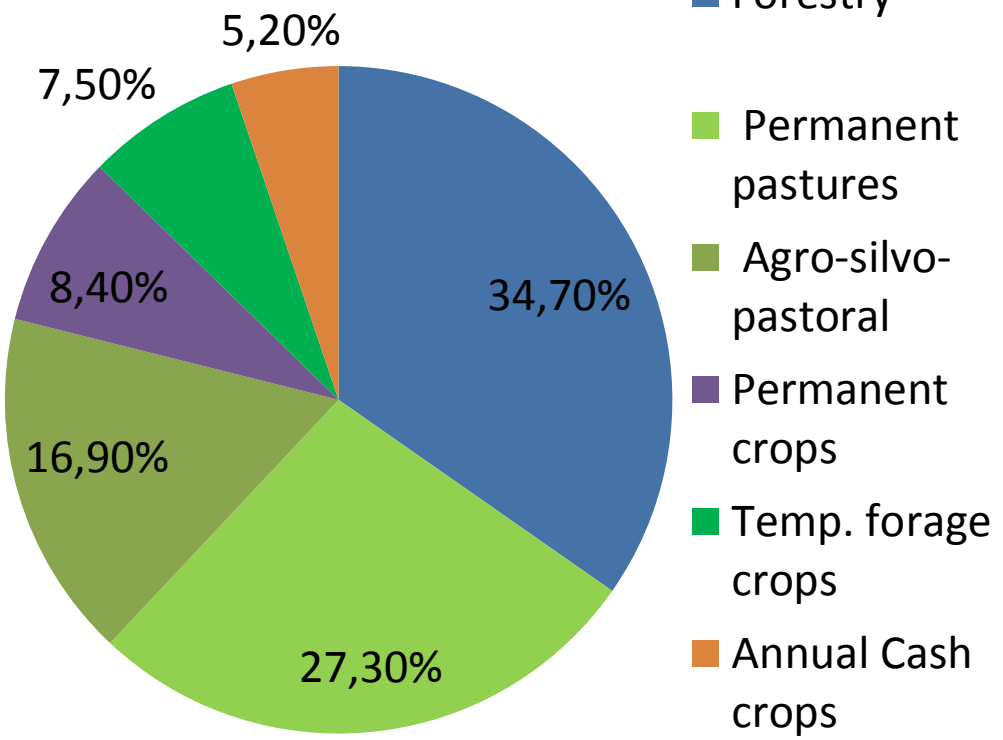
Rainfall and land use in Portugal





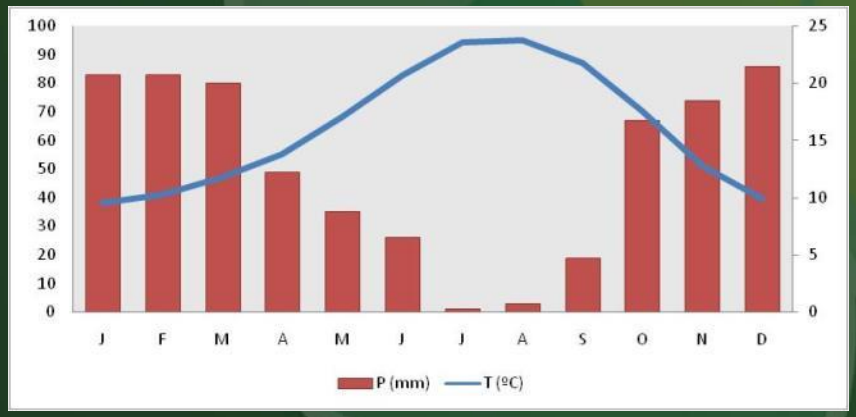
Source: INE, 2011

Soils and Climate of Portugal

Predominant soils are:

- Acid
- Low in organic matter - 0,5 to 1,5%
- Low in phosphorus
- Shallow and stony, sloppy
- Drainage deficient
- Prone to erosion

Need to improve soil condition

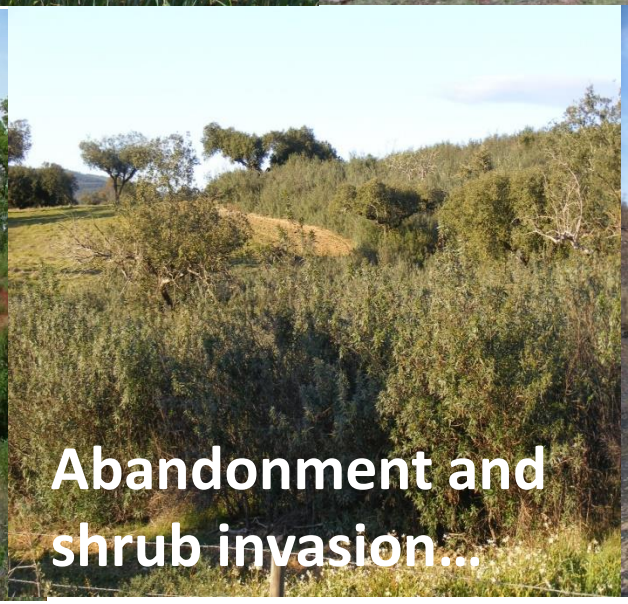


- Mediterranean Climate
  - 2500 to 3200 hours of sunshine/year
  - Annual Rainfall <400 – >1000mm, 85% in autumn/spring
  - Mild temperatures in winter, hot summers

Good to grow legumes

TRADITIONAL SYSTEMS OF ANIMAL PRODUCTION

LAND DEGRADATION IN PORTUGAL



The solution to rehabilitate degraded lands:

SOWN BIODIVERSE LEGUME RICH PERMANENT PASTURES & FORAGE CROPS (SBLRPP&FC):

Fundaments: Mediterranean region is the Centre of origin of a great number of legume species; Legumes are able to fix high amounts of symbiotic N; Biodiversity enhance persistence and productivity.

System: 65-80 % of the land used for animal production with permanent pastures(PP), grazed all the year; 20-35% is cultivated with annual forage crops for eventual early grazing (autumn/ winter) and/or cutting in spring for conservation to feed the animals during periods of scarce quantity or quality of the PP.

WHAT ARE SBLRPP&FC

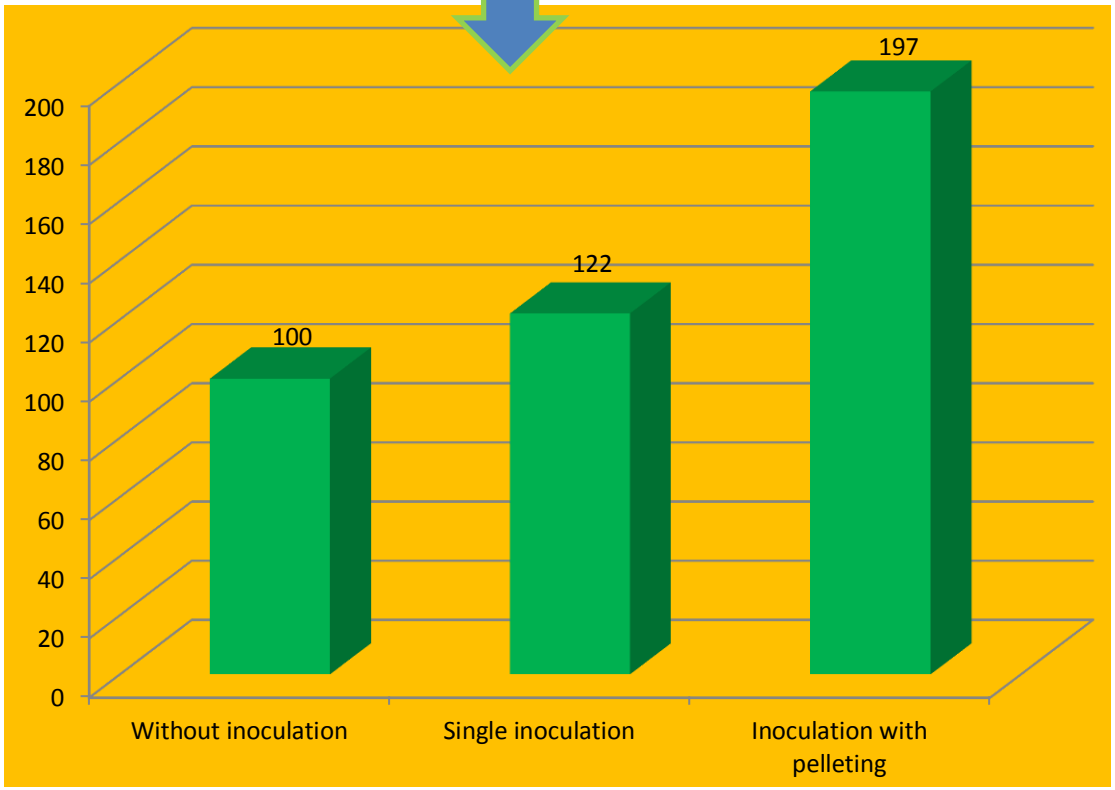
Herbage mixtures formed by various species/cultivars of legumes, grasses or others.

- **Formulated according to local soil (pH, texture, depth, drainage, etc.) and climate (annual rainfall and its distribution, minimum temperature).**
- **Each mixture contains a large number of species/cultivars, normally 12-20 for SBLRPP and 6-10 for BLRFC, chosen among more than 50 species and 200 cultivars.**

SEED INOCULATION

- Before mixing, the seeds of each species are inoculated with specific effective strains of Rhizobium, to enhance symbiotic N fixation (80-160 kg N/ha/year), in order to be self- sufficient in N.

- Graphic showing relative yields of subterranean clover in response to two methods of seed inoculation.



Characteristics of SBLRPP

- **Long lasting productive pastures with high intake** , well balanced in **energy/protein/minerals,** containing **@linolenic acid, vitamins,** eventually also **condensed tannins,** with an important role in animal health and quality of the products.
- **Improve soil fertility and the environment, through symbiotic N fixation and atmospheric carbon sequestration in the soil.**
- **Control soil erosion and the invasion of weeds and shrubs.**
- **Improve water cycle and increase biodiversity of the ecosystem.**

BIODIVERSITY in SBLRPP

Each mixture formed by species and cultivars well adapted to local soil and climate conditions and their eventual variations

- It improves pasture persistency; promotes better yield and quality of the herbage, and may act as self medication to the grazing animals .
- In particular, improves soil cover and minimizes the effects of grazing mismanagement.

MOST COMMON SPECIES USED: Annual legumes (no or few hard seeds)


T. suaveolens


T. incarnatum


T. alexandrinum


T. squarrosum


L. cicera


V. villosa


V. sativa


P. sativum


L. albus


L. luteus


L. angustifolius

Annual self-reseeding legumes (with many hard seeds)


T. subterraneum (3ssp)


B. pelecinus


O. sativus


O. compressus


T. glanduliferum


Medicago spp (9)


T. resupinatum


T. hirtum


T. isthmocarpum


T. vesiculosum


T. michelianum

Perennial Leaumes (with summer dormancy or deep root systems)

Annual grasses

Perennial grasses

Others.

Conditions required for the success of SBLRP&FC

Rational fertilization: according to soil analysis -

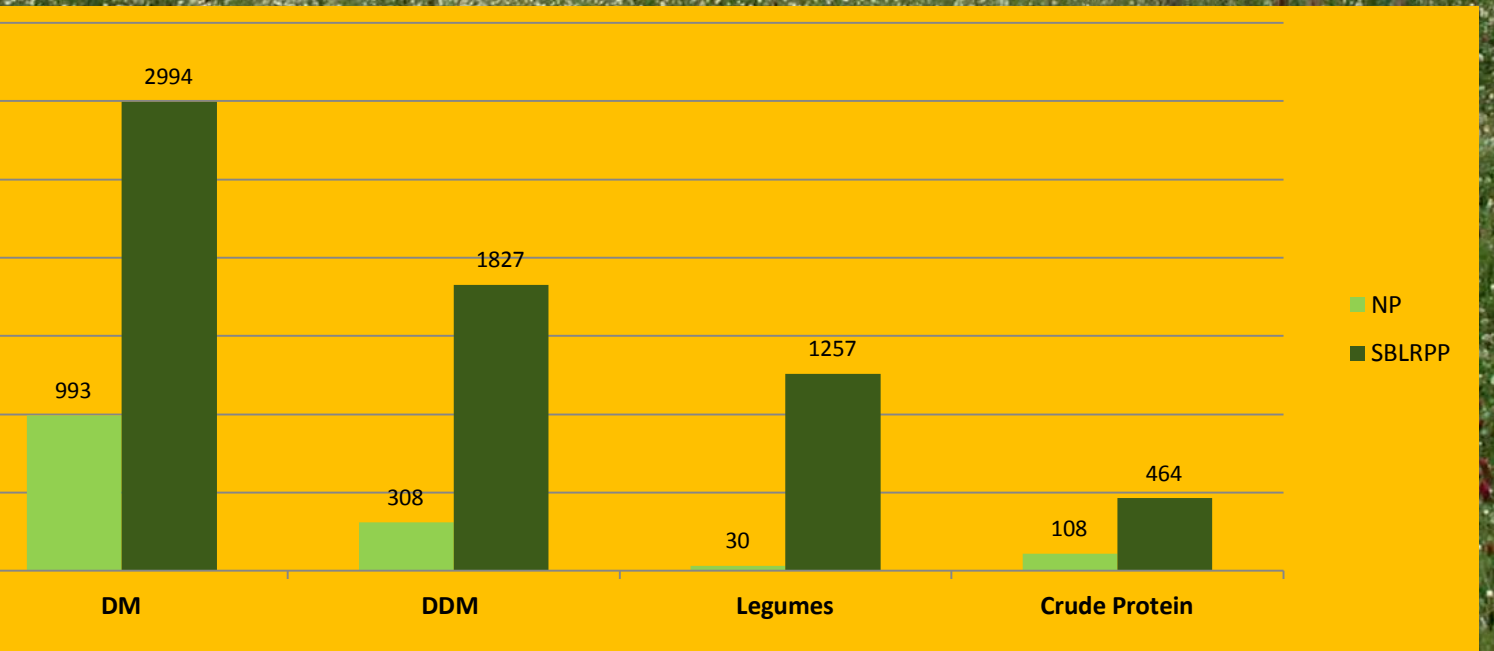
Early sowing: soil temperature >12ºC; ideally>16 º C.

Fertilization: self-sufficient in N, but requiring other macro-nutrients, particularly P , eventually also K, Ca, S, Mg, or micro-nutrients (Mo, B, Zn, Mn, Cu, Fe, Co).

SOME RESULTS ON YIELD AND QUALITY

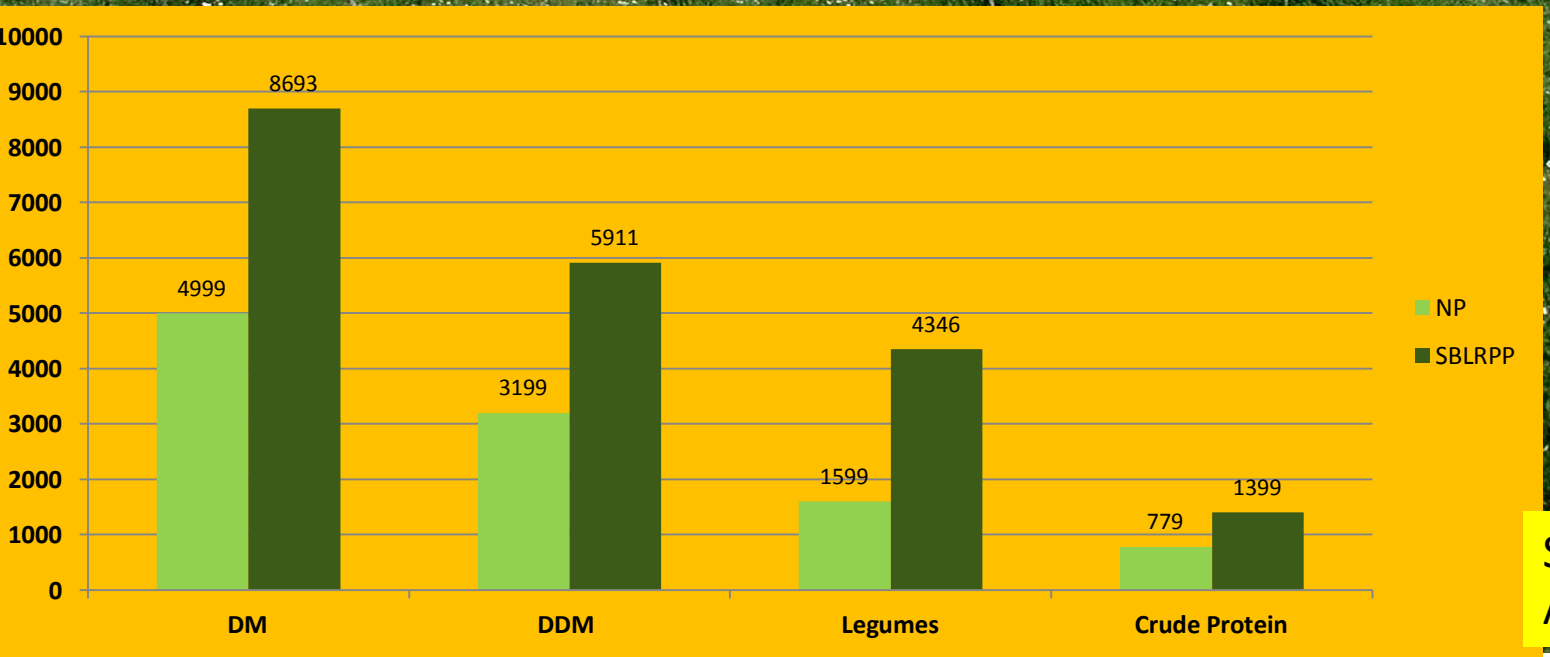
Natural pastures (NP) vs. SBLRPP in a poor acid sandy soil

Average of 3 years (kg/ha/year)



Source: Project Agro 87, Portrugal

SOME RESULTS ON YIELD AND QUALITY
Natural pastures (NP) vs. SBLRPP in a neutral clay soil
Average of 3 years (Kg/ha/year)

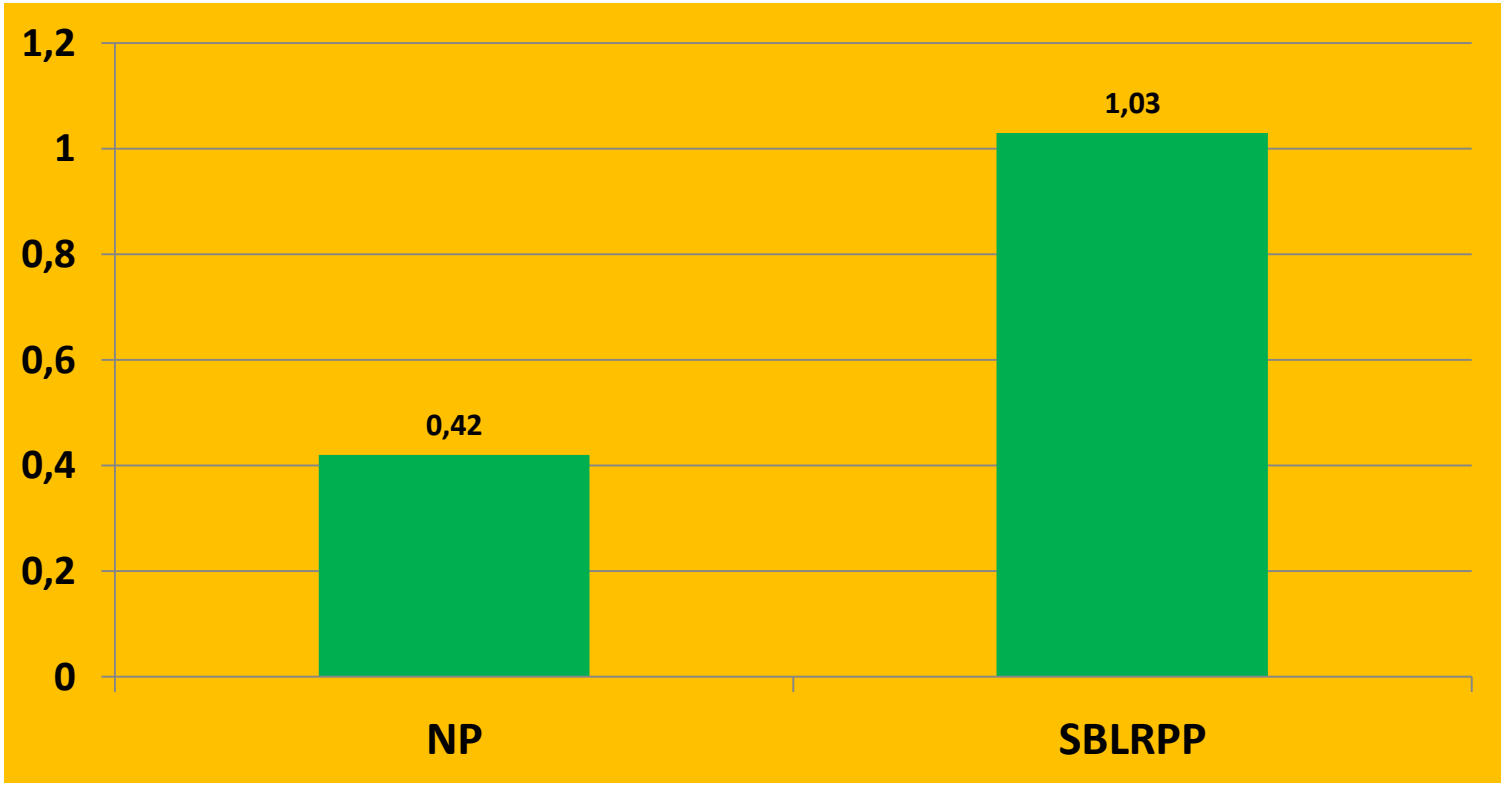


Source: Project Agro 87, Portugal

SOME RESULTS

CARRYING CAPACITY (C.U.equiv./ha/year) of NP vs. SBRPP

Average results of 6 experimental farm units during 3 years



Source: Project Agro 87, Portugal.

SOME RESULTS
CARBON SEQUESTRATION IN THE SOIL
Natural pastures (NP) vs. SBLRPP

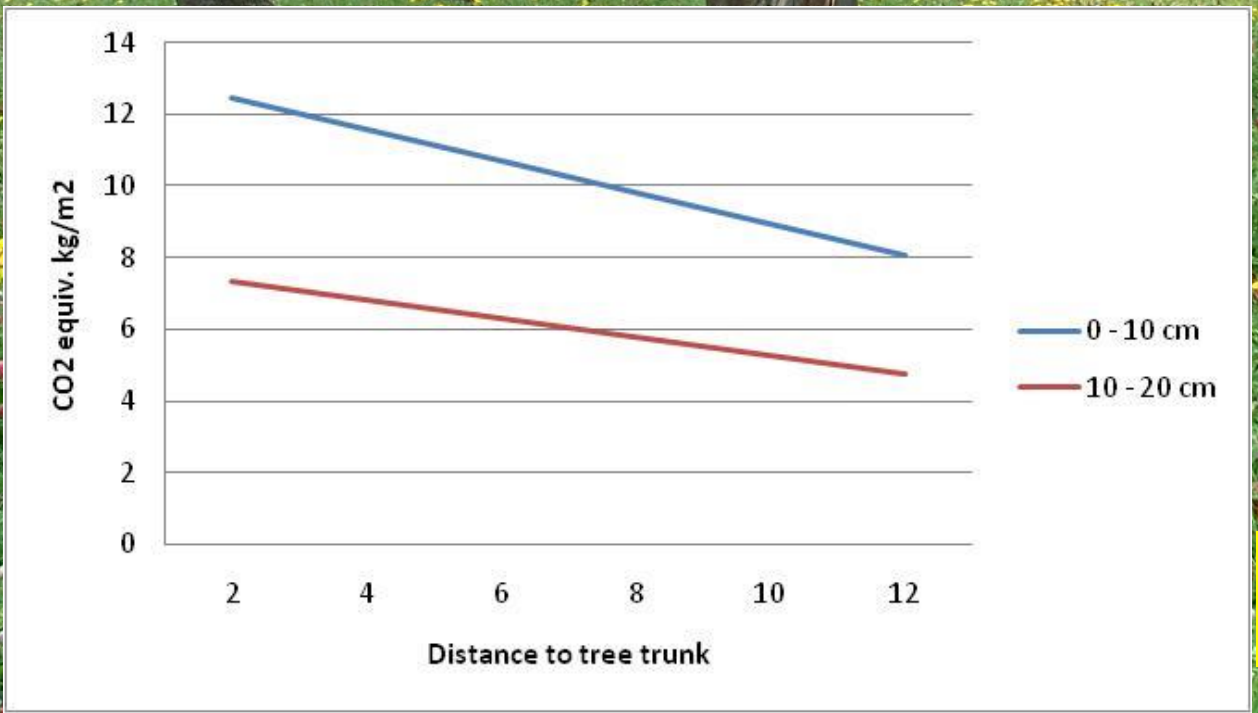
- Dead roots (most species are self reseeding annuals)
- Senescent Stems and leaves + pasture not consumed
- Animal faeces

Increase the content of soil organic matter (SOM), acting as a carbon sink

METHOD OF SEED BED PREPARATION FOR PASTURE ESTABLISHMENT	TYPE OF PASTURE	SOIL ORGANIC MATTER (%)				MEAN ANNUAL VARIATION (%/year)	**MEAN CARBON SEQUESTRATION (t CO2/ha/year)**
		Year 1	Year 2	Year 3	Year 4		
Minimum tillage	Natural	0,84	1,06	1,10	1,45	**0,20**	**5,95**
	BLRP	0,80	1,40	1,54	2,08	**0,43**	**12,80**

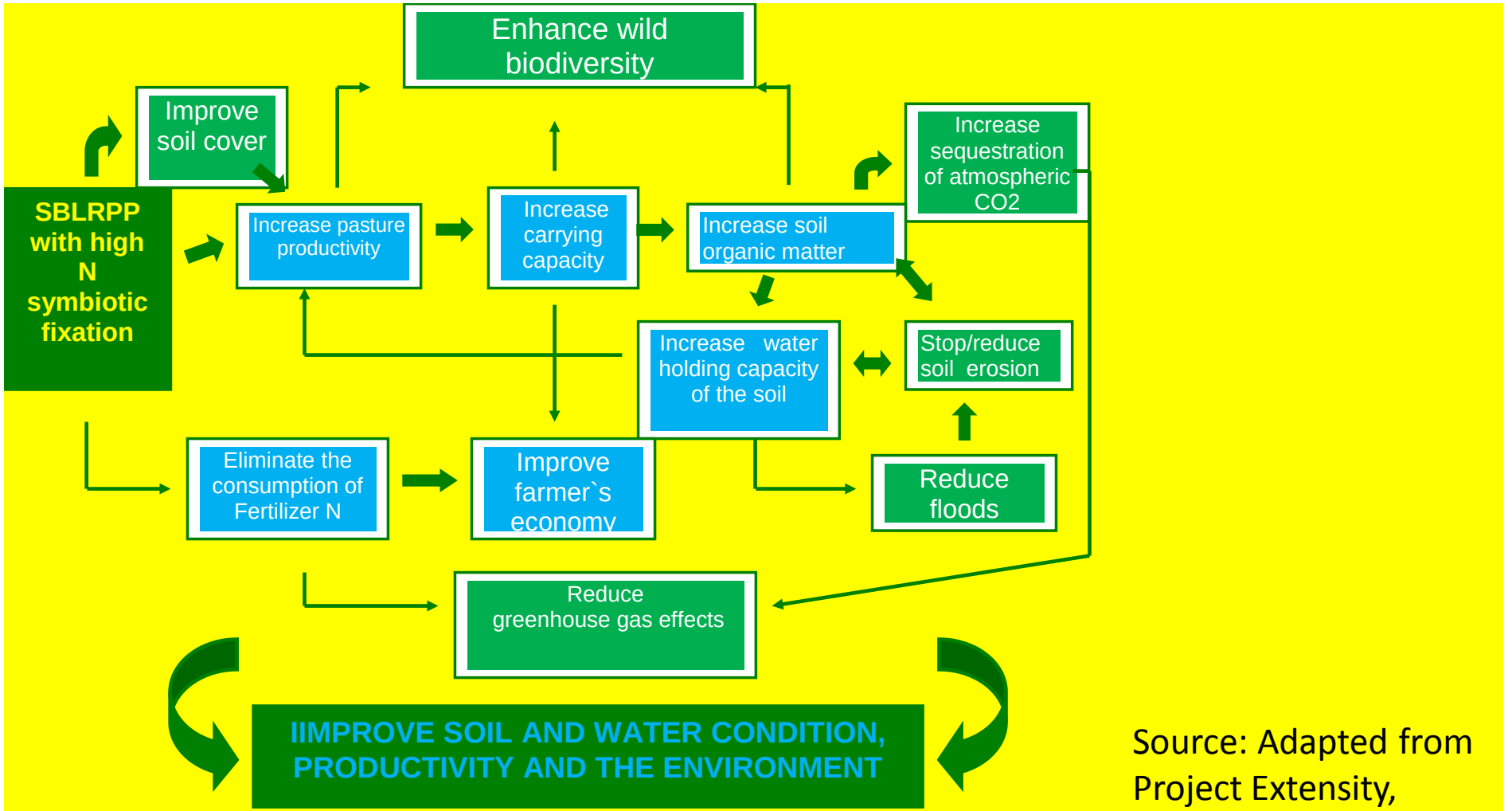
Source: Project Agro 74, Portugal

Spatial variation of soil organic carbon in 2 layers (0-10 and 10-20 cm) with increased distance from the cork oak trunks, on a 26 years old BLRP, established in a “montado”:



Source: Project Valmont, Portugal

RESUMING: Degraded lands can be restored through the use of SBLRPP, as they are able to:



Source: Adapted from Project Extensity, Portugal


THANK YOU VERY MUCH FOR YOUR ATENTION!