

Soil Erosion (and compaction) Risk Assessment in *Eucalyptus sp.* (Portugal) and *Pinus radiata* (Basque Country) stands (or plantations?)

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Soil Degradation Risks in Planted Forests
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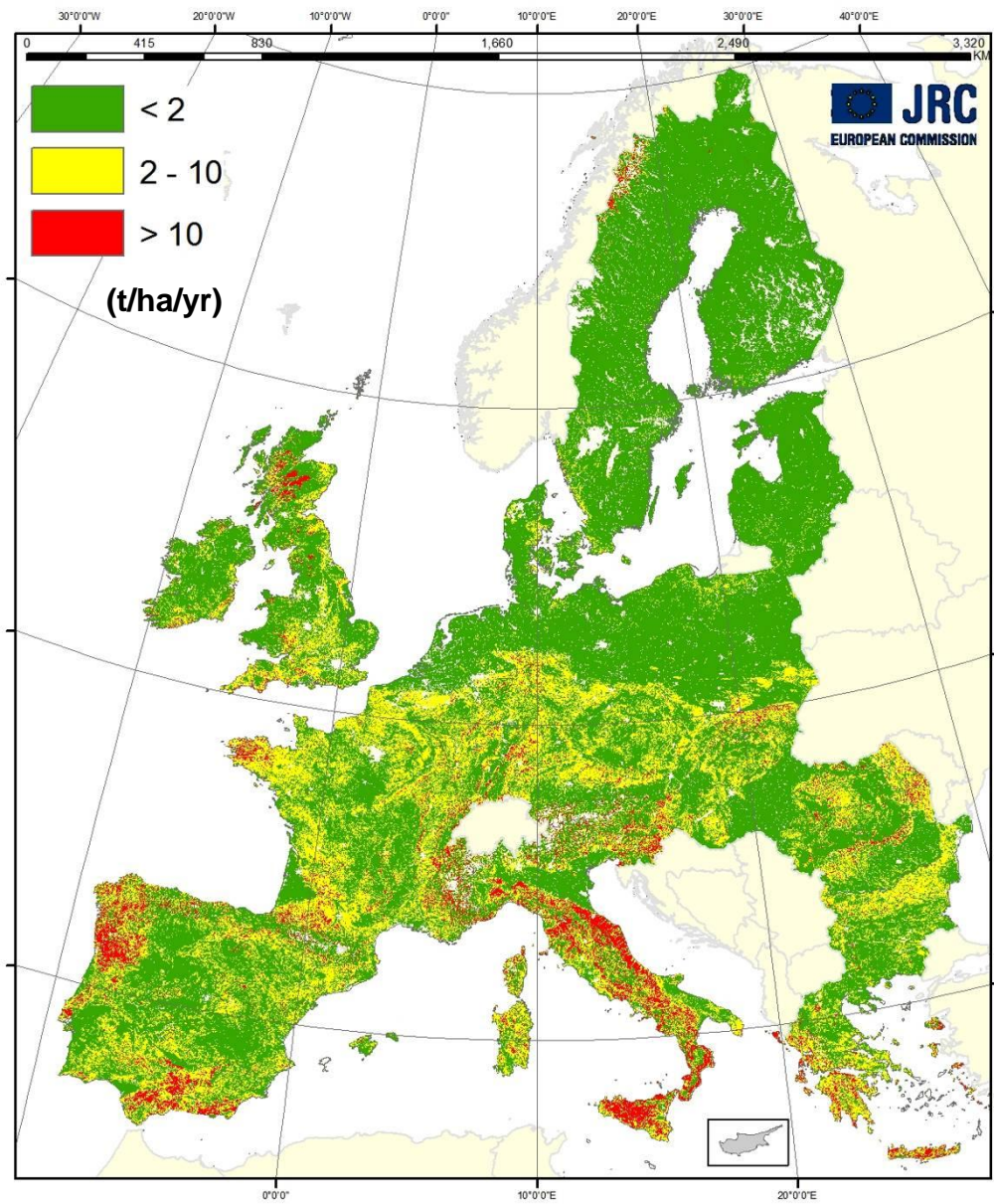


Soil erosion

- **Soil erosion is the wearing away of the earth's surface by water and wind**
- **“Accelerated” erosion is that which is caused by human activities, and that results in more than just geological erosion**
- **It causes both on-site impacts (soil loss, nutrient loss, lower productivity) and off-site impacts (reduced water quality, increased sedimentation, loss of habitat)**
- **The ability of forests to limit natural processes of erosion is well established**

Soil erosion in EU

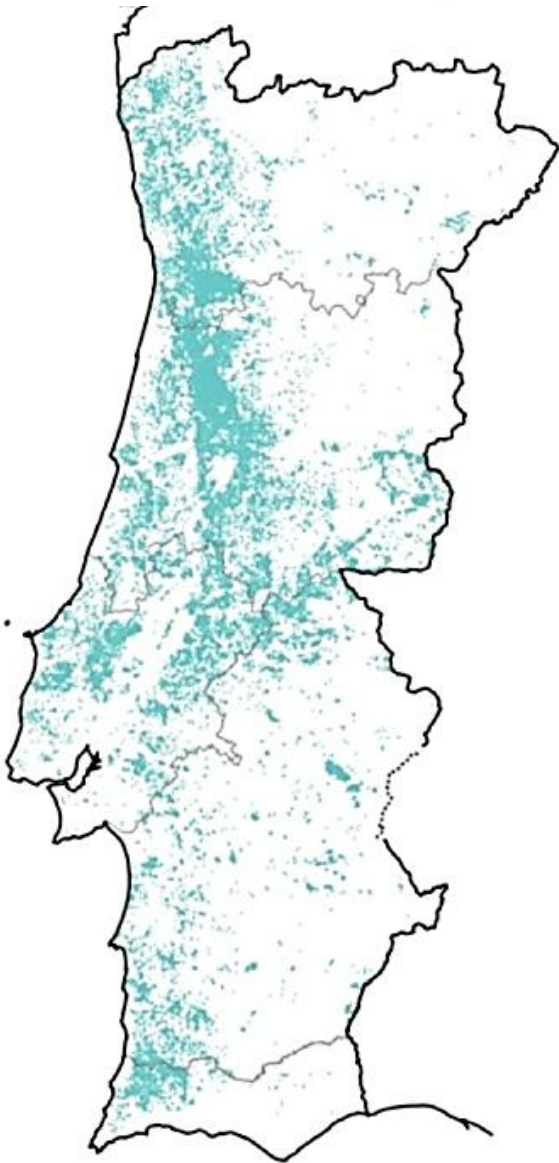
- **The European Commission (DG Joint Research Centre) has estimated that the surface area affected in Europe is about 1.3 million km²**
- **Almost 20% of this area is subject to a soil loss in excess of 10 t/ha/yr**
- **Erosion is not only a serious problem for soil functions (estimated to cost €53 million per year in the United Kingdom alone)**



Soil erosion by water in the EU (t/ha y)

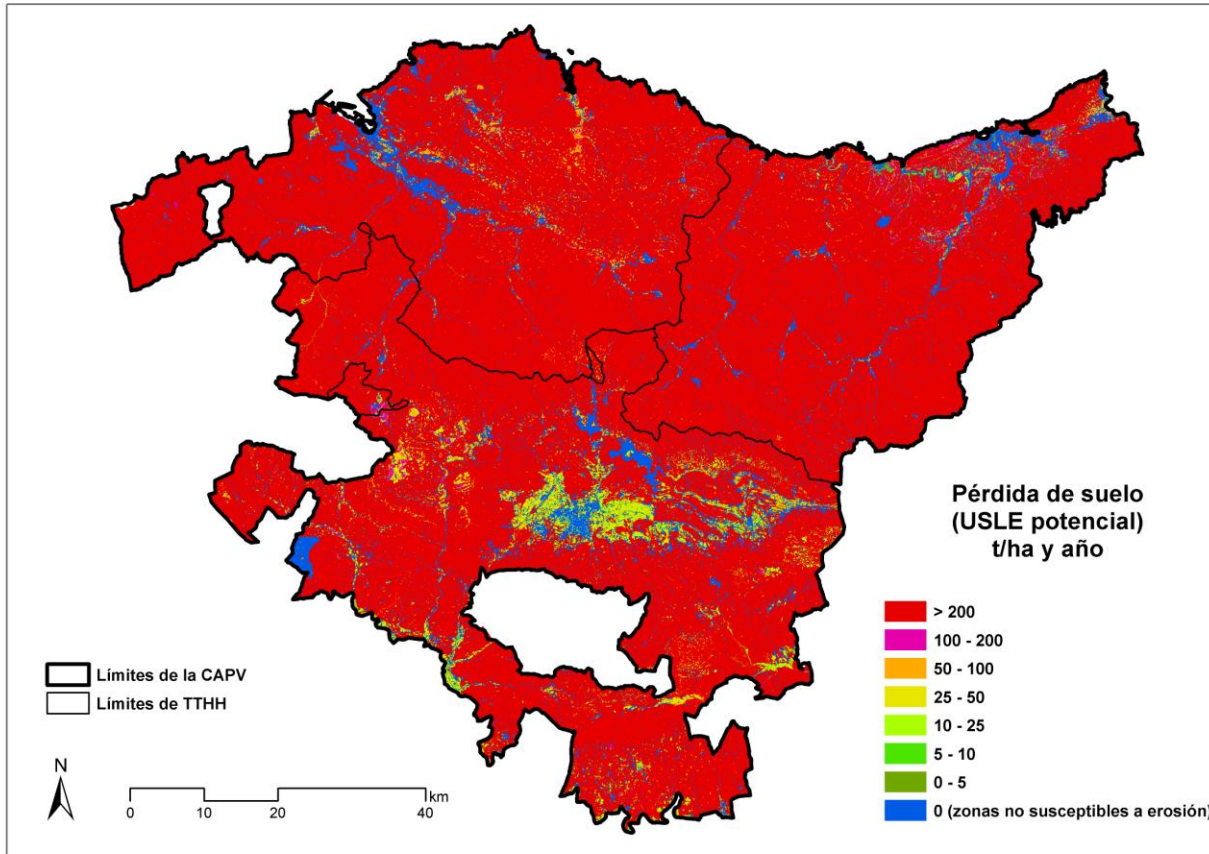
Eucalyptus plantations in Portugal

A large proportion occur in areas considered sensitive to erosion



Distribution (820 000 ha) of *E. globulus*

Pinus plantations in the Basque Country



A large proportion also occurs in areas considered sensitive to erosion

Gobierno Vasco 2005. Mapa de erosión de suelos de la Comunidad Autónoma de Euskadi

Factors of Risk for soil erosion

- **Climate (precipitation factor)**
 - **rain intensity/duration**
- **Topography**
 - **slope gradient, length and uniformity**
- **Soil properties**
 - **texture**
 - **Structure (SOM)**
 - **coarse fragments**
 - **water-restricting layers**

Risk for soil erosion: Management

- **Forests are the best “infrastructure” to prevent soil erosion**
- **Plantation Forestry and the inter-rotation period:**
 - **Loss of vegetation cover**
 - **Use of heavy machinery unadequately**
 - **Construction of forest roads, skidding trails and fire breaks**
- **Researchers do not usually account for this period when modelling erosion rates from cultivated forests**
- **Risk of erosion increases during inter-rotation period**

Erosion Risk Evaluation (ALTRI/ISA)

Adapted from: B.C. Ministry of Forests. 1999. Hazard assessment keys for evaluating site sensitivity to soil degrading processes guidebook. 2nd ed., Version 2.1. For. Prac. Br., B.C. Min. For., Victoria, B.C. Forest Practices Code of British Columbia Guidebook

SITE CHARACTERISTICS	DEGREE OF CONTRIBUTION FACTORS			
	Low	Medium	High	Very high
CLIMATE				
Precipitation (mm)	<700	700-1200	1200-1800	>1800
	2	4	6	8
TOPOGRAPHY				
Slope gradient (%)	0 –5 ^a	5 –25 ^a	25 – 45	> 45
	1	3	6	9
Slope length (m)/uniformity	SH broken	SH uniform	LN broken	LN uniform
	1	2	3	4
SOIL				
DEPTH TO WATER RESTRICTING LAYER (cm)	> 100 cm	51 – 100cm	26 – 50 cm	< 25 cm
	1	2	3	4
SURFACE SOIL DETACHABILITY (0-15cm; surface horizon)				
Texture ⁵	SC, C, SiC	SiCL, CL,SCL	SL, L	Si, SiL,fSL,LS,S
	1	2	4	8
COARSE FRAGMENTS (0 – 15 cm)				
	> 60	31 - 60	16 - 30	<16
	1	2	3	4
SUBSOIL PERMEABILITY (16 – 60 cm)				
Texture	S, LS,SL	L,SiL,Si	CL,SCL,SiCL	C,SC,SiC
	1	2	3	4
EROSION RISK				
	LOW	MEDIUM	HIGH	VERY HIGH
Total score	< 16	16 - 22	23 - 31	> 32



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Erosion Risk Evaluation (ALTRI/ISA)

- **Alternatives to PPT:**
 - “Aridity index” (semi arid $<0,5$, dry sub-humid $0,5-0,65$, sub-humid $0,65-1$, humid >1)
 - Fournier index.
- **Slope gradient: 25% (threshold for permission of terraces in Portugal)**
- **Slope length: SH (short) $\leq 150\text{m}$; LN (long) $> 150\text{m}$**
- **Depth to restrict layer: Leptosols $<25\text{ cm}$; Epileptic: $25-50\text{ cm}$; endoleptic: $50-100\text{ cm}$; haplic: $>100\text{ cm}$;**
- **Texture: sandy clay SC, clay C, silty clay SiC, silty clay loam SiCL, clay loam CL, sandy clay loam SCL, sandy loam SL, loam L, silt Si, silt loam SiL, loam sandy LS, sandy S, fine sandy loam fSL**

Soil Erosion Risk: Basque Country

12 Plots analysed

NAME	UTM_X	UTM_Y	Texture	Slope (%)	Slope length	PPT (mm)	Coarse fragments	Depth WRL (m)	Points	Erosion Risk
Arbaliza I	483654	4781268	Loam	18	SH uniform	>1200	<16	0-0,5	24	High
Arbaliza II	484856	4781044	Loam	14	SH uniform	>1200	<16	0-0,5	24	High
Kolitxa	479932	4783301	Loam	29	SH uniform	>1200	<16	0,5-1	26	High
La Guinea	481433	4784039	Clay loam	40	SH uniform	>1200	<16	0,5-1	25	High
La Herbosa I	483205	4785522	Loam	25	SH uniform	>1200	<16	0,5-1	23	High
La Herbosa II	483763	4785707	Loam	25	SH uniform	>1200	<16	0,5-1	23	High
La Sancha I	481387	4786796	Clay loam	13	SH uniform	>1200	<16	2-4	21	Medium
La Sancha II	481458	4786635	Clay loam	11	SH uniform	>1200	<16	2-4	21	Medium
Aretxabalagane	520125	4792200	Silty clay loam	15	SH uniform	>1200	<16	0,5-1	22	Medium
Sarasolalde	514000	4776450	Silty clay loam	10	SH uniform	>1200	<16	0,5-1	22	Medium
Santa Lucia	523300	4795550	Silty clay loam	46	SH uniform	>1200	<16	1-2	27	High
Baluga	488175	4784250	Silty clay loam	25	SH uniform	>1200	<16	0,5-1	22	High

Soil compaction

- **Soil compaction is the increase in soil bulk density that results from the rearrangement of soil particles in response to applied external forces**
- **Soil puddling is the destruction of soil structure and the associated loss of macroporosity that results from working the soil when wet**
- **Compaction can reduce water infiltration capacity and thereby increase the risk of erosion through accelerated run-off**
- **Compaction can affect root development/expansion and therefore the productivity**

Factors of Risk for soil compaction

- The soil compaction and puddling risk evaluation derives from an assessment of how the load-bearing capacity of the soil is affected by the combined influences of soil texture, coarse fragment content, moisture regime.
- Texture
- Coarse fragments
- Moisture regime
- Depth (or thickness?) of forest floor (organic horizons)

Moisture Regimes

- **Hydric** - Wet, plants periodically or often inundated by water.
- **Sub-hydric** - Water removed slowly enough to keep water table at or near surface for most of year.
- **Hygric** - Water removed slowly enough to keep soil wet for most of growing season.
- **Sub-hygric** - Water removed slowly enough to keep soil wet for a significant part of growing season.
- **Mesic** - Moist, adequate soil moisture retention year-round. Available soil moisture reflects climatic inputs.
- **Sub-mesic** - Water removed readily in relation to supply; water available for moderately short periods following precipitation.
- **Sub-xeric** - Moist to dry, seasonally moist, periodically dry. Water removed rapidly in relation to supply; soil is moist for short periods following precipitation.
- **Xeric** - Dry and drought resistant, little moisture retention, excessively drained.
- **Very xeric** - Water removed extremely rapidly in relation to supply.

Compaction Risk Evaluation

Adapted from: B.C. Ministry of Forests. 1999. Hazard assessment keys for evaluating site sensitivity to soil degrading processes guidebook. 2nd ed., Version 2.1. For. Prac. Br., B.C. Min. For., Victoria, B.C. Forest Practices Code of British Columbia Guidebook

Soil texture (0-20 cm)		Risk rating	
		Xeric-subhygric (O horizons <5 cm)	Subhygric-subhydric (O horizons ≥5 cm)
Coarse fragments >70%		Low	Medium
Coarse fragments ≤70%	Sandy S, LS	Low	Very High
	Sandy loam SL, fSL	Medium	
	Silty/loamy SiL, Si, L	High	
	Clayey SCL, CL, SiCL, VH SC, SiC, C	Very High	

Soil Compaction Risk: Basque Country

12 Plots analysed

NAME	UTM_X	UTM_Y	Texture	Moisture Regime	Coarse fragments	Erosion Risk
Arbaliza I	483654	4781268	Loam	Mesic-Sub-hygric	<16	High
Arbaliza II	484856	4781044	Loam	Mesic-Sub-hygric	<16	High
Kolitxa	479932	4783301	Loam	Mesic-Sub-hygric	<16	High
La Guinea	481433	4784039	Clay loam	Mesic-Sub-hygric	<16	Very high
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Eskerrik asko!!!
iii Muchas gracias!!!
Moito Obrigado!!!
Merci beaucoup!!!