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Soil Protection in Sloping Mediterranean Agri-Environments

Lectures and exercises

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Front: Vineyards near Régua, in the Douro Valley (UNESCO World Heritage) – soil protection structures control erosion in very steep slopes, the Port Wine grounds
Back, top: Olive grove near Mirandela (NE Portugal) – the soil is left bare by conventional tillage; nevertheless erosion rates might be low in stony areas
Back, down: Wheat field near Bragança (NE Portugal) – severe gully erosion and partial crop loss after heavy rainfalls in the initial stages of crop growth

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Soil Conservation Measures: Exercises

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Foreword

Exercises proposed under the topic of Soil Conservation Measures addresses to the design of structural measure, namely waterways in the context of a soil conservation plan. However, to get a better insight on the actual meaning of soil loss as a resource loss, a prior exercise is proposed to students. It concerns calculations of soil loss due to sheet (interrill) erosion and to gully erosion, and allows the perception through realistic number of the impact of these mechanisms on soil resource.

HOW MUCH DO WE LOSE WHEN WE LOOSE SOIL?

Sheet erosion

A soil, characterized as presented below, suffers soil loss by water erosion estimated as 12 t/ha per year.

a) Calculate annual soil depth removal by erosion

b) Calculate annual loss per hectare of the following constituents: clay, organic matter, Nitrogen

c) Calculate loss in soil water storage capacity, after 10 years under such soil loss rate

d) Comment on results

Bulk density: BD = 1,2

Organic matter: %OM = 2,5% (Com = 58%; Nom = 5%)

Rock fragment: %RF = 15% %

Clay = 20% %

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Effective depth of arable soil: z = 30cm

Water content at Field Capacity (pF 2,0): %Hcc = 30%

Wilting point (pF 4,2): %Hcc = 12%

Gully erosion

After a heavy storm, a gully incised a 2ha field. All along the 70m gully, measurements were taken every 10m frm head to end of gully: depth, width at surface and shape o cross section. Results are presented in Table.

Fill in the blank cases in Table, performing the appropriate calculations.

Show calculations and comment on results.

Table 1. Gully field measurements and calculation of volume eroded (T – Triangular; R – Rectangular)

Gully Section/Part		Distance (m)	Gully (cm)		Form of cross section	Area of cross section (cm2)	Volume of part (m3)
			Depth	Width			
-	Head	0	-	-	-		
1		10	10	10	T		
2		20	15	20	T		
3		30	25	40	R		
4		40	40	70	R		
5		50	45	80	R		
6		60	50	80	R		
7	End	70	50	85	R		
Gully Total Volume (m3)							
Total Loss per unit area, volume (m3/ha)							
Total Loss per unit area, weight (ton/ha)							

HOW DO WE CONTROL SOIL LOSS

Design of waterways in the context of a soil conservation plan
(Application of methodology proposed by Morgan 2005)ully erosion

Read the text provided in class, regarding directly the design of soil conservation structural measures, such as terraces and waterways (Morgan 2005).

Explore the example detailed for water ways.

Basic formulas are:

Manning – $v = (1/n)\ r^{2/3}\ s^{1/2}$

Discharge – Q = v A

v – flow velocity (m/s)

r – hydraulic radius (m) (cross sectional wetted area / perimeter)

s – slope (-)

n – Manning friction factor

Q – discharge (m^3/s)

Consider the procedures explained in the example in the text provided and apply them to the following conditions and scenarios:

a. Conditions

Waterway:

Slope – 1,5%

Clay loam soil

Medium grass cover with height – 4cm (Bermuda)

Drainage area:

Square shape

Area 60ha

1/5 – Forest over shallow soil in steep slope

30% - Scrub over shallow soil in rolling area

½ - cultivated area over loam soil in moderate slope area

Design storm:

Consider a 10 return period of temperate type of precipitation

b. Scenarios

1) The above
2) Waterway bed with very good grass cover with height – 10cm (Bermuda) and 0,5% slope
3) Waterway bed made on soft rock, non vegetated and 1,5% slope
4) 50 year return period of precipitation

Comment on results, interpreting scenarios and comparing results.

References

Morgan, R.P.C., 2005: Soil erosion and conservation, 3rd ed. Blackwell, Oxford, UK.