

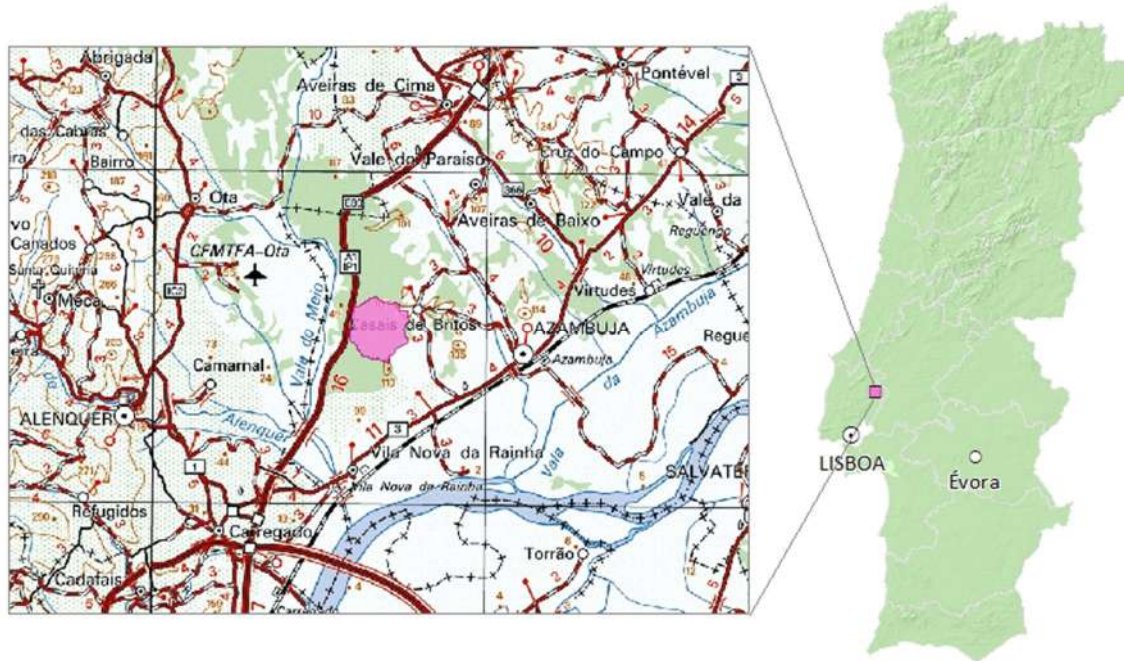


## **RECOVERY PROGRAMME AFTER SEVERE SOIL EROSION: LESSONS LEARNED FROM THE VALE MOURO CASE**

Plasencia, 28 de junho de 2017



## WHAT HAPPENED IN VALE MOURO?



- Vale Mouro – 670 ha of eucalypt plantations
- Forest fire in 2008: 290 ha burned
- The burned area was cut in 2009
- Reforestation started in summer 2010
- From 2010 to 2013, 600 ha was replanted in three planting phases



- Winter 2010/11: Very rainy winter and spring, with several moments of peak precipitation, originated severe erosion on the slopes and heavy sedimentation in the lower areas
- Soil recovery interventions started in March 2011 and continued until the end of 2012
- The Vale Mouro case was the sole reason for the suspension of the company's FSC Forest Management certificate, with huge negative impact on a commercial level, public image of the company and public relations with ENGO and other stakeholders.
- So what were the erosion phenomena observed?





altriflorestal



24/02/2011





altriflorestal







altriflorestal







altriflorestal







altriflorestal







altriflorestal







altriflorestal







## **What went wrong? A Root Cause Analysis**

What are not Root Causes!:

- Heavy rainfall that occurred during stand establishment
- Vulnerable soils
- Coincidence of factors

What are Root Causes:

- Inadequate erosion risk assessment, due to:
  - Lack of senior experience in the management team
  - Ignorance of previous experiences at the site
  - Insufficient information and management support tools
- Wrong diagnosis of current situation (undo the terraces)
- No measures included to prevent or minimize erosion



## **AFTER EVERYTHING WENT WRONG, WHAT DID WE DO?**

- 1st priority: stabilize the slopes and prevent further erosion and soil loss
  - Reconstruction of the undone terraces





altriflorestal







## **AFTER EVERYTHING WENT WRONG, WHAT DID WE DO?**

- 1st priority: stabilize the slopes and prevent further erosion and soil loss:
  - Use innovative techniques of natural engineering, based on coarse woody debris available on site, filling up the gullies to slow down water speed





altriflorestal







altriflorestal







altriflorestal







altriflorestal







## **AFTER EVERYTHING WENT WRONG, WHAT DID WE DO?**

- 1st priority: stabilize the slopes and prevent further erosion and soil loss:
  - Use locally available stumps to fill up ravines, in order to slow down water speed but allowing water to pass.





altriflorestal



02/09/2011





altriflorestal



02/09/2011





altriflorestal







## **AFTER EVERYTHING WENT WRONG, WHAT DID WE DO?**

- 1st priority: stabilize the slopes and prevent further erosion and soil loss:
  - Hidrosowing to establish herbaceous vegetation on slopes





altriflorestal







## **AFTER EVERYTHING WENT WRONG, WHAT DID WE DO?**

- 1st priority: stabilize the slopes and prevent further erosion and soil loss:
  - Plant riparian species in sedimentation areas





altriflorestal







## **HAVING DONE THAT, WHAT DID WE DO NEXT?**

- 2nd priority: prevent re-occurrence: Implement erosion prevention measures such as:
  - Strip harrowing instead of continuous harrowing





altriflorestal







## **HAVING DONE THAT, WHAT DID WE DO NEXT?**

- 2nd priority: prevent re-occurrence: Implement erosion prevention measures such as:
  - Retain stumps alive in the lower parts as a barrier to sediment transport









## **HAVING DONE THAT, WHAT DID WE DO NEXT?**

- 2nd priority: prevent re-occurrence: Implement erosion prevention measures such as:
  - Retain stumps alive midway of the slope









## **HAVING DONE THAT, WHAT DID WE DO NEXT?**

- 2nd priority: prevent re-occurrence: Implement erosion prevention measures such as:
  - Chemical stump treatment without removal





altriflorestal







## **HAVING DONE THAT, WHAT DID WE DO NEXT?**

- 2nd priority: prevent re-occurrence: Implement erosion prevention measures such as:
  - Minimal soil mobilization on terraces





29/02/2012





What was going on at the office in the meantime?

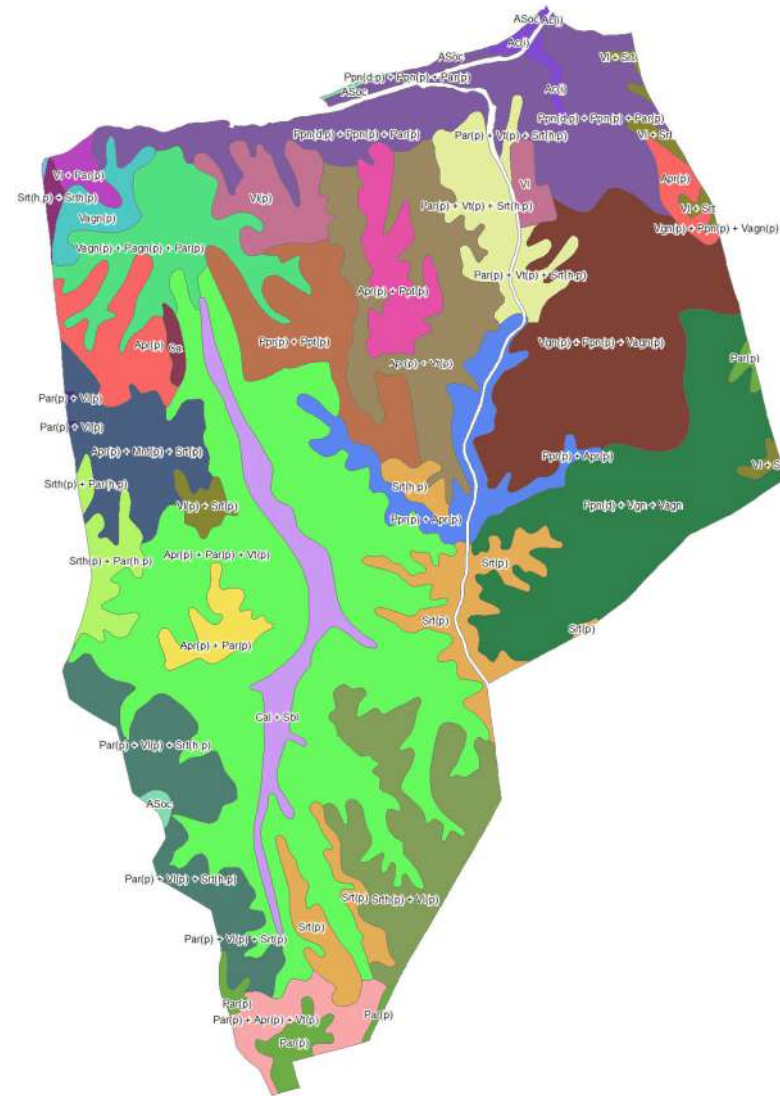
- 3rd priority: increase our knowledge on erosion risk assessment
  - Aquisition of information on soil characteristics necessary for the prediction models





- Diagnostic Soil Characteristics (Gonçalves Ferreira, 2001):

- No limitations
- Expansive Depth
- Active Calcarian Soils
- Textural Descontinuity
- Vertic Characteristics
- Salinity
- External Drainage
- Internal Drainage
- Sandy Texture
- Effective Depth
- Rocky Outcrops







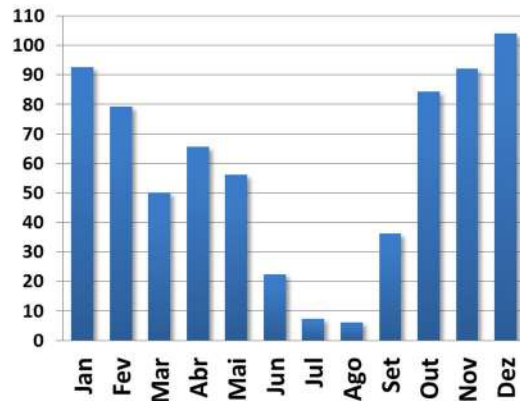
## **WHAT WAS GOING ON AT THE OFFICE IN THE MEANTIME?**

- 3rd priority: increase our knowledge on erosion risk assessment
  - MSC thesis on erosion prediction models applied to our properties

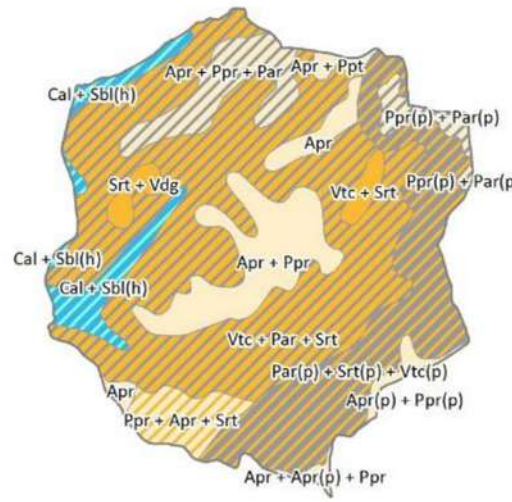


# METODOLOGIA:

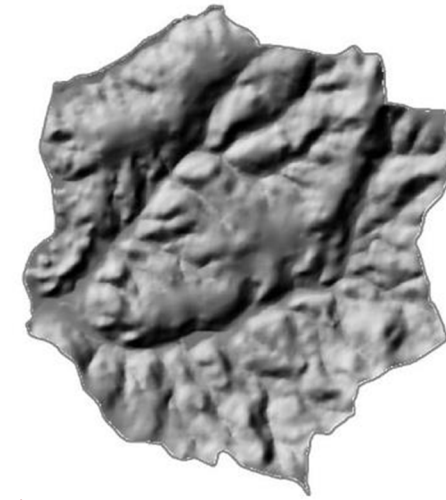
## modelação por adaptação da USLE



*Normas de precipitação*



*Carta de Solos*



*Modelo Digital de Elevação*

$$R = F_m = \sum_{i=1}^{12} \frac{P_i^2}{P}$$

(Índice de Fournier)

**X**

$$K = 0,06232 - 0,003746 * DMG$$

(para  $DMG \leq 0,007395$ )

$$K = 0,010616 - 0,020523 * DMG$$

(para  $DMG > 0,007395$ )

(Silva, 1999)

*Acumulação do escoamento*

**X**

$$LS = \left( \frac{a * l}{22,13} \right)^{0,4} * \left( \frac{s}{0,0896} \right)^{1,3}$$

(Moore & Burch, 1986)





## **WHAT WAS GOING ON AT THE OFFICE IN THE MEANTIME?**

- 3rd priority: increase our knowledge on erosion risk assessment
  - Internal training program for technical staff of the company by research staff of the University of Évora









## **WHAT WAS GOING ON AT THE OFFICE IN THE MEANTIME?**

- 3rd priority: increase our knowledge on erosion risk assessment
  - Include new knowledge in risk assessment procedures and results in operational planning





## Carta de Risco de Erosão Potencial dos Solos

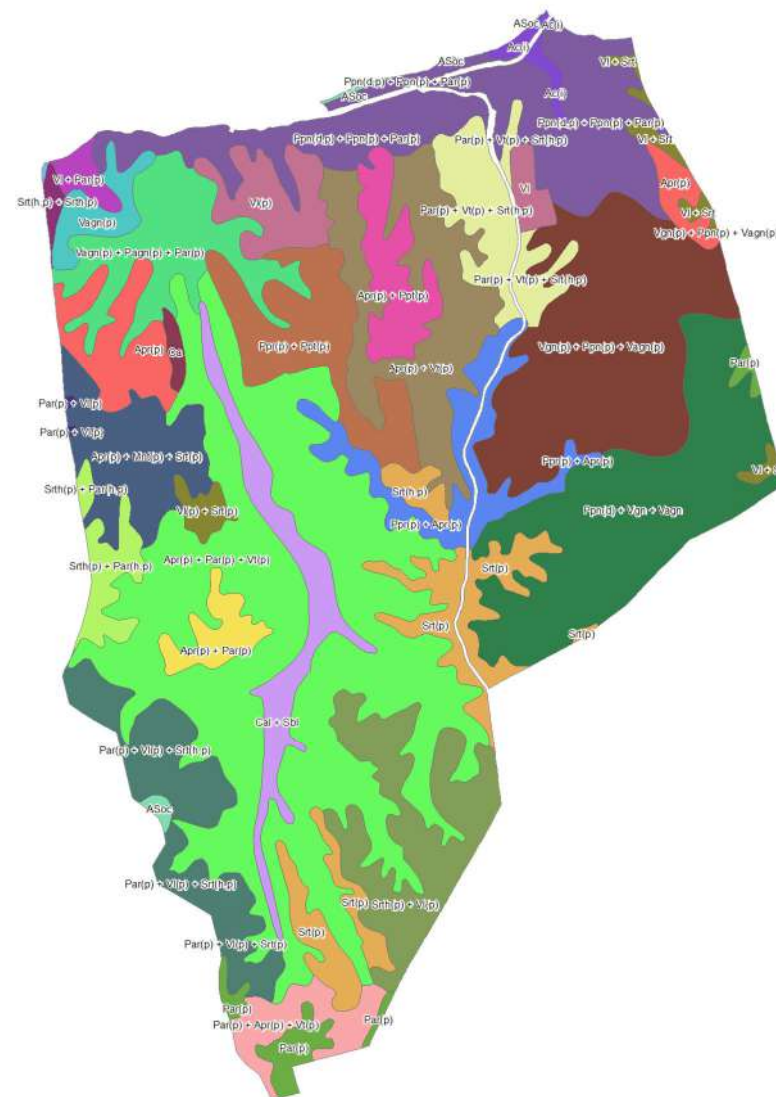
$$K \cdot R \cdot LS = A$$







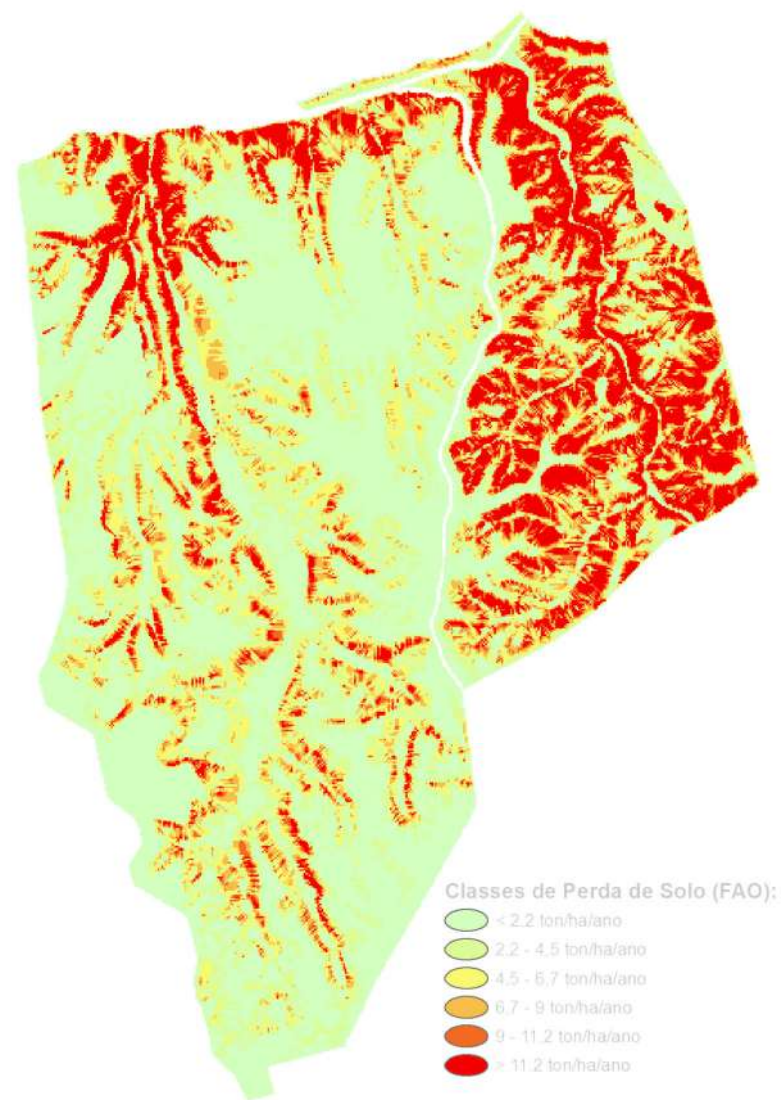
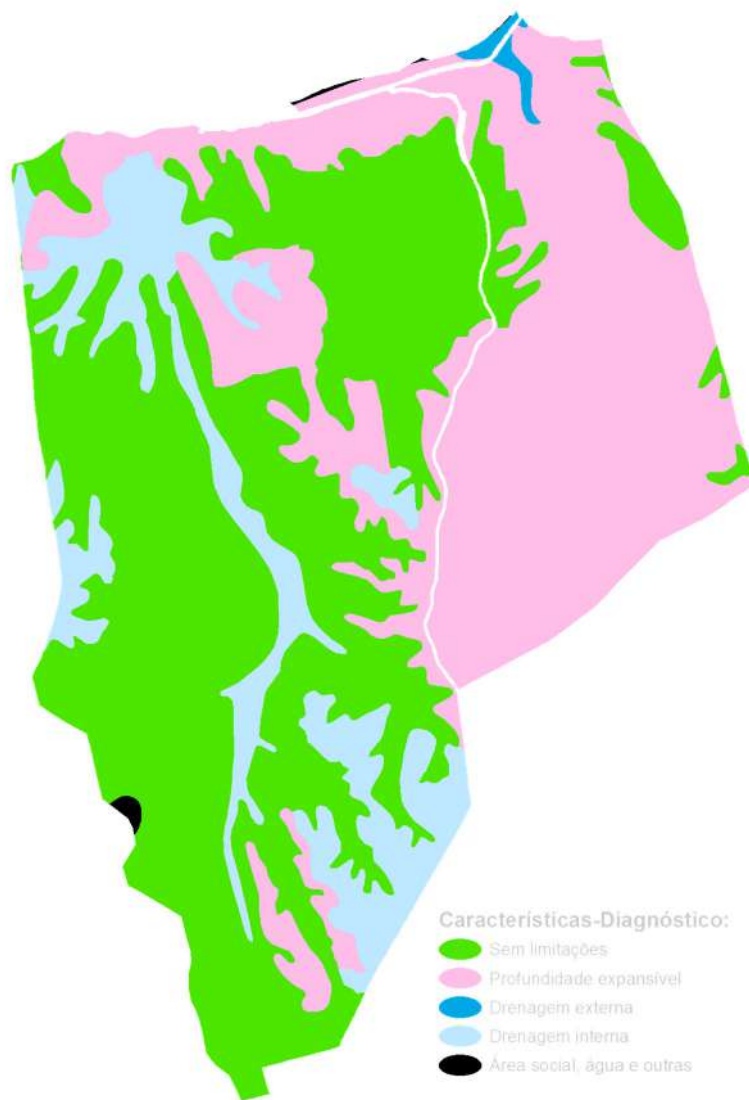
altriflorestal







altriflorestal







altriflorestal

## **AND WHAT ABOUT EVERYBODY ELSE?**

- 4th priority: stakeholder engagement
  - Engage all members of the company with the problem and the corrective measures





22/06/2011













22/06/2011





22/06/2011





## **AND WHAT ABOUT EVERYBODY ELSE?**

- 4nd priority: stakeholder engagement
  - Explain to stakeholders what happened and what we are doing about it









## **AND WHAT ABOUT EVERYBODY ELSE?**

- 4nd priority: stakeholder engagement
  - Increased training programme for service suppliers
  - Promote de inovative engineering techniques beyond company borders





altriflorestal



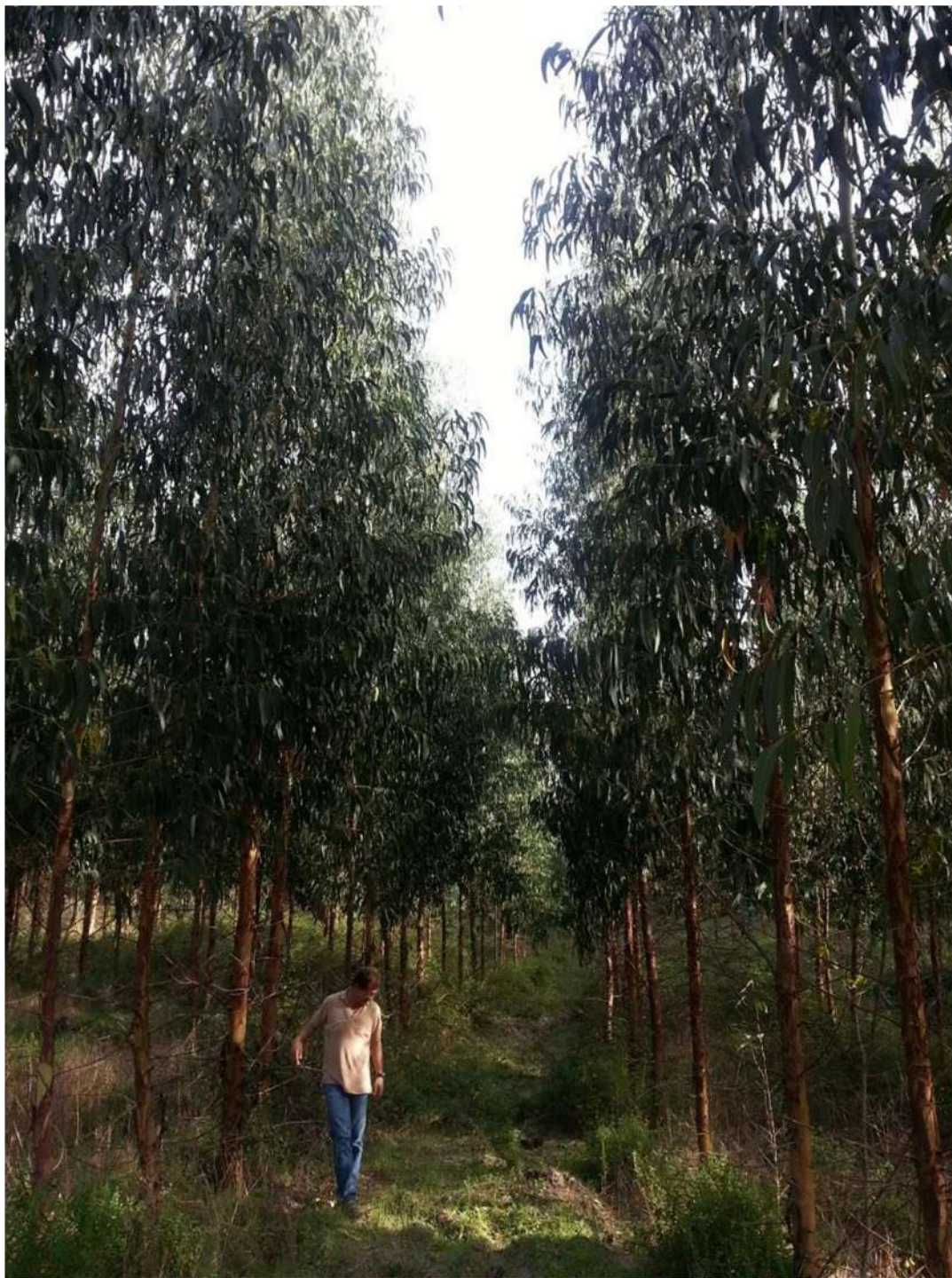




altriflorestal

**AND NOW, FIVE YEARS LATER, HOW IS VALE MOURO?**





altriflorestal





altriflorestal







altriflorestal







altriflorestal







altriflorestal







altriflorestal







## **VALE MOURO – LESSONS LEARNED**

- Insufficient risk assessment can lead to severe soil erosion under adverse circumstances
- Several innovative recovery techniques, using natural engineering, were very effective in stopping the erosive processes
- Due to its huge impact, Vale Mouro was a turning point in the company's forest policy





altriflorestal

**Thank you for your attention**

Henk Feith  
hfeith@altri.pt