ALTERFOR

ASSOCIAÇÃO FLORESTAL VALEDOSOUSA

INSTITUTO SUPERIOR DE AGRONOMIA
Universidade de Lisboa

ALTERNATIVE FOREST MANAGEMENT MODELS AND ROBUST DECISION-MAKING FOR FUTURE FOREST MANAGEMENT

ALTERFOR 3rd cross-project meeting

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Brigite Botequim*, *Patrícia Pécurto , *Susete Marques, Carlos Caldas, Marlene Marques, Marco Marto, José G. Borges*

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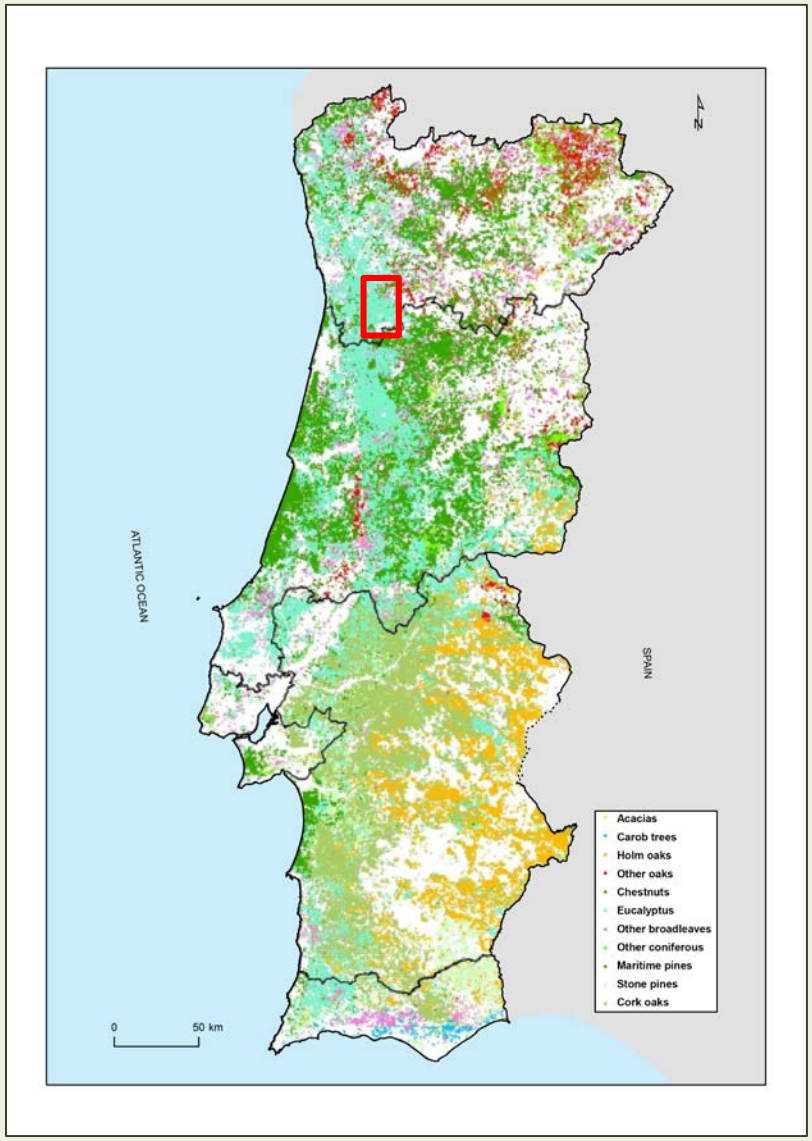
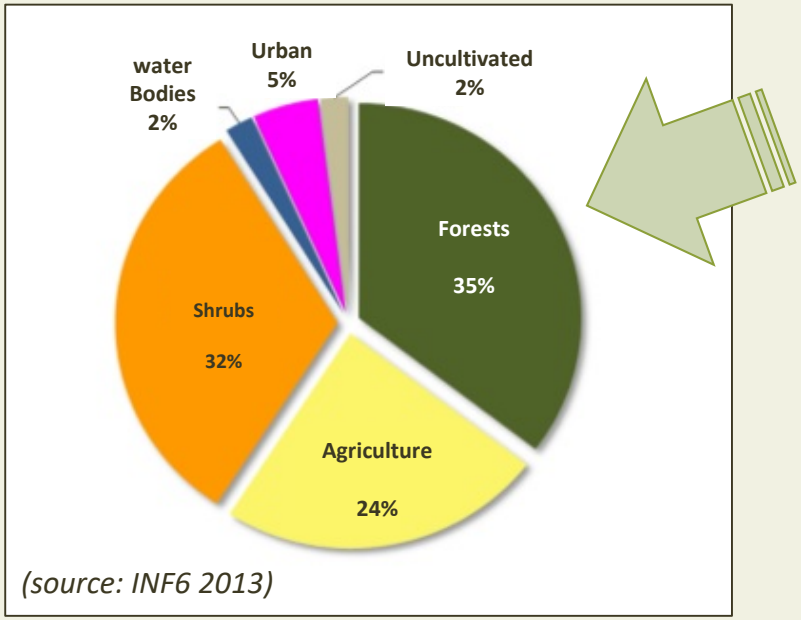
Background - Forest in Portugal



(source: INF6 2013)

Land cover (%)



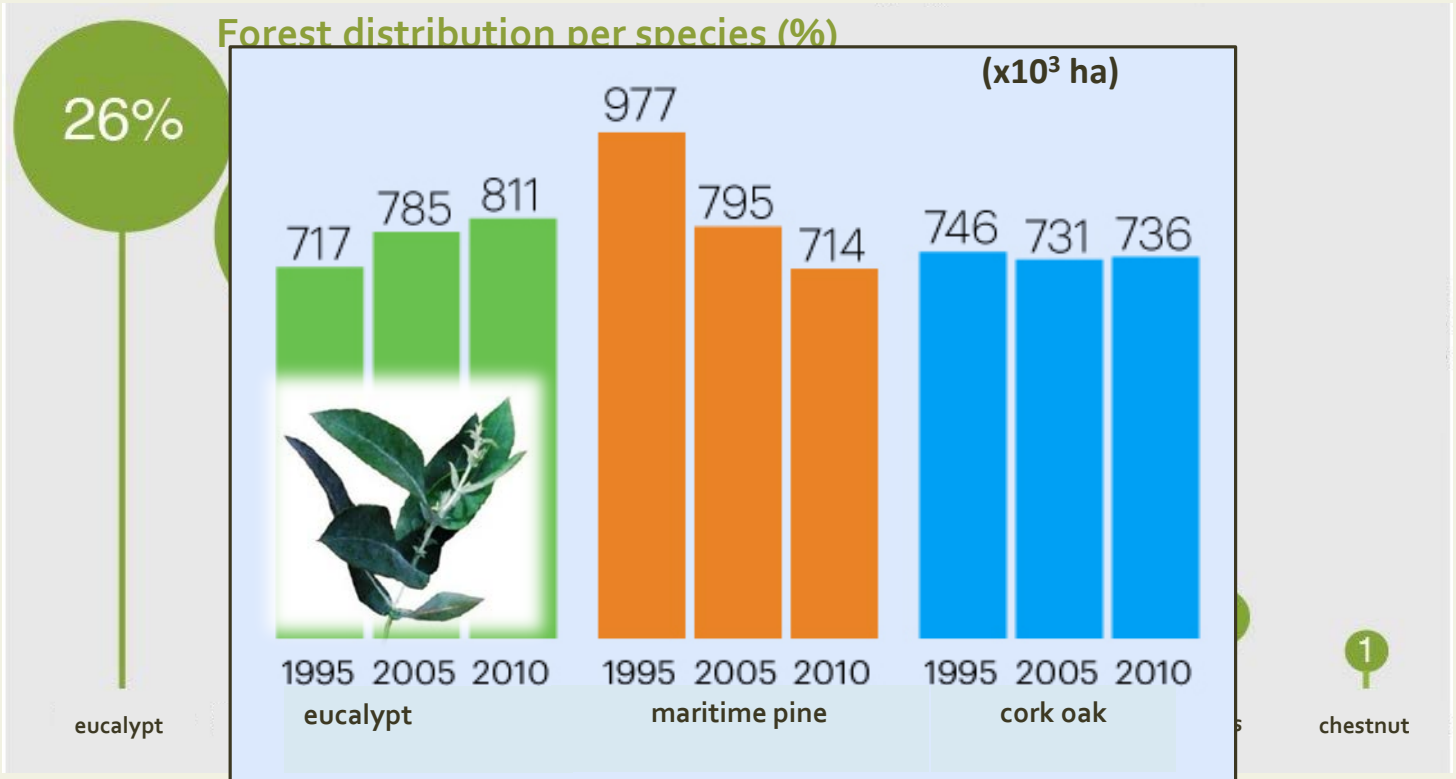
(source: INF6 2013)

- Over 85% of the forest area is privately owned
- Only 3% of forests are in state hands!

(Source: DGCI, 2006 in ENF, 2015)

Background - Forest in Portugal

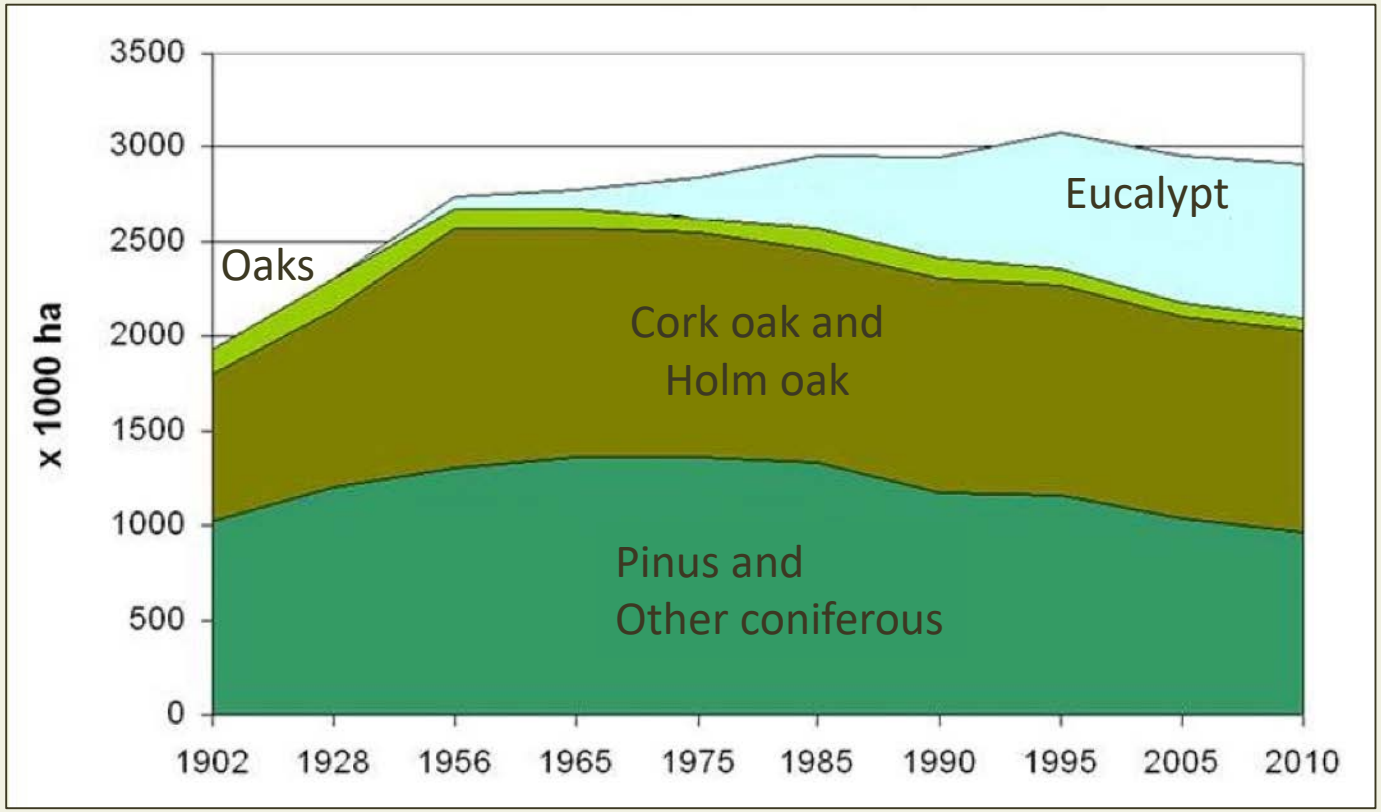
- 35 % Portuguese mainland covered by forest
- 3 major tree species
- Mostly plantations
- Eucalypts encompass 811 thousand hectares



(source: INF6 2013)

Background - Forest in Portugal

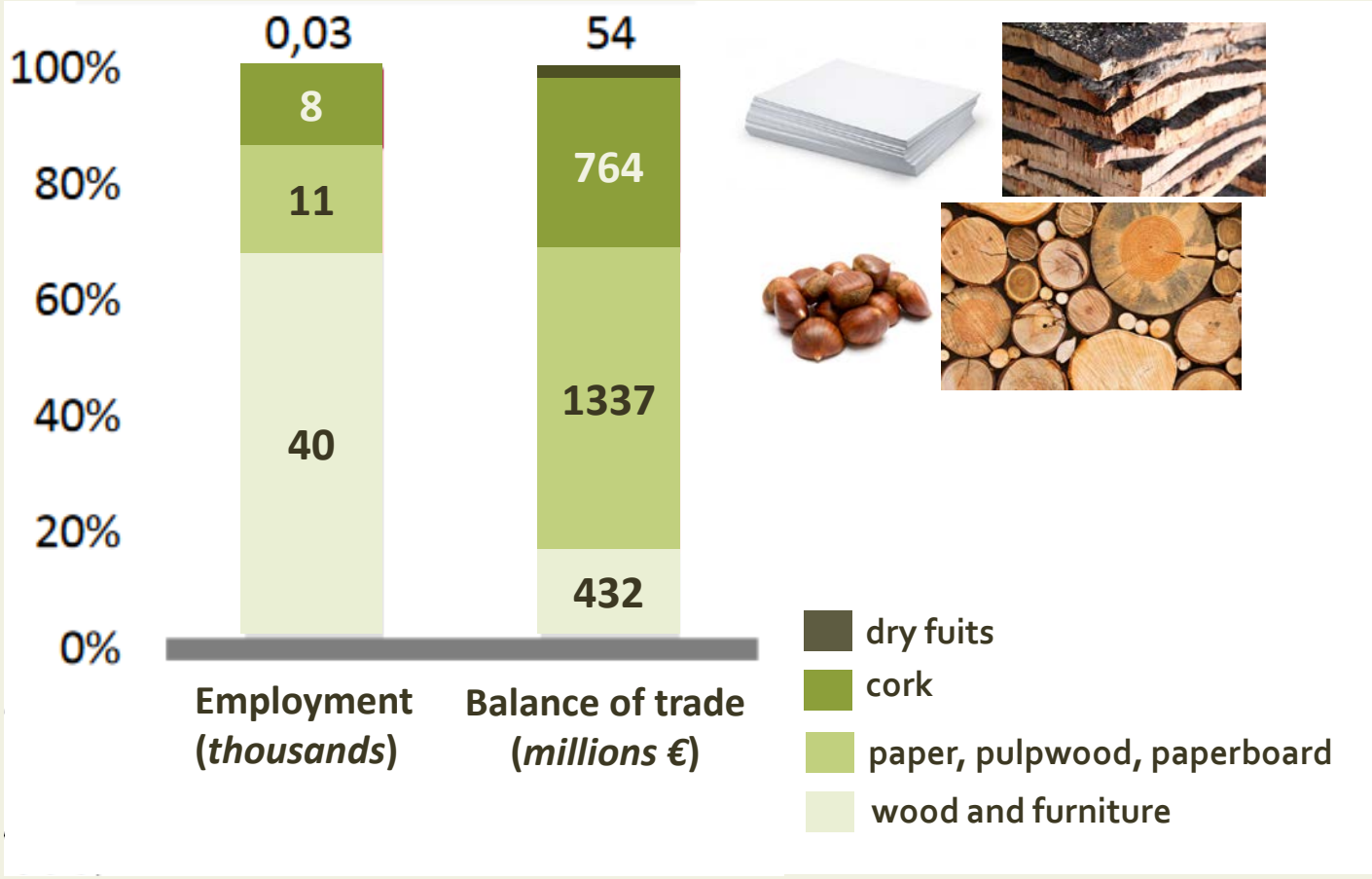
Forest species evolution in Portugal (1902 – 2010)



(source: INF6 2013)

Background - Forest Sector

Trade balance of the main forest products

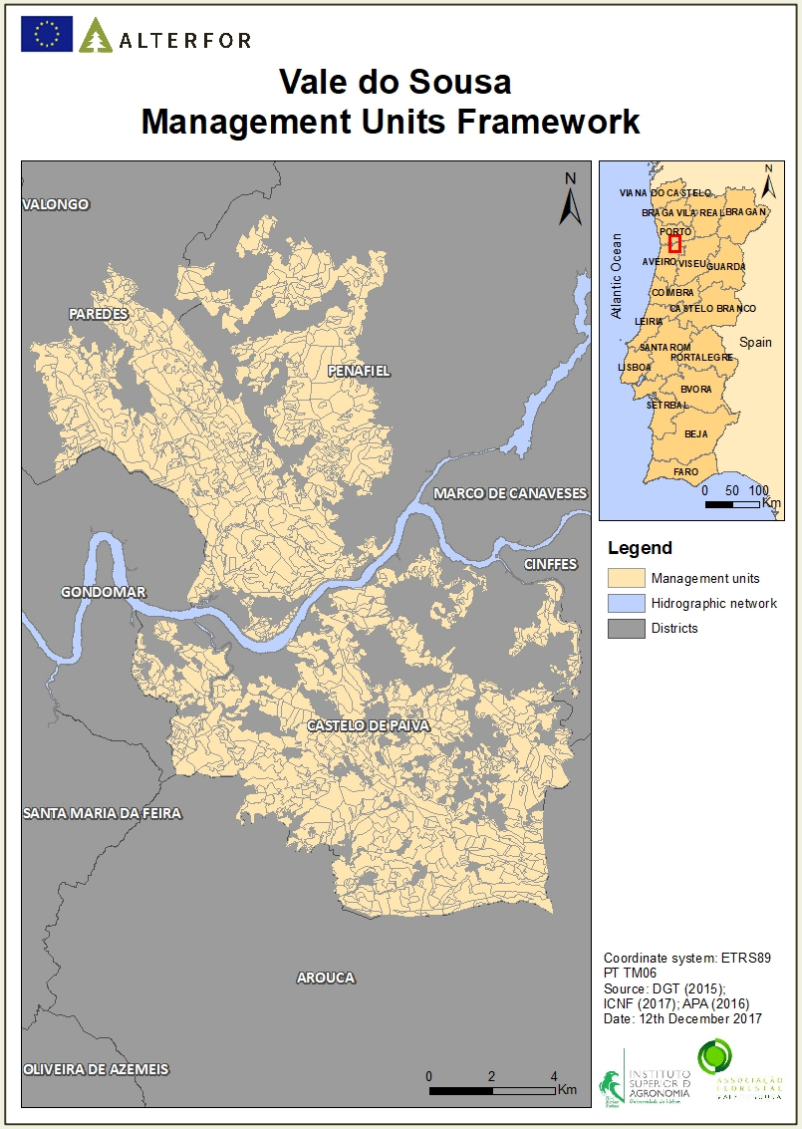


(source: DAPFVRS/DGPF 2016)

Vale do Sousa CSA

Brief description

- Located in Northwest Portugal and covers the southern part of the Sousa Valley;
- Extents over **14 837** ha - **1373** stands;
- Separated by the Douro river;
- Contains: ZIF Entre Douro e Sousa, and ZIF Paiva;
- 360 forest owners (members of ZIF);
- Representative of Portuguese conditions
  - ✓ownership type,
  - ✓structure,
  - ✓species composition



Vale do Sousa CSA - Ownership

- Most forest owners prefer high harvesting intensities
- tree species selection based on the demand by timber industries

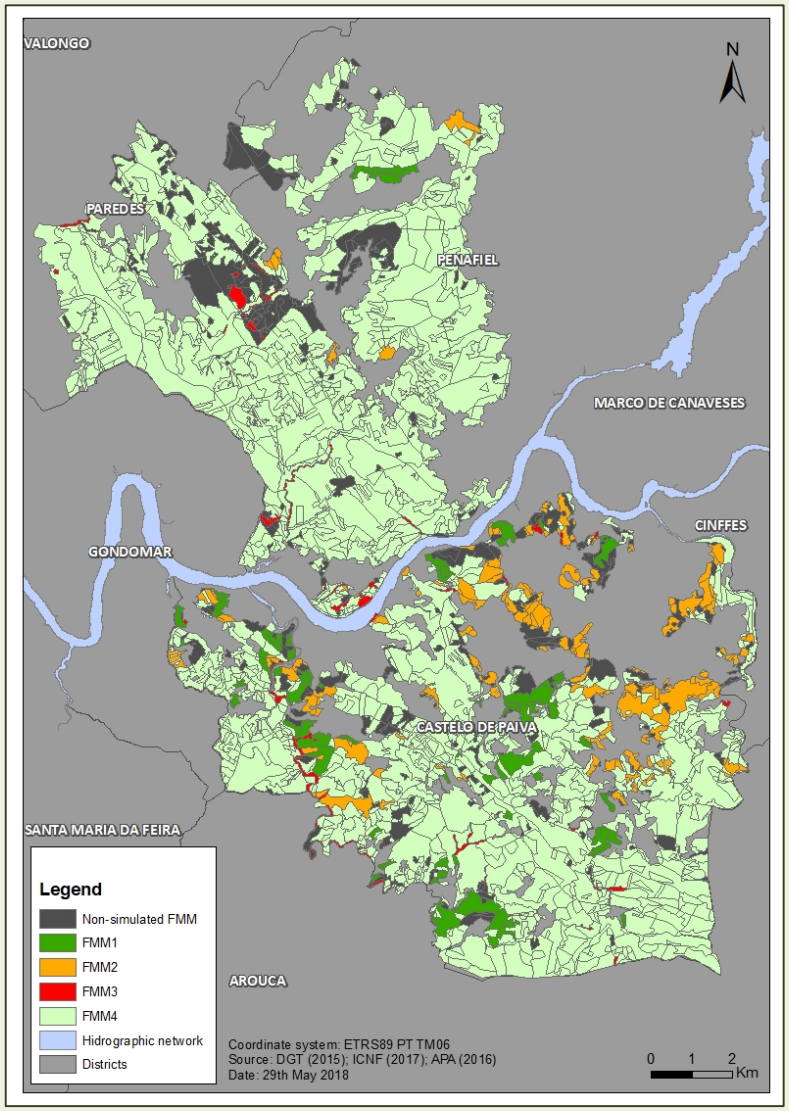
Vs

- Nature conservation and environmental groups aims to protect forest resources
- interested in the supporting and regulating forest ecosystem services

The conflicts within the case study area are almost similar to the condition at national level due mainly to the ownership structure

Vale do Sousa CSA

Current Forest Management Models (cFMM)



- **FMM1 |** Mixed maritime pine and eucalyptus

✓4% of forest area

✓**FMM2 |** Mixed eucalyptus and maritime pine

✓6% of forest area

- **FMM3 |** Chestnut forest system for saw logs production

✓1% of forest area

- **FMM4|** Eucalyptus forest system for pulpwood production

✓89% of forest area

cFMM - Description

Maritime pine prescriptions

- ✓ Plantations with 1,400 plants per hectare
- ✓ thinning occurring every five years between 20 and 50 years of age based on FW of 0.27
- ✓ Rotation between 40 e 60 years with ranging 5 years.

Marques, M. (Feb. 2018)

cFMM - Description

Chestnuts prescriptions

- ✓ Plantations of 1,250 trees per ha
- ✓ Alternative thinning periodicities of 5 or 10 years starting at age 15
- ✓ Rotations range from 40 to 70 years

Marques, M. (Feb. 2018)

cFMM - Description

Chestnuts pests and diseases

- Increased number of dead chestnut trees

✓ Chestnut ink disease

Phytophthora spp

✓ Blinght disease

Cryphonectria parasitica

✓ pest gall wasp

Dryocosmus kuriphilus

Responsible for important economic losses!

cFMM - Description

Eucalyt prescriptions

- ✓Plantations of 1,400 trees per ha
- ✓Rotations based on three coppice cycles ranging from 10 to 14 years in length
- ✓Stool thinning option : average of 2 shoots per stool at year 2 of each cycle

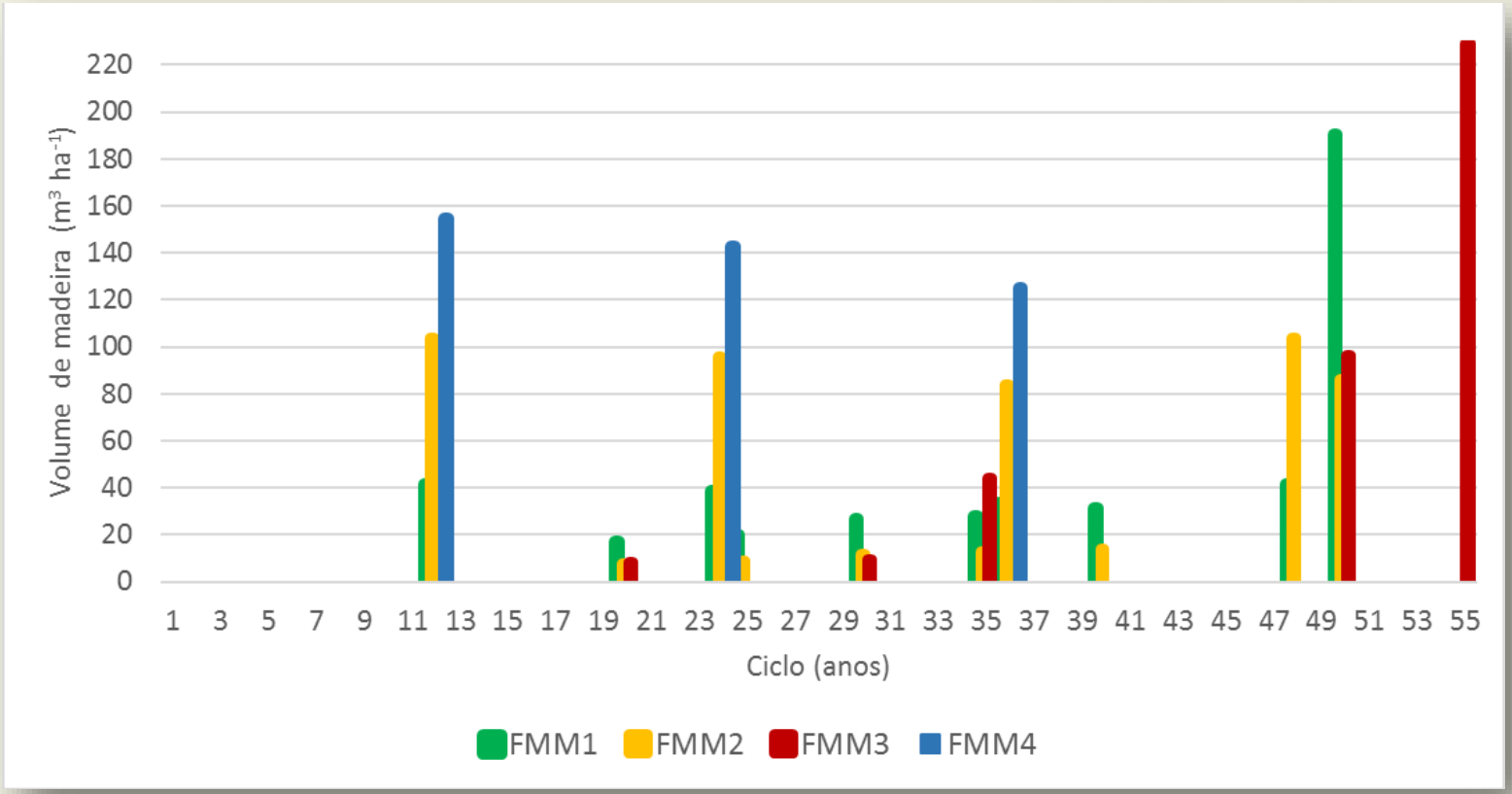
Marques, M. (Feb. 2018)

cFMM – Stand level example

cFMM's	Description	Forest specie (%)	Considered revolutions to the contribution of each FMM for ES	% Forest Area
FMM1	Mixed maritime pine and eucalyptus	Maritime pine (73%) Eucalypt (27%)	SI = 22 |rotation of 50 years + fuel treatments each 5 years SI = 19 |rotation of 12 years + fuel treatments each 5 years	4%
FMM2	Mixed eucalyptus and maritime pine	Eucalypt (67%) Maritime pine (33%)	SI = 19 |rotation of 12 years + fuel treatments each 5 years SI = 22 |rotation of 50 years + fuel treatments each 5 years	6%
FMM3	Chestnut forest system for saw logs production	100%	SI = 20 |rotation of 55 years + fuel treatments each 5 years	1%
FMM4	Eucalyptus forest system for pulpwood production	100%	SI = 19 |rotation of 12 years + fuel treatments each 5 years	89%

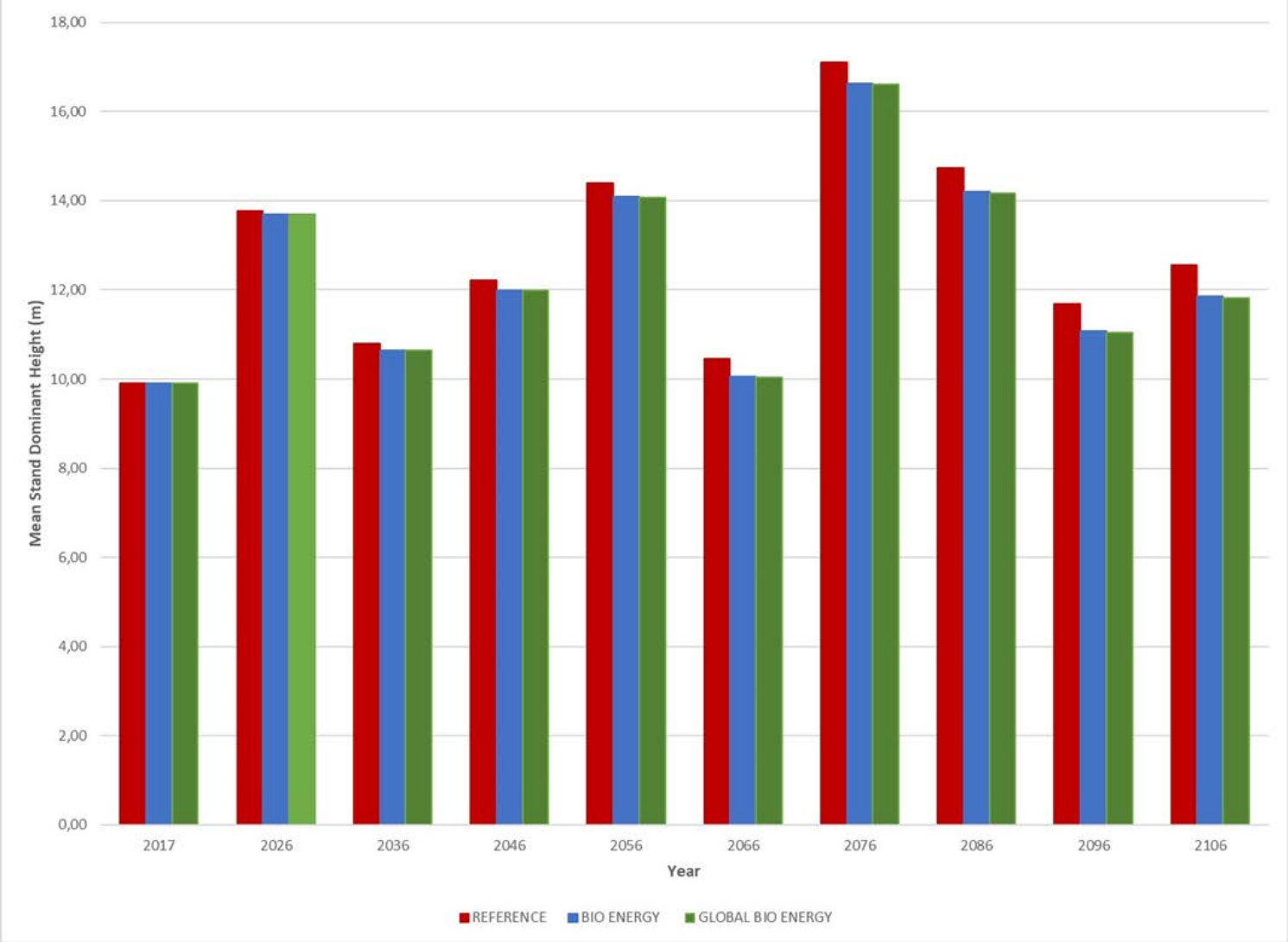
cFMM – Stand level

Wood production ($m^3 ha^{-1}$) – BAU



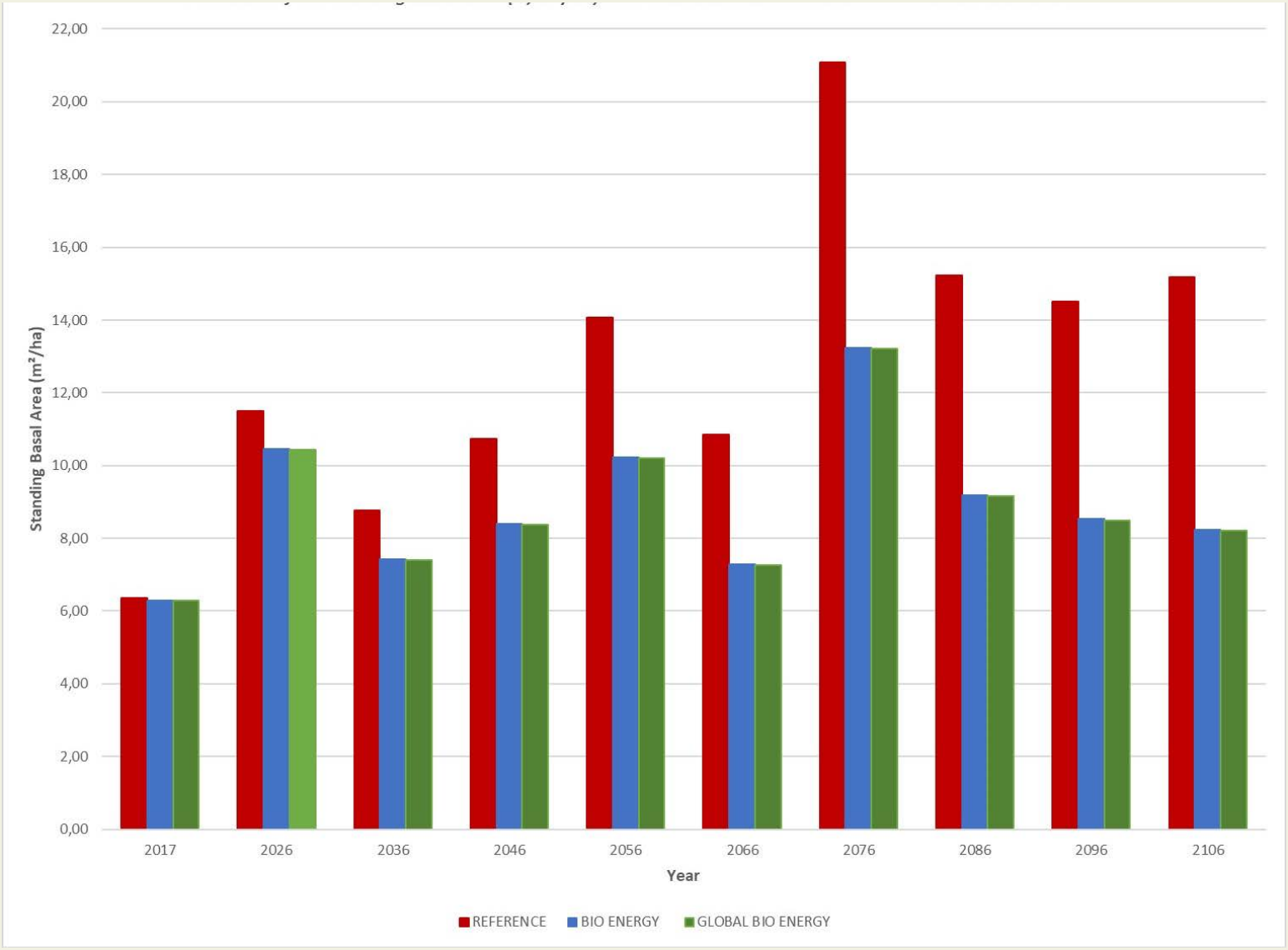
cFMM – Landscape level

Dominant height (m)– IIASA scenarios



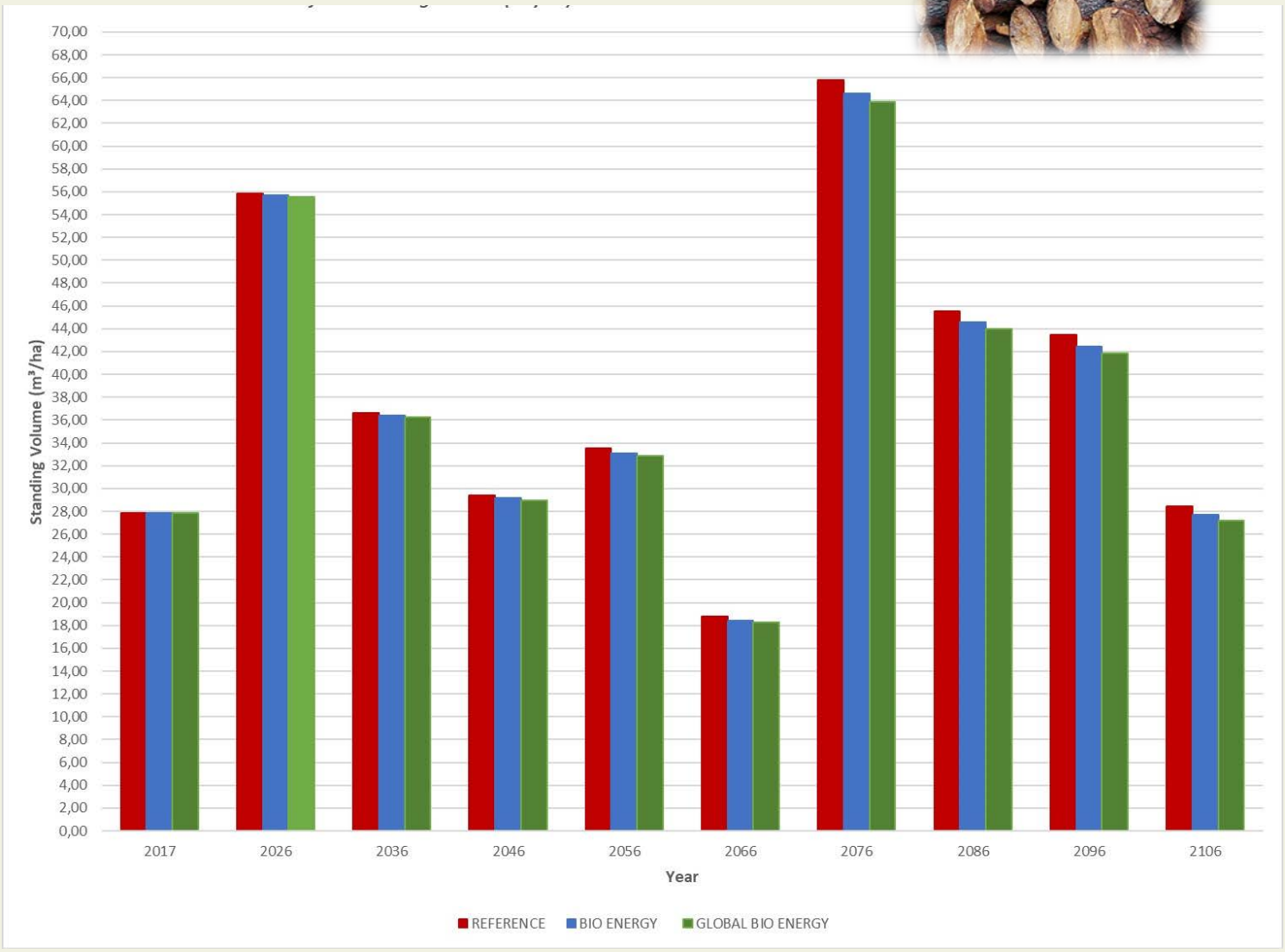
cFMM – Landscape level

Basal area ($m^3 ha^{-1}$) – IIASA scenarios



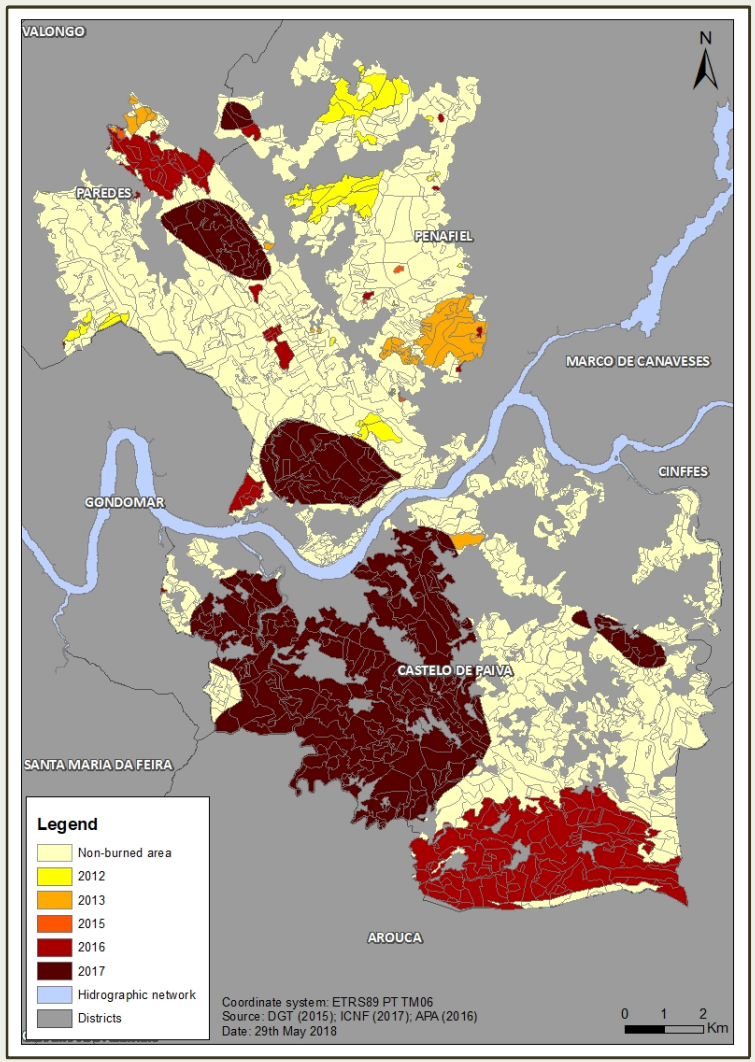
cFMM – Landscape level

Standing volume ($m^3 ha^{-1}$) – IIASA scenarios



Wildfires since 2012

- About **43% of the total CSA area was burned** (6 422 ha)



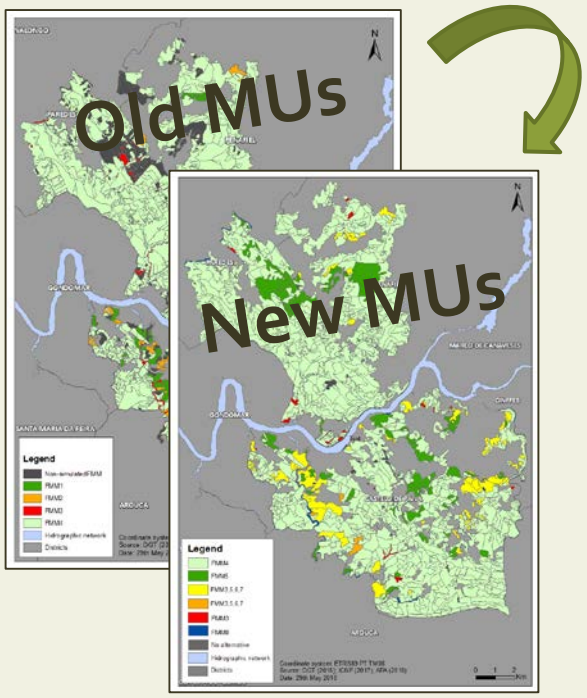
Fire year	Area (ha)	Area (%)
2012	421	2,84
2013	322	2,17
2015	11	0,07
2016	1706	11,50
2017	3963	26,71
Total	6422	43,29

Redefinition of Management Units (MUs)

The team was challenged by the need to update the inventory to reflect the current forest conditions.

2182 stands

1373 stands



- Agregation of burned areas with same land cover, age and areas < 5 ha;
- Segmentation of areas > 50 ha;
- Defenition of several options to assign aFMMs

Redefinition of MUs

Methodology

- Google earth (2010, 2012, 2013, 2016) and sentinel images (2017) was used to:

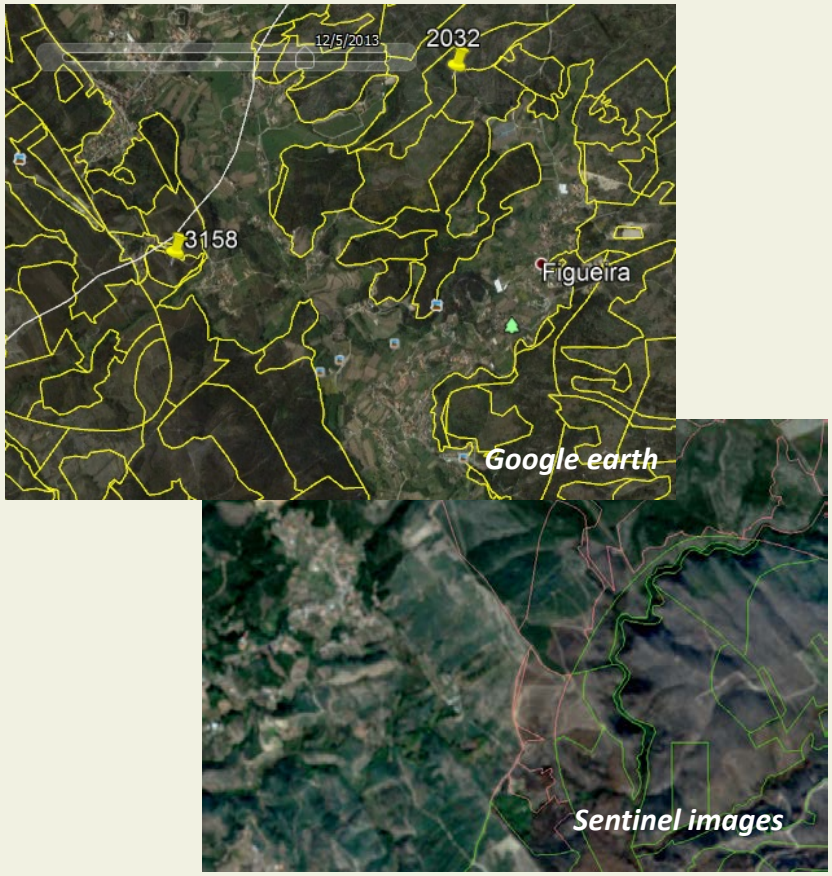
✓ identify forest cover;
✓ validate the stand ages;
✓ define initialization of aFMM

- MUs burned in 2017:

✓the aFMM inicialized in 2017

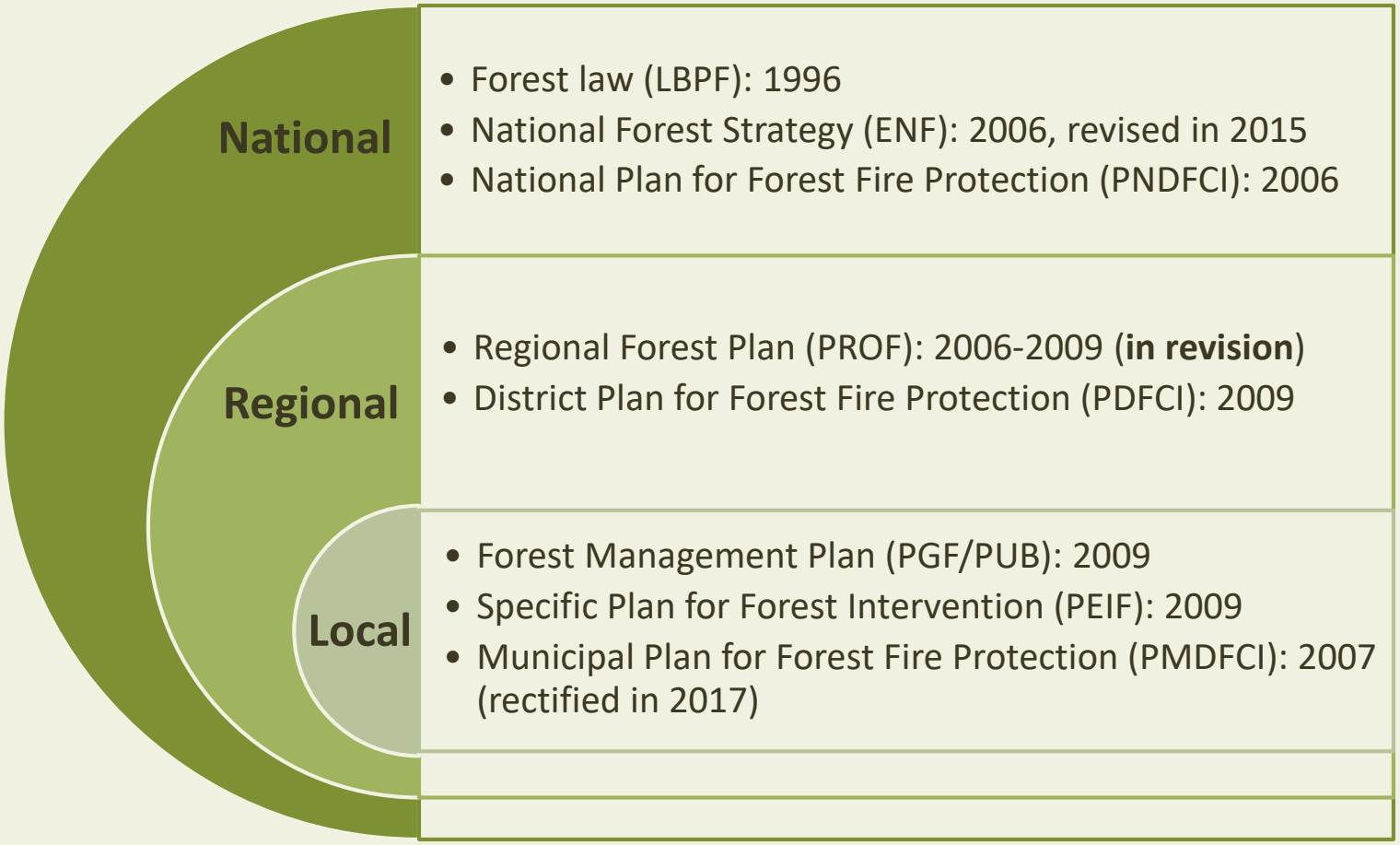
- MUs burned before 2017

✓verification of forest presence (stand age, new plantations, natural regeneration, clear cuts, etc.)



aFMM – Motivation

National forest policies



aFMM – Motivation

- After the catastrophic wildfires in the last year policy decisions was prompted to adress prevention and control the eucalypt's plantations (*Law nº77/2017, 19 July*);

Lei n.º 77/2017

de 17 de agosto

Primeira alteração ao Decreto-Lei n.º 96/2013, de 19 de julho, que estabelece o regime jurídico aplicável às ações de arborização e rearborização

A Assembleia da República decreta, nos termos da alínea *c*) do artigo 161.º da Constituição, o seguinte:

Artigo 1.º

Objeto

A presente lei procede à primeira alteração ao Decreto-Lei n.º 96/2013, de 19 de julho, que estabelece o regime jurídico a que estão sujeitas, no território continental, as ações de arborização e rearborização com recurso a espécies florestais.

Artigo 2.º

Alteração ao Decreto-Lei n.º 96/2013, de 19 de julho

Os artigos 2.º a 15.º, 19.º e 22.º do Decreto-Lei n.º 96/2013, de 19 de julho, passam a ter a seguinte redação:

«Artigo 2.º

[...]

- It was prepared the 1st Stakeholder Workshop to reach the aFMM preferences (November '17)

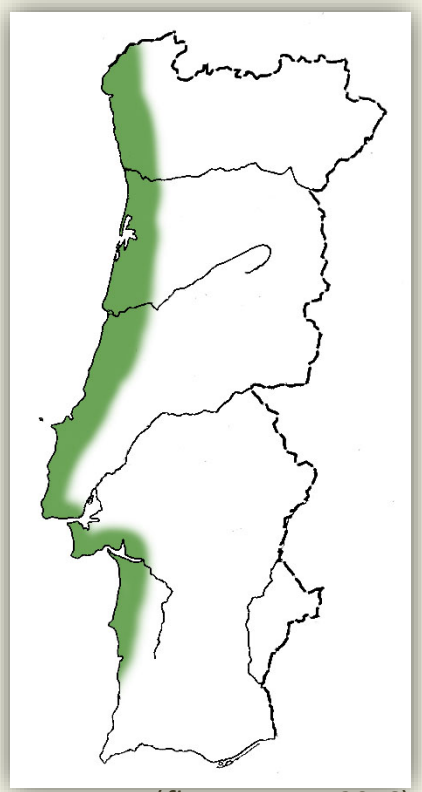
Alternative FMM's

- **FMM5 |** Pure maritime pine (*Pinus pinaster)* forest system for sawlogs production
- **FMM6|** Pure pedunculate oak (*Quercus robur*) forest system for sawlogs production
- **FMM7|** Pure cork oak (*Quercus suber*) forest system for cork production
- **FMM8 |** Riparian systems for biodiversity conservation

FMM5 – Pure maritime pine

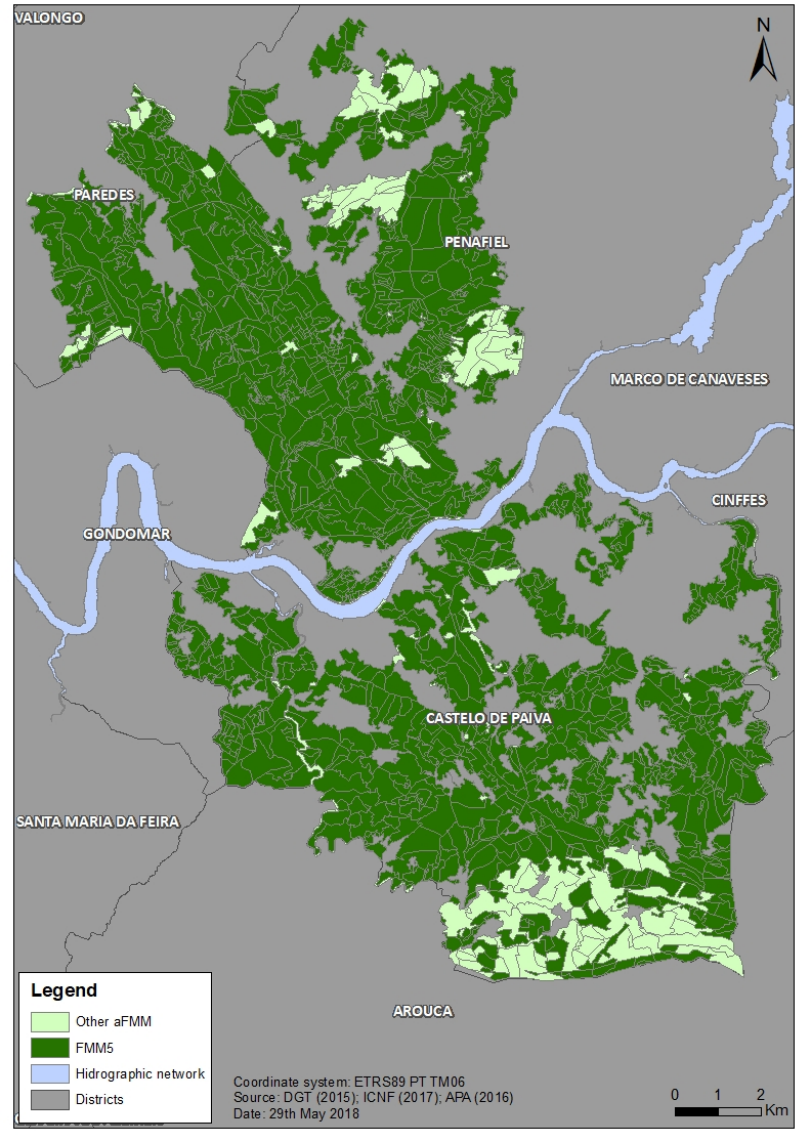
The main reasons

- There is a small area of the CSA occupied with mismanaged maritime pine stands;
- There is a strong internal demand for pine wood;
- Site conditions in the CSA are good for maritime pine and technical knowledge exists;
- Provides revenues that result from several commercial thinning's



(*florestar.net, 2018*)

FMM5 – Pure maritime pine



- Number of simulated MUs: 1 176;
- Area: 13 040 ha;
- Growth & yield simulation:

✓individual-tree empirical growth yield model PINASTER (even-aged and 1-year time step) implemented in StandsSIM-MD (Barreiro et al. 2016)

FMM5 – Pure maritime pine

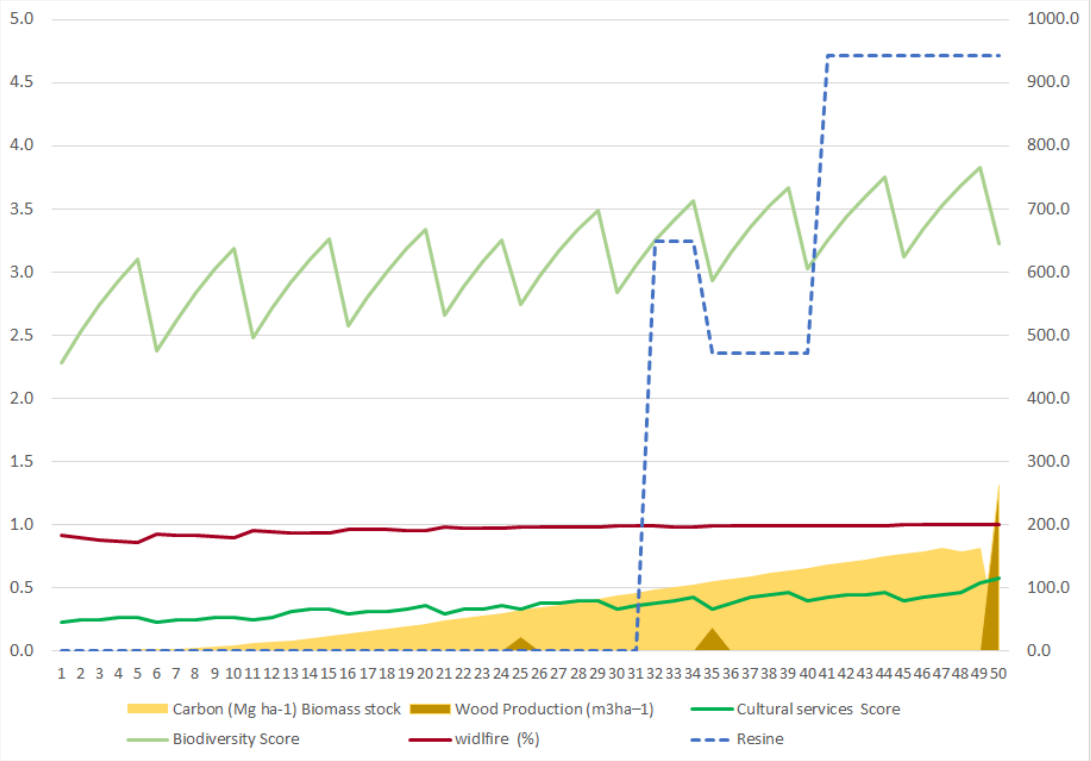
Management characteristics

Plantation	1111 trees/ ha (3 x 3)
Pre-commercial thinning	15 years (remove 30-40% of trees)
Commercial thinning (periodicity)	Each 10 years (25 – 45) based on wilson factor = 0.27
Tappin resin	dbh > 20 cm
Clearcut (age)	35, 40, 45, 50 years

FMM5 – Pure maritime pine

Ecosystem services targets

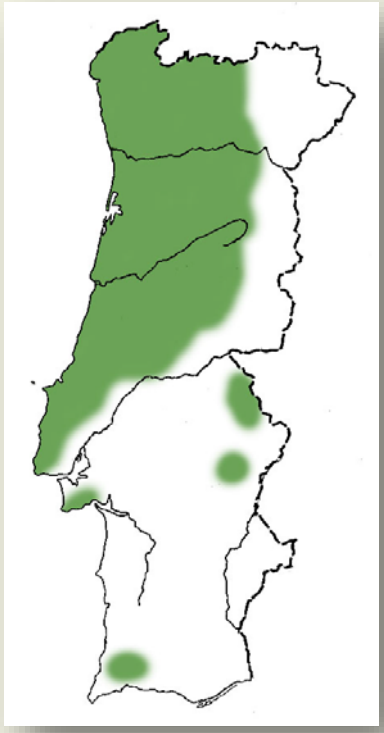
- Native vegetation
- Timber
- Resin (non-wood product)
- Biodiversity
- cultural services
- Recreational areas



FMM6 – Pure pedunculate oak

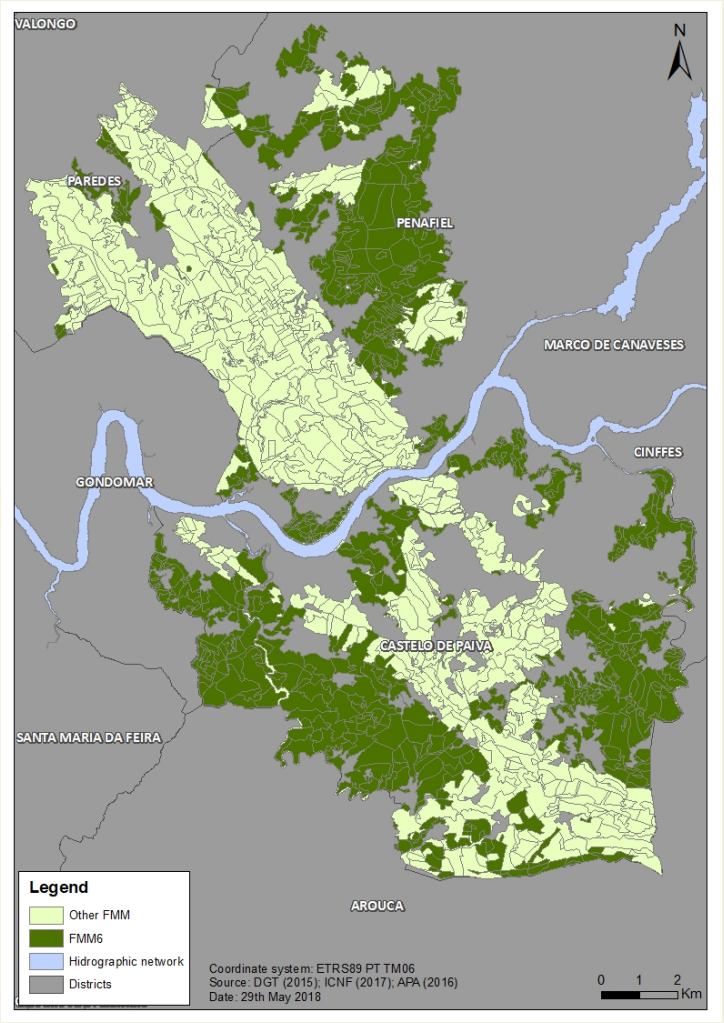
The main reasons

- Pedunculate oak is a good alternative for abandoned agricultural land, where the soils are fertile and deep with good water availability;
- Stronger planting restrictions on eucalyptus, and thus the forest owners are looking for native alternative species for wood production;
- Forest mosaics diversification with pedunculate oak and other broadleaves could be a positive contribution/help to reduce fires and diseases risks.



(*florestar.net, 2018*)

FMM6 – Pure pedunculate oak



- Number of simulated MUs: 701;
- Area: 6784.86ha;
- Selection of MU with fertile and deep soils;
- Growth & yield simulation:

✓empirical growth and yield models integrated in SimGaliza, developed in Spain for Galicia (Gómez-García et al. 2015, 2016)

FMM6 – Pure pedunculate oak

Management characteristics

Plantation	1600 trees/ ha (3 x 2)
Pruning	23 years
Pre-commercial thinning	18 - 22 years
Commercial thinning (periodicity)	13 m (25 – 29 years) 16 m (35 – 39 years) 18 m (43 – 47 years)
Clearcut (age)	40, 50, 60 years

FMM6 – Pure pedunculate oak

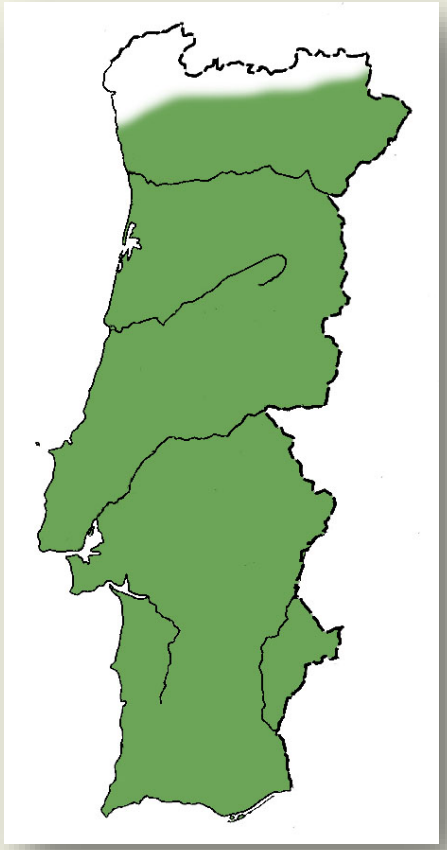
Ecosystem services targets

- Native vegetation
- High qualitity timber
- biodiversity
- cultural services
- Resistance to wildfires

FMM7 – Pure cork oak

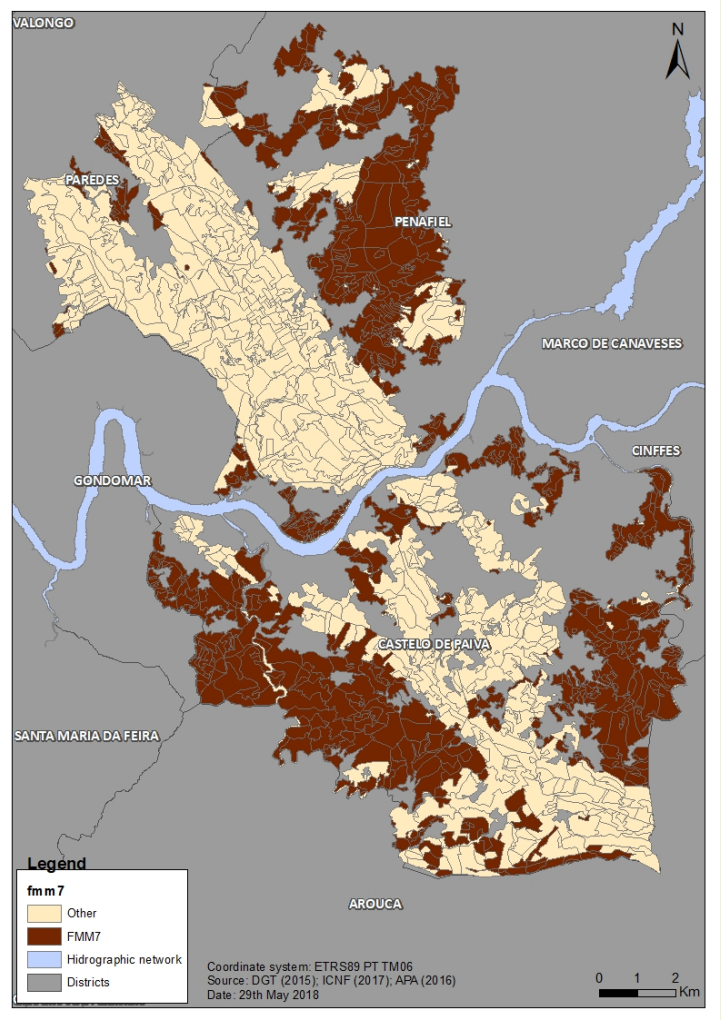
The main reasons

- Existence of several spots with spontaneous regeneration of the two climax oak species (*Q. robur* and *Q. suber*), suggesting that with proper guidance they could succeed and gradually replace mixed stands with pine and eucalyptus;
- Stronger planting restrictions on eucalyptus, and thus the forest owners are looking for native alternative species for cork production;
- Forest mosaics diversification with cork oak and other broadleaves could be a positive contribution/help to reduce these fire and diseases risks.



(*florestar.net, 2018*)

FMM7 – Pure cork oak



- Number of simulated MUs: 693;
- Area: 6597.46 ha;
- Selection of MU with fertile and deep soils;
- Growth & yield simulation:

✓growth and yield model SUBER V5.0 currently available in the sIMfLOR Platform (Faias et al. 2012).

FMM7 – Pure cork oak

Management characteristics

Plantation	1600 trees/ ha (3 x 2)
Pre-commercial thinning	15 years
Commercial thinning	30, 40, 58 and 76 years
1st debarking	30 years
2nd debarking	40 years
3rd debarking	each 9 years

FMM7 – Pure cork oak

Debarking operation

FMM7 – Pure cork oak

Ecosystem services targets

- Native vegetation
- Cork
- Biodiversity
- cultural services
- Resistance to wildfires




FMM8 – Riparian systems

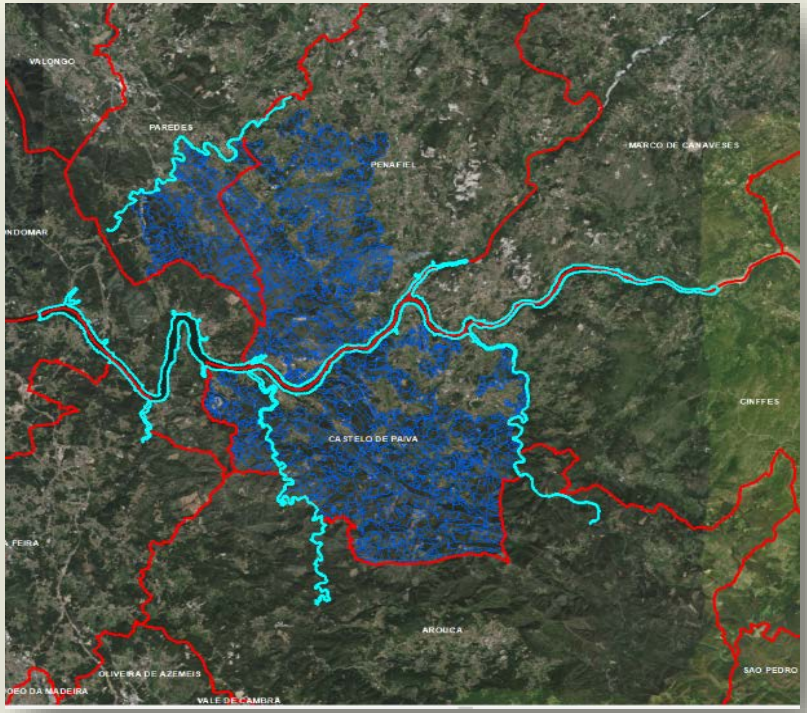
The main reasons

- Is not focused on the supply of wood but in:
  - ✓alluvial ecosystems sustainability
  - ✓nature conservation
  - ✓watershed management
  - ✓provides carbon stock storage
  - ✓assist water resources (filtration and purification in waterlogged soils)
  - ✓root system helps to control floods and stabilize riverbanks

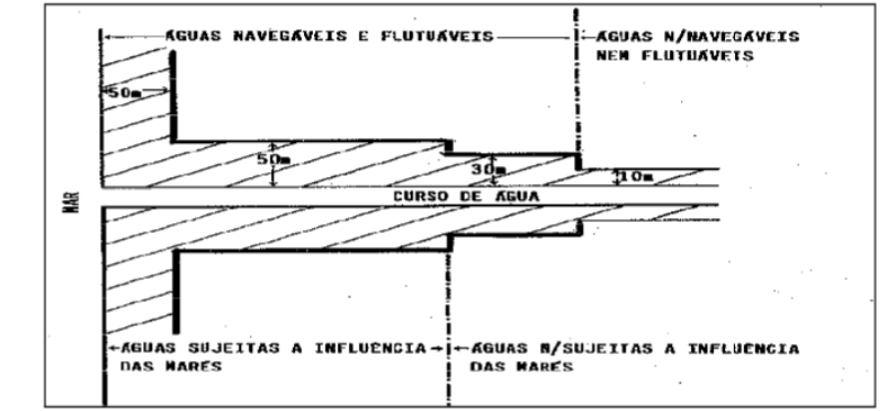
FMM8 – Riparian systems

Methodology

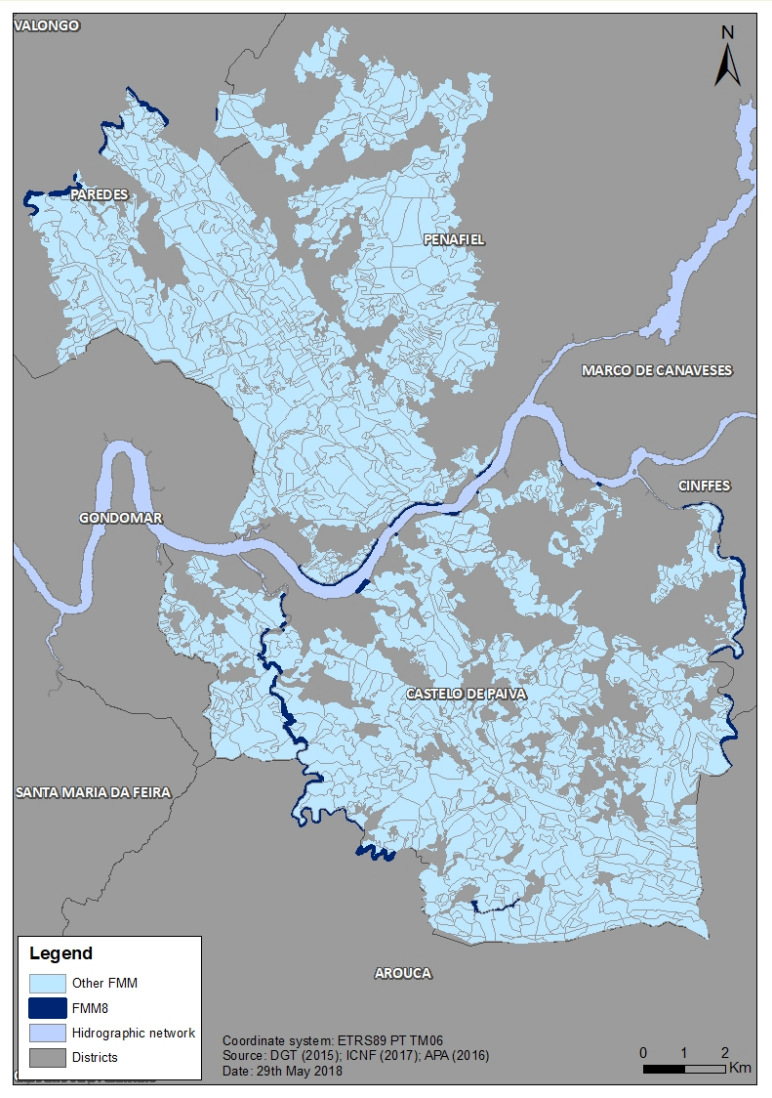
- Buffer of 10 m from non-navigable waters
- Buffer of 30 m from navigable waters



- Legal policies : DL nº 54/2005



FMM8 – Riparian systems



- Mainly a lentic system **located in depressional areas of the Vale Sousa CSA**,

✓on soils subject to frequent flooding and saturation,

✓ or with markedly impeded drainage with different levels of connectivity with the fluvial network

- Number of simulated MUs: 60;
- Area: 10,29 ha;
- dominated by :

✓*Alnus glutinosa*
✓*Salix atrocinera*
✓*Salix alba*
✓*Fraxinus angustifólia*
✓*Populus nigra*

http://riplante.apambiente.pt:8080/riplante/riplante.html

FMM8 – Riparian systems

- Structural parameters over time were obtained from freshwater wetland forest stands from National databases:

  - ✓diameter breast height (dhb) for all trunks ≥ 5cm
  - ✓number of dead and live trunks per individual (%)
  - ✓tree height (H, only trees > 1.5m)
  - ✓tree density (trees/Ha)
  - ✓basal area increment

aFMMs – IIASA scenarios

Challenges

FMM5

FMM6

1. **Challenge**
   - It is not feasible to use a process-based model to project the growth of Maritime pine and pedunculate oak

1. **Approach**
   - Our timber projections and pine-related products such as resin ⇨ empirical growth and yield models :
     scenario REF = 10% productivity
     scenario BIO = 6,76%
     scenario GLOB = 4.75%

FMM7

FMM8

2. **Challenge**
   - It is not feasible to use a process-based model to project the growth of cork oak, dominant production is based on cork extraction

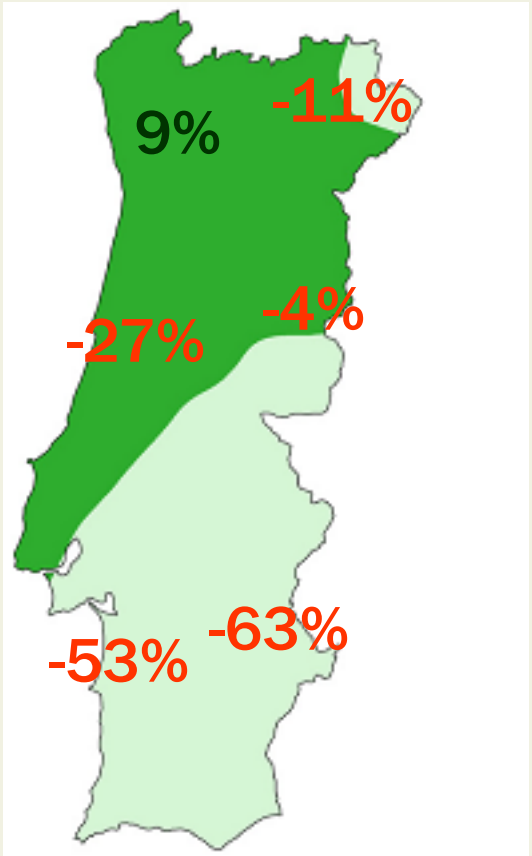
2. **Approach**
   - adjustments on cork projections by empirical growth and yield models.
     scenario REF = 19% productivity
     scenario BIO = 12,8%
     scenario GLOB = 9%

aFMMs – DSS issues

Adjustments in climate change

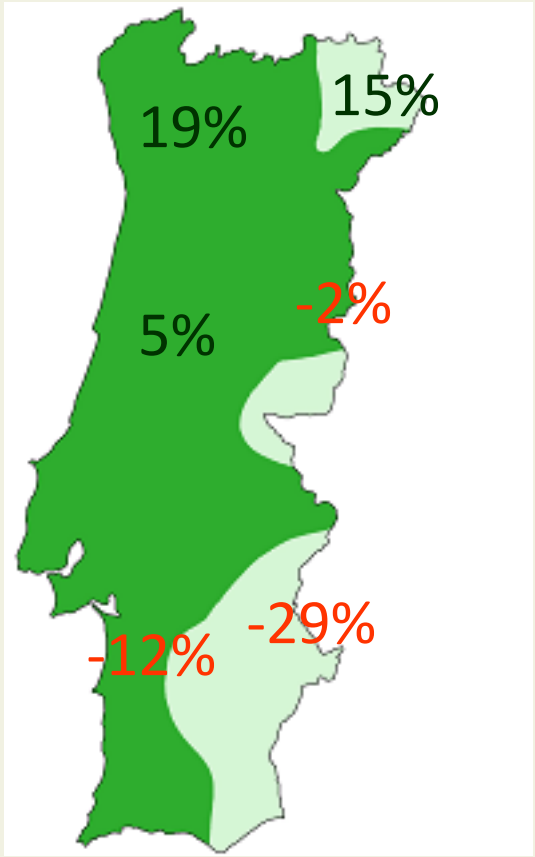
Maritime pine

Productivity – AMA
(m^3 ha^{-1} ano^{-1})

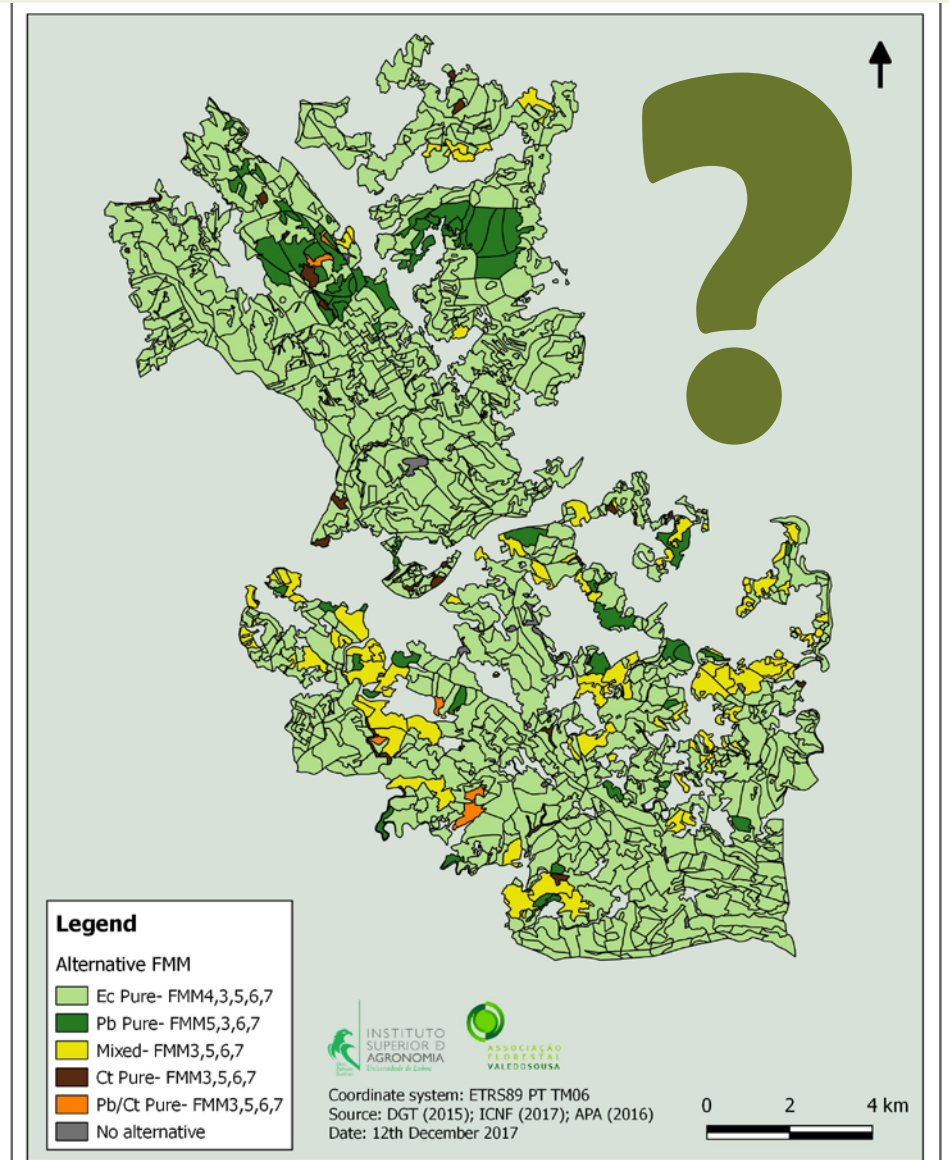


Cork oak

Produtivity– NPP
(gC m^{-2} ano^{-1})



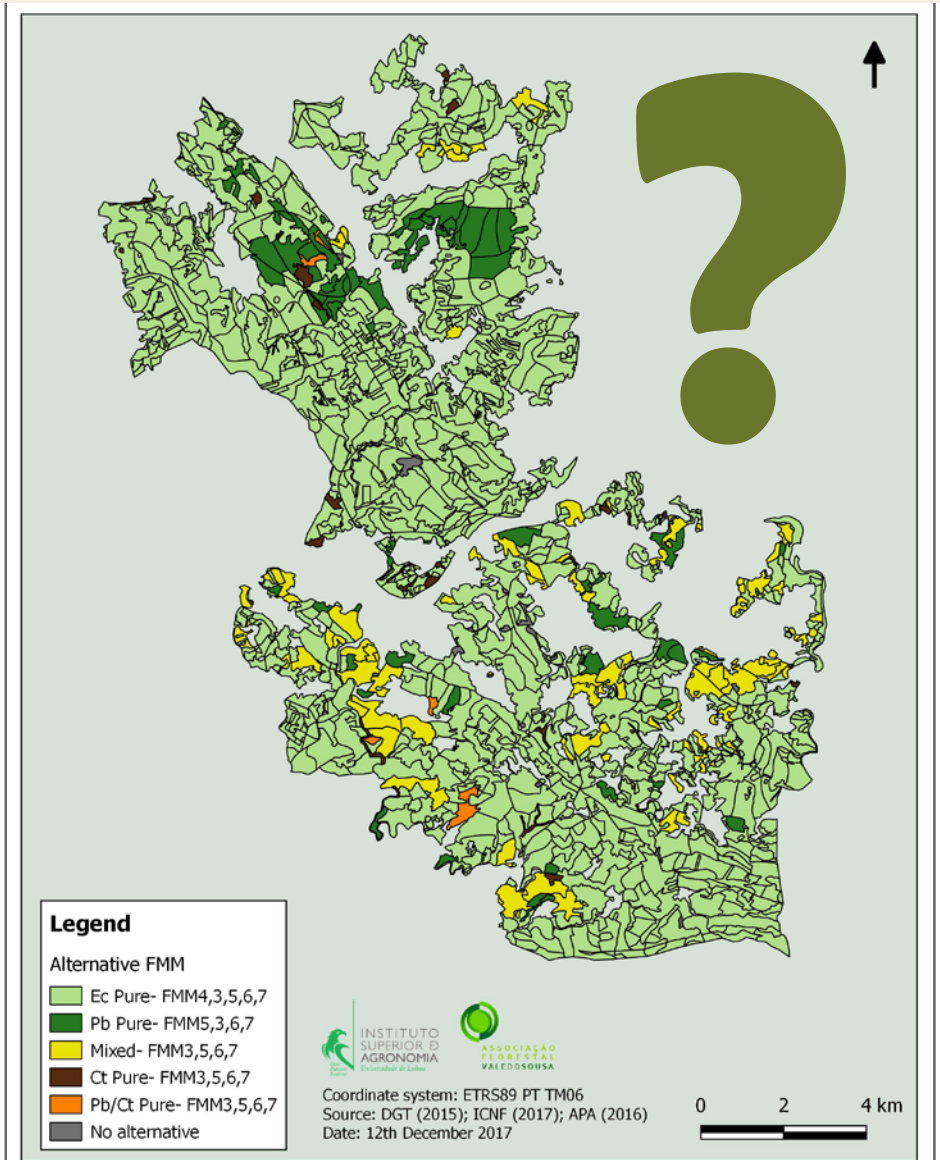
After stand design and simulation of decision spaces



- *What can we do to meet demand, safeguard biodiversity, and reduce risks by modified FMM?*

2nd Workshop, October 2018

After stand design and simulation of decision spaces



- *Are the alternatives inspired by ALTERFOR?*