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Country report 10: The land use domain in Portugal

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Preface

This report is produced in the context of work package 2 ('Dynamics of transition pathways') of the FP-7 funded PATHWAYS project ('Exploring transition pathways to sustainable, low carbon societies'). This report analyses the land use domain for Portugal, as the case study, for deliverable 2.3. ('Integrated analysis of D2.1 and D2.2 to assess the feasibility of different transition pathways').

The analysis in this report is based on a research template that is shared between the different contributors to WP2 to enable comparative analysis of findings between countries (UK, Netherlands, Sweden, Portugal, Germany, Hungary) and empirical domains (electricity, heat, mobility, agro-food and land-use).

Executive summary

This report assesses the present feasibility of a sustainable transition pathway to occur in the land use domain for Portugal under the current socio-economic circumstances. The assessment analysis builds on work developed on previous reports: identification and analysis of niche innovations and regime stability analysis for the land use domain in Portugal, as presented in Deliverables 2.1 and 2.2 respectively. The feasibility assessment will firstly evaluate the various niche innovations likelihood to breakthrough. Secondly, this report will appraise how the niche innovations relate to the dominant regimes identified for the land use domain for Portugal and how reasonable a process of reorientation for each of the main land use regimes is. This report concludes with a general discussion of the findings.

The land use domain is the realm that analyses land systems and the changes within it and typically involves the analysis of land cover and land use. The land use domain often includes different use regimes. In Portugal, land use domain is characterized by four use regimes: forestry, agriculture, nature and urban. Such regimes may be more or less stable and may hence, need smaller or bigger changes to achieve sustainable land use. Niche innovations are essentially movements whose action counters the existing mainstream way, and which may influence and shape a regime. Niche innovations can originate a regime re-configuration brought about by small pool of actors, which nurture a re-alignment of processes. The actors push for a re-configuration of a domain by addressing the cracks and tensions within it while trying to implement a *modus operandus* that “works”.

Seven niche innovations were identified for the land use domain in Portugal. An important characteristic of these niche innovations is their multifunctional use of the land but also, that all of them address points of tension within the dominant land use regimes identified in Portugal (agriculture, forest, nature and urban). The internal momentum for every niche innovation is assessed in this report, based on techno-economic, socio-cognitive and governance elements. All niche innovations are classified to belong to pathway B, with few niches showing elements of pathway A.

Niche innovation	Momentum	Alignment with broader regime characteristics and developments	Likelihood of breakthrough	Pathway
1. Biodiverse cities	Medium to Low	Low to Moderate Agriculture and urban regimes are fairly stable but there is a window of opportunity for better alignment lying with better policy alignment and more public engagement.	Low Niche is growing slowly. The stability of the regimes involved and low internal momentum hinder the break through.	B
2. Business & Biodiversity	Medium to Low	Low to Moderate Agriculture regime is more stable than the	Low Regimes are relatively stable	B with elements of A

		nature regime. Issues related to the Nature have also in policy a low degree of priority in general. There are nonetheless windows of opportunity pushed by commitments of the national government to meet foreign policy as well as increased societal pressure on businesses to account for their impacts on nature.	and improved socio-knowledge transfer and financial assurance hinder the growth of the niche.	
3. Multifunctionality for renewable energy	Low	Low Agriculture and forestry are the two main regimes in Portugal and are relatively stable. Windows of opportunity lie with policy long-term commitment and improved scientific support.	Low Regimes are stable and there are technological and operational constraints for the niche to break through.	B
4. Fire resilient landscapes	Medium	Moderate Developments at the agriculture and forestry regimes in Portugal and this niche are strong as far as fire is concerned.	Growing, but limited perception of its development due to time constraints	B
5. Land sharing and Integrated Territorial Interventions (ITI)	Medium to Low	Low to Moderate Alignment with developments at the agriculture and nature regimes is relatively positive. Better scientific evidence supporting the niche proposed actions and long-term commitment from the government.	Low Regimes are stable and there is operational constraints for the niche to break through.	B
6. Rewilding	Low	Low Need for more public engagement but also from the government and institutions of the nature and agriculture regimes.	Low Low degree of interest from the public and government.	B
7. Biodiverse Pastures	Medium to Low	Low to Moderate Alignment with developments at the agriculture and nature regimes is relatively positive. Better scientific evidence supporting the niche proposed actions and long-term	Low to Medium Regimes are well aligned to the niche but financial long-term sustainability and improved scientific support evidence hinder	B with elements of A

		commitment from the government.	the niche break through.	
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Table A. Breakthrough analysis of the 7 niche innovations for the land use domain in Portugal.

All the niche innovations for the land use domain in Portugal present a low to medium momentum, except for the fire resilient landscape niche innovation. The former shows medium breakthrough potential. It shows highest momentum of breaking through, if not already en route. However, since the benefits will only be visible on the long run, broadleaved species take about 50 years to grow, hence the perception is that no transition is happening. Moreover, public interest and debate has lost importance. This niche suffers from a time-perception constraint.

The analysis of the regimes and external elements allows identifying how the niches are influencing the regimes and how likely the niches will break through. The land use regimes (agriculture, forest, nature and urban) show a moderate to strong degree of lock in. The land use domain is assessed to be moderately stable. At the current state of affairs, a breakthrough from the niche innovations is thus, unlikely, except for the fire resilient landscape niche. Nonetheless, even without instability within the regimes, niche innovations will most probably continue to emerge and penetrate causing incremental disruption at the regime level. Incremental changes to address environmental challenges inside the regimes have been adopted, denoting an open attitude from the dominant regime actors to change.

Regime	Lock-in, stabilizing forces	Cracks, tensions, problems in regime	Orientation towards environmental problems	Main socio-technical regime problems
Agriculture	Moderate to strong	Strong	Moderate (some incremental change)	e.g. long term policy assurance, subsidy dependence, high long term investments from farmers, cultural & historical attachment to the land
Forest	Strong	Weak to moderate	Moderate (some incremental change)	e.g. market demand for pulp, paper and cork.
Nature	Strong	Moderate	Moderate (some incremental change)	e.g. need for more investments, society interest, better policy integration
Urban	Strong	Weak	Moderate (some incremental change)	e.g. Physical constraints, political apathy, need for better policy integration, more investment

Table B. Assessment of regime trends for the land use domain in Portugal.

The likelihood of a breakthrough in the present time is unlikely, either due to limiting internal aspects or due to the overall stability of the land use domain and the relatively strong regime lock in. The incumbent land use regime actors have shown to be taking incremental changes to address environmental challenges and appear to be open for re-organization of the system. Instability of the land use domain does not appear to represent a barrier for the niche innovations to initiate a transition

pathway. A distinguishing feature of the land use domain is in fact the high level of dynamic interactions it allows for: different regimes which are dynamic on their own (intra-regime changes) and between them (inter-regime changes) as well as allowing for niche innovations underlining more than one regime. Niche innovations will most probably continue to emerge and penetrate causing incremental disruption at the regime level.

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1. Introduction

1.1 Context, goals and research questions

This report aims to analyse and make an interpretive assessment of the feasibility of different sustainable transition pathways, in the present moment in time, for each niche innovation previously identified, on deliverables 2.1 and 2.2. For each niche innovation identified and corresponding dominant land use regime(s), this report will look at the economic, political and socio-cultural contexts as well as the trends in their recent past. This analysis will allow to evaluate how strong the present momentum is for a particular niche to breakthrough and become mainstream. Niche-innovations may gradually build up internal momentum through positive interactions between learning processes, vision articulation, and social network building. External pressures that may result in changes to the dominant land use regimes, and hence accelerate and aggravate the mismatch between niche-innovations and regimes, also play an important role in creating opportunity for niche-innovations breakthrough.

A great challenge of the land use domain, in Portugal but also in most of Europe, is land use segregation. Regimes' such as nature, agriculture and forestry have become spatially segregated as a result of a process of specialization and intensification of production (Antrop 2004, 2005). This functional separation of the land is pointed out to contribute to many of the environmental problems we face today (Selma 2006) such as biodiversity loss and emission of greenhouse gases. In an attempt to counterbalance this trend and the consequent problems thought to derive from this land use pattern, and allied to a decreasing budget available for conservation, preference is being given to land management which favours the multifunctional use of land i.e. the same portion of land is used for more than one use, with each function strengthening the other (Priemus et al. 2000). The above niche innovations identified for Portugal are examples of multifunctional land use, therefore aiming to contribute for a more sustainable land use.

The following questions will guide the analysis of deliverable 2.3, to evaluate the feasibility of a sustainable transition materializing today:

- (a) Do the analysis of recent developments in green niche-innovations and regime (in)stability suggest a transition is beginning to take place? If so does this transition appear to be more like pathways A or B?
- (b) Are the niche-innovations identified to be about to break through?
- (c) If niche innovations are *not* expected to break through, how dominant are the land use regime trends in Portugal? i) Are these trends continuing as "Business as usual", with limited regime change to address environmental problems? or ii) Are existing regime actors implementing incremental changes to address environmental problems?

1.2 Report structure

This report is structured as follows: chapter 2 will discuss each niche innovation in detail to assess the feasibility of a breakthrough in the present moment and context; chapter 3 will analyse the land use regimes for Portugal and the feasibility for a process of reorientation within the main land use regimes; finally chapter 4 will discuss the wider general findings and set the concluding main remarks of this report.

2. Assessment of breakthrough feasibility of the various niche-innovations

Seven niche innovations were identified for the land use domain in Portugal: 1. biodiverse cities; 2. business and biodiversity; 3. multifunctionality for renewable energy; 4. fire resilient landscapes; 5. Land sharing and Integrated Territorial Interventions (ITI); 6. rewilding and 7. biodiverse pastures. The majority of which present a low likelihood of breaking through the dominant land use regimes and hence, to initiate a sustainable transition (Table 1). The highest likelihood of a break through concerns the fire resilient landscape niche, followed by biodiverse cities niche innovation, land sharing-ITI, business and biodiversity and biodiverse pastures. The likelihood of a break through, for each niche innovation, is influenced by both internal and external events.

Niche Innovation	Momentum
Biodiverse cities	Low to medium
Business and Biodiversity	Low to medium
Multifunctionality for renewable energy	Low
Fire resilience landscapes	Medium
Land sharing and Integrated Territorial Interventions (ITI)	Low to medium
Rewilding	Low
Biodiverse pastures	Low to medium

Table 1. Niche innovations identified for Portugal land use domain and correspondent momentum (from WP 2.1).

2.1 Niche innovations internal momentum

The internal momentum of each niche innovation is influenced by three main dimensions: i) techno-economic, ii) socio-cognitive and iii) governance. Techno-economic is linked to the technological advancements and economic feasibility a niche innovation can generate. The socio-cognitive dimension is related to the process of knowledge transfer and learning. Finally, governance is related to institutional forces and organizational improvements. The main internal forces pushing back the breakthrough of the identified niche innovations are mostly associated with the socio-cognitive and techno-economic dimensions for example, the knowledge of the different actors involved is not being correctly integrated (biodiverse cities and fire resilient landscapes), society is not sufficiently engaged (business and biodiversity) or there is a techno-economic/ operational barrier (ITI).

2.1.1. Biodiverse Cities

Movement pushing for the increase of urban gardens in the cities.

Techno-economic factors

Citizen support for greener cities has been increasing, demonstrated by the steady increase in area occupied by urban allotments. However, no official national statistic figure is available. The best source of information on this regard is the PORTAU website, but the information available here is not consistent nor updated in a systematic manner, making it difficult to have a clear view of its development.

The number of active supporters is however oscillating and the niche has lost visibility in the past few years.

Socio-cognitive factors

The main actors involved are parish and municipal councils, urban planners, birdwatchers and bird watching associations such as SPEA¹, other public and private charity NGO as well as research centres. Other important actor group is the education sector.

Governance and policy

Policy support already exists. National law recognizes agriculture to be a compatible activity with green infrastructure development as well as there is national law supporting green infrastructure development within urban perimeter. Furthermore, a recently approved national law on soil and planning (Law no.31/2014, 30 May) states government support to enhance air quality, reduce noise and increase green public spaces, which help to achieve the former.

Better policy integration between policy on green infrastructure and urban farming is needed and is appointed has one aspect hindering the niche diffusion. Another limiting factor is the lack of scientific evidence backing up green infrastructure policy and the benefits it claims to bring to cities. For example, how much energy cities will save if green infrastructure is improved (Burkhard et al. 2009).

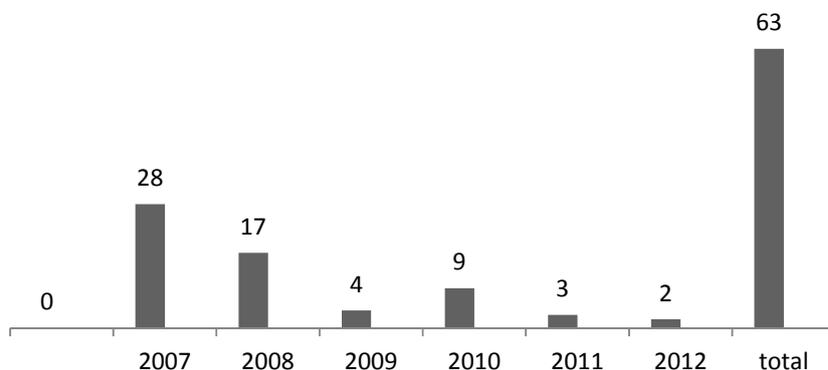
Internal Momentum: Low to medium

2.1.2. Business and biodiversity

Niche promotes the voluntarily engagement and commitment of businesses to biodiversity conservation.

Techno-economic factors

In 2012, there were 63 businesses that officially committed to implement conservation actions. Since 2007, new businesses engaged in the initiative every year. The first round of applications to take part is now closed but a new round is planned to open in the near future.



¹ <http://www.spea.pt/pt/>

Figure 1. Number of biodiversity compromises in Portugal between 2007 and 2012

Socio-cognitive factors

“Market pressures”, from consumers to producers, push businesses to incorporate sustainable production modes and biodiversity friendly practices. The actions businesses could promote covered by the niche were varied. Some examples of actions undertaken, includes restoration of natural habitats, or addressing habitat fragmentation resultant from the effects of collateral actions of the businesses under scrutiny.

An area needing improvement in the next round of the initiative is public engagement, namely as far as taking into account society preferences when choosing for compensatory measures. In the first round it was marginal and failed to engage key potential actors such as farmers. Although enterprises committed to organize workshops and forums these was not targeted to society as a whole in a participatory bottom up process. For example, if farmers involvement was called for in the BB program it the engagement might have been more successful. Learning and knowledge share needs to be improved.

Governance and policy

Policy support is strong both nationally but also internationally. Policy projects such as the TEEB²- The Economics of Ecosystem and Biodiversity - introduced new perspectives to land management. The Portuguese government is committed to implement TEEB in one protected area until 2016 and in all until 2020. Further actions include the public accountability of the economic value of ecosystem services, and 50% of TEEB included into Portuguese politics until 2020 and 60% until 2030. Implement the brand “natural.pt” to all products and services developed into the Portuguese protected areas. It is expected that 50 % of enterprises in natural parks will uptake the brand “natural.pt”- until 2020 and up to 75% until 2030. Ministry of Environment, Territorial Planning and Energy- MAOTE- initiative (MAOTE 2014).

At the European level, in 2010 the European Commission launched a platform to provide information and support to businesses wanting to get involved (<http://www.business-biodiversity.eu/default.asp>). Also, at international level the Convention on Biological Diversity (CBD) website has a dedicated global platform for business and biodiversity (<https://www.cbd.int/business/>).

National government is committed to keep promoting the initiative, which is planned to run until 2020. The government goal is to increase by 50% until 2020 and by 75% in 2030 the number of environmental agreements. This is in line with CDB-COP 2007. A possible problem might be, in our view, that the type of actions to be undertaken is not specified. Enterprises can simply commit to support the program but do nothing to improve the biodiversity status; or they can create offsets that are comparatively small to their effective impact. More rapid ecological assessments and/or biodiversity actions plans should be considered as possible voluntary strategies from companies, but instead offsetting seems to be the easier-and likely the cheaper option.

² <http://www.teebweb.org/>

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Internal Momentum: Low to medium

2.1.3. Multifunctionality for renewable energy

This niche promotes renewable energy production on farms, mainly wind and biomass. It advocates a new way of organizing energy supply through multifunctional use of the land. The land used for agriculture and forestry becomes also used for energy production, reducing production costs while also reducing carbon emissions.

Techno-economic factors

Portugal is a country with little fossil fuel resources. On the other hand, it is a country with high potential for renewable energy, such as solar, wind, hydro and biomass (MAOTE 2014). The production of renewable energy in Portugal increased dramatically in the last years (MAOTE 2014). This occurred in different land use regimes such as forestry, agriculture and water, and engaged all its actors. Renewable energy, both within the agricultural and forestry regime, in Portugal have a very short chain.

South-western Europe is one of the regions with the highest forest productivity (Pommerening and Murphy 2004, PNDFCI 2011). However, it is also one of the regions with the highest number of forest fires, the greatest area burnt and the highest vulnerability to plagues and diseases. To obtain timber of high quality, as well as an efficient and sustainable forest management, certain traditional practices are needed e.g. thinnings, which lead to different types of forest by-products. The high forest biomass is blamed for causing greater frequency of forest fires; however if the by-products from forestry are to be used to produce heating, or even more importantly energy, their economic value will increase, approach being advocated by this niche. Within this context, the use of renewable energy sources, mainly forest biomass, appears to be a win-win solution for Portugal. For heating small buildings it is indeed efficient and there are several examples where forestry by-products are used to heat schools, elderly centres and kinder gardens. On the other hand, it is now clear that forest biomass will unlikely solve the issue of fires, as well as it is now clear that transforming forest biomass into energy is not economically viable (DGRF 2007). The costs of removing the biomass from the forests and transporting it to a biomass central were prohibitive (DTI 2007) and therefore, the government plans to install 15 biomass plants were not implemented. Still another issue related to energy production from forest biomass, was that to keep up the biomass centrals capacity, the natural regeneration of forests could be compromised (CIBIO 2011). Forestry biomass removal raised concerns on the biodiversity front by not allowing the forest to regenerate. Thus, the prevailing small-scale projects generating heating, do not create sufficient dynamics for consuming all the shrubs the Portuguese forests produces annually and therefore not solving the issue of forest fires either.

Despite not being economically viable to use forest biomass as a source of energy, there is demand from industry. Examples are the big pulp industries as well as the pellets market. The pulp industries have the forestry by-products already within the premises of their factories and use the energy of forest by-products for producing energy to overcome their production needs (DGRF 2007).

In agriculture, the olive oil industry has increased its efficiency by using the hot water they need to extract the olive oil for heating the enterprise buildings. Although this energy is not traded commercially, it increases the efficiency of the olive oil production.

The use of land for wind energy production has developed in the last ten years and despite covering a relatively small area, the income generated by this wind energy is high - when compared with that of traditional forestry. Figure 2 shows the location of eolic parks. Moreover, income from wind energy is certain while that coming from forestry is of high risk of fire in Portugal. Added to this, wind energy might require changes in forestry management. Where wind parks are located in communal lands, grazing can still occur as there is no spatial incompatibility.

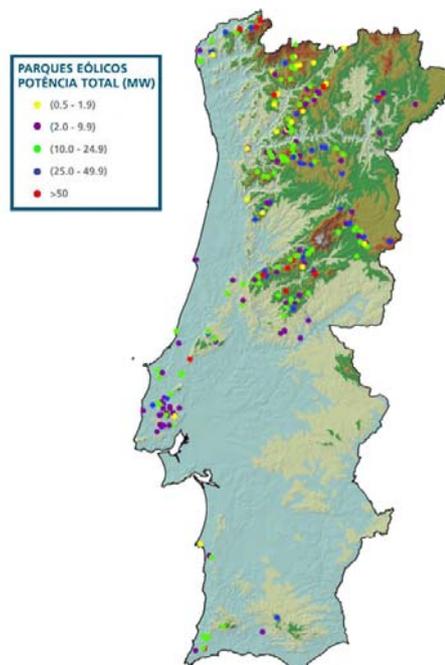


Figure 2. Location of wind parks in Portugal. Source ENEOP 2013³

Socio-cognitive factors

Production of renewable energy has occurred in different land used regimes like agriculture, forestry and water, and engaged all different kind of actors. In the case of agriculture, engagement is linked to private businesses such as for example the medium to big size enterprises of olive oil. In forestry, government has taken a more centralized top-down approach, through governmental fixed tariffs. The pulp industry is another big player in bridging forestry and energy regimes. This industry efficiently uses forest biomass to produce its own energy. Another important business linking the forestry regime with the energy is the pellets industry – there are 24 small to medium scale business.

³ http://www.eneop.pt/subcanais_n1.asp?id_subcanal_n1=171&id_canal=110

As far as forestry is concerned the initiatives emerging from grass roots are for example the communal land management organizations, which saw in the energy sector a more reliable source of income-as forestry has high fire risk- they shift their land management from timber to wind energy production.

NGOs and grass root movements have also been involved as opposing actors. There were numerous ecological movements against the government plans to build biomass centrals. These ecological movements were also strong when the government committed to build 10 dams in the Portuguese rivers in order to produce hydropower energy. There actions of these groups were well organised and vocal and most of the construction work for the dams was stopped - the Sabor dam is still under construction despite protests from several environmental NGOs and protected areas. Other societal movements against energy landscapes also include wind energy. Wind turbines are often a source of disagreement some liking other hating it. There are implementing initiatives dealing with the impact of eolic parks on biodiversity ⁴ The public support in Portugal seems to be stronger on the solar and biomass types.

Governance and policy

In order to tackle fire issues the law - Decreto-Lei n° 33-A/2005, established a favourable tariff for energy produced from forestry biomass (about 109€/MWh). The tariff paid for energy from forestry biomass is higher than the tariff attributed to the hydro, wind, solid residues or biogas from landfills. Only solar energy from photovoltaic centrals has higher tariff than forestry biomass. For the future , while the installed capacity (MW) seems to be stabilizing, the efficiency is expected to increase (Gwh).

	2010		2013		2020	
	MW	Gwh	MW	Gwh	MW	Gwh
Biomass centrals	203	1175	226	1266	305	1708
Biomass co-generation	476	1627	459	2570	464	2598
Solid biomass centrals	679	2802	685	3836	769	4306
Total FER	9688	29042	11153	27301	15824	32300
Contribution of biomass in FER (%)	7,01%	9,65%	6,14%	14,05%	4,86%	13,33%

Table 2. Biomass production installed and estimated capacity and production (Source: PNAER 2020, Resolucao do Conselho de Ministros no. 20/2013 <https://dre.pt/application/dir/pdf1sdip/2013/04/07000/0202202091.pdf>).

Internal Momentum: Low

2.1.4. Fire resilient landscapes

This niche innovation deals with fire in a non-traditional way. Instead of focussing on strategies to combat fire, this niche focus lies on strategies to prevent fires via land management practices. It promotes replanting of native broadleaved tree species, which are more fire resistant than for example, the invasive national wide present Eucalyptus.

⁴ <http://www.bio3.pt/servicos-e-projectos/wind-and-biodiversity>

Techno-economic factors

Although the Mediterranean type vegetation presents unique adaptation characteristics to fire, forest fires are the most important threat to forests and wooded areas in Southern Europe.

Fires in Portugal cause extensive damage every year, leading to loss of human lives, affecting human health, burning properties, infrastructure and businesses and causing extensive environmental damage in regimes such as forestry, agriculture and urban. Forest fires also contribute to global warming through the emission of CO₂. However, in the 90s and in the beginning of 2000 decade, when fires were recurrent, there was stronger commitment from the national government to implement fire resilient landscapes. Comprehensive forest management reforms include measures like: i) cross sectorial approach to forest management including the participation of urban planning, agricultural sector and protected areas for implementing compartmentalization of forests into other land uses across the whole landscape mosaic; ii) emphasis of reforestation projects with native broadleaved trees - such as *Quercus robur*, in the Northwest part of the country- and cork oak- *Quercus suber* and holm oak in the southern part of the country, iii) bringing people into the forest on a permanent basis e.g. the local fire fighters parishes councils or communal land organizations might apply to manage all year round a team of five men managing the forest areas dealing with the whole forest cycle.

Due to the long life cycle of forest ecosystems - broadleaved forest take nearly 50 years to grow- there is a need for a long-term commitment. At the present, this government commitment appears to have set back and lost momentum. The economic crisis in Portugal raised new government priorities (economic growth).

Innovative approaches have also taken place from civil society. Since it is not economically viable to remove the fuel wood from the forests, an alternative might be to use the grazing animals such as goats - known by eating all the shrubby types- in the forest areas. Civil society has organized: i) a number of forest owners' associations which are nowadays well established especially in the northern and central regions where small-scale forestry is more salient, ii) local environmental activities try to re-establish connection between people and the rural land, iii) NGOs educate society at large (farmers, hunters, recreationalists...) concerning good environmental practices (including fire management).

Socio-cognitive factors

There is a very high commitment from the society as a whole to address the issue fire issues in Portugal. Dealing with resilience to fire has been a priority for society as a whole as well as governments. Although this niche has certainly been supported by governmental discourses as well as top down approaches- mainly regulations- much of the initiatives have developed from a grass root perspective. User groups such as livestock grazers e.g. programmed grazing, or communal land management associations have taken an active role in addressing fires. These are innovative social arrangements revealing grass root commitments power. Implementing fire resilient landscapes imply a change in paradigm and problem framing. There is a clear need for science-based knowledge and know-how on the societal, economic and environmental aspects of this integrative approach to tackle fire issues. An official framework and roadmap for action is does not exist.

Difficulties have been reported in bridging across traditional planning- engaging multiple sectors – agriculture, forestry, nature (protected areas) and urban planners into the process. Another difficulty is that this niche innovation developed by at two fronts by government as well as grass root

initiatives, and the link between the two organisational levels is missing. An intermediate position- might be at the landscape scale- to join the efforts from the governments and the civil society to build fire resilient landscapes would be beneficial.

Governance and policy

Policy support exists but requires long-term commitment. No planning framework in Portugal for landscape sustainable management as a whole. There is a lack of clear property rights for engaging landowners to cooperate in a fully collaborative arrangement. While there are planning and management rules in Portugal for approaching these matters e.g. ZIFs Zonal Forest Plans, these are not strong enough, nor sufficiently established (Carvalho-Ribeiro, Lovett et al. 2010). With such an unreliable institutional and financing framework, it is difficult successfully to implement long-term revenue creating benefits in such areas as fire prevention and control.

Governance for this niche innovation has been put forward by formal institutions though a top down approach. It implies both change in the *setting* of existing policy instruments (e.g. existing afforestation projects) and b) introduction of new *kinds* of instruments (e.g. creation of tax on fossil fuels to finance forest management Law 63/2004, 22sd March). There is a problem of low technical performance of the innovation. Economic viability is yet insufficient to reinforce the development of this niche.

Internal Momentum: Medium

2.5. *Integrated Territorial Intervention*

This niche promotes sustainable land management practices. Land under agricultural and/or forestry which fall within the limits of designated protected area is eligible for the program. Farmers get financial support to establish farming practices while also accounting for nature conservation.

Techno-economic factors

The Integrated Territorial Intervention is a national measure of the rural development program PRODER. In Portugal, eleven Integrated Territorial Intervention sites were created by law. Only areas included in protected areas/special protection sites were eligible to apply. Despite Integrated Territorial Intervention sites having been created for 11 areas, each had different rules in the different socio-ecological contexts, because of different cultural contexts needing to be taken into account in order to develop land management strategies to enhance biodiversity. Therefore, the local management structure of each area has been called for to develop the actions and land management activities able to enhance biodiversity status. For the eleven Integrated Territorial Intervention (ITI) sites 1919 projects were to restore agro forestry systems in situ while 29 projects were sponsored to manage the local management structures. For those ITI projects in land there were spent 61 196 million euros, while managing the whole implementation process had a cost of 1 724 million euros. The way in which the money was distributed amongst the eleven ITI greatly differed.

An important innovation of the ITI measure is that it allowed the communal land organizations to apply for funding to restore the communal land as whole- forests, agricultural land, and cultural heritage. In the past only separate applications either for forestry or agriculture actions was allowed. This government top down approach to land management was the first national program to consider the payment for ecosystem services of the traditional landscapes. Both the number of projects and actors involved are considerable.

Socio-cognitive factors

Main actors involved include government and communal land organizations.

Governance and policy

The management of the commons in Portugal is based on legislation established in 1976 (laws 39 and 40) and the law 68/93. The law from 1976 represents an important shift in the history of the common lands in Portugal. After the 70s the state gave the possibility to manage and own the land to the commoners. In this law, the commoners organized as CDB “Conselho Directivo de Baldios” can choose between two types of management, one with direct intervention from the government (modality B), and one with exclusive responsibility for the management attributed to the commoners (modality A). After some reluctance, the Portuguese government finally included the ITI action measure into the official rural development programme, hence there is policy support for ITI. There was difficulty to justify that public money should be spent in financing agricultural/ forestry measures in areas known to lack market competitiveness. The mainstream –mainly agriculture-actors were heavily against these areas official inclusion. Nevertheless the ITI was one measure within the Portuguese rural development Program called PRODER. This might be seen as a way in which the society is paying for the ecosystem services that those rural areas are providing. It follows from the above that, although being put forward by government as a mainstream national programme, ITI is here considered a niche innovation because it emerged from a wider societal demand for enhancing the biodiversity status of Portuguese protected areas. It also innovates as it attempts at reconciling the goals of production of the ministry of agriculture with the protection goals from the ministry of environment. The implementation of ITI calls for a local management network - Estrutura Local de Apoio (ELA)- bringing to the initiative other rural development actors, NGOs.

A problem with the ITI implementation is that it is well below its estimated implementation. Operational problems such as difficulties in ministry of agriculture and environment working together seem to be on the basis of the low uptake of ITI.

Internal Momentum: Low to medium

2.1.6. Rewilding

This niche is about freeing land for nature and letting nature take over its natural processes with minimum or no human intervention.

Techno-economic factors

The Institute for European Environmental Policy (IEEP) estimates that more than 120,000 square kilometres (46,300 square miles), an area almost as large as Greece, will likely be abandoned throughout Europe in the next few decades. This land abandonment trend is an opportunity to restore European degraded habitats through ecological rewilding as there will be lower human pressure. However, the prevailing belief in Europe is that wilderness equals to the growing of forestry regime and shrinking of the agriculture but it is not as straightforward as it seems. In many areas, animals, for example large herbivores, might be responsible for clearing the land creating open landscapes such as steppes, tundra, flood plains and open grassland. Innovative aspect of this niche lies on its approach to land management, by which an area of land is restored to its natural uncultivated state.

The active land management strategy embedded into the rewilding concept normally implies the reintroduction of species of wild animals that have been driven out or exterminated from that land.

In Portugal, two different land management strategies are able to deliver rewilding at the landscape scale. One is a passive management of land. In this case rewilding might be seen as unintended outcome of discontinuation of farming activities resulting in farmland abandonment. This occurs because large stretches of land are already being abandoned, particularly in mountainous areas. In many instances, traditional cultivated landscapes can only be preserved when the last few remaining farmers are paid to keep the meadows mowed. This type of rewilding, as a passive land management strategy, has been occurring in Portugal for decades. This type of rewilding can also be seen as a side effect of the long-term socio-ecological changes occurring in the country, like migration to the cities. Today, few people are still interested in farming as environmental conditions limit production potential. At present, especially in high altitude land, with generally poor and acidic soils, the only land use occurring is grazing cattle, sheep and goats. Cultural traditions of the whole community e.g. transhumance are changing as farmer communities are ageing (Aguiar et al., 2009 and Domingues and Rodrigues, 2008). In some areas there are villages where no one lives for decades, in which houses are increasingly in disrepair.

The other type of land management strategy implementing rewilding is both intentional and planned. This can be seen as the “formal” rewilding movement that has been exploring an opportune time, as some rural areas, become increasingly depopulated, for buying land and let the ecosystems to rewild only introducing grazing pressures- if and when it is needed- to break up locks on the ecosystem functioning allowing rewild process to undergo.

Different organizational structures taking advantage of the land abandonment process undergoing in Portugal for decades is: Associacao transumancia Natureza (ATN) –wich owns around 900 hectare of land at the Côa Valley. ATN is the manager of the Faia Brava Reserve, the first private protected area in Portugal. ATN owns and manages several other reserves in the Northeast of Portugal and is the Portuguese local partner of the Rewilding Europe initiative.

Other case is the MONTIS association, which does not specifically promotes rewilding. It instead aims at managing the land to produce biodiversity assets that can be transformed into economic income.

Socio-cognitive factors

Committed network of NGOs and research institutions and universities explore the rewilding concept.

Governance and policy

There are European as well as national movements by NGOs exploring the rewilding concept and its implementation issues. There is no policy framework at present.

Internal Momentum: Low

2.1.7. *Biodiverse pastures*

This niche promotes a management approach to grazing that improves carbon sequestration. Farmers agree to use an engineered mixed seed package, which is able to sequester more carbon and in return they receive an income per ton of carbon sequestered, from the Portuguese Carbon Fund. Moreover

these pastures claim to be more bio diverse than other planted pastures but to date, there are no studies comparing these with natural pastures.

Techno-economic factors

Pastures occupy a larger share of the Portuguese land. They are at least 3 types of pastures such as natural grasslands, fertilized grasslands and Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL). The latter, promotes the increase of the soil organic matter and consequent carbon sequestration. The Portuguese carbon fund has been supporting the geographical expansion of the SBPPRL by remunerating the farmers for the provision of an environmental service. In addition the carbon fund has also demonstrated interest in remunerating the farmers willing to control shrub encroachment at pastures through the use of non-invasive techniques at promote carbon sequestration in the soil.

About 50 000 ha of SBPPRL pastures installed between 2009 and 2014. The carbon fund pays 150 euros per ha to all the farmers involved. Approximately 1000 farmers are involved. Moreover, about 37 000 ha of shrubs have been removed without mobilizing the soil.

These pastures are more bio diverse than other planted pastures but there are, to date, no studies comparing these with natural pastures.

Socio-cognitive factors

One of the most important stakeholders in this niche innovation is the farming community. At the present there are approximately 1400 farmers involved. After adopting the technology, farmer's yields increase, the need for costly fertilizers and concentrated feeds is reduced, and there are less negative environmental impacts (Fernandes 2012). One of the strengths of the project is the direct involvement of farmers who are provided with technical support during frequent field visits, at which consultants advise them about the best management practices (Fernandes 2012).

Technical support is provided by both the agriculture and forestry NGOs in the areas where the participating farmers are located as well as by private companies offering both technical support as well as monitoring the whole process and continuously visiting the farmers' activities so that only committed actions are in place.

Finally, Terraprima⁵ is the actor establishing the linkages between farmers, advisory and monitoring team with the Portuguese carbon fund by the Portuguese ministry of the environment. Terraprima is a business group formed by 3 companies,

- Terraprima Ambiental is a spin-off of the IST technical university dedicated to the design and implementation of integrated systems for compensating for the environmental impact of human activity. Its work includes managing remuneration projects for environmental services provided through good soil management practices, including Sown Biodiverse Pastures.
- Terraprima Agrícola runs the agroforestry management of Quinta da França, a farm which is involved in demonstration projects related to the environment and sustainability.
- Terraprima Inovação is the latest company of the group and was established to provide consultancy in agriculture and the environment in the areas of scientific research and technological development.

⁵ <http://www.terraprima.pt/en/>

Governance and policy

The Portuguese Carbon Fund (PCF) started in 2006 with a 6 000 000 Euro budget. It was an operational instrument intending to finance several actions with positive returns regarding a decrease in GHG emissions (Teixeira 2010). The fund was developed with public money only and there is uncertainty for the future of the fund. Until now, the actors involved were not able to be independent from public funds which can compromise the future of the business, which otherwise seems to work well.

Internal Momentum: Low to medium

Niche innovation	Internal Momentum		
	<i>Techno-economic</i>	<i>Socio-cognitive</i>	<i>Governance</i>
Biodiverse cities	Need more economic investment Need better policy integration (Green Infrastructure and Urban Farming)	Better knowledge transfer and communication between social groups and incumbent actors	Organisational improvements needed
Business and biodiversity	Stronger scientific-evidence supporting actions taken	Increased public engagement	Uncertainty concerning institutional long term support
Multifunctionality for renewable energy	Economic feasibility Technical problems: where to locate the biomass plants?	Public opposition (biomass centrals) More information and communication to society	-
Fire resilient landscapes	Time scale issue constrains the perception that change is already under way.	Time scale issue constrains the perception that change is already under way.	-
Integrated Territorial Intervention (ITI)	Needs more economic investment Technical issues (better planning & scientifically sound support), but also transferability of measures between sites.	Increase engagement and adhesion of actors	Improved organizational structure
Rewilding	-	Improved public engagement	No policy support
Biodiverse pastures	Stronger scientific-evidence supporting the improved performance of the mix used	-	Uncertainty concerning institutional long term support

Table 3. Niche innovations internal momentum dimension(s) pushing back a potential niche break through.

The majority of the niche innovations identified fall under sustainable transition pathway type B, although some niche innovations showed elements of pathway type A (e.g. Biodiverse pastures; Business and Biodiversity). Typically, niche innovations that belong to pathway B involve broad transformation in this case of how the land is used (e.g. moving from single functions to multifunctional land use by intersecting regimes) and deep behavioural changes in society. Habits are not easy to change nor are such processes fast. Overall, the niches require new forms of governance and a shift of paradigm. The actors involved in the niche innovations are in their majority marginal actors, with national government, in some cases, caring to support some of the niche innovations, or remaining neutral. A fundamental aspect for a breakthrough to happen hangs with the actors' capacity to be receptive to change. Emerging actors play multiple roles, across regimes or innovations, e.g. farmers managing the land for biodiversity or urban dwellers interested in gardening and ecosystem services. The socio-economic performance of the niches is low.

Niche innovations in the Portuguese land use domain classified to have a medium to low momentum are somewhere between Phase 1 (pre-development stage) and Phase 2 (early markets) of the niche innovation life cycle, while those that show a low momentum are certainly still at Phase 1. The main difference between these two stages is that by the second stage, the degree of involvement from different actors is already substantial. Dedicated communities emerge, institutionalized governance actors may, or not, offer support but essentially, the niche has a trajectory of its own even though, it continues constrained by dominant mainstream forces.

2.3. Niche innovations alignment with the land use regimes and wider landscape developments

The land use domain in Portugal is characterized by four land use regimes: agriculture, forestry, nature and urban. As previously highlighted, all the niches innovations are examples of multifunctional land use. Hence, in relation to the regimes all of them overlay at least two land use regimes (Table 4). Throughout Europe there is an increasing trend to address biodiversity and environmental issues in land management strategies.

<i>Niche innovations</i>	<i>Regime</i>			
	<i>Agriculture</i>	<i>Forest</i>	<i>Nature</i>	<i>Urban</i>
1. Biodiverse cities	X		X	X
2. Business and biodiversity	X	X	X	X
3. Multifunctionality for renewable energy	X	X		
4. Fire resilient landscapes		X	X	
5. Integrated Territorial Intervention	X	X	X	
6. Rewilding	X	X	X	
7. Biodiverse pastures	X		X	

Table 4. Land use regimes mapped to the niche innovations identified in deliverable 2.1

Despite the niche innovations presenting overall low momentum and the land use regimes high stability, positive alignments between niche innovation and the wider land use regimes can be recognized, in the sense that niche innovations address the points of tension and problems inside the regimes. Such alignment has engendered different developments. For example, the *biodiverse cities* niche innovation, which overlays agriculture, nature and urban regimes, and promotes urban farming in cities, is an example of a positive alignment that has already raised public interest, from at least

certain citizen groups like birdwatchers, youth groups, NGOs, engaged political will, mainly within local authorities and has the potential to promote policy adjustments. The niche shows potential to become an important policy tool in the urban regime to enhance biodiversity status in cities. Moreover, this niche-innovation reinforces and complements an existing policy tool for improving biodiversity in cities, the green infrastructure plan. Another example of a niche innovation, which positively aligns with the wider regime changes, is the *business and biodiversity* niche innovation, which offers the opportunity for businesses to voluntarily engage on biodiversity conservation actions. This niche innovation positively aligns with international and EU policy goals and hence, even though still voluntarily, it has potential to result in policy adjustments, further financial investment and political will. There is increasing public pressure and sensitivity to the impact of businesses on biodiversity. *Fire resilient landscapes* niche innovation, which overlay agriculture and nature regimes, is an example of a positive alignment strongly driven by widespread public debate, political will and that has resulted in financial investments and policy adjustments.

Regime	Lock-in, stabilising forces	Cracks, tensions, problems
Agriculture	<p>MODERATE/ STRONG</p> <ul style="list-style-type: none"> - EU policy e.g. CAP influences many of the decisions farmers take upon their agricultural practices. - Subsidies paid to farmers create dependency. - High financial investments from farmers as well as cultural and historical relation with the land. - Consumers play a decisive role through their demands influencing food production and prices. <p>Agriculture is currently an important national land use and is forecasted to remain so. The main stabilising forces are probably policy and the subsidies offered. Changes in crop cultivated are quick, and happen in response to subsidies target changes.</p>	<p>STRONG</p> <ul style="list-style-type: none"> - Financial-economic crisis. - EU policy e.g. CAP and Natura 2000; agricultural CAP subsidies influence agricultural practices as well as place requirements on how to use and manage the land used for agriculture which is not always understood by farmers. - Farmers struggle to make a living from agriculture (little pay, high investment and hard life in rural areas) - High performance demands from consumers and retail sector <p>There are major tensions in the agriculture regime. Tensions are mainly related to a decreasing income from the sector and decreasing interest in agriculture (type of work) from younger generations. Total surface occupied by agriculture has decreased slightly but mainly in marginal areas.</p>
Forest	<p>STRONG</p> <ul style="list-style-type: none"> - Market demand for paper, pulp and cork. - Market demand for agro-forestry products. - Economically important sector. - Land ownership and investments in forestry associated technology. - Forest owners organized in cooperatives. - Policy supports forest expansion. <p>Forest represents a strong source of income nationally.</p>	<p>WEAK/ MODERATE</p> <ul style="list-style-type: none"> - Climate change associated markets e.g. biofuel and carbon - Market price fluctuations for timber. - Demand for certified wood. - Increasing competition to cork bottle tops. - Policy support on forest expansion has paid little attention to management issues. - Eucalyptus plantations have raised discontent among conservation groups (because of being a non-native species) and society (increased fire risk) - Fire is a serious problem. <p>Fire is a big issue in the national context.</p>
Nature	<p>WEAK/ MODERATE</p>	<p>MODERATE</p>

	<ul style="list-style-type: none"> - EU policies on conservation influences land use decisions to a certain extent, however the regime poor economic importance, when compared to other regimes, makes it more vulnerable to pressures. - Public awareness to conservation and environmental issues is increasing but a lot of conflicting misconceptions persist e.g. natural areas are for recreation, as well as a stylized view of nature e.g. nature are parks and gardens. - National institutional force is well defined e.g. ICNF <p>National nature regime overlays to a great extent to the Natura 2000 network, which denotes how European policies strongly, influence national conservation.</p>	<ul style="list-style-type: none"> - Climate change adaptation challenges, biodiversity loss and land use pressures. - Stakeholder engagement and intervention is still limited to certain groups. - Policy goal conflicts addressing different economic sectors. - Low ranking priority - Moderate upheaval from pressure groups. <p>There are opportunities for the Nature regime to take over agricultural land estimated to become abandoned in the future, especially when such land is located in marginal difficult access areas such as mountains.</p>
Urban	<p>STRONG</p> <ul style="list-style-type: none"> - Physical constraints. - Construction sector crisis - Supports great percentage of the national population. <p>Once the built environment is built it is quite unlikely it will change.</p>	<p>WEAK</p> <ul style="list-style-type: none"> - Urban design solutions available. - Policy divide concerning urban in relation to all other regimes. - Social demand for greener cities <p>Tensions within the regime urge for a reorganization of the regime pattern. Citizen demands can influence the pace of the change.</p>

Table 5. Portuguese land use regimes stabilizing and destabilizing forces.

2.4. Niche-innovations likelihood of breaking through

In spite of the acknowledged positive alignment and numerous rupture points between niche innovations and land use regimes, no niche innovation (except for Fire resilient landscapes) is close to entering Phase 3 of the niche life cycle i.e. breakthrough and wider diffusion. In some cases, the lack of internal momentum as pointed out previously, may be pushing back the niche innovation. On other cases, the stability of the regime may be hindering niche innovations from gaining a more generalized importance. In all niche innovations, both internal and external aspects are altogether constraining the niche innovations.

Niche innovation	Momentum	Alignment with broader regime characteristics and developments	Likelihood of breakthrough	Pathway
1.Biodiverse cities	Medium to	Low to Moderate	Low	B

	Low	Agriculture and urban regimes are fairly stable but there is a window of opportunity for better alignment lying with better policy alignment and more public engagement.	Niche is growing slowly. The stability of the regimes involved and low internal momentum hinder the break through.	
2. Business & Biodiversity	Medium to Low	Low to Moderate Agriculture regime is more stable than the nature regime. Issues related to the Nature have also in policy a low degree of priority in general. There are nonetheless windows of opportunity pushed by commitments of the national government to meet foreign policy as well as increased societal pressure on businesses to account for their impacts on nature.	Low Regimes are relatively stable and improved socio-knowledge transfer and financial assurance hinder the growth of the niche.	B with elements of A
3. Multifunctionality for renewable energy	Low	Low Agriculture and forestry are the two main regimes in Portugal and are relatively stable. Windows of opportunity lie with policy long-term commitment and improved scientific support.	Low Regimes are stable and there are technological and operational constraints for the niche to break through.	B
4. Fire resilient landscapes	Medium	Moderate Developments at the agriculture and forestry regimes in Portugal and this niche are strong as far as fire is concerned.	Growing, but limited perception of its development due to time constraints	B
5. Land sharing and Integrated Territorial Interventions (ITI)	Medium to Low	Low to Moderate Alignment with developments at the agriculture and nature regimes is relatively positive. Better scientific evidence supporting the niche proposed actions and long-term commitment from the government.	Low Regimes are stable and there is operational constraints for the niche to break through.	B
6. Rewilding	Low	Low Need for more public engagement but also from the government and	Low Low degree of interest from the public and	B

		institutions of the nature and agriculture regimes.	government.	
7. Biodiverse Pastures	Medium to Low	Low to Moderate Alignment with developments at the agriculture and nature regimes is relatively positive. Better scientific evidence supporting the niche proposed actions and long-term commitment from the government.	Low to Medium Regimes are well aligned to the niche but financial long-term sustainability and improved scientific support evidence hinder the niche break through.	B with elements of A

Table 6. Breakthrough analysis of the niche-innovations in the land use domain for Portugal.

3. Assessment of regime reorientation

Land can be used for different purposes by society. At any point in time, land use reflects the needs of the various direct and indirect stakeholders upon the land. Changes to land use result from complex and on-going numerous interactions between drivers acting at different spatial scales (Lambin et al. 2001). Some of the drivers influencing changes in land use are economic, political, technological, socio-cultural and biophysical. Changes in land use contribute greatly to the shaping of both the physical and human environment and even though land use changes happen at specific locations, their aggregated impact represent an important aspect of environmental global change (Vitousek 1992).

Land use concerns how people use the land (forestry versus agriculture), in contrast to land cover, which is used to describe the physical aspect of a land (e.g. trees versus grass). The mapping of a land cover does not restrict that land to a single land use e.g. a forest land cover, might be used for timber production or it may be used for nature conservation. The cover type will still be identified as forest – one will only be able to identify a patch of trees as cover - but the regime, i.e. end-use of that land, will influence the type of species one finds in that forest.

Regimes in the land domain are based mainly on use. In Portugal, the land use domain is composed by four regimes: agriculture, forestry, nature and urban. One sub-regime, the Montado agro-forestry has been identified in the Portuguese land use domain, which covers the agriculture and forestry regime simultaneously.

A defining and unique characteristic of the land use domain is that not only, multiple regimes can overlap at any single location such as exemplified by the Portuguese agro-forestry sub-regime, the Montado (intersection of forest and agriculture regimes) or by the niche innovations, which lie at the intersection of at least two regimes, but also inter-regime changes, when an area shifts between two regimes, e.g. conversion from nature to agriculture, and intra-regime changes, when a regime suffer changes internally such as intensification of agriculture take place at all times. The most profound land use changes, emerge however as a result of inter-regime shifts, such as agriculture conversion to forestry for example.

In the past 100 years in Portugal, land use changes have been marked by inter- and intra-regime changes in the agriculture, forest and urban regimes. These regimes suffered changes in the proportion of the area of the country occupied by them. There were also significant changes within regimes, for example the agriculture regime that underwent intensification and the forest regime which, was highly modified with the introduction of eucalyptus and the associated paper pulp industry (MA 2009). Overall, agriculture and forest regimes dominated the national land cover (Figure 3).

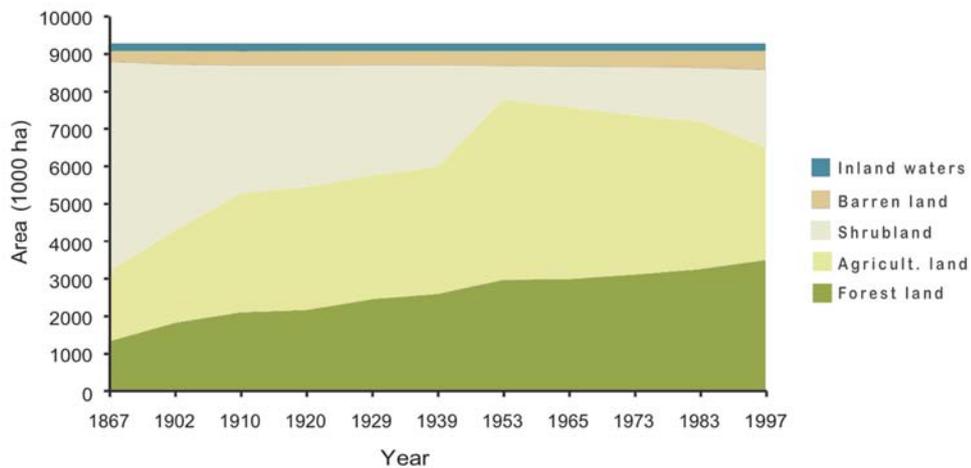


Figure 3. Trends in land-use in Portugal in the last 100 years. The nature regime overlaps mainly with the barren and scrubland land-use, and to a lesser extent with forest. (Source: 2009, MA)

At the present moment, the land use domain is assessed to be moderately stable in Portugal. The observed stability is in part a consequence of the intrinsic nature of the domain. Land use changes are often a long-term slow-paced process. Nonetheless, as already highlighted, land use is a dynamic domain. In the near future the greatest amount of land use change in Portugal is expected to occur in the agriculture regime. In the near future, agricultural land is forecasted to become abandoned, freeing such land to be taken up by another regime. The momentum for a transition pathway to happen in the land use domain appears to be still low.

Three types of stakeholder classes represent the land use domain: land owners, land users and regulators. These stakeholders can play multiple roles at the same time. A landowner may be also a land user, while regulator may be a landowner but not necessarily. A land user may or not only play that role upon the system. The interests of stakeholders upon the land are diverse and different stakeholders may have different and conflicting interest to another stakeholder.

3.1 Regime developments

Agriculture Regime

Agriculture represents about 39% of the Portuguese national territory (ICNF 2013a) and contributes about 2% to the national gross domestic product (MAMAOT 2013). However, in recent years there has been a tendency for farmland abandonment, especially in mountainous or semi-mountainous areas, leading to depopulation of rural areas. After the second half of the twentieth century, agriculture practices in Portugal intensified, i.e. productivity increased per unit area, and there was a decrease in the overall surface area utilized by agriculture. Permanent pastures substituted annual crops. The surface area released from agriculture, was converted into urban, nature or forestry. On the other hand, agriculture extensification, i.e. system where agriculture occurs side-by-side with other land uses such as forestry and/or nature conservation and which, is a traditional agriculture practice in Portugal, especially in the south, did also occur in parallel. In an extensification system,

there is a less intense application of the production factors, for example less use of fertilizers and/or pesticides, fewer animals per hectare and a decrease in the number of years, in a rotation system that the land is under cultivation. In areas like the Alentejo, extensification production traditionally have been the best strategy for the farmer to optimise production in the face of the existing environmental conditions (temperature, water availability, etc.). There are strong tensions in the agriculture regime. Tensions are mainly related to a decreasing income from the sector and decreasing interest in agriculture (type of work) from younger generations. Nonetheless, the agriculture regime is still currently a dominant national land use and, despite the trend of farmland abandonment, the regime is forecasted to remain a dominant land use. The main stabilising forces are policy such as the Common Agricultural Policy (CAP) and the subsidies offered. The choice to produce one crop over another changes quickly, usually in response to subsidies targets.

Forest Regime

Forestry represents about 35 % of the Portuguese national territory and it contributes about 3% to the national gross domestic product (ICNF 2013a). The Portuguese forest has a relatively recent origin and is marked by high human intervention. Afforestation happened in response to an increase in demand from the logging and paper industry and largely at the expense of cluster pine and eucalyptus (EC 2004). The emphasis of forestry policies has been on promoting forest expansion in detriment to their management, and consequently on fire incidence which is a big problem nationally. In Europe, Portugal is the country where the transition from non-forest to forest happened the fastest. The total area of forest was in 1870 about 4 – 7 %, reaching more than 30% of the national territory in only one century (MA 2009). The forest regime is strongly locked-in, in great part due to its weight on national economy but also because policy supports forest expansion. Except for fire, which nationally is a big issue for the forest regime, there are only minor tensions inside the regime.

Nature Regime

The Portuguese natural territory is the result of a long history of practices associated to agriculture and husbandry, which accommodate a great diversity of native breeds and agriculture varieties, and other highly human-modified ecosystems, some of which are recognized to play a key role for the conservation of certain endangered species (MA 2009). The Nature regime is a moderately locked-in regime, where European policy has played a key role as a stabilizing force. The Portuguese National System of Designated Areas (SNAC) is constituted by the National Network of Protected Areas (RNAP), the areas that integrate the Natura 2000 network and areas designated under other international agreements to which Portugal is a signatory member, such as CITES and RAMSAR. The total area classified under RNAP and Natura 2000 was in the end of 2013 about 22% of the national mainland territory (APA 2014a).

In the last 25 years, natural areas have mainly taken over marginal areas at high altitude and steep, where both agriculture and urban expansion are unlikely to establish. Natura 2000 policy afforded protection from urban sprawl, but has on the other hand made some areas more vulnerable to farmland abandonment or agriculture intensification (Diogo & Koomen 2012).

Urban Regime

The urban regime represents about 3% of the Portuguese national territory. Urbanization have grown disorderly, uncontrolled and biasedly along the coast. About 76% of the national population lives on the coast (OECD 2011), especially concentrated in the metropolitan areas of Lisbon and Oporto.

Urban areas and other artificial developments took over areas that before were mainly used for agriculture or forestry. The urban regime is a regime strongly locked-in. Physically constrained, once it is established it is hard to change it. In that sense, this may be one of the reasons why improving biodiversity status on cities has proved so difficult. Not only better policy integration is needed but it is also difficult to re-organise the already established built environment.

3.2. Regime transition challenge & orientation towards environmental problems

From an environmental perspective the emission of greenhouse gases (GHG) is a great challenge for the land use domain. In Portugal following a period of economic growth in the 90s, national carbon emissions have been decreasing consistently. Excluding land use, land use changes and forests (LULUCF) in 2010, national emissions were 1,9% lower than those of 2005. In 2010, agriculture was one of the sectors that contribute more heavily to national emissions, only falling behind the energy and transport sectors, even though it shows general decreasing trend. The Portuguese forest has functioned as net sink since 1900, sequestering between -11 and -18 Mt of CO₂eq (APA 2014b). However, forest fires (natural, accidental or induced) are common and are an important problem in Portugal. In 2013, about 152 756 hectares of forest was burned (APA 2014a). The frequency and extent of forest fires puts in jeopardy the forests capacity for sequestering greenhouse gases emissions and contributes to the emission of air pollutants such as particulate matter. About 3% of national forests carbon-fixing capacity is estimated to have already been lost (Queiroz et al. 2014). Recovering the carbon capture capacity is a long process, as trees take years before they reach their full absorption capacity. Forest fires can also affect biodiversity. In 2013, 1,2% of the fires happened in an area integrated in the National System of Designated Areas (APA 2014a). Forest fires but also the increasing number of exotic species such as *Eucalyptus globulus*, have contributed to major changes in soil properties (Carvalho et al. 2002).

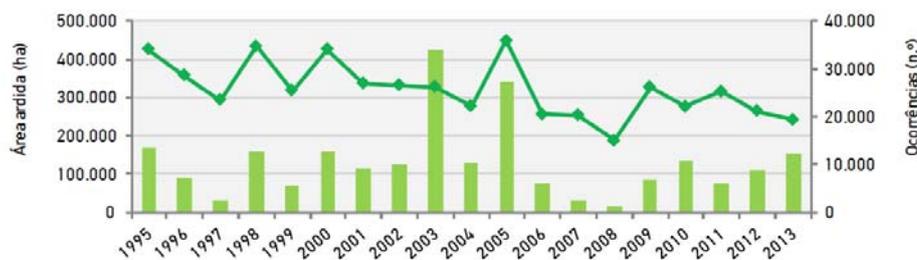


Figure 4: Forest fires in mainland Portugal. (a) bar graph: burned area; (b) trend line: frequency
Source: (APA 2014a)

Forest fires in Portugal present a high inter-annual variability. In the period between 1990 and 2010, the fire occurrence of the year 2003 and 2005 were especially pronounced. Fire occurrence in Portugal is recognized to show a seasonal pattern, being heavily concentrated to occur in the summer. A study estimating the national level of greenhouse gas emissions directly caused by fires between the period of 1990 - 2008 found that Carbon Dioxide was the gas emitted in higher quantity. Unlike the GHG emissions derived from the activities of industry, transportation and agriculture,

which result in goods and services, GHG emitted from wildfires, which are estimated to represent about 1- 9% of total GHG emissions, have often an environmental and economic weight attached (Rosa et al. 2011).

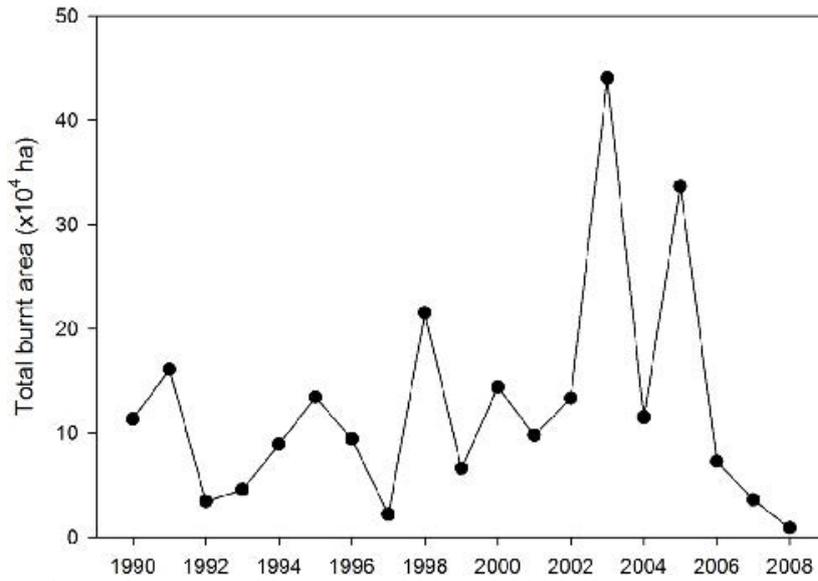


Figure 5. Total area burnt in Portugal between 1990 and 2008 (Source: (Rosa et al. 2011)).

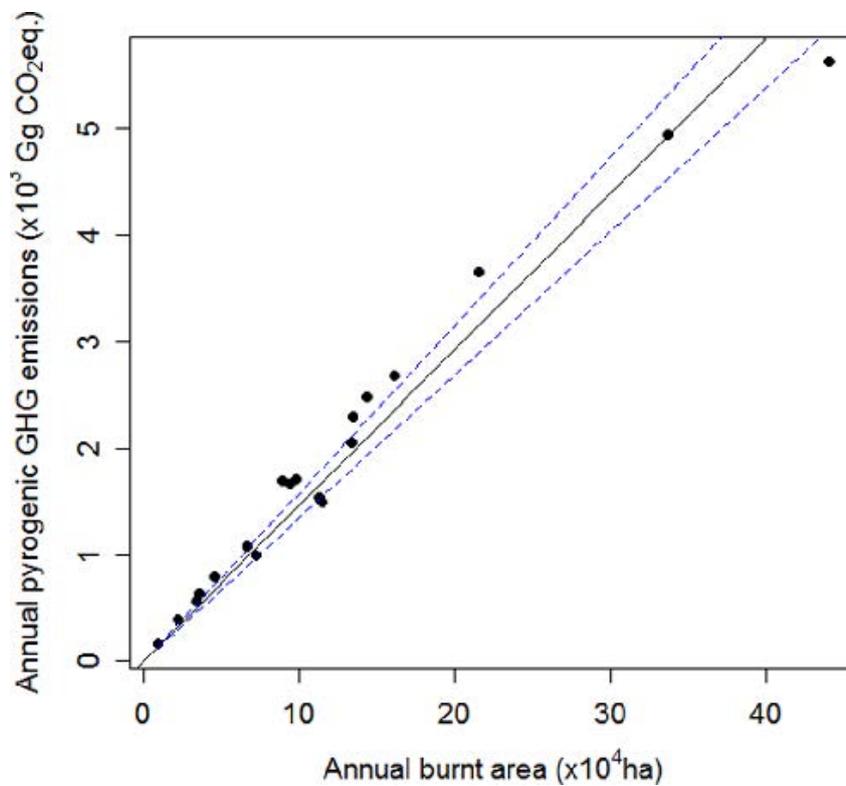


Figure 6. Linear regression between the annual area burnt and annual GHG emissions in Portugal between 1990 and 2008. Dashed lines represent the slope's 95% confidence interval 2008 (Source: (Rosa et al. 2011)) .

A unique feature of the land use domain is its direct influence on biodiversity conservation. Most European countries, Portugal included, in the late 20th century, have spatially segregated their land use regimes (nature, agriculture, forestry and urban) as a result of specialization and intensification of production (Antrop 2004, 2005). Some argue, that this functional separation of land contributes to many environmental problems (Selma 2006), including biodiversity loss. To counter balance this tendency, in the last few decades' biodiversity issues have increasingly been included into land management and integration of multiple functions in the landscape has regained importance. This trend is also observed in all niche innovations identified in deliverable 2.1 for Portugal. The Portuguese niche innovations involve the use of land under more than one regime (Niche Innovations, Deliverable 2.1).

Below we analyse for each land use regime the status and trend for biodiversity. Important to keep in mind for this analysis is that assessing biodiversity status is complex issue. Due to its multi dimensions, several relevant indicators can be used to assess biodiversity. Depending on the indicator used, the status and trend can vary. In other words, assessing biodiversity status and trends is intrinsically dependent on the indicator chosen. Unlike with greenhouse gases, where it is possible to convert the different gases into an equivalent measure of Carbon Dioxide, no equivalence unit exists for biodiversity, which makes difficult to draw any general conclusions on the status and trends for biodiversity.

Agriculture Regime, selected biodiversity indicators:

Greenhouse gas (GHG) emissions from agriculture

The quantity of GHG emitted from the agricultural sector, between 1990 and 2011, has not changed much. During this period the impact of greenhouse gases originating from agriculture have been stable. In the future, this pattern is not expected to suffer great changes, given the moderate to strong degree of lock-in for this regime. Despite the many tensions taking place in the agriculture regime, the tendency is for farmland abandonment, especially of marginal areas, which can result in a slight decrease in the contribution of GHG emissions associated with agriculture.

Trend: Positive trend for biodiversity.

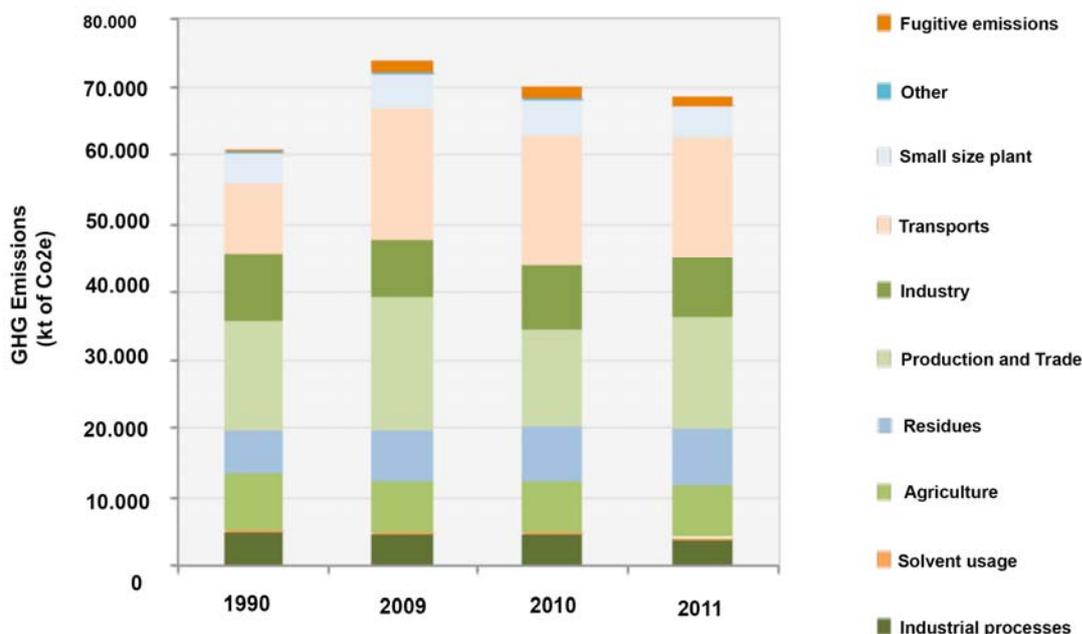


Figure 7. Evolution of greenhouse gas emitted per sector (Source: (APA 2013)).

Farmland common birds

Bird populations are recognized to act as sensors on the state of biodiversity. Since environmental policies affect land management, the Common Bird Index, per habitat (e.g. farmland, forest, etc) is used to measure the sustainability of policies and human activities that affect the relative abundance of selected species, over time.

The table below lists twenty-three common farmland bird species in Portugal and their expected population trend. The majority of agricultural common birds populations studied show to be stable. Ten out of twenty-three common farmland bird species have stable populations. Five bird species show to be increasing, three species have decreased and other five species show an unclear population trend. Overall, farmland bird species appear to be doing well (see table X).

Trend: Positive trend for biodiversity.

Scientific Name	Common Name	Index variation 2004 – 2011 (%)	Trend
<i>Bubulcus ibis</i>	Cattle egret	25	Unclear
<i>Ciconia ciconia</i>	White stork	-4	Stable
<i>Milvus migrans</i>	Black kite	-12	Unclear
<i>Falco tinnunculus</i>	Common kestrel	18	Stable
<i>Coturnix coturnix</i>	Common quail	1	Stable
<i>Athene noctua</i>	Little owl	1	Unclear
<i>Merops apiaster</i>	European bee-eater	-6	Moderate decrease

<i>Upupa epops</i>	Hoopoe	-17	Stable
<i>Galerida cristata</i>	Crested lark	65	Sharp increase
<i>Hirundo rustica</i>	Barn swallow	30	Sharp increase
<i>Delichon urbicum</i>	Common house martin	86	Sharp increase
<i>Saxicola torquata</i>	African stonechat	5	Stable
<i>Cisticola juncidis</i>	Streaked fantail warbler	-16	Stable
<i>Lanius meridionalis</i>	Southern grey shrike	-26	Moderate decrease
<i>Pica pica</i>	Eurasian magpie	107	Moderate increase
<i>Sturnus unicolor</i>	Spotless starling	15	Unclear
<i>Passer domesticus</i>	House sparrow	5	Stable
<i>Serinus serinus</i>	European serin	-20	Moderate decrease
<i>Carduelis chloris</i>	European greenfinch	-6	Stable
<i>Carduelis carduelis</i>	European goldfinch	-21	Stable
<i>Carduelis cannabina</i>	Common linnet	-22	Unclear
<i>Emberiza cirlus</i>	Cirl bunting	69	Moderate increase
<i>Emberiza calandra</i>	Corn bunting	23	Stable

Table 7. Common agricultural birds index variation (%) for the years between 2004 and 2011 for Portugal. Positive values indicate population increase and negative values population decrease. Population trend for each species was calculated through data analysis using TRIM software (Source: (SPEA 2013))

Forestry Regime, selected biodiversity indicators:

Native tree species abundance (total area and percentage)

For this analysis we classified Eucalyptus, an exotic species introduced in 1950s, to represent the greatest non-native national species. The Eucalyptus is known to be widespread nation-wide. Due to the species fast growth rate, it is in great demand by the pulp industry and represents a significant slice of the species that make up Portuguese forest (both in % and total area occupied). Eucalyptus has surpassed the native species (Figure 8 and 9) and appears to still be in expansion (Figure 8). As an invasive exotic species, the Eucalyptus does not really favour biodiversity. The expansion of Eucalyptus is hence, expected to have a negative impact on the status of biodiversity associated to forest habitat. However, the fire resilient niche innovation, which presents the highest momentum and which can be considered to be en route to breaking through, if considered on the long-run, may play a counter effect (positive) on the status of biodiversity on forest habitats.

Trend: Unclear trend for biodiversity

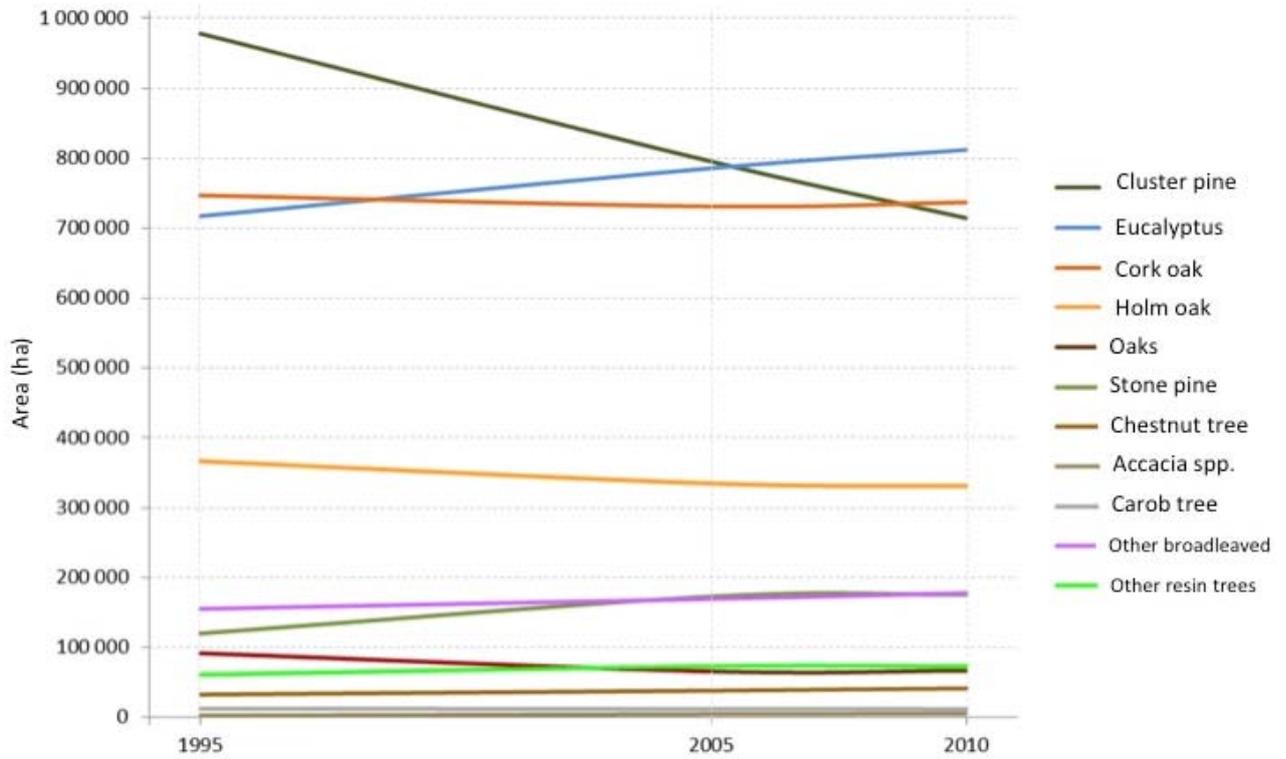


Figure 8. Historic evolution of total area occupied by tree species (Source: (ICNF 2013b)).

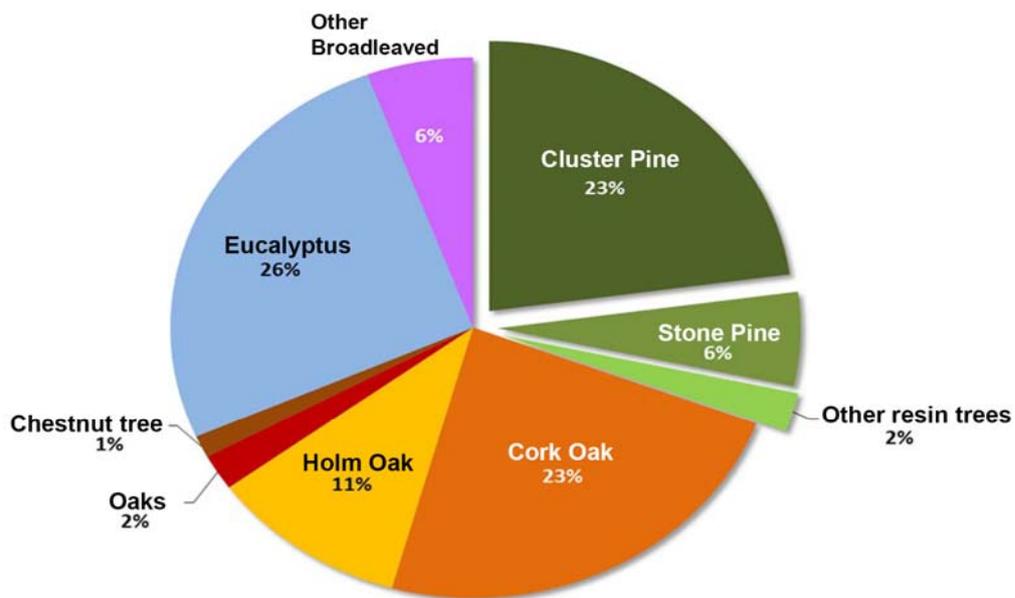


Figure 9. Distribution of total area per tree species/ group of species (Source: (ICNF 2013b)).

Forest common birds

The table below lists twenty common forest bird species in Portugal and their expected population trend. Nine out of twenty common forest bird species have stable population numbers. No sharp population oscillations have been registered since 2004 (see table X).

Trend: Positive trend for biodiversity

Scientific Name	Common Name	Index variation 2004 – 2011 (%)	Trend
<i>Columba palumbus</i>	Common wood pigeon	99	Unclear
<i>Streptopelia turtur</i>	European turtle dove	-49	Moderate decrease
<i>Cuculus canorus</i>	Common cuckoo	-3	Stable
<i>Picus viridis</i>	European green woodpecker	18	Unclear
<i>Dendrocopos major</i>	Great spotted woodpecker	4	Stable
<i>Lullula arborea</i>	Woodlark	-16	Stable
<i>Troglodytes troglodytes</i>	Eurasian wren	4	Stable
<i>Erithacus rubecula</i>	European robin	5	Stable
<i>Sylvia atricapilla</i>	Eurasian blackcap	59	Moderate increase
<i>Aegithalos caudatus</i>	Long-tail tit	0	Unclear
<i>Parus cristatus</i>	European crested tit	-29	Unclear
<i>Parus ater</i>	Coal tit	77	Unclear
<i>Parus caeruleus</i>	Eurasian blue tit	24	Moderate increase
<i>Parus major</i>	Great tit	12	Stable
<i>Sitta europaea</i>	Eurasian nuthatch	3	Unclear
<i>Certhia brachydactyla</i>	Short-toed treecreeper	-9	Stable
<i>Oriolus oriolus</i>	Eurasian golden oriole	-9	Stable
<i>Lanius senator</i>	Woodchat shrike	-38	Moderate decrease
<i>Garrulus glandarius</i>	Eurasian jay	41	Unclear
<i>Fringilla coelebs</i>	Common chaffinch	13	Stable

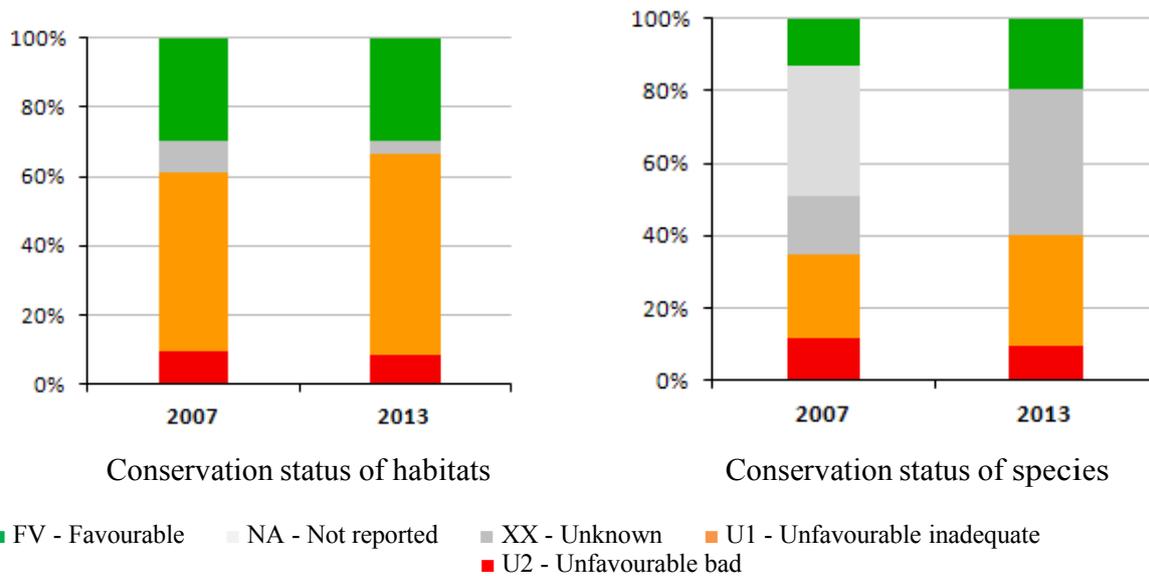
Table 8. Common forest birds index variation (%) for the years between 2004 and 2011 for Portugal. Positive values indicate population increase and negative values population decrease. Population trend for each species was calculated through data analysis using TRIM software (Source: (SPEA 2013)).

Nature Regime, selected biodiversity indicators:

Habitats and Species conservation status

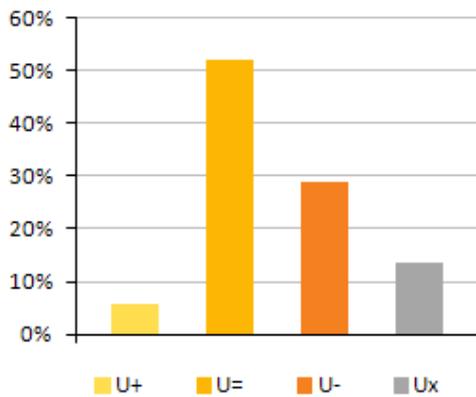
All Member States are requested by the Habitats Directive (1992) to monitor habitat types and species considered to be of Community interest. With regard to the Natura 2000 network in Portugal monitoring of the habitats and species was carried between 2007 and 2012. By the end of 2012, a total of 70 Sites of Community Importance and 51 Special Protection Areas, terrestrial and marine, had been classified for Portugal (ICNF 2014). According to the analysis below, both species and habitats of community interest have shown a small improvement in their conservation status from

2007 to 2013. There was a decrease in the percentage of habitats and species under bad unfavourable conservation status but there has been an increase in the percentage of habitats and species classified under inadequate unfavourable conservation status. Nature regime presents a weak to moderate degree of lock in, being improvements to the regime very dependent on political will and availability of financial investment. National policy is highly influenced by European policy. In general there is increasing awareness to nature related issues and actors (nature conservation is centrally governed and institutional force is well defined) have taken incremental actions to address biodiversity issues. Trend: Small improvement

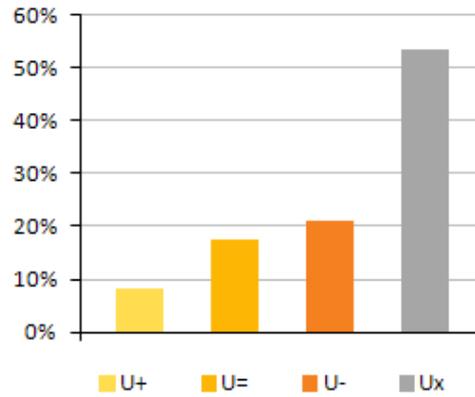


Year of assessment	HABITATS					SPECIES				
	FV	NA	XX	U1	U2	FV	NA	XX	U1	U2
2007	47		14	82	15	55	155	70	99	50
2013	46		6	91	13	83		171	131	41

Figure 10. Overall assessment of conservation status for habitats and species as requested by Article 17 of Habitats Directive (1992) for the years 2007 and 2013 (Source: (ICNF 2014)).



Habitats – overall trend in Conservation Status



Species – overall trend in Conservation Status

U (+) = unfavourable improving (inadequate and bad), U (=) = unfavourable stable,
 U (-) = unfavourable declining, U (x) = unfavourable unknown trend

Figure 11. Proportion of unfavorable assessments (U1 & U2) which are improving, deteriorating, stable or unknown (Source: (ICNF 2014)).

Urban Regime, selected biodiversity indicators

Number of urban farms in Portugal

In Portugal the area of urban allotments has been steadily increasing. PORTAU is the name of the web-site in Portugal which compiles information on urban farming initiatives. According to the web-site in mainland Portugal, 28 urban farming allotments were created by municipalities, 13 by charities, 7 by communal grass root initiatives and 12 were led by schools and other research centres. However, the information in PORTAU is not updated systematically and there is not yet an official estimate of the current area under urban farming at national level. The urban regime is a regime strongly locked-in, once built environment is built it is difficult to change. However, there is a growing demand from society for greener cities and a trend in public policies towards bringing nature to the built environment. The need to adapt cities to potential consequences of climate change has pushed urban design and planning to become more environmentally conscious.
 Trend: Slowly improving

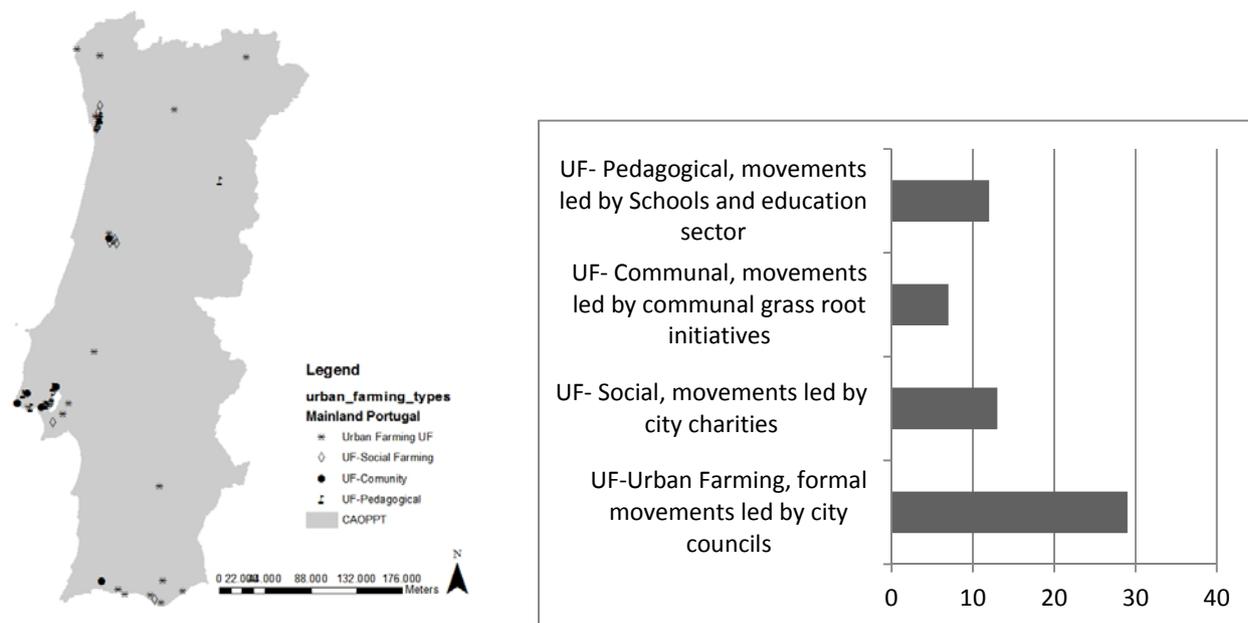


Figure 12. (Left) Types of urban farming (Right) Number of urban farms by type.

Regime	Lock-in, stabilizing forces	Cracks, tensions, problems in regime	Orientation towards environmental problems	Main socio-technical regime problems
Agriculture	Moderate/Strong	Strong	Moderate (some incremental change)	e.g. long term policy assurance, subsidy dependence, high long term investments from farmers, cultural & historical attachment to the land
Forest	Strong	Weak/ Moderate	Moderate (some incremental change)	e.g. market demand for pulp, paper and cork.
Nature	Weak/ Moderate	Moderate	Moderate (some incremental change)	e.g. need for more investments, society interest, better policy integration
Urban	Strong	Weak	Moderate (some incremental	e.g. Physical constraints, political

			change)	apathy, need for better policy integration, more investment
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Table 9: Assessment of regime trends in the land use domain in Portugal (with indicative ‘scores’)

There is very little regime re-orientation forecasted to happen in the near future. The actors of the main land use regimes continue to act in a “business as usual” modus. However, there have been small changes, instigated by external pressure, environmental problems and public discontent. Incumbent actors have demonstrated permeability to try different approaches when they are not perceived as a threat to the on-going practices. A possible reason for little real changes may be the lack financial resources and mild public debate but also, the need for more political initiative making use for example, of existing potential policy complementarity.

4. Conclusions

From the seven niche innovations identified for Portugal, the fire resilient landscape niche innovation is the niche showing the highest momentum of breaking through, it can even be said to be on route already. However, since the benefits will only be visible on the long-run, broadleaved species take about 50 years to grow, hence the perception is that no transition is happening. Also the public interest and debate has lost magnitude. This niche suffers from a time-perception constraint.

All the other niche innovations identified for Portugal land use domain present a low to medium momentum. Akin, the land use regimes show a moderate to strong degree of lock in. Overall, the land use domain is assessed to be moderately stable. At the current state of affairs, a breakthrough from the other niche innovations is thus, highly unlikely. Nonetheless, even without instability within the regimes, niche innovations will most probably continue to emerge and penetrate causing incremental disruption at the regime level. Incremental changes to address environmental challenges inside the regimes have been adopted, denoting an open attitude from the dominant regime actors to change. For example, in the niche innovation business and biodiversity, businesses voluntarily invested on concrete actions to address environmental challenges. On the other hand, in the case of the rewilding niche innovation where window of opportunity is real – present trend for abandonment of marginal agricultural land – that could potentially represent a high momentum for a breakthrough of this niche, as a result of the low economic value of such land, instead it shows a low momentum due to high political resistance and misinformation from society.

Niche innovations: biodiverse cities, business and biodiversity, ITI and biodiverse pastures are the other niches closest to reaching phase 3 are. All present a low to medium momentum and would benefit from increased financial support and more public debate. None of them requires disruptive changes to the “business as usual” operation mode but instead require for small changes only while addressing the existing, or at least some, of the tension points of the land use regimes they are associated with.

	Biod. cities	Bus. & biod.	Multif. for renewable energy	Fire resi. lands.	ITI	Rewilding	Biod. pastures
Need for increased investments?	3	3	2	3	3	1	2
Need more public debate?	2	2	1	2	3	3	1
Increased political will?	2	1	1	2	2	3	2
Better policy alignment/ support?	2	1	1	1	2	3	2
Tackles existing regimes tension points?	3	1	3	3	3	2	2
Internal momentum?	Medium to low	Medium to low	Low	Medium	Medium to low	Low	Medium to low

Table 10. Niche innovations analysis summary findings (Grading: 1 needs little; 3 needs a lot).

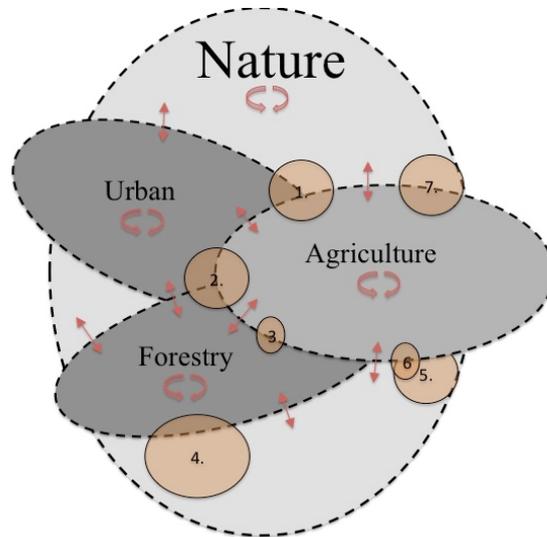


Figure 13. Conceptual illustration of niche innovations (orange circles) momentum (the bigger the size the higher the momentum) mapped to the land use regimes identified for Portugal (grey bubbles) and their respective degree of lock-in (the darker the grey the stronger the lock in). The arrows (in red) represent the dynamic changes that shape the land use domain; the circular arrows represent the intra-regimes changes while the double sided straight arrows represent the inter-regime changes.

Niche innovations: 1. Biodiverse cities; 2. Business and biodiversity; 3. Multifunctionality for renewable energy; 4. Fire resilient landscapes; 5. ITI; 6. Rewilding and 7. Biodiverse pastures.

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