

# Training on land restoration: Impact analysis on “green employment”

*Monografías do IBADER - Serie Territorio*

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DEPUTACIÓN DE LUGO

# Training on land restoration: Impact analysis on “green employment”

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## **This book is dedicated to the students of the LANDCARE project**

Thanks to the enthusiasm of the students and the great opportunity to collaborate in an international environment, we not only improved as teachers but also become better people.

Our environment faces unprecedented challenges, for which it is necessary to work together and be willing to continue learning. We are convinced that the next LANDCARE generation is ready for it.

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# Contents

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<b>Preface</b> .....	<b>11</b>
<b>Landcare Project: Summary</b> .....	<b>13</b>
<b>Description of the report</b> .....	<b>16</b>
<b>I. Land restoration in Europe, challenges and opportunities</b> .....	<b>17</b>
I.1. Land restoration, economy and employment in Southern Europe .....	17
I.2. Land restoration in Europe: Scope of the problems and needs of training and other limitations to address the restoration .....	23
I.2.1. Wildfires .....	23
I.2.2. Freshwater wetlands and aquatic ecosystems .....	27
I.2.3. Coastal restoration .....	33
I.2.4. Soil contamination .....	35
<b>II. Teaching land restoration: Current offer and needs</b> .....	<b>41</b>
II.1. Studies on land restoration in Southern Europe .....	41
II.1.1. Spain .....	41
II.1.2. Portugal .....	43
II.1.3. Italy .....	45
II.1.2. Greece .....	45
II.2. Evaluation the main needs for landcare studies: Survey on land restoration education capacities .....	47
II.2.1. Characteristics of the population interviewed .....	47
II.2.2. Main barriers hampering land restoration .....	49
II.2.3. Role of the teaching quality on land restoration .....	49
II.2.4. Quality, adequacy and availability of teaching resources .....	51
II.2.5. Network on education and training on landcare .....	52
<b>III. Improving teaching capacities in landcare</b> .....	<b>54</b>
III.1. Training teachers in the Landcare Project. Designing a virtual and personalised environment .....	55
III.2. Exchange of good practices on landcare .....	62
III.2.1. Exchange of good practices in pedagogical approaches .....	62
III.2.2. Teaching land restoration: exchange of good practices .....	65

III.3. Teaching methods, resources and materials developed during the landcare project .....	68
III.3.1. E-learning tools .....	68
III.3.2. Handbook on best practices .....	70
III.3.3. Videos .....	72
III.4. Applying and improving the resources and materials in the intensive training courses .....	75
III.4.1. Student selection .....	75
III.4.2. Teaching in the classroom .....	75
III.4.3. Practices in the laboratory and in the field .....	76
III.4.4. Students tasks and evaluation .....	76
III.5. Blended education .....	77
III.5.1. Learning about post-fire treatments in the Landcare Project .....	77
III.5.2. Teaching experience in landcare for native vegetation conservation .....	79
III.5.3. Soil contamination and decontamination in the landcare project .....	87
III.5.4. Landcare students participating in land restoration, environmental Education and marine and terrestrial monitoring projects .....	92
III.5.5. Employment and entrepreneurship .....	97
<b>IV. Impact of the landcare project .....</b>	<b>102</b>
IV.1. Impacts and quality criteria: Indicators .....	102
IV.1.1. Intellectual outputs .....	102
IV.1.2. Multiplier events .....	104
IV.1.3. Learning and teaching activities .....	105
IV.2. Impact on landcare in other organizations and sustainability of the results .....	107
IV.2.1. Multiplier events planned in the proposal .....	107
IV.2.2. Active participation as guest collaborators .....	108
IV.3. Participation in other forums .....	111
IV.3.1. Landcare in social media .....	112
IV.3.2. Landcare forever: network on education and training .....	116
IV.4. Testing the impact of the blended training on the employment skills. Survey (annex 2) .....	116
IV.5. Testing the impact of the blended training on the employment skills (annex 3) .....	121
IV.6. Testing the impact of the blended training on the employment skills. Campfire session for landcare students and collaborators .....	132
IV.6.1. Campfire session management .....	132
IV.6.2. Campfire session session results .....	133
<b>V. Conclusions .....</b>	<b>139</b>
References .....	141
<b>Annexes:</b>	
Annex 1. Survey section II.2. Evaluation the main needs for landcare studies: Survey on land restoration education capacities .....	145
Annex 2. Survey section IV.2. Testing the resources, materials and activities in the training .....	148
Annex 3. Survey section IV.3. Testing the impact of the blended training on the employment skills .....	150

# Preface

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This book is the story of a successful project, product of an international collective action driven by academics and environmental service providers in southern Europe concerned about the future of the earth or what we can call the emergency facing planet Earth. The lessons learned here should be repeated throughout the world. The document in your hands includes an evaluation of the LANDCARE project, which focused on training in the development of human skills with the aim of preventing land degradation, while simultaneously searching for ways of restoring degraded land. Loss of soil, forest fires, salinization and deforestation are all real problems that are affecting the earth and will have serious repercussions for the provision of environmental services in the near future. Ways of preparing human resources to face this emergency are urgently needed. Eco-industry, the response of science and technology to the problem of land degradation, is a fundamental pillar of the European economy and will soon also be so in the rest of the world. In the specific case of continental Europe, the market value of the eco-industry has increased to almost double that of the car industry. In addition, European companies control approximately one third of the world market of available solutions to environmental problems. All of this led a group of international experts to propose the project described in detail in this document. From an economic point of view, the size of the future market associated with land degradation and ways of attempting to re-establish the equilibrium requires strong, immediate action. Training will provide the skilled human resources that will be required in the future to tackle these environmental problems. The strength of the LANDCARE (Landcare and Land Rehabilitation in Mediterranean Environments) project, co-funded by Erasmus+ Programme of the European Union, lies in the development of an international network including eight institutions, three of which are strictly academic and the rest of which are businesses and research institutions with some interest in the topic. All of the institutions are located in southern Europe (Spain, Italy, Greece and Portugal). As indicated above, the main objective of the project was to provide quality education and specific training to young people in aspects related to the restoration of degraded land and in rehabilitation technologies. The project objectives implicitly recognise that although training includes the general causes of land degradation, more advanced training is often required to enable the students to face the demands of an emerging market, in the so-called green economy. This demand is not exclusive to southern European countries, but to all countries in Europe and throughout the world. The most interesting aspect of the LANDCARE project was the design and implementation of a series of objectives and challenges, of international interest, which has attracted the attention of the European Union. The creation of virtual training platforms, the proposal and application of teaching methods, the design of appropriate educational materials for the challenges outlined –which serve to transmit the desired knowledge in a clear, precise manner– is a model to which particular attention should be paid in order to address these and other, similar problems. The success of the project lies in the combined efforts made by a group of experts from the participating countries to

provide pilot courses aimed at teaching and improving the skills needed to deal with land degradation and land restoration. This model could be duplicated in any country in the world where the young population is increasing and where young people are facing difficulties in finding decent jobs. The project was mainly motivated by the perceived and real situation whereby many young people cannot find work on completing their formal studies. The project thus considered that these students should be given training providing them with the skills required to resolve specific problems and that that would help them to find stable work or to become entrepreneurs and create their own business and thus use their new knowledge and skill to re-establish ecosystem equilibrium and biodiversity. One of the virtues of the project is that the training was based on real case studies rather than classroom examples and was complemented by online learning and international mobility. The project findings show us that formation of groups of teachers is essential to obtaining a successful outcome. These teachers came from different educational institutions, companies and countries, and the collective teaching provided was thus enriched by their different personal experiences. The findings also show that the successful outcome depended on following two different routes: short-term training, which serves to visualize and apply the training received online, with systems such as Personalised Learning Environments (PLE), adapted to the needs of this educational project; and collective fieldwork, which reinforced the theoretical knowledge of land degradation and restoration. The pilot projects implemented were visited and studied by interested parties who travelled from various different countries and then disseminated the practices learned via the electronic platforms established by the participating universities, finally creating a network of teachers and experts on the topic. The outcome of the project is extremely positive, because it has provided access to innovative methods in the field of land degradation and restoration, enhancing language and skills, as well as preparing students to find jobs in this sector of the green economy. It is not only the students who have benefitted from the project, as universities, companies and non-governmental organizations now have available an established platform that they can consult before initiating projects in this field. Finally, the information generated can be used by decision-makers to develop scientifically-based public policies. Another important result of the project is the opportunity for researchers in other parts of the world to undertake similar projects by using the lessons learned in the present initiative as an example. As external evaluators we vote that experiences such as this project should be repeated and enriched with new available technologies.

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# Landcare Project: Summary

---

Land Degradation and Rehabilitation in Mediterranean Environments, the LANDCARE and Erasmus + project, was developed through the Strategic Partnership for Higher Education (KA203) programme. This partnership is a cooperative network aimed at providing better quality education, training and youth employment.

## **Context/background of the project**

The Mediterranean region is vulnerable to land degradation, which affects important sectors of the economy (agriculture, fishing, tourism) and the supply of vital goods (water, food). Although "actions to restore ecosystems and biodiversity have significant potential to create new skills, jobs and business opportunities" ((ED 2011/2307(INI))), there is a considerable shortage of skilled workers in this field due to the lack of proper training. This is especially important in Southern Europe, where youth unemployment is extremely high.

## **Objective of the project**

The overall objective of LANDCARE was to improve training capacities in relation to Land Degradation and Rehabilitation (LD&R) in Southern Europe, in order to fulfil the demands of an emerging labour market and contribute to the green economy.

LD&R is a field that requires training involving real study cases and hands-on experience. For this reason, the educational path proposed in the project combined short-term international mobility and innovative online learning: Personal Learning Editions (PLEs) and Small Private Online Courses (SPOCs).

The project attempted to recover skilled unemployed people to encourage employability in the sector. Employability skills were enhanced by means of personalized training and hands-on practices. To increase the scope of this strategy, the project reinforced interactions between students, educators, researchers, companies/agencies/NGOs and decision-makers.

## **Number and profile of participants**

The consortium consisted of 8 partners from Spain, Greece, Portugal and Italy. The four academic partners comprise educators/researchers with recognized expertise in LD&R and project management. The partners also have university entrepreneurship abilities. The four professional partners include Small and medium Enterprises-SMEs, an NGO and decision-

makers. The professional partners complemented the training and also increased the scope of the project outcomes. The coordinator (USC) is the academic partner with the strongest structures in place for virtual learning, employment and Quality Assurance.

### **Description of activities**

The main activities focused on training both staff (from academic and professional partners) and students (High Education Institutions-HEI, company staff and selected unemployed people). Teacher training included a) intensive training in innovative online learning tools (PLE, SPOCs) and b) short-term, joint events to reinforce training capacities in LD&R.

The student training was based on two types of blended mobility. The concepts of LD&R were taught by means of an intensive study programme, involving mobility and flexible online training (PLE, SPOC). Practical experience and employment skills were provided by means of an internship programme combined with solid online and personalized training in employment and entrepreneurship. The trainees included HEI students, staff of companies involved in LD&R and selected unemployed people.

As expected, certain teaching outputs of the project had strong multiplier effects: the virtual platform, the development of blended mobility to enhance employability in the "Green Economy", publication of the first handbook linking Land Restoration and employability opportunities and launch of a peer teaching network. The main multiplier social effect was the enhancement of the green economy to create jobs.

### **Methods used in carrying out the project**

The project was divided in four main logistical phases:

1. Stock-taking of good practice and evaluation of available materials and resources for LD&R training.
2. Collection and production of materials and case studies for the interactive courses.
3. Implementation of a pilot project. The trainees travelled from the home institutions to attend training sessions and also used the online learning tools.
4. Dissemination/multiplier events towards outcomes, at three levels: a) dissemination of good practice by all participants, b) interactive courses and an electronic platform involving universities, social media and alumni and c) launch of a LD&R network with peer teachers and experts.

### **Short description of the results and envisaged impact**

The impacts at individual levels include access to innovative methods and techniques in LD&R, improvement of language and digital skills and increased employability of the workforce. At organizational levels, the companies/agencies/NGO have benefitted from access to knowledge and special facilities and increased supply of skilled workers. University structures involving online learning and employment have also been reinforced. Help has been provided to decision-makers to solve certain environmental cross-border challenges.

## **Sustainability**

The project outcomes are expected to be maintained after the project as a result of the effects on the institutions (staff training, reinforcement of QA schemes and virtual and employment structures). They will also support environmental policies, such "Our life insurance" (ED 2011/2307(INI)) or the "Green Employment Initiative".

### **Project web page:**

<http://landcare.es> (<http://www.ibader.gal/seccion/454/Landcare-Background.html>)

### **Presentation of the Landcare project:**

<https://youtu.be/P9HbCYEh2VQ>

### **News and activities carried out:**

<https://www.facebook.com/landcareproject>

### **Multiplier event in Lisbon (October, 2017):**

<https://www.isa.ulisboa.pt/vida-no-isa/destaques/eventos-internos/20171026-training-in-land-degradation-and-rehabilitation>

### **Multiplier event in Santiago de Compostela (July, 2018):**

<http://www.landcareforfuture.com/>

### **Youtube channel:**

<https://www.youtube.com/channel/UCprzqDSEKrGiYkyzTh7DZdQ/videos>

# Description of the report

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The present report assesses the impact of the LANDCARE Project on the training capacities and the employability within the field of land degradation and restoration.

Throughout the project, different good practices have been developed and implemented to improve the training capacities on land degradation and restoration. This report documents the design, implementation, results and impact of a number of goals of Landcare such as improved internationalization, construction of a flexible virtual training platform, development of interactive teaching methods, creation of innovative teaching materials, incorporation of employment as part of the syllabus, and engagement of professional partners in the training. These goals have been emphasized in the different activities throughout the project, particularly in the pilot courses.

The present assessment investigates the impact of these innovative teaching practices and the role of technological tools to complement updated training. Another aspect considered and discussed in this report is the impact of this type of training to enhance employability skills.

The success of these activities and blended mobility was measured on the basis of different criteria and using relevant indicators. Aspects such as the way learners react to their experience of the course or the new knowledge, skills and attitudes gained from the course have been assessed.



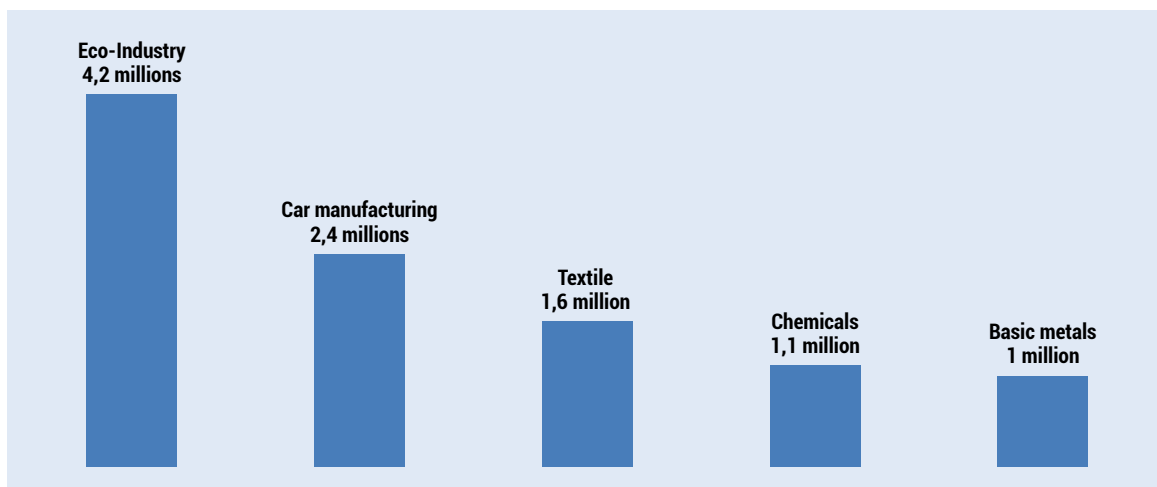
# Land restoration in Europe, challenges and opportunities

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## I.1. Land restoration, economy and employment in Southern Europe

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According to 2013 data, it can be affirmed that the eco-industry is, and will increasingly become, one of the main pillars of the European economy. Based on these figures, it was estimated that the eco-industry employed around 4.2 million workers in Europe with a turnover of more than EUR 700 billion (European Commission, 2016a) with an expected growing trend for the following years (Figure 1).

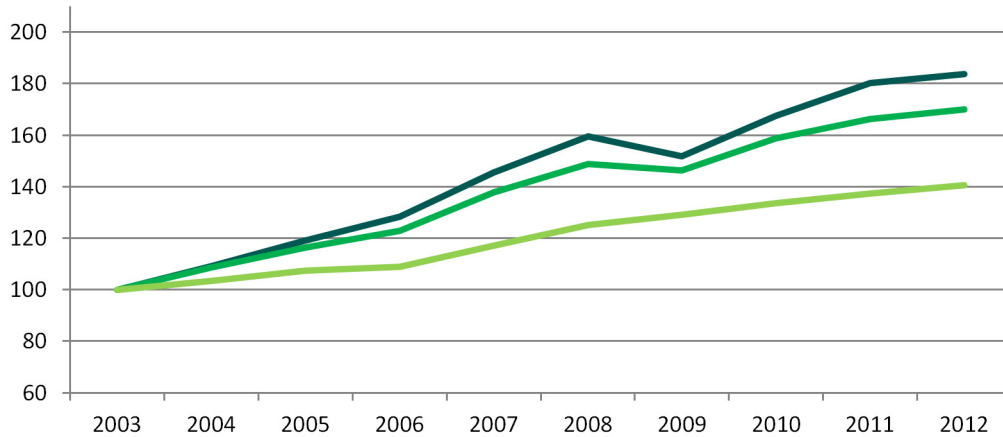


**Figure 1.** Employment in the EU, 2014 (Source: Eurostat, Structural Business Statistics and Environmental Goods and Service Sector).

As stated in the latest report, State Report and Environmental Perspectives of Europe (SOER), the green industries sector continues to increase its activity in Europe with very high growth rates close to 50%. According to this same report "European companies now claim about a third of the world market for environmental protection solutions." If we also consider the 2020 strategy of the EU, this means that the forecast of growth in employment in the environmental sector will be maintained, at least for the next few years, creating a great variety of new jobs.

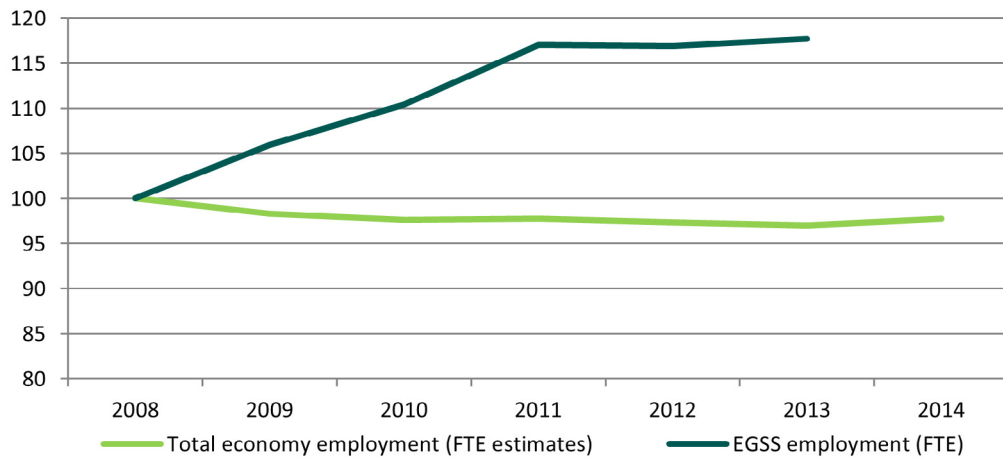
In order to verify this trend, we can look back to analyse the time series of the main issues of the environmental sector. In the next figure time series of output, employment, gross value added related to the environmental sector are presented (EC, 2016b).

We can see that both output, gross value added, and employment have followed a positive and continued trend in the analysed 10 years, with a slight recession in 2009, at the worst moment of the economic crisis that affected all of Europe (Figure 2).



**Figure 2.** Evolution of Environmental Goods and Service Sector characteristics EU 28 (index=100 in 2003). Source: Eurostat database env\_ac\_egss3.

If we look more in detail, regarding employment and comparing it with the values of the economy, we can see that, despite the reduction of employment in the economy in general with respect to 2008, employment in the sector of EGSS-Environmental Goods and Service Sector has had an important growth from 2008 to 2011 and has remained in recent years (Figure 3).



**Figure 3.** Evolution of EGSS- Environmental Goods and Services employment compared to employment in the total economy (EU28) (index=100 in 2008). Source: produced from Eurostat databases.

One of the main problems, dealing with specific data related to environmental employment is how to establish the limits of what is considered environmental employment and what is not. In the handbook Environmental goods and services sector accounts (EC, 2016b) all the definitions and the guidelines to establish these specific aspects, which include the NACE activities that have been incorporated in the case of the EGSS, can be found. However, it continues to be a problem of difficult statistical consideration, because from a practical

point of view, many activities that are considered as activities of environmental production or provision of environmental services, are excluded from this scope. In any case, this detail would lead us to conclude that the data obtained can be considered as a lower limit and certainly, the real data could be even greater.

If we try to deepen the environmental accounts and we focus on the aspects that refer to protection and environmental restoration we will find some problems. Although at the conceptual level these terms are well defined, as in the previous case, it is difficult in practice to include all those activities that actually have that purpose. It would be even harder to establish the part of this environmental employment destined specifically for land restoration.

However, although at this level it is not possible to make precise calculations of employment for each of the environmental protection activities, we can have an estimate idea of the importance of these activities considering the expenses they imply in relation to GDP. In relation to this point, we could consider the expenditure made by the government, companies or domestic economies of each country (Figure 4). However we will focus on the expenditure made by governments as a representative indicator of the rest of the considered sectors. This is because part of the data, especially those based on the expenditure of companies and domestic sector are not available for all countries, so the aggregate data would not serve as an accurate indicator for the analysis.

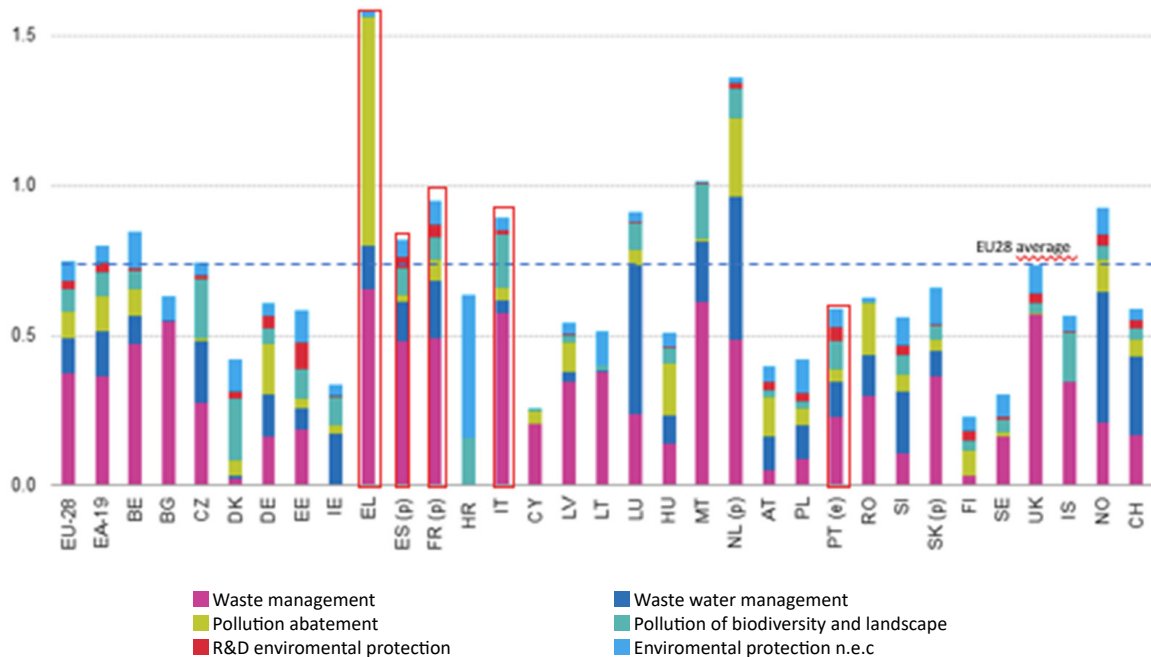


Figure 4. Total general government expenditure on environmental protection, 2016 (% of GDP). Source: Eurostat.

Based on the latest data obtained in 2016, next figure shows the percentages of the expenditure of each of the governments of the member countries of the EU in each of the environmental protection activities. It should be noted, in this sense, that the countries of southern Europe are above the EU28 average, with the exception of Portugal, and it is very significant in the case of Greece which obtains the highest GDP percentage of the entire EU28.

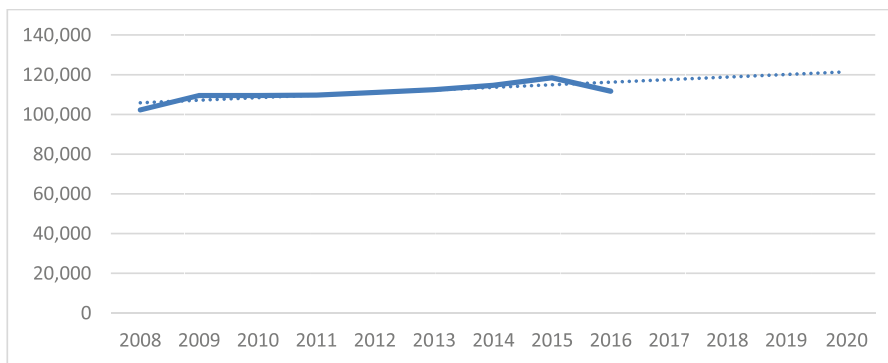
This, at first, means that the governments of southern Europe are making a great effort in terms of environmental protection activities. But as in the previous case, it is necessary to know the trends of this expenditure in recent years, to try to determine to what extent this can contribute to the creation of environmental protection employment.

**Table 1.** Total general government expenditure in Environmental protection EU28 (million €). Source: Eurostat

GEO/TIME	2008	2009	2010	2011	2012	2013	2014	2015	2016
European Union (current composition)	102.251,2	109.499,2	109.520,4	109.711,1	111.043,0	112.470,1	114.673,3	118.437,6	111.703,7
Austria	1.350,2	1.576,9	1.693,0	1.504,7	1.528,4	1.457,2	1.512,9	1.377,5	1.410,2
Belgium	2.856,5	3.233,0	3.683,5	4.463,4	4.605,5	4.650,9	4.019,2	3.520,2	3.583,3
Bulgaria	252,1	410,8	254,6	284,0	289,1	384,4	295,2	357,7	304,8
Croatia	173,0	176,1	166,4	153,3	166,7	185,5	161,5	256,6	295,7
Cyprus	51,5	54,6	58,3	60,6	54,1	81,0	45,8	62,8	46,3
Czech Republic	1.464,9	1.018,3	1.551,9	2.104,0	2.139,0	1.596,1	1.628,9	1.831,4	1.313,2
Denmark	1.100,2	1.019,0	1.000,0	950,7	1.018,0	1.224,2	1.233,6	1.154,0	1.168,7
Estonia	173,3	139,3	-23,4	-47,0	148,4	116,9	122,7	141,4	123,1
Finland	594,0	619,0	520,0	480,0	496,0	522,0	521,0	499,0	499,0
France	17.796,0	19.207,0	19.833,0	20.406,0	21.009,0	21.651,0	21.995,0	21.984,0	21.168,0
Germany (until 1990 former territory of the FRG)	13.098,0	17.729,0	15.479,0	15.796,0	16.569,0	17.376,0	17.744,0	17.975,0	19.185,0
Greece	2.199,0	2.087,0	1.748,0	1.749,0	2.114,0	3.079,0	2.629,0	2.538,0	2.752,0
Hungary	693,8	532,5	578,8	722,9	690,3	927,9	1.229,2	1.342,2	578,6
Ireland	2.137,0	1.859,7	1.620,3	1.243,3	1.243,2	1.010,7	987,1	894,8	927,0
Italy	13.235,0	13.868,0	13.796,0	14.455,0	14.575,0	15.518,0	15.262,0	15.685,0	15.027,0
Latvia	201,5	34,8	53,1	137,9	160,6	151,7	160,5	161,8	134,7
Lithuania	274,9	319,2	375,9	232,1	269,5	163,8	205,5	201,3	186,2
Luxembourg	432,6	475,4	460,7	469,9	500,0	470,5	494,8	514,1	483,3
Malta	94,3	96,4	128,3	87,5	100,9	104,4	126,3	187,4	101,0
Netherlands	9.928,0	10.546,0	10.286,0	10.295,0	10.073,0	10.076,0	9.770,0	10.412,0	9.571,0
Poland	2.402,3	2.231,0	2.669,8	2.620,0	2.288,3	2.461,7	2.541,8	2.586,5	1.794,2
Portugal	1.144,2	1.050,5	1.263,3	1.209,4	1.021,9	1.094,4	987,3	1.143,4	1.090,4
Romania	702,4	689,1	963,4	1.240,8	1.103,4	1.159,4	1.193,4	1.599,8	1.064,0
Slovakia	521,1	619,0	604,5	547,7	603,7	594,5	640,6	783,4	534,5
Slovenia	293,7	321,6	242,1	293,5	275,0	272,6	365,3	390,4	226,1
Spain	10.884,0	11.518,0	11.358,0	10.174,0	9.302,0	8.621,0	9.096,0	9.307,0	9.163,0
Sweden	1.176,2	1.085,8	1.208,4	1.319,2	1.429,8	1.445,2	1.337,8	1.303,3	1.419,7
United Kingdom	17.021,7	16.982,1	17.947,4	16.758,1	17.269,1	16.074,0	18.367,0	20.227,6	17.553,8

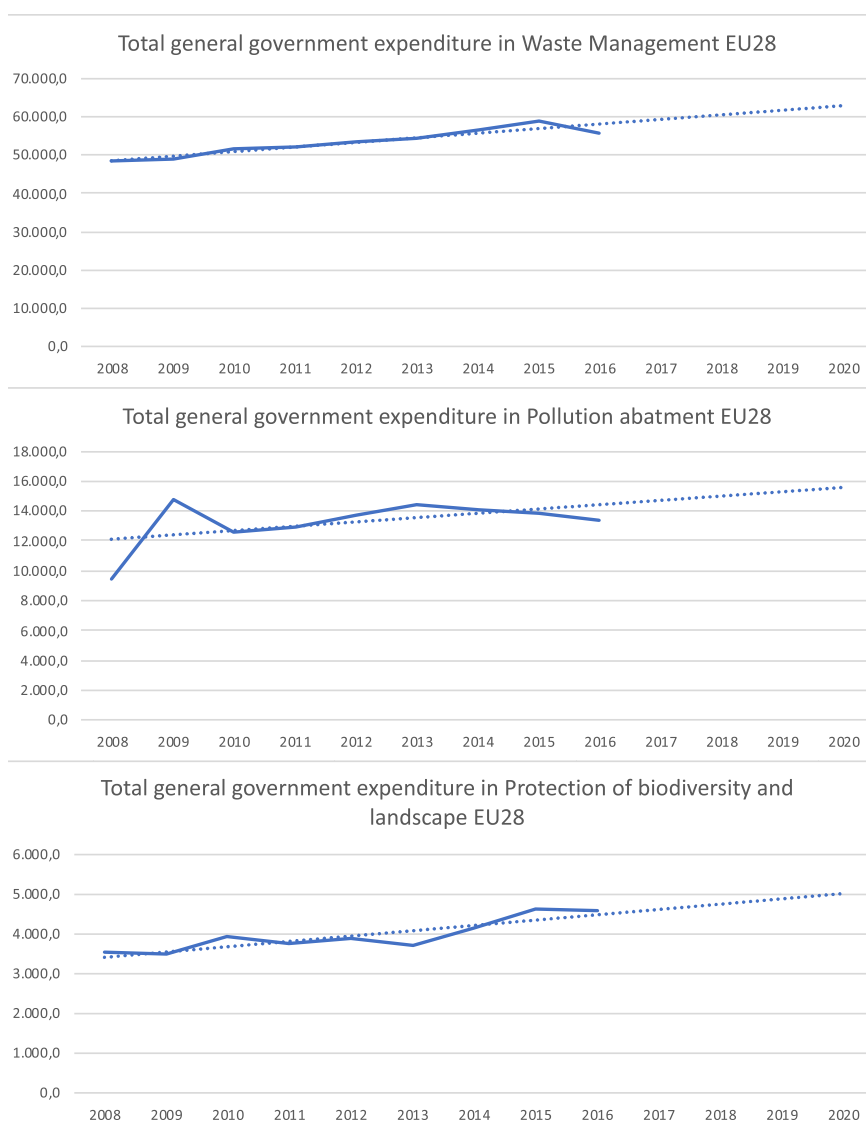
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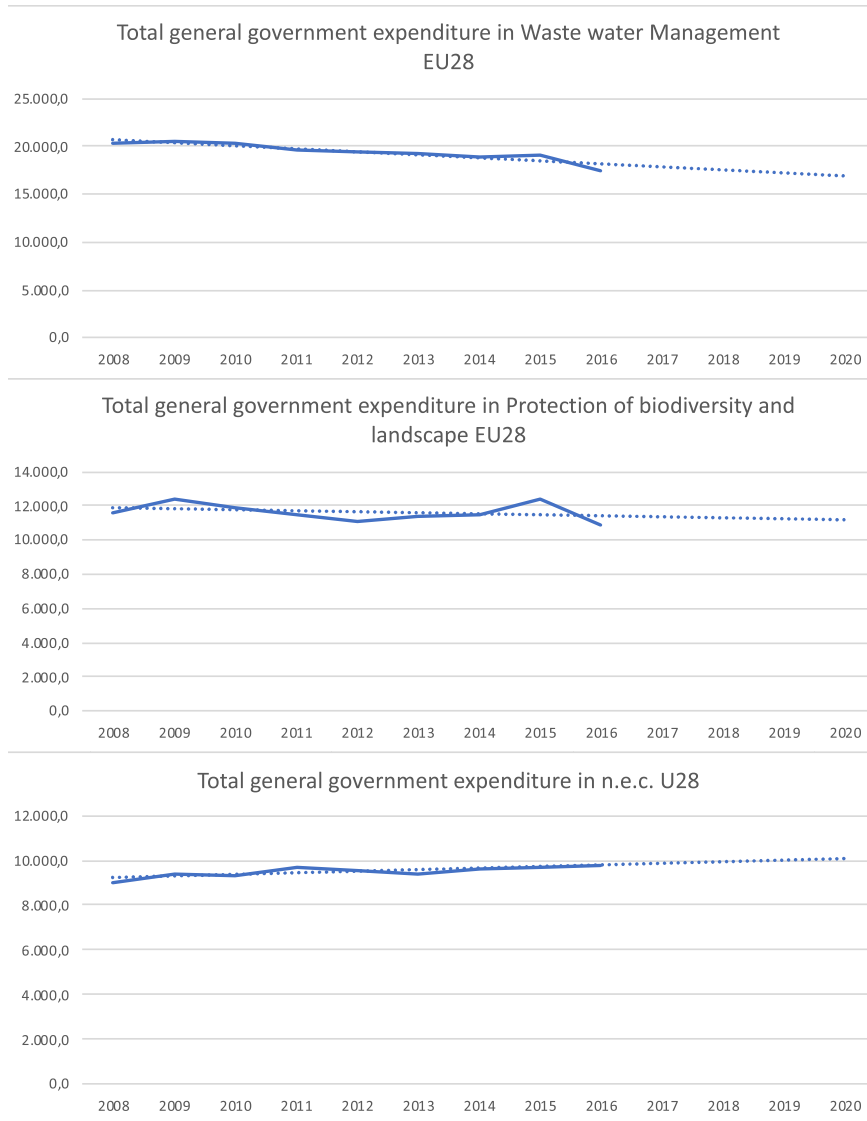
According to this data, it can be observed that, at a general level, there is a tendency for the next few years of a slight increase in environmental protection expenditures (Figure 5). The data differ by country, but based on the possible mobility between countries, it is assumed that, associated with this growth, there could be also an increase in the number of jobs related to environmental protection.



**Figure 5.** Total general government expenditure in Environmental protection EU28. Source: Eurostat.

It could also be interesting to analyse the evolution of national expenditure on the different activities according to CEPA that are shown below (Figure 6): waste management, waste water management, pollution abatement, protection of biodiversity and landscape, R&D activities and n.e.c. (not elsewhere classified).





**Figure 6.** Government expenditure in Environmental protection by CEPA and CReMA classification UE28. Source: Eurostat.

In general terms, there is a growing tendency in all the activities, except waste water management, made by the governments of the different countries of the EU. Although specific landcare activities are not specified, at least this type of data can serve as a reference to consider that there will be an increase in demand of jobs related to this sector in the next few years.

## I.2. Land restoration in Europe: Scope of the problems and needs of training and other limitations to address the restoration

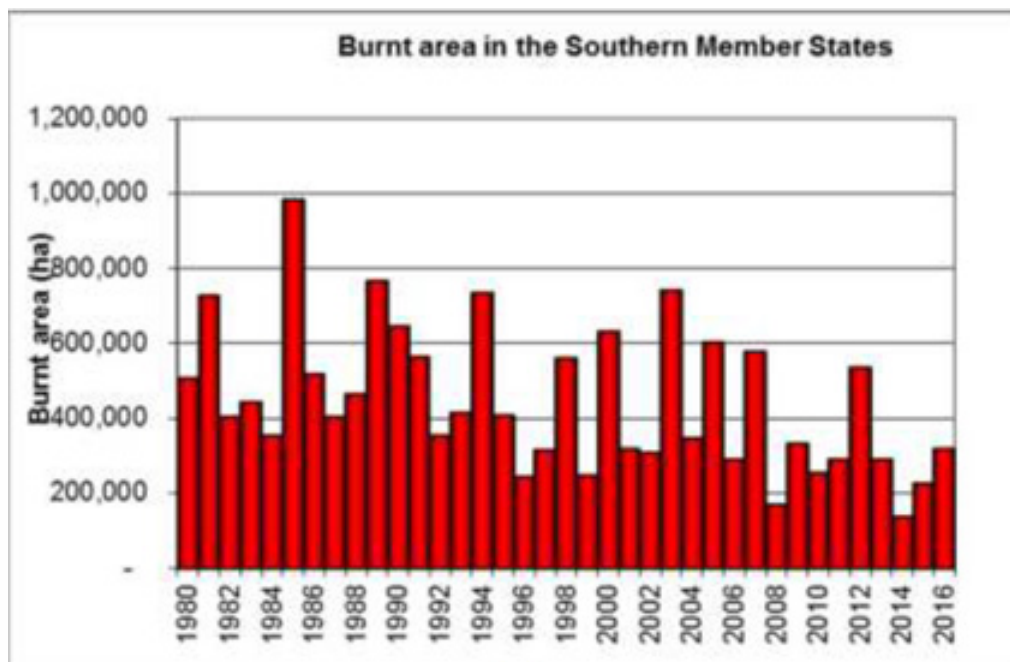
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### I.2.1. Wildfires

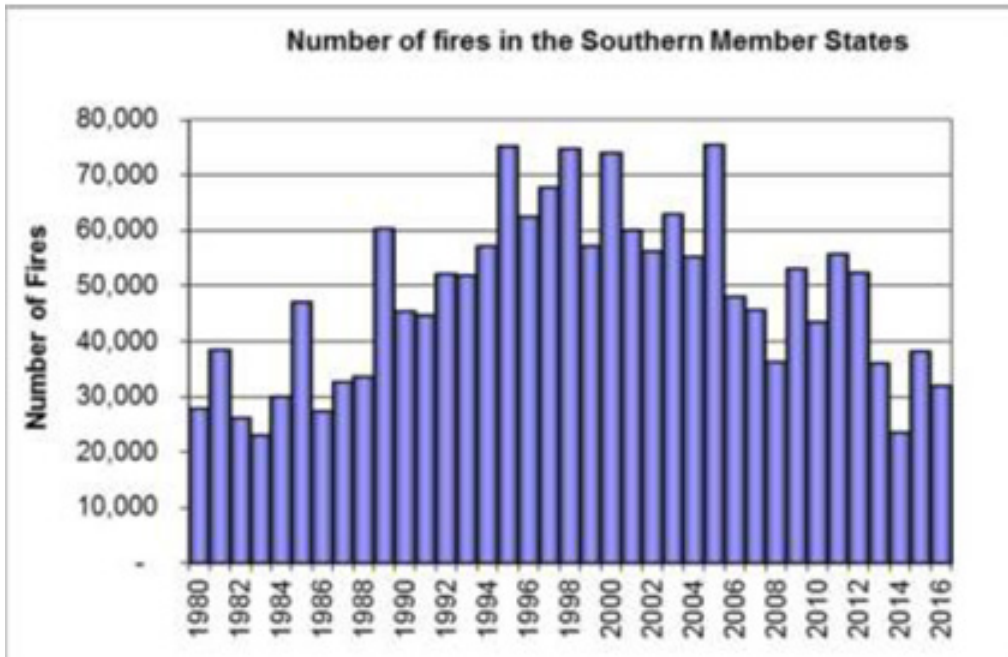
#### Scope of the problem in Europe (Summary)

Forest fires have always been a disaster that many European countries have to cope with especially during the summer season. Southern Europe is one of the regions more affected by wildfires in the Earth (Figures 6 and 7). This causes very important damages in the environment, rural development and different sectors of the society and economy (Thomas et al. 2015; Doerr and Santin, 2016). At global scale, in the period 1900-2014 the number of people killed due to wildfire was 3753 and injured, 6812 (EM-DAT, 2015). The annual records of economic damage, considering damage to the property, crops and livestock, in the period 1987-2014 range from 4 to 12318 million of Euros (annual average 2306 million of Euros). Other damages not included in this estimation are, human losses, injuries and longer-term health implications. The fire suppression costs are not either considered in these figures. In Greece, France, Italy, Portugal and Spain together invest €2500 million each year in fire management, being most of the budget dedicated to fire detection and suppression. However, the investment to restore damages in the environment is very low. In addition to these direct impacts on people losses and economy, fires also have other remarkable effects through indirect impacts. Post-fire environmental effects such as flooding, soil erosion, mass movement and degradation of waters are considered the most costly impacts.

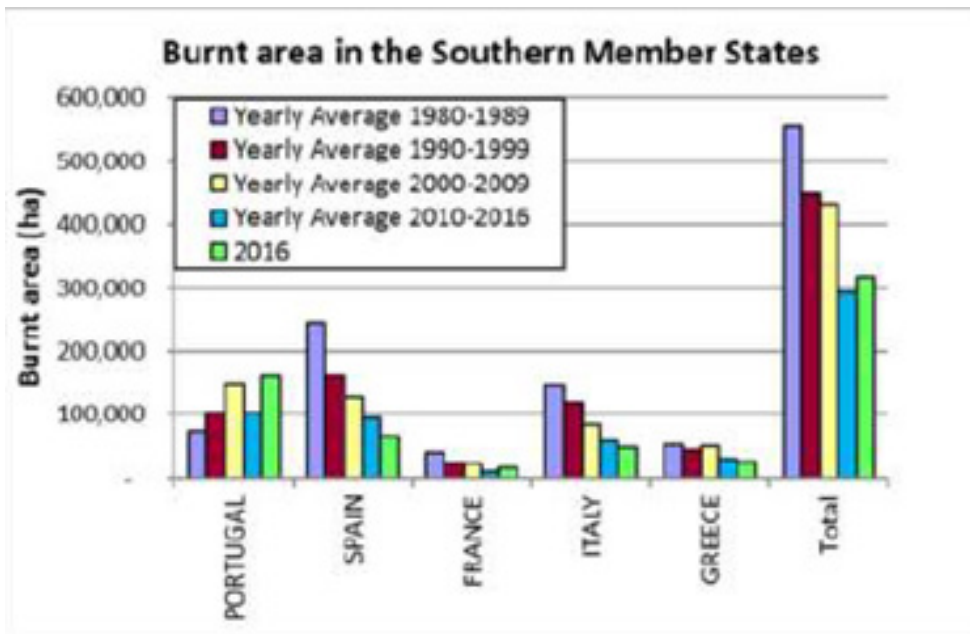
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(a)



**Figure 6.** Burnt area (a) and number of fires (b) in the five Southern Member States for the last 37 years. (Source: San-Miguel-Ayanz et al., 2017).



**Figure 7.** Burnt areas in the five Southern Member States in the year 2016 as compared with average values for previous decades (Source: San-Miguel-Ayanz et al., 2017).

## Main limitations to implement the restoration of burnt areas in Southern Europe

### *Knowledge available (very short summary)*

In general, three types of responses can be distinguished aiming to mitigate adverse effects after a wildfire: a) emergency stabilization, which are carried out within one year after a wildland fire to immediately stabilize and prevent unacceptable degradation, b) rehabilitation tasks, which can follow one to three years after wildfire in order to repair critical damages and to accelerate the recovery of ecosystem functions and c) post-fire restoration, which involves planned long term actions aimed to recover the functions, services and productivity of the ecosystems. The BAER program, developed by USDA and USDI (Napper, 2006; Robichaud et al., 2014), addresses emergency stabilization policies and procedures following wildfires. The decision of where and when to carry out this type of action requires an assessment of the severity of the fire, the climate, the soils, the topography, the watershed and the resources that are at risk of being damaged (Napper et al., 2006). Costs and efficiency of treatment developed in this guide have been evaluated in different areas (e.g. Moreira and Vallejo et al., 2009; Robichaud et al., 2014; Vega et al., 2013). After monitoring of effectiveness and costs for 37 yr of different treatments, straw mulching has been found to be quite effective at reducing post-fire erosion (Figure 8).

25



**Figure 8.** Application of straw mulching by helicopter in NW Spain, considered the most effective emergency technique for soil conservation.

Different approaches to assess the vulnerability to wildfire have been developed, which consider socio-economic aspects or environmental impacts (Oliveira et al., 2018). However, the evaluation of post-fire vulnerability of the environment to assess the implementation of emergency response after wildfire requires more efforts (Duguy et al., 2012).

### *Land restoration in burnt areas in Southern Europe*

The different National Laws of the Southern European countries highlight the need to take hydrological-forest restoration measures in forest areas affected by fires. To carry out these measures the development of contingency plans, which plan a series of urgent actions after the fire is required. In certain countries such as Canada and United States the plans for soil and water protection after wildfire have been established decades ago but, and therefore implementation of the emergency stabilization treatments is general (Robichaud et al., 2004; Vega et al, 2018). In Europe however the implementation of these techniques is still incipient.

In Southern Europe, some regions are at this moment developing planning guides for urgent actions against erosion in burned forest areas. Some examples are the guides published for Northern Spain (Vega et al., 2013) and in semiarid areas (Alloza et al 2013), and managers are beginning to apply them in the field.

In spite of all these technological advances, a review of the literature (including grey literature) shows that most European countries still do not apply any emergency actions to preserve the soil and waters after wildfire (Vega et al., 2018). Most of the countries only carry out assessments of the severity of the fire and the damages in infrastructures. The greatest investments are carried out in the most inhabited areas, threatened by water deterioration, flooding and debris flow. However, in the regions with less population soil protection measures are not usually carried out. This is the case, for example, of remote area, such as Greek islands or mountainous abandoned landscapes.

In addition, in many cases up-to-date knowledge on the topic are not usually employed. Or the agencies responsible for post-fire emergency actions are often investing less than is required for successful outcomes.

26

#### *Some proposals to encourage land restoration of burnt areas*

An important factor limiting the restoration of burnt area is the high costs of the actions. The application of post-fire urgent actions in severely affected areas is around range between 3000 and 9000 € ha, and therefore its implementation depends on external factors, such as economic situation, budgetary fluctuations or the lack of consistent policies (Vega et al., 2018). Although the costs of restoration are much lower than other investments, in many cases the society not always understand it is whole justified in terms of cost/benefit (GAO, 2003; Vega et al., 2018). The society is not aware that the treatment costs are lower than the value-at-risk (Robichaud et al., 2014). In addition, dependency of these measures form administrative bureaucracy is an additional difficulty to carry out an efficient investment.

To try to solve this situation, improving training of the new generation of environmentalists (foresters, biologist..) will be essential to adopt the most updated knowledge about the techniques and procedures. As it is shown in the next chapter, only few universities offer appropriate teaching on land restoration after wildfires.

Improved communication and awareness by stakeholders is necessary. In fact, the restoration of burn areas is only effective with the participation in the decision-making process of the population affected and other stakeholders (Paveglio et al., 2018). Communication between managers and researchers will help to transfer the updated knowledge increasing the effectiveness of the investment in the restoration of burnt areas and promoting self-protection measures. In addition, the engagement of communities and volunteering not only can help to reduce the state costs, but also will improve the public awareness about the effects of wildfires on the environment and rural development.

Although technical preventive measures are absolutely necessary, it was found that one of the preventive measures with the greatest future is environmental education, especially at the child-juvenile age (Ballard, 2012).

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## 1.2.2. Freshwater wetlands and aquatic ecosystems

### Scope of the problem in Europe (summary)

Wetland ecosystems are hotspots for ecological restoration because of the disproportionately high value and diversity of the ecological functions and services which they support and their high level of vulnerability to anthropogenic pressures, including climate change. The Ramsar Convention (1971), recognizes a diversity of types of wetlands, including all lakes and rivers, underground aquifers, swamps and marshes, wet grasslands, peatlands, oases, estuaries, deltas and tidal flats, mangroves and other coastal areas, coral reefs, and all human-made sites such as fish ponds, rice paddies, reservoirs and salt pans (Ramsar 2009). This report section focuses on open freshwater inland wetlands such as rivers and lakes, and non-open inland freshwater wetlands. In spite of their importance, freshwater ecosystems have suffered intense and long-lasting human pressures since water is one of the most essential natural resources. Until the 1970's, the drainage and destruction of wetlands were accepted practices around the world and even encouraged by specific government policies (Mitsch & Gosselink 2015). The extent of the world's wetlands is now thought to be from 7 to 10 million km<sup>2</sup>, or about 5 to 8 percent of the land surface of Earth. The loss of wetlands is difficult to determine, but estimates suggest that more than 80% of wetlands area has been lost in Europe (Verhoeven 2014).

27

Among major pressures transforming freshwater ecosystems we could cite widespread land cover change, urbanization, industrialization and engineering schemes such as reservoirs, water diversion, groundwater pumping, irrigation and inter-basin transfers that maximize human access to water (Vörösmarty et al. 2010). In the 20th century, >70% of largest rivers in the Northern hemisphere have been strongly or moderately affected by regulation, water diversion or irrigation (Dynesius & Nilsson 1994) and this situation is aggravating worldwide. These multiple changes have modified natural processes and fragmented the aquatic landscape, increasing the ecosystem vulnerability to the additional stresses associated with climate change. In the Mediterranean region, human activities have impacted wetlands more than their counterparts in more humid regions because of the severe competition for water that occurs in Mediterranean-climate regions (Gasith & Resh 1999). This makes conservation, sustainable management and restoration of freshwater and riparian ecosystems a major challenge for this century.

### Main limitations for restoration

#### *Knowledge available (very short summary)*

The effectiveness and predictability of stream and wetland ecosystem restoration improves with an increased understanding of the physical and ecological processes by which ecosystems develop and are maintained (Lake et al 2007, Mitsch and Gosselink 2015). Scientific evidence increasingly gives support to process-based principles that ensure ecological restoration will be guided towards sustainable actions, such as: (1) restoration actions should address the root causes of degradation, (2) actions must be consistent with the physical and biological potential of the site, (3) actions should be at a scale commensurate with environmental problems, and (4) actions should have clearly articulated expected outcomes for ecosystem dynamics (Beechie et al 2010). However, conventional approaches

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are frequently too narrow in focus – spatially, temporally, ecologically and socially – to adequately or equitably address the goals to which they aspire (Capon and Petit, 2018). Indeed, recent literature reviews (Gonzalez et al 2015, Jones et al 2018), revealed limitations on the effectiveness of ecosystem restoration in real-world application. Jones et al 2018 point out that while wetlands and rivers display a relatively good response to restoration measures in relation to other ecosystem types, the final stages of recovery are the most challenging to achieve. In Europe, major constraints to restoration are evidenced for wetlands located in areas with a long-term legacy of human occupation and anthropogenic pressures, as shown in Gonzalez et al 2015 review. This review also revealed noteworthy limitations in the spatio-temporal approaches chosen for evaluation of restoration. Evaluations were mostly from one single project and frequently ignored the multidimensional nature of fluvial systems: landscape spatial patterns were rarely assessed, and most projects were only evaluated locally. Monitoring rarely lasted for more than six years and the projects evaluated were usually not more than six years old.

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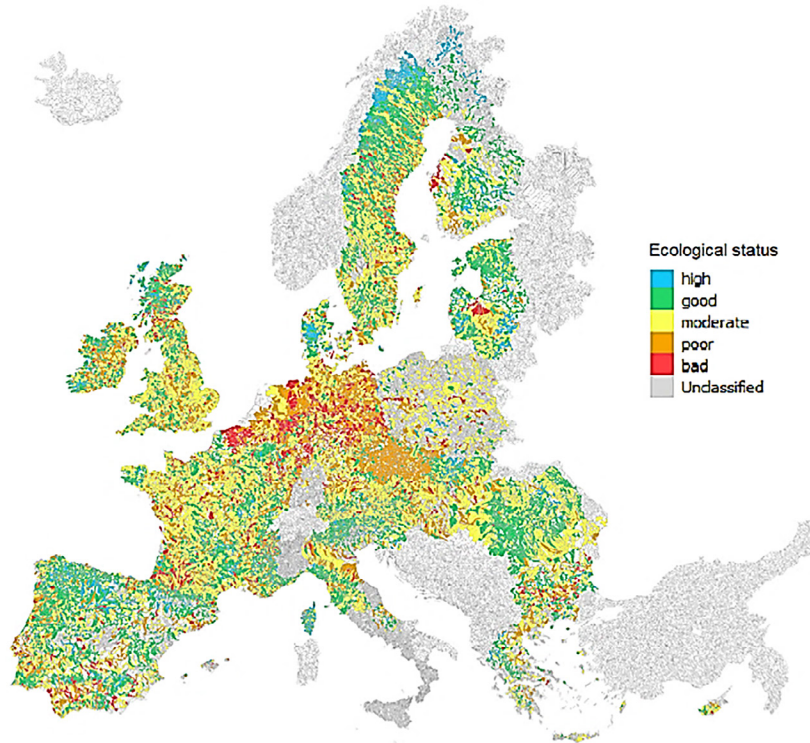
### *Restoration of freshwater wetlands and aquatic ecosystems in Europe*

In European countries, recent directives such as the Water Framework Directive (WFD) (2000/60/EC 23 October 2000), the Flood Directive (2007/60/EC 23 October 2007) and the Pesticide Directive (2009/128/EC 21 October 2009) explicitly require the Member States to produce integrated river basin management plans (RBMPs) which shall include programs of restoration measures to prevent further deterioration and ameliorate the ecological status of their water bodies and river ecosystems. In particular, the WFD, was issued with the purpose of establishing a new framework for the assessment, management, protection and improvement of the quality of water resources across the EU (inland surface waters, transitional waters, coastal waters and groundwater). In addition, some countries have developed national scale policies to fulfill the WFD requirements, (see for example, Spain, developed in 2006 a National Strategy for River Restoration, Gonzalez del Tánago et al 2012). However, after two updates of River Basin Management Plans (RBMP), namely in 1999 and 2015, country reports showed that a substantial proportion of Europe's freshwaters did not achieve the 'good status' as shown in the latest report European Waters: Assessment of Status and Pressures 2018 (Figures 9 and 10).

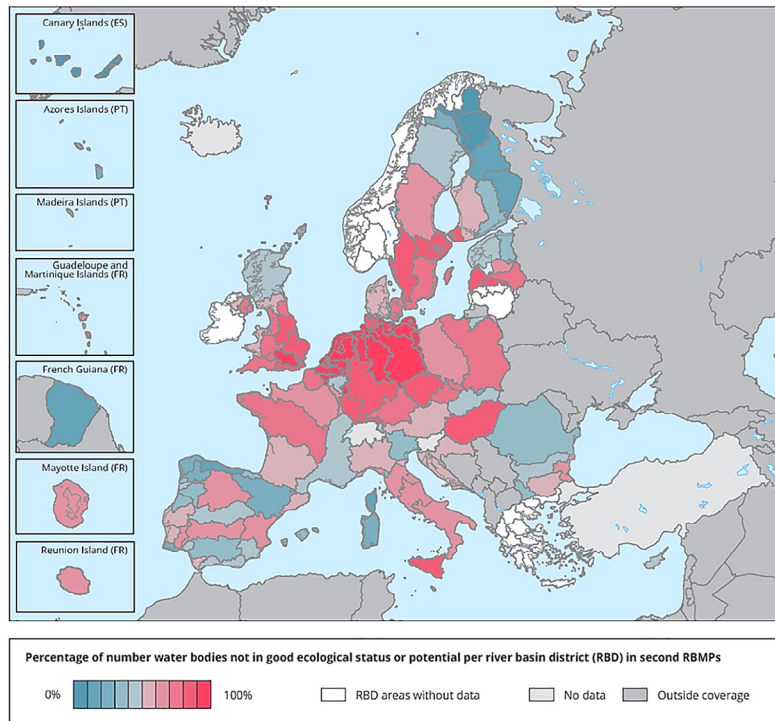
In addition to their intrinsic ecological complexity and dynamics, one key challenge for the improvement of freshwater ecosystem status is the fact that they are subject to multiple stressors often with interacting and synergistic effects. The figure 11 illustrates the proportion of water bodies affected by main pressures, detailed point source, diffuse source and hydromorphological pressures. Among the hydromorphological pressures, dams and alterations in channel and riparian areas are widespread. Also, a high proportion of water bodies is affected by urban wastewater impacts and agricultural diffuse pollution.

The ecological status of wetlands is highly sensitive to conflicts with land uses and water supply for population, a major issue even in protected areas. For example large proportion of Ramsar wetland areas in southern, central and north-western Europe include or are surrounded by agricultural land (figure 12). This makes them extremely sensitive to land use pressures such as farming practices. Several harmful social and ecological consequences derive from the degradation and destruction of wetlands, such as the increase in vulnerability to floods, a critical issue under climate change (figure 13).

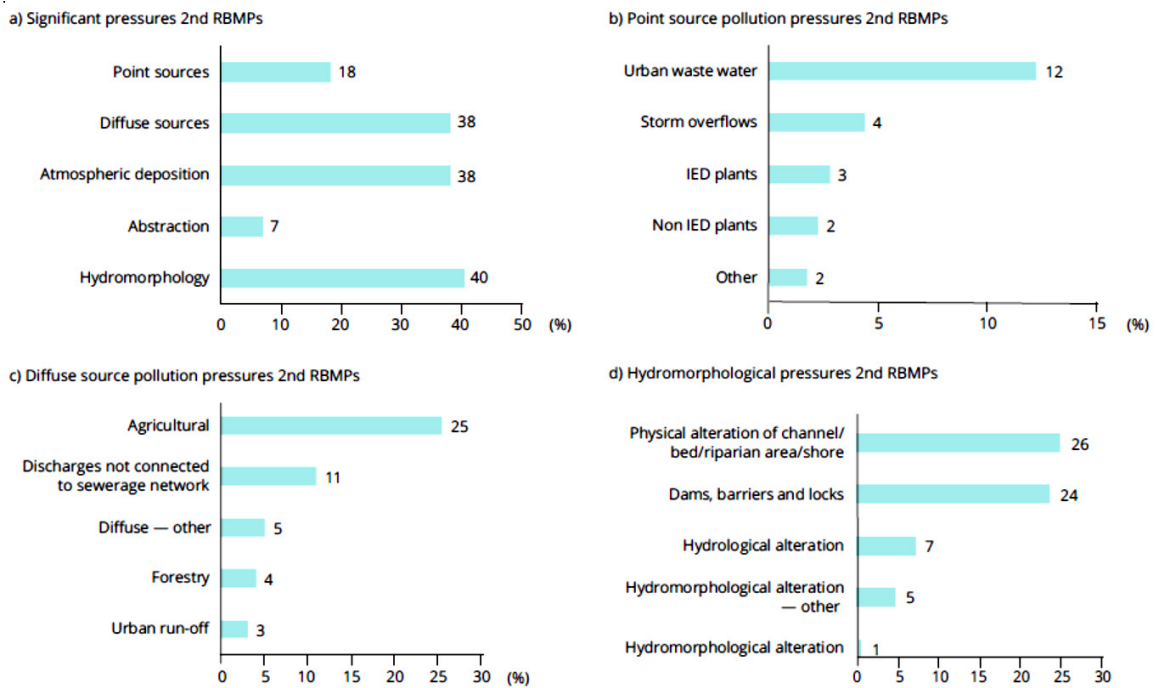
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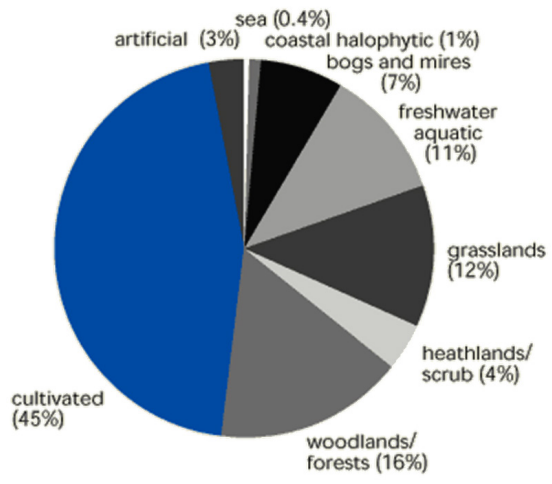
**Figure 9.** Ecological status per Functional Elementary Catchment (Data source: EEA, 2012a) EEA, 2012a.WISE WFD database. [http://www.eea.europa.eu/data-and-maps/data/wise\\_wfd](http://www.eea.europa.eu/data-and-maps/data/wise_wfd) (last modified 6 May 2015).



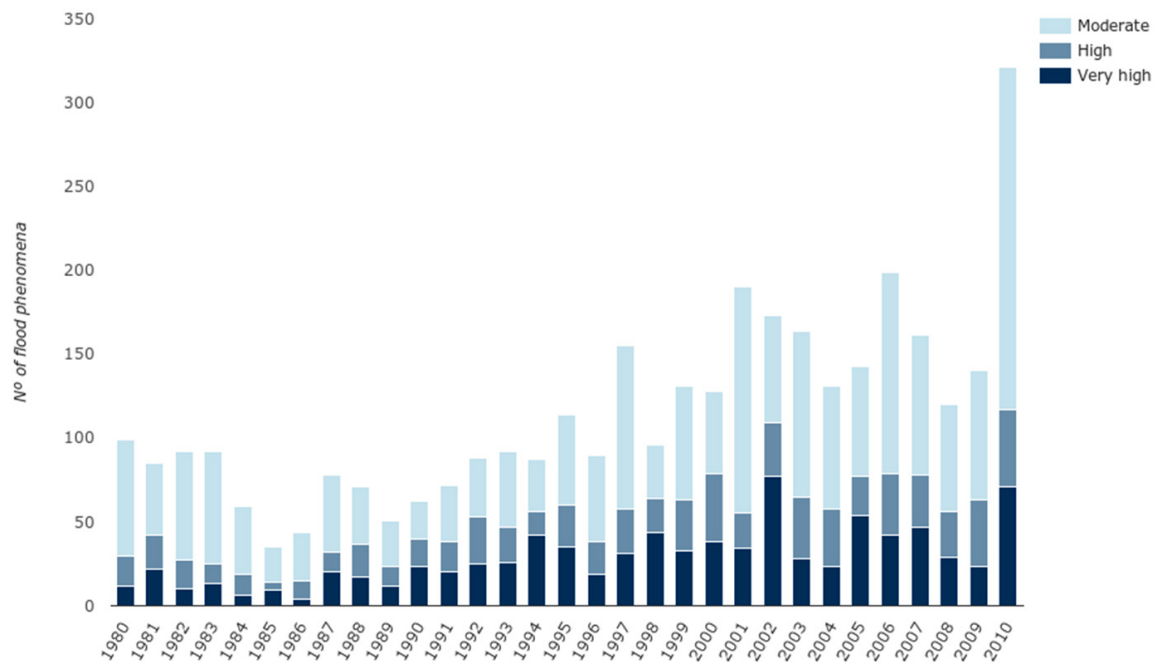
**Figure 10.** The map present the proportion of surface water bodies (rivers, lakes, transitional and coastal waters) in less than good ecological status per River Basin District. RBMP: River Basin Management Plan. Source: European Waters: Assessment of Status and Pressures 2018 (<https://www.eea.europa.eu/data-and-maps/figures/proportion-of-classified-surface-water-5>).



**Figure 11.** Proportion of water bodies affected by a) main pressures, b) detailed point source, c) diffuse source and d) hydromorphological pressures; Coverage period 2000-2015. Source: Source: European Waters: Assessment of Status and Pressures 2018 (<https://www.eea.europa.eu/data-and-maps/figures/proportion-of-classified-surface-water-5>).



**Figure 12.** Land cover in and around inland Ramsar areas in southern and north-western Europe. Source Ramsar Bureau; Wetlands International; EEA Corine Land Cover; EEA-ETC/LC and EEA-ETC/NC (<https://www.eea.europa.eu/publications/signals-2000/page015.html>); Last modified 2016.



**Figure 13.** European past floods provided by European Environment Agency (EEA). ([http://www.eea.europa.eu/data-and-maps/daviz/reported-flood-phenomena#tab-chart\\_1](http://www.eea.europa.eu/data-and-maps/daviz/reported-flood-phenomena#tab-chart_1)).

### Proposals to encourage restoration of freshwater wetlands and aquatic ecosystems

The increased understanding achieved over the last decades in river and wetland functioning provides a solid basis for a rational resource management (e.g., Downs et al., 2011). Approaches with strong precedent include for example releasing ecological flows (EC, 2015) to benefit riverine (Acreman et al 2014) and riparian species (Rivaes et al, 2015), as well as non-native species management (Richardson et al 2007). However, there are still gaps and deficiencies in the transfer from scientific findings to sound policies notably because of the extensive time required to integrate research results into conservation and restoration strategies (Palmer et al., 2010). Riparian vegetation usually requires a reasonable period of years to potentiate relevant improvement (Bunting et al. 2013).

Several European projects (see for example MARS <http://www.mars-project.eu/>; REFORM; <https://reformrivers.eu/>) have recently assessed pressures and proposed recommendations for the improvement of water system status at the European level, while contributing for the implementation of the main EU Directives. More recently, ongoing European projects such as AMBER (<https://amber.international/>) or initiatives such as "Dam Removal Europe" (<https://www.damremoval.eu/>) intend to contribute to the restoration of rivers in Europe that have high natural or cultural importance by reducing fragmentation and recovering their connectivity through the removal of obsolete dams.

While WFD is one of most ambitious legal instruments for improvement of ecological quality of water bodies, there are still space for improvement. For example, it provides a too limited legislative framework for riparian zones and floodplains which have a crucial role in river morphodynamics and ecology (Stella et al 2013). Indeed, one of the results of REFORM

project highlights that vegetation and plants can play a cost-effective and significant role as physical ecosystem engineers for river restoration. Riparian and floodplain ecosystems are not subject to extensive monitoring but are crucial to river morphodynamics and ecology. Direct measurements of hydromorphological processes and riparian vegetation are likely to be better in assessing hydromorphological degradation than in-stream biota.

The EU project MARS recently evaluated the predictive linkage between ecological data collected across Europe and pressures assessed by pan-European models, including pollution, hydrological and hydromorphological alterations and related them with ecological status of water bodies (Hering et al., 2014). This analysis found that a better ecological status is associated with the presence of natural areas in floodplains, while urbanisation and nutrient pollution are important predictors of ecological degradation (Grizzetti et al 2017). After exploration of different scenarios of improvement of rivers ecological status for Europe, the results strengthen the need to halt urban land take, curb nitrogen pollution and maintain and restore nature along rivers (<http://www.mars-project.eu/index.php/deliverables.html>), but they also show that most ecosystems will show a very slow recovery of ecological status, albeit all the efforts undertaken so far by European member states.

32

Climate change is expected to exacerbate anthropogenic degradation with particular emphasis in freshwater habitats, causing shifts into undesirable states with fewer services, but synergetic effects could be avoided by reducing existing local impacts and promoting ecosystem resilience (Green et al 2017). It is vital to identify the thresholds of interacting stressors because once these thresholds are exceeded this will lead to losses in biodiversity and ecosystem services. Thus, research is needed on specific vulnerabilities and thresholds that can drive freshwater ecosystems into alternative undesirable states, particularly in highly water-dependent areas, such as the Mediterranean region (Stella et al 2013).

Restoration efficacy varies and its success is generally lower than expected when considering the ecosystem responses (Palmer et al 2010, Jahnig et al, 2011). Restoration projects should adopt a synergistic approach with other resource users to secure win-win scenarios and have well-defined quantitative success criteria e.g. ranging from hydromorphological improvements to the expected beneficial impact on biota and ecosystem services. Application of existing planning and management tools such as PDCA (Plan-Do-Check-Act), DPSIR, setting SMART objectives and BACI monitoring, can substantially enhance the efficiency and effectiveness of restoration. Cost-benefit analysis can help in prioritizing restoration measures and plans. At present, cost data are too scarce hampering cost-benefit analysis of restoration measures. There is a need to gather and incorporate cost information in a more systematic way.

Finally, latest scientific studies increasingly highlight the need of reinforcing innovative collaborative efforts between scientists, local communities and practitioners to develop restoration techniques that are ecologically, economically and socially viable while enabling a more strategic investment of limited restoration resources (Jones et al 2018, Gellie et al 2018). Achieving such goals will require a larger evidence base of restoration studies and case-studies sharing (see for example Gumiero et al 2013), which could be realized by systematically embedding scientific experiments within restoration programs (Gellie et al 2018).

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### 1.2.3. Coastal restoration

#### Degradation of the coastal zone

Worldwide, the development of the anthropogenic environment and the coastal urban areas implies the change in the corresponding land use. The continuous changes in the coastal zone are owed to the effect of climate change and the growing human interference. The nature of coastal response to rapid sea-level rise and other environmental changes has become an issue of urgency (Forbes *et al.*, 2004).

A significant impact on the coastal areas but also on the alternative adaptive techniques have undoubtedly occurred by the continuous climate change, the sea level rise, the profound increased number and intensity of storm surges and other extreme weather events of the coastal zone and the intense habitation of the coasts (Orford and Pethick, 2006; Chapin *et al.*, 2009).

33

In order to limit and manage the advance of the coastal area degradation, ecosystem techniques and services have been developed (Barbier, 2013). These rehabilitation techniques can be environmental, social and cultural. The rehabilitation of this dynamic ecosystem is limited between the land and the sea. Consequently, techniques are applied to wetlands, coastal dunes and shoreline mangrove forests. Attention is mainly given to sandy shorelines and coastal dunes due to the high tourist attraction and heavy human habitation (Martínez *et al.*, 2013).

#### Rehabilitation of coastal areas

The rehabilitation of a coastal system is usually partially or fully (in exceptional applications) replacing its structural or functional characteristics that have been degraded. Frequently, those damaged original characteristics of the coastal ecosystem, can be substituted by equivalent or by alternative qualities with more social-economic or environmental value (Edwards, 1998; Elliott *et al.*, 2007). There is a variety of methodologies to reduce or to overcome the environmental downgrading. Most of the methodologies are simulations of natural processes like vegetative, hydrologic and structural.

#### Coastal dunes

The degradation and loss of coastal dunes owing to human interventions is a consequence of different activities performed at the coast by humans. These actions can be distinguished into six groups and to a major or minor extent, all affect coastal dunes: a) housing and recreation, b) industrial and commercial use, c) waste disposal, d) agriculture and fisheries, e) mining, military activities.

For the rehabilitation of coastal dunes a series of methodologies may be applied: reshaping dunes and recovering sediment dynamics (by using vegetation roots or fences for sand traps), transferring of sediment from the beach to the backshore and creating manmade dunes, and by removing manmade landforms and structures.

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## Coastal wetlands

Coastal wetlands are very important and valued features due to their high biodiversity and ecosystem services. These coastal systems are heavily protected by environmental international laws, however, in some cases they have been modified or destroyed. Except from the anthropogenic interventions, the continuous sea level rise due to the climate change is affecting wetlands severally.

The restoration of these ecosystems is based on: a) rapid reclamation of coastal land through the mechanical extraction and delivery of dredged sediments (Aust, 2006; Merino *et al.*, 2011), b) large-scale river diversion projects designed to mimic the alluvial land building process (e.g. Allison and Meselhe, 2010; Nittrouer *et al.*, 2012; Simenstad *et al.*, 2006).

## Marshes

34

Marshes provide important life support, water quality and hydrologic functions. Additionally, these systems provide protection from coastal erosion, stabilization of dredged material, dampening the effects of waves and storm tides, trapping water-borne sediments, nutrient cycling and transformations, and, also, serving as nutrient reservoirs (Matthews and Minello, 1994).

The rehabilitation of marshes is focused on the establishment of self-sustaining ecosystems, which resemble in structure and function to the natural systems that they are designed to emulate or one that will become like the natural system through succession of flora and fauna (Broome, 1990; Zedler, 1992). Another method used exclusively in the areas of fluvial systems is the one of large-scale river diversions, aimed at imitating the alluvial land building process (e.g. Nittrouer *et al.*, 2012).

## Limitations

A large number of sustainable coastal management practices have been considered in many scientific papers about environmental restoration and rehabilitation in recent decades. However, established scientific evidence rarely drives adoption of efficient management practices, mainly due to the lack of connection between science and practice (e.g. Quillérou and Thomas, 2012).

Coastal environments are transitional areas in the middle of two ecosystems (land and sea) and they are dominated by naturally dynamic processes in both spatial and temporal dimensions that are difficult to manage. Thus, these ecosystems require long-term monitoring and social involvement to achieve successful sustainability.

For example, in dune nourishment method, providing the necessary sand volume and space for the dunes to develop, maintenance is necessary for the preservation of dune integrity and time is needed for dune species to colonize (Martínez, 2013). Unfortunately, the restoration of vegetation and morphology can last up to ten years and can be expensive.

The major reason for insufficient implementation and adoption of environmentally healthy management is the lack of passing knowledge and technology between environmental science

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and policy (Thomas *et al.*, 2012). Additional drawback is the lack of environmental awareness of the local community. People should work in groups, communities in order to prevent coastal degradation. There is an additional benefit when people or community groups, such as wildlife societies, school natural history clubs, or scout or guide groups, become involved in projects that are guided by experienced scientists (Evans and Birchenough, 2001).

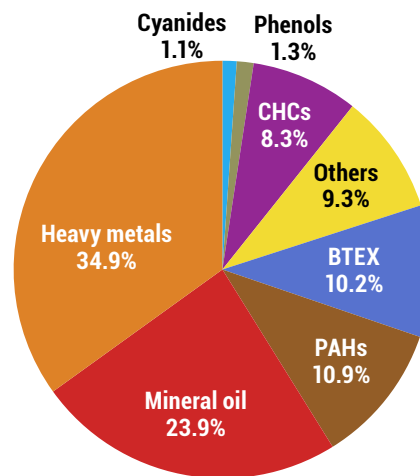
## 1.2.4. Soil contamination

### Scope of the problem in Europe

In 2011, information available for 20 European countries revealed that the estimated number of potentially contaminated sites in Europe was 2,553,000 and about 45% of them have been identified (1,170,000). More than 14% of the total estimated potentially contaminated sites of around 342,000 are estimated to be contaminated sites and 27% (127,000) have been already identified. Moreover, the ratio of remediated sites to contaminated sites was around 45% as more than 58,000 contaminated sites have been already remediated (Panagos *et al.*, 2013).

35

In these sites, the main contaminant categories were trace metals and mineral oil contributing to around 60% in soil contamination, followed by BTEX, CHCs, PAHs and others which had similar contributions to soil contamination varying between 8 and 11% (figure 14).

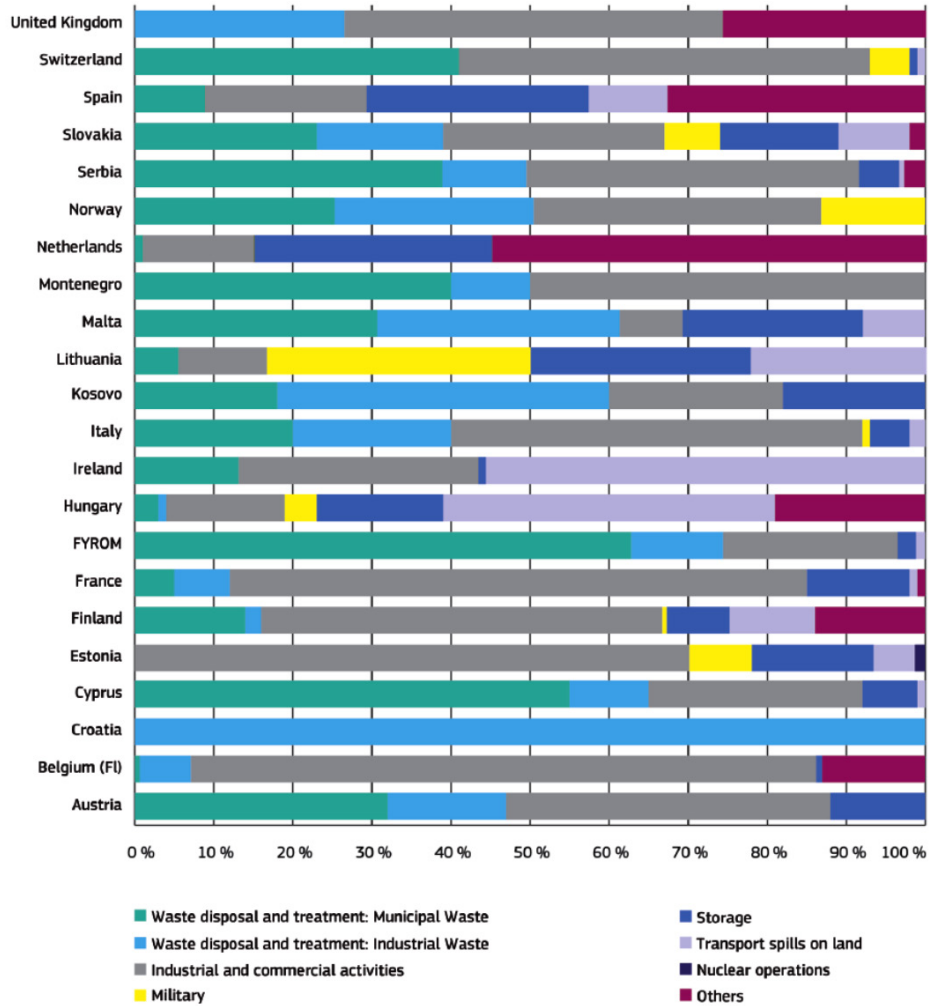


**Figure 14.** Distribution of contaminants affecting soil in Europe (European Commission, 2013; Panagos *et al.*, 2013).

Land contamination usually affects areas with a high density of urban agglomeration and with a long tradition of heavy industry, or in the vicinity of former military installations.

The largest and most affected areas are located in north-west Europe, from Nord-Pasde Calais in France to the Rhein-Ruhr region in Germany, across Belgium and the Netherlands. Other areas include the Saar region in Germany; northern Italy, north of the river Po, from Milan to

Padua; the region located at the corner of Poland, the Czech Republic and the Slovak Republic, with Krakow and Katowice at its centre; and the areas around all major urban agglomerations in Europe (figure 15).



**Figure 15.** Breakdown of activities causing soil contamination as reported in 2011 (European Commission, 2014).

The large volume of waste production and the widespread use of chemicals during the past decades have left numerous sites with local soil contamination. The dominant major sources of local soil contamination are inadequate or unauthorised waste disposal, unsafe handling of dangerous substances within industrial or commercial processes, and accidents.

In Europe, contaminated soil continues to be commonly managed using "traditional" techniques, e.g. excavation and off-site disposal (Figure 3, 4), which accounts for about one third of management practices.

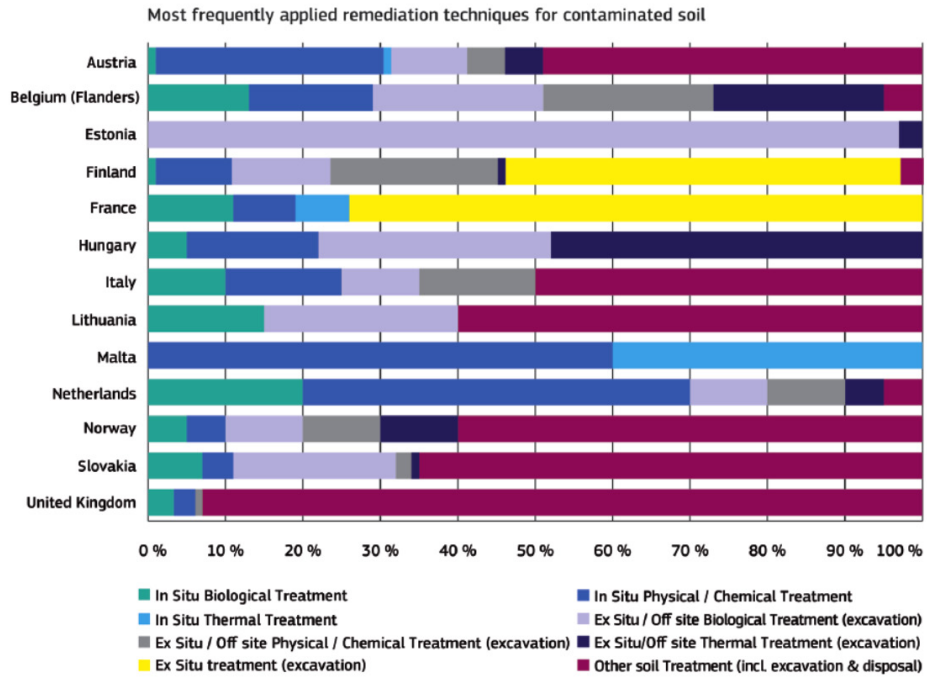


Figure 16. Dominant remediation technologies for contaminated soil reported in 2011 (European Commission, 2014).

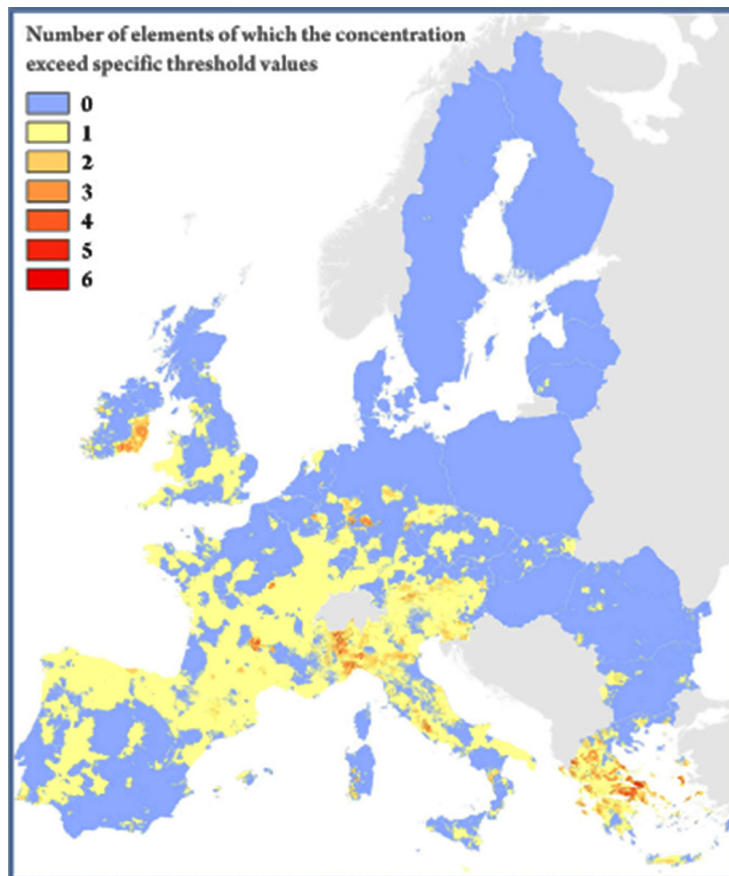


Figure 17. Priority areas of detailed assessment of soil have metals (Tóth et al., 2016). Science of Total Environment, 565, 1054-1062.

However, increasing regulatory control of landfill operations and associated rising costs, combined with the development of improved *ex-situ* and *in-situ* remediation techniques, is altering the pattern of remediation practices.

*In-situ* and *ex-situ* remediation techniques for contaminated soil are applied more or less equally.

### **Main limitations to implement the restoration**

Soil contamination belongs to one of the most serious degradation threats that are defined in European "Toward Thematic Strategy for Soil Protection" (Report of the Implementation of the soil thematic strategy and ongoing activities. 2015). Preventing soil contamination is critical because cleaning contaminated soils is extremely expensive and difficult.

Under the EU Soil Framework Directive three steps are defined for the soil status report:

- (a) the background history of the site, as available from official records;
- (b) chemical analysis determining the concentration levels of the dangerous substances in the soil, limited to those substances that are linked to the potentially polluting activity on the site;
- (c) the concentration levels at which there are sufficient reasons to believe that the dangerous substances concerned pose a significant risk to human health or to the environment.

**The directive sets a common approach for monitoring soil contamination across all Member States but does not specify the methods.** It is up to Member States to decide the best method based on local conditions and existing national approaches.

In addition, the Joint Research Center in their recent report "Progress in the management of Contaminated Sites in Europe" described four steps to characterize and assess soil contaminated areas, namely: 1) site identification (or preliminary studies), 2) preliminary investigations, 3) main site investigations, and 4) implementation of risk reduction measures.

The negative effects of soil contamination are connected with animal and human exposure by toxic elements and substances entering food chains via transfer from root to shoot of agricultural crops or via surface contamination. The direct human risks by inhalation, oral and dermal intake of contaminated soil particles can be relevant not only on urban soils.

**The risk assessment for human health, therefore, is assuming more and more importance in the solution of problems connected with soil remediation.** Indeed, the risk assessment criteria are applied to identify and classify the various sites on the basis of intervention priority, to establish objectives and standard of decontamination, to select the technology more appropriate and site-specific. Many countries have their own tools for risk regulation based on scientific results, for example policy of soil protection and the methods of soil remediation. The policies of soil protection and remediation (decontamination) are different in many countries. The limit values of contaminants were set in European countries. In these countries different national limit values of soil contamination were defined due to the fact that the soils and local conditions can differ sharply in each country. Recent approaches are

based on hierarchical limits respecting contaminants background values in soils, defined risks and remediation (decontamination) limit values (Vacha et al., 2014). These approaches are based on the cooperation of the specialist from many disciplines like pedology, toxicology, plant sciences or animal and human medicine. The communication between the scientists and researchers through the disciplines is a very important aspect that brings the successful results applicable in many parts of the World.

The final choice of remedial technology largely depends on the nature and degree of contamination, the intended function or utilization of the remediated site and the availability of innovative and cost-effective techniques. The choice is further complicated by environmental, legal, geographical, and social factors. More often the choice is site-specific. For example, home gardens and agricultural fields in large rural areas that are contaminated may require a remedial approach different from that for smaller but heavily contaminated areas. Similarly, large areas around old mining and smelter sites need an approach which differs from that of a heavily polluted spot.

39

In areas affected by high contamination, direct and indirect health hazards require urgent restoration and acceptable costs, regardless of the remediation technology selected for the site. In other cases, such as land with non-hazardous contaminant levels, or excessive costs compared to the expected benefits, remediation may eliminate or reduce the environmental hazard and contribute to the valorisation of green areas, public services, and arable land otherwise not utilizable.

Decision makers should evaluate the selection of the remediation technologies also in relation to the effects that it may have on the soil quality. Many processes, indeed, determine significant changes in soil characteristics (e.g. pH variation, red-ox conditions, fertility, structure loosening, sterilization and decline of biological activity). Action for restoration of degraded areas, therefore, should take care of both costs for remediation and management of the site to secure, of the hazards derived from the site itself, and of the benefits derived from site restoration.

Various physico-chemical processes (soil washing, electrokinetic, chemical reduction or oxidation of contaminants, incineration) have been developed for treating polluted soil. These approaches are often prohibitively expensive, non-specific and produce secondary contamination. In particular, the most utilized technical solutions are clearly inadequate for cleaning large areas moderately contaminated, where soft and (environmental) friendly technologies are needed to restore soil fertility, in such a way that they could be utilized for agriculture or public/residential green areas. Therefore, in recent years the interest of both public Authorities and private Companies towards innovative bio-based methodologies for decontamination and restoration of contaminated sites, known as bioremediation, is increasing. Bioremediation techniques, which are based on the use of living organisms (microorganisms, plants and earthworms) to degrade and detoxify environmental contaminants, are more cost-effective and ensure the conservation of the site and of its biological potential. As asserted by Adriano et al. (2004), the purpose of soil bioremediation is "not only to enhance the timely degradation, transformation, remediation or detoxification of pollutants by biological means, but also to protect soil quality. Bioremediation techniques accelerate the naturally occurring degradation of organic compounds by optimizing conditions for biodegradation through, for example, aeration, addition of nutrients and control of pH and temperature. Their primary disadvantages are that biological techniques need a long duration to achieve the required

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pollutant concentration thresholds and suitable environmental condition to sustain living organisms. However, other than advantages above mentioned, being a natural process it is perceived by the public as an acceptable decontamination treatment for polluted soil. For example, phytoremediation (plant based biotechnology) is a technology that holds great potential in cleaning up contaminants, both organic and inorganic, that: 1) are near the surface, 2) are relatively non-leachable, 3) pose little imminent risk to human health or the environment, and 4) cover large surface areas. Moreover, it is cost-effective in comparison to current technologies, and environmental friendly.

### ***Some proposals to encourage soil decontamination***

A considerable share of remediation expenditure, about 35% on average, comes from public budgets. Although considerable efforts have been made already, it will take decades to clean up a legacy of contamination. Even if most cases of contamination are a legacy from the past, current activities may still cause soil contamination. The implementation of the EU and national legislative and regulatory frameworks already in place (e.g. Landfill Directive, Integrated Pollution Prevention and Control Directive, Water Framework Directive, Environmental Liability Directive) should result in the more efficient prevention of releases of contaminants into the environment, and into soil in particular.

40

Several techniques are available for the reduction of the risks caused by soil contamination. In the European countries, there is a balance in the application of innovative in situ (on-site) and ex situ (off-site) techniques. A significant high percentage of the most-frequently applied techniques can be defined as traditional such as the so-called "dig and dump" techniques and the containment of the contaminated area. This reflects the fact that contaminated soil is frequently treated as waste to be disposed of rather than a valuable resource to be cleaned and reused. The research of environmentally and economically sustainable technologies is of paramount importance in order to increase the decontamination.

In order to standardize the information about soil contamination at the European level, it is important to identify the type of information and methods most commonly used in the soil assessment as a guide to data collection. In this sense, emerging technologies in data and knowledge engineering provides excellent possibilities for soil contamination and decontamination assessment. This involves the development and linkage of integrated databases, evaluation models, and spatialization tools. Within this context, decision support systems for land evaluation are considered very appropriate tools to include the soil and climatic attributes for a better identification of soil contamination and vulnerable zones and, eventually, for formulation of decontamination programs.

Finally, future efforts in the area of soil contamination and decontamination assessment will involve integrated methodologies that incorporate all these different methodologies. Also, screening methods for the identification of pesticides and other organic pollutants resulting from diffuse sources are not available and their development is urgently needed.

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# Teaching land restoration: Current offer and needs

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## II.1. Studies on land restoration in Southern Europe

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### II.1.1. Studies on land restoration: Spain

#### Undergraduate studies

Most Universities offer studies where land restoration can be studied. Most of the studies are included in general studies on Environment. Forestry, Agronomy, Environmental education, Environmental Law, Biotechnology, Management, Agrobiological, Global change, Nanotechnology, Planning, Contamination and toxicology, Environmental Geology, Hydrology, Biology engineering,

At the **University of Santiago de Compostela**, different subjects include teaching on Land Restoration:

- Restoration of Degraded Lands, in the Degree of Forestry and Environmental Management
  - Soil Science, in the Degrees of Agriculture
  - Contamination and Environmental Audit, in the Degree of Forestry and Environmental Management
  - Environmental Chemistry, in the Degree of Biology
  - Biogeochemistry, in the Degree of Biology
  - Applied Soil Science, in the Degree of Biology
  - Environment and health
  - Residues management and treatment
  - Contamination and Recuperation of soils
  - Effects of wildfire on the ecosystems
  - Regeneration and Restoration after wildfire
  - Laboratory of soils and residues
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## Masters on land restoration

Four specific masters on Land Restoration are offered in Spain

- a) Management and restoration of the natural environment/ Gestión y restauración del medio natural. University of Alicante (<https://cvnet.cpd.ua.es/webcvnet/planestudio/planestudiond.aspx?plan=D055&lengua=C>).  
Restoration of arid environments, Decontamination of soils, regeneration of dunes and beaches, rehabilitation of wetlands and rivers, rehabilitation of mines and quarries, forest restoration.
- b) Restoration of Ecosystems / Restauración de ecosistemas, Alcalá de Henares + Universidad Complutense de Madrid + Rey Juan Carlos ([http://www3.uah.es/master\\_rest\\_eco/](http://www3.uah.es/master_rest_eco/)).  
The master considers subject, such as Erosion and soil restoration, Restoration of polluted soils, Restoration of biodiversity, Forest restoration, Restoration in civil works, coastal areas and agrosystems, and wetlands and rivers.
- c) Master's degree in ecology, management and restoration of the natural environment / Máster de ecología, gestión y restauración del medio natural. University of Barcelona: (<http://www.ub.edu/estudis/mastersuniversitaris/ecologiamedinatural/>).  
This master includes specific topics on wildfires, wetlands and rivers, coastal degradation, restoration of polluted areas
- d) Conservation, management and restoration of biodiversity / Conservación, gestión y restauración de la biodiversidad. University of Granada. (<http://masteres.ugr.es/biodiversidad/>).  
This master includes subjects, such as Diagnosis and restoration of aquatic ecosystems, Restoration of soils and restoration of terrestrial ecosystems.

42

At the **University of Santiago**, different subjects related with Land Restoration are offered in the following masters:

- a) Terrestrial Biodiversity
- b) Marine Biology
- c) Landscape architecture
- d) Agronomy engineering
- e) Environmental engineering
- f) Forestry engineering
- g) Sustainable Land Management

The **Forest Research Centre of Lourizan**, focused on the restoration of land affected by wildfires, provides of important support for training at different levels. On one hand, the center offers practical training to university students. Every year.

On the other hand the center also organized courses of specialization on soil rehabilitation techniques and strategies. The staff also participates in numerous courses and workshops organized by others entities.

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## Other courses

Different courses of specialization are also offered by universities, research centers, companies, associations and NGO's. The main subjects are wildfires, bioengineering or mine restoration.

To be held in 2018:

- Congress on Bioengineering (<http://aeip.org.es/xi-congreso-de-la-aeip/>)
- Course on fluvial morphology and continuity, 17-18 April 2018, Vitoria)
- Seminary on The landscape route (9 y 10 de mayo de 2018, Barcelona)
- Congress on Restoration and diversification of the rural landscape: technical strategies (17-19 de octubre de 2018, Alcázar de San Juan)
- Course on Landform design and modelling for best practise in mine rehabilitation, Complutense University Madrid
- Restoration of degraded arid zones and follow-up of desertification processes. 5 al 10 de febrero 2018, Zaragoza

43

## II.1.2. Studies on land restoration: Portugal

The topics related with Restoration are addressed in several disciplines related with Environmental sciences, and integrating the syllabus of these degrees on those topics. A PhD program explicitly mentioning "restoration" in the title is found in the University of Lisboa (FLUVIO).

### Undergraduate studies

- Many Forestry and biological courses include courses and disciplines related with restoration. See for exemple (not exhaustive):
- Licenciatura em Engenharia Florestal e dos Recursos Naturais, Universidade de Lisboa (<https://fenix-edu.isa.ulisboa.pt/degrees/lefrn>)
- Licenciatura em Engenharia do Ambiente, Universidade de Lisboa, (<https://fenix.isa.ulisboa.pt/qubEdu/cursos/leamb>)
- Licenciatura em Arquitectura Paisajista, Universidade de Lisboa (<https://fenix-edu.isa.ulisboa.pt/degrees/lap>)
- Engenharia do Ambiente, Universidade do Algarve, (<https://www.ualg.pt/pt/curso/1534>)

### MASTERS

- Mestrado em Bioengenharia, Universidade de Trás os Montes e Alto Douro and University of Porto, Portugal. <https://www.utad.pt/estudar/cursos/bioengenharia/>

Examples of Masters Including disciplines related with restoration (not exhaustive):

- Mestrado em Engenharia Florestal: Sistemas Mediterrânicos, Universidade de Évora ([http://www.estudar.uevora.pt/Oferta/mestrados/curso/\(codigo\)/359](http://www.estudar.uevora.pt/Oferta/mestrados/curso/(codigo)/359))
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- Mestrado em Gestão e Conservação de Recursos Naturais, Universidade de Lisboa e Universidade de Évora (<http://home.uevora.pt/~pmra/mgcrn/>)
- Licenciatura em Engenharia Florestal e dos Recursos Naturais, Universidade de Lisboa (<https://fenix-edu.isa.ulisboa.pt/degrees/mefrn>)
- MEDFOR - Mediterranean Forestry and Natural Resources Management, MEDfOR is a Erasmus MUNDUS two-year world-class International Master Programme focuses on the integrating theme of sustainability in Mediterranean forests and woodlands in the University of Lisbon in collaboration with University of Lisbon, Portugal; University of Padova, Italy; University of Lleida, Spain; University of Valladolid, Spain; Technical University of Karadeniz, Turkey; University of Tuscia, Italy and Portuguese Catholic University, Portugal (<http://www.medfor.eu/>)

## PhD programmes

44

A specific Doctoral Programme in the Restoration of Fluvial systems:

- FLUVIO - River Restoration and Management, Universidade de Lisboa in a international Consortium with Universidad Politécnica de Madrid, Spain (UPM); University of Natural Resources and Life Sciences, Vienna, Austria (BOKU); Universidade Federal da Bahia, Brazil (UFBA), several Research Centres and two private companies Environmental Consulting Klagenfurt (ECK), and Katopodis Ecohydraulics Ltd. (KE) (<https://www.isa.ulisboa.pt/ensino/pd-f/fluvio>)
- Doutoramento em Bioengenharia, Universidade do Minho, a Universidade de Lisboa e a Universidade Nova de Lisboa Universidade do Minho, a Universidade de Lisboa e a Universidade Nova de Lisboa. [https://www.uminho.pt/PT/ensino/oferta-educativa/\\_layouts/15/UMinho.PortalUM.UI/Pages/CatalogoCursoDetail.aspx?itemId=3144&catId=9](https://www.uminho.pt/PT/ensino/oferta-educativa/_layouts/15/UMinho.PortalUM.UI/Pages/CatalogoCursoDetail.aspx?itemId=3144&catId=9)
- Doutoramento em Arquitetura Paisagista: Universidade de Lisboa (<https://fenix.isa.ulisboa.pt/qubEdu/cursos/dap>)
- Doutoramento em Gestão Interdisciplinar da Paisagem, Universidade de Lisboa cm Universidade de Evora e Universidade dos Açores (<https://fenix.isa.ulisboa.pt/qubEdu/cursos/dgip>)

## Other courses

Different courses of specialization are also offered by universities, research centers, companies, associations and NGO's. Some examples:

- Jornadas de Restauro Fluvial (Associação Portuguesa dos Recursos Hidricos) (5 Edições ate 2017)
  - Workshop -Técnicas de Engenharia Natural - Do Projeto à Execução, 27-28 September 2018 (Santarém)
  - Curso de Engenharia Natural, APENA, Escola Superior Agraria de Coimbra Jan-Fev 2018
  - Curso de Introdução à Engenharia Natural 16-17 Fevereiro 2013 (Braga)
  - Curso Materiais e Técnicas de Restauro Ecológico (14-15 Abril 2011, Lisboa)
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### II.1.3. Studies on land restoration: Italy

#### Undergraduate courses

- Analisi di sistemi ecologici (Degree of Environmental Science)
- Effetti dell'inquinamento sulla salute (Degree of Environmental Science)
- Dinamica degli inquinanti (Degree of Environmental Science)
- Monitoraggio di matrici ambientali (Degree of Environmental Science)
- Ingegneria sanitaria ambientale (Degree of Engineering)
- Applicazioni di ingegneria ambientale (Degree of Biology)

#### Postgraduate courses

- Bonifiche dei Siti Inquinati (Department of Earth Sciences)

45

### II.1.4. Studies on land restoration: Greece

In the National and Kapodistrian University of Athens, many faculties have, in their curriculum, courses related to land research and land restoration. Faculties such as Geology and Geoenvironment, Biology and Chemistry are in the front line of higher education concerning environmental issues.

#### Undergraduate courses

- Physical Geography and Environment, fac. Geology and Geoenvironment
- Climatology and climatic changes, fac. Geology and Geoenvironment
- Sedimentology, fac. Geology and Geoenvironment
- Geomorphology, fac. Geology and Geoenvironment
- Environmental Geochemistry, fac. Geology and Geoenvironment
- Environmental Geology, fac. Geology and Geoenvironment
- Protection of aquifers - Vulnerability, fac. Geology and Geoenvironment
- Environmental Chemistry, fac. Chemistry
- Anorganic Chemistry 2, fac. Chemistry
- Biotechnology, fac. Biology
- Terrestrial Ecosystems of Greece, fac. Biology
- Terrestrial Plants & Fungi, fac. Biology

The National and Kapodistrian University of Athens offers a large number of Postgraduate Programs (Segmental, Interdisciplinary, Transnational) covering a variety of scientific fields

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and enables its graduates and graduates of other academic institutions to promote physical sciences and to claim their place in the labor market. A large number of NKUA's Master programs are focused on environmental issues, hazards and environmental protection.

### **Postgraduate courses**

- Hydrometeorologic disasters and climate change, fac. Geology and Geoenvironment
- Ecology and biodiversity management, fac. Geology and Geoenvironment
- Climate change, fac. Geology and Geoenvironment
- Environmental management - protection and restoration, fac. Geology and Geoenvironment
- Environmental institutional framework, fac. Geology and Geoenvironment
- Environmental impact assessment, fac. Geology and Geoenvironment
- Environmental Geology, fac. Geology and Geoenvironment
- Environmental Geochemistry, fac. Geology and Geoenvironment
- Waste management, fac. Geology and Geoenvironment
- Aquatic and terrestrial ecosystems, fac. Geology and Geoenvironment
- Methods of analysis of geographic and environmental data, fac. Geology and Geoenvironment
- Analysis and Management of anthropogenic - natural hazards and disasters, fac. Geology and Geoenvironment
- Effects and Adaptation to Climate Change, fac. Geology and Geoenvironment
- Environmental management and sustainable development, fac. Chemistry
- Chemistry-Pollution of water systems, fac. Chemistry
- Ecotoxicology, fac. Chemistry
- Methods of consulting environmental issues, fac. Chemistry
- Standards and Conservation / Management of Biodiversity, fac. Biology
- Ecosystem Management, fac. Biology
- Analysis and processing of ecological spatial data, fac. Biology
- Mycotoxicity, fac. Biology
- Ecology of Terrestrial Ecosystems, fac. Biology
- Environmental legislation - Environment and administration, fac. Biology
- Conservation and Management of Biodiversity in Greece, fac. Biology

46

The National and Kapodistrian University of Athens educates undergraduate and postgraduate students on environmental issues and their analysis using multidisciplinary and different approaches. Nevertheless NKUA doesn't have a department of agriculture or forestry.

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## II.2. Evaluation the main needs for landcare studies: Survey on land restoration education capacities (Annex 1)

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### II.2.1 Characteristics of the population interviewed

To assess the specific needs of education and training, a survey was conducted. The interview was conducted using two different discussion forums on Education and Training (Landcare for Future- <http://www.ibader.gal/seccion/535/2018-International-Conference-Santiago-de-Compostela.html>- and Workshop on Education and Training Ecological Restoration -<http://www.ibader.gal/seccion/571/2018-International-Workshop-at-SERE-Conference-Reykjavik.html>), both organized by the Landcare project. It collects representative data of people, distributed by gender, role (student / professional) and type of activity (teacher, NGO, company...). The study includes data from 21 nationalities. Although the number does not allow to differentiate the results in different countries. It has also managed to cover a wide range of topics of interest. People also show a varied type of university teaching experience, undergraduate, master's and doctoral degrees.

47

Number of participants in the survey: 70.

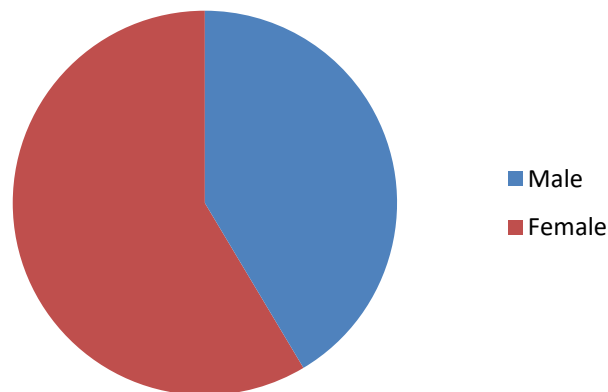


Figure 18. Percentage of participants by gender: 58,6% females - 41,4% males (survey, Annex 1).

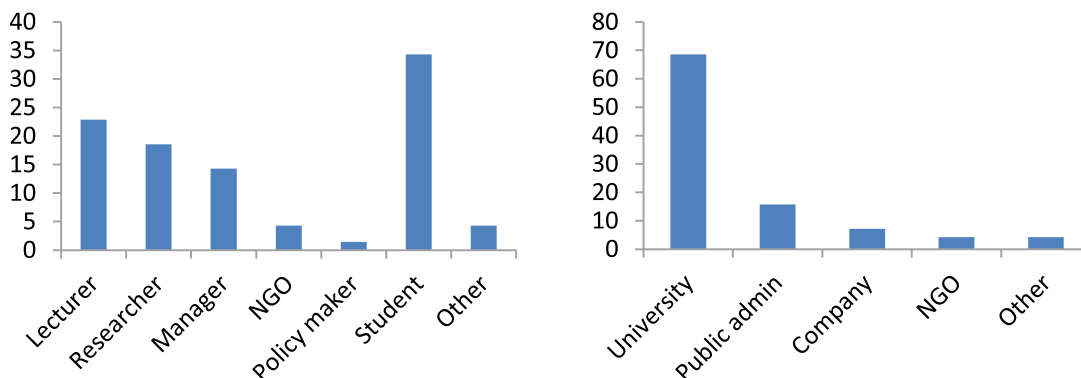


Figure 19. Percentage of participants by category (survey, Annex 1).

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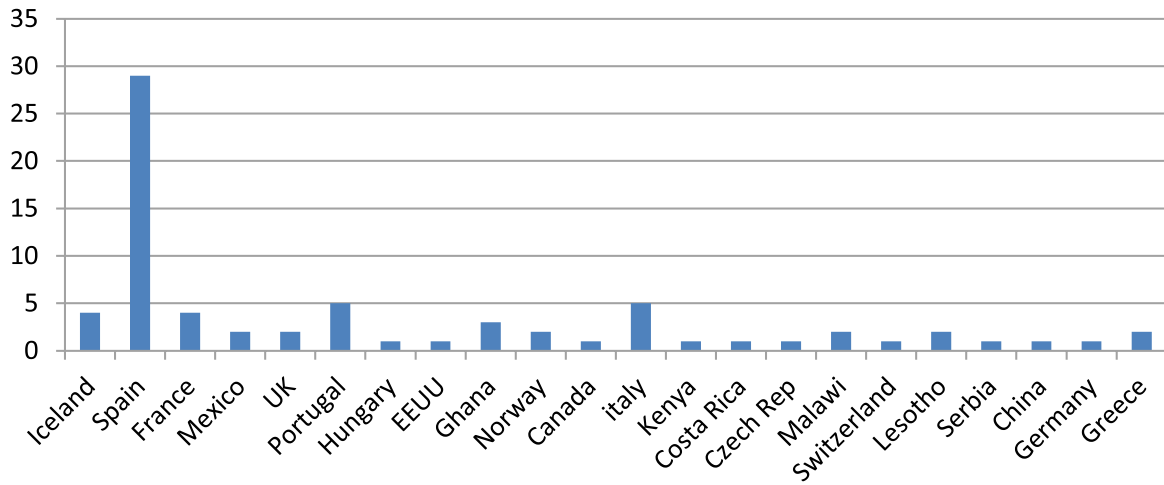


Figure 20. Percentage of participants by country (survey, Annex 1).

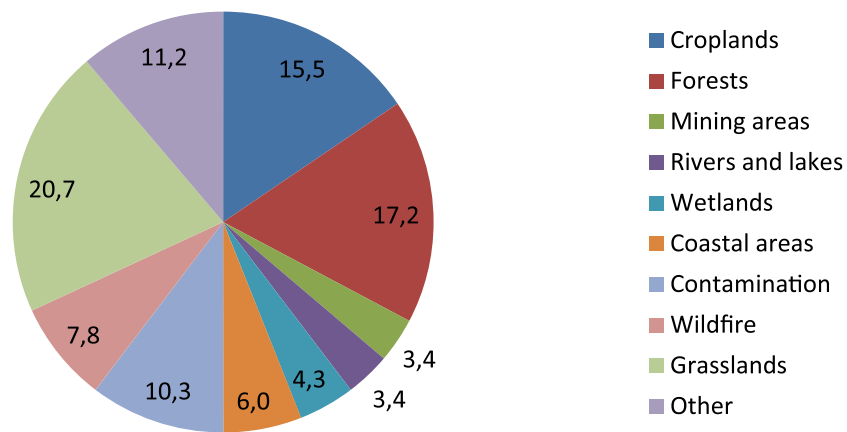


Figure 21. Percentage of participants by interest topics (survey, Annex 1).

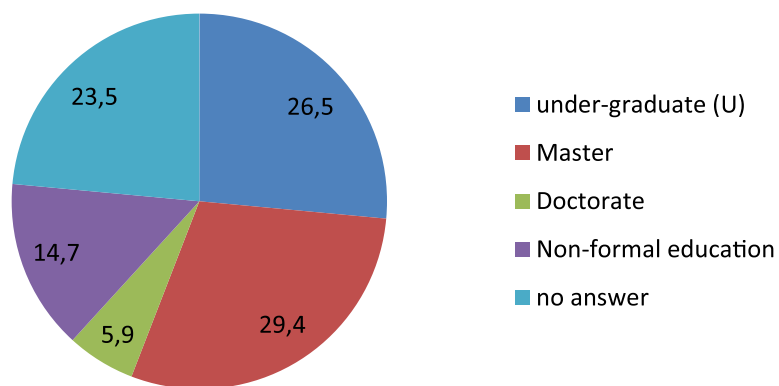
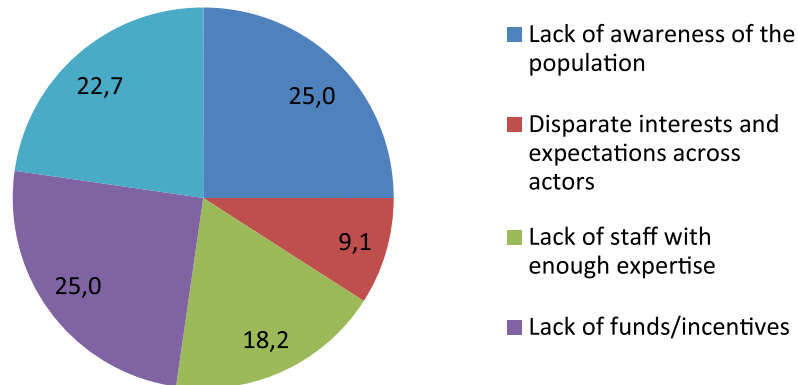


Figure 22. Courses or topics related to ecological restoration that participants teach and their level (survey, Annex 1).

## II.2.2. Main barriers hampering land restoration

Which are the main barriers hampering the development of the employment sector in land restoration?

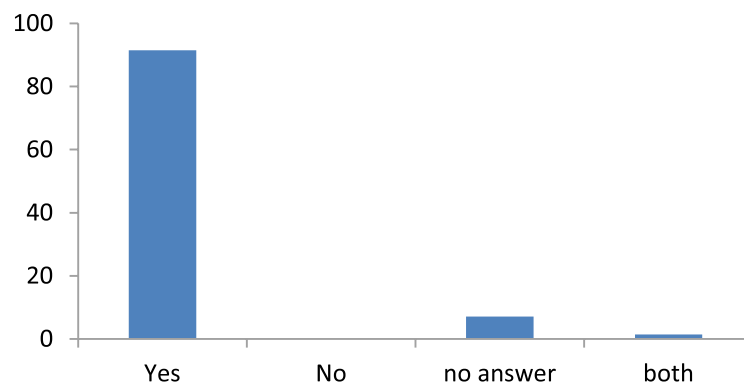


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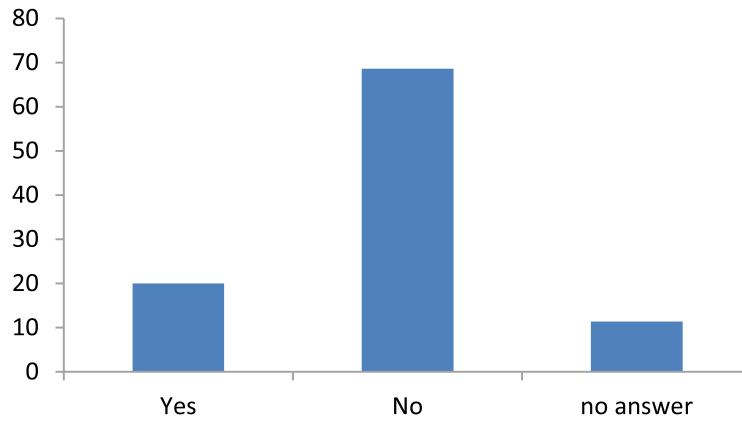
**Figure 23.** Main barriers hampering the development of the employment sector in land restoration (survey, Annex 1).

There is unanimity that the restoration work is not enough to cover the problem in Europe. It is striking that among the different reasons, 43% of the problem is due to education issues (Lack of awareness of the population) and training (Lack of staff with enough expertise).

## II.2.3. Role of the teaching quality on land restoration

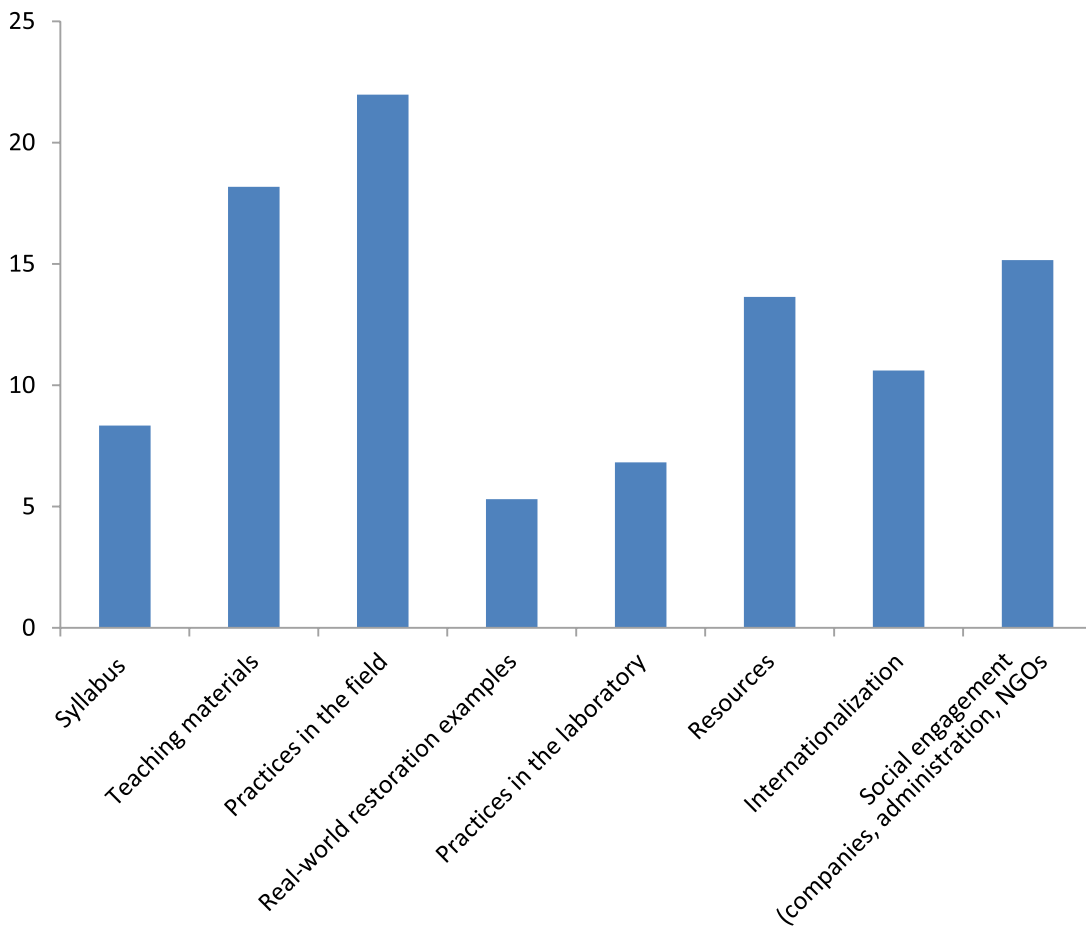


**Figure 24.** Do you think that the reinforcing of teaching on land restoration might contribute to improve the implementation of land restoration in your country of work? (survey, Annex 1).



**Figure 25.** Do you think land restoration studies are properly addressed in your country of work? (survey, Annex 1).

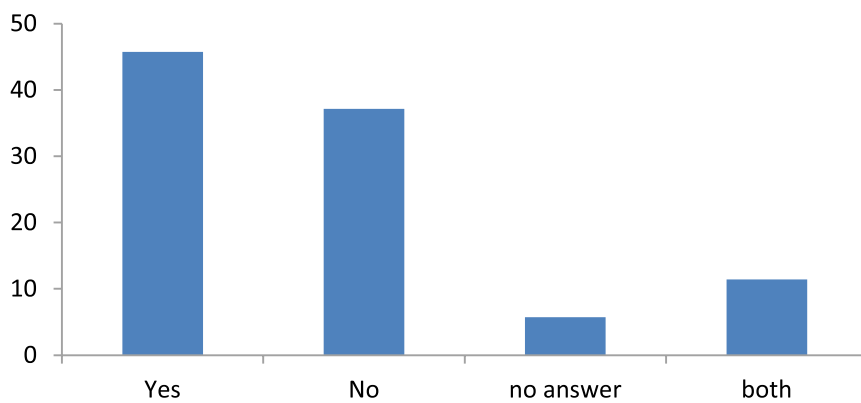
These two questions show that there is a lack of quality in the training of personnel, and that this affects the restoration.



**Figure 26.** Participants answering NO, pointed out these main limitations (survey, Annex 1).

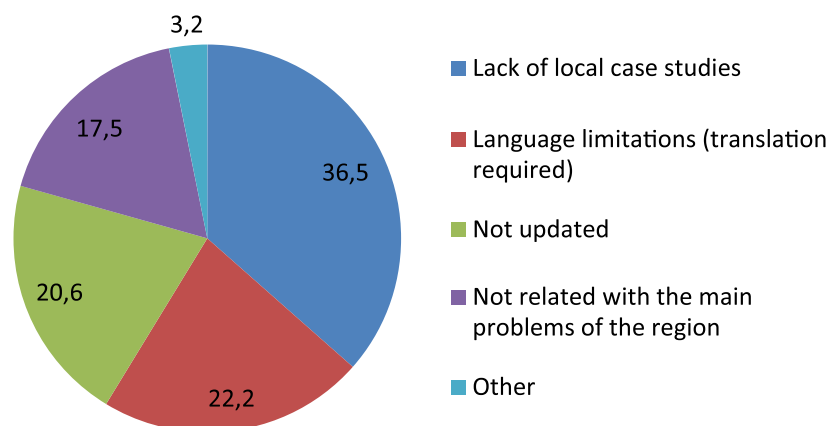
The people who thought that the training was burdening the restoration work, considered as more important educational needs: 1) the practices in the field, 2) the teaching materials, and 3) the engagement of companies, administration and NGO. The lack of resources for Organization of practices is also highlighted. International collaboration is indicated as a point to improve.

## II.2.4. Quality, adequacy and availability of teaching resources



51

**Figure 27.** Are the available teaching materials (bibliographic audiovisual materials) and real-world restoration examples appropriate for teaching? (survey, Annex 1).



**Figure 28.** The main limitations argued by the people surveyed (survey, Annex 1).

The people who thought that an improvement of the materials is necessary, point out that a training with case studies is necessary. It also seems that it is necessary to have manuals in different languages other than English. It also points out as deficiencies the lack of relationship with the particularities of the different regions.

## II.2.5. Network on education and training on landcare

**General objectives and management of the Network (proposal delivered in the workshop on Education and training on land restoration, organized in the Society for Ecological Restoration conference, in Reykjavik, September 2018).**

The overall objective of this network is to improve training capacities on ecological restoration and land rehabilitation in order to a) contribute to a sustainable environmental management and meet international commitments on ecological restoration and, b) to fulfil the demands of an emerging labour market with crucial implications for rural development, promoting a multiplicative effect on green economy. In this context, an overarching priority of this network will be to encourage the involvement and on-board participation of students and early career researchers to increase the long term impact of this capacity building initiative.

This network will enhance international innovative learning opportunities by a) Conveying appropriate knowledge to recover degraded environments, b) Exchanging technical expertise, good practices and teaching materials, c) Promoting collaborative projects on education, training and knowledge transfer, d) Organizing specialized education and training activities, e) Establishing a virtual platform for the exchange of training and educational materials and demonstration field plots.

52

The employability skills will be enhanced by means of collaborations with companies, national and international agencies (internships, training plots, courses), specific training on employability and entrepreneurship of students (cooperation between companies, NGO'S, and specific units at the universities, and promoting links with international platforms such as ILTER...).

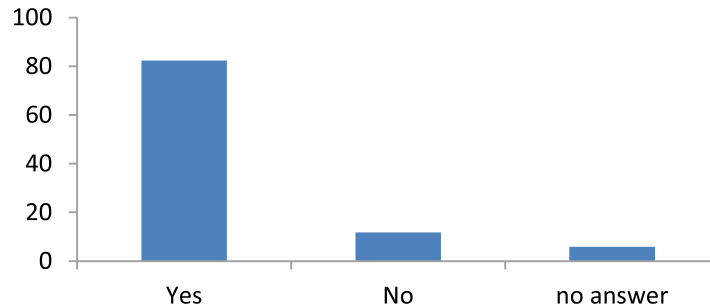
To increase the scope of this strategy, the network pursues to grow on and reinforce the synergies between Universities including teachers, researchers, students, and structures focused on innovative learning and employability; vocational schools; private companies in the field of ecological restoration; NGOs and Volunteer organizations; Research centers; Policy makers (national and regional departments for development).

With respect to its management, this network will be promoted by the European Chapter of the Society for Ecological Restoration and will coordinate efforts with national and international organizations such as scientific institutions, industry and, NGOs. The network will be managed by a working group hosted in the Society for Ecological Restoration (SER):

Specific objectives of the network may be:

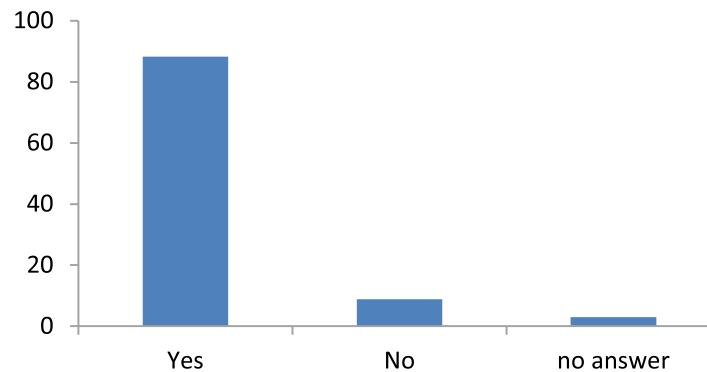
- a) Design and implement the dissemination strategy for relevant training events: webpage hosted in the SER and social networks such as Twitter, Facebook, Youtube Channel.
  - b) Promote the production of training materials and resources.
  - c) Organize workshops on Education at regular SER meetings or other events; give support to the annual official SER training school, and give support to other initiatives,.
  - d) Report the working group in regular SER conferences.
-

- e) Promote collaborative projects in international programs (including ITN, Erasmus + and COST actions).
- f) Design a long-term strategy to maintain, reinforce and enlarge networking effort and synergies with supporting institutions linked through SERE or others.



**Figure 29.** Would you be interested in becoming an active member of an international network for training and education in ecological restoration? (survey, Annex 1).

53

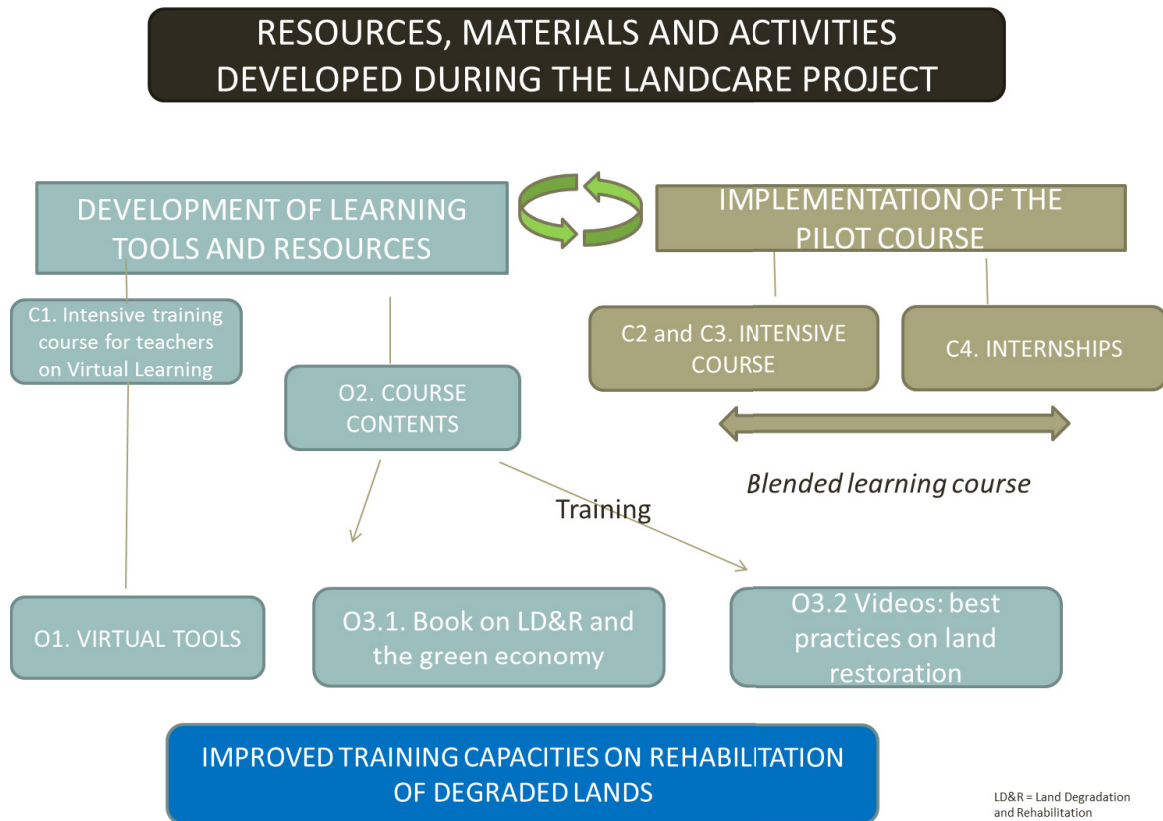


**Figure 30.** Would you be interested in receiving updates on the advances of this network? (survey, Annex 1).

Most of the people interviewed indicate that a network in training and formation can be interesting, and they could be interested in, at least, receiving information.



# Improving teaching capacities in landcare: Resources, materials and activities developed during the Landcare Project



**Figure 30.** Strategy of the Landcare to contribute to improve the training capacities on land restoration.

### **III.1. Training teachers in the landcare project. designing a virtual and personalised environment**

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The aim of the project was to offer participating teachers training related to personal learning environments, networks and other tools that can be used in teaching. At the same time, a bank of materials to promote autonomous learning was created. The materials were especially related to employment and the development of practical skills.

#### **Training for teachers landcare project on the use of virtual and personalised environment**

Pedagogical research related to educational technology points out that technology provides opportunities to improve our teaching when we integrate technology in our daily practices. The learning designs nowadays focus around two major areas:

55

- Technologies can support learning meeting each person's needs. We must always rethink what we do, how we work with our students, what resources and tools we use to support our work, how we integrate ICT in our daily practice, what learning pathways we offer our students. The learning process is open and permanent. We can learn at any time and the training environment is available thanks to technology.
- In the process of learning, context and people are very important. We must take into account that we learn from the context that surrounds us and each person can contribute to his/her own learning. ICT allows the design of practical / hand-on activities that take into account context and interaction with other people.

The ICT possibilities in education are the following:

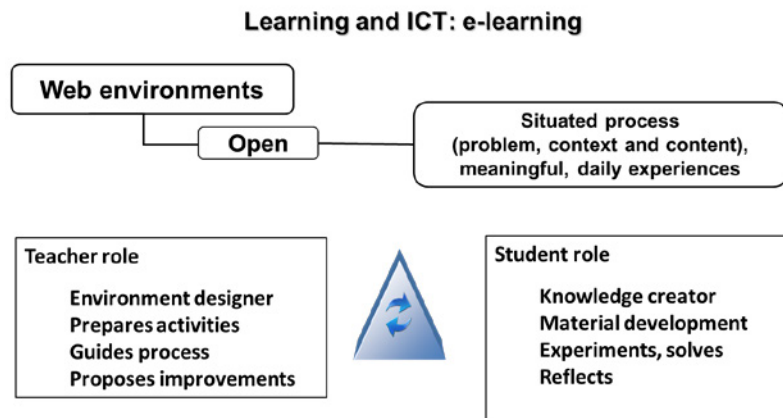
- Internet as Platform (space for interaction, learning and knowledge creation)
- Social software (tools that promote social interaction and allow us to create, modify and public information on the Internet)
- Access from different devices: PC, PDA, TEL, IPOD... (ubiquitous environments)
- Group development of contents on the Internet (from consumers to contributors)
- Network development and virtual communities that share interests, worries and aims.
- Personal Learning Environment development (personalised spaces that integrate resources, tools, interaction networks...)

With these ideas in mind, partners of the Landcare project proposed the design of an innovative training for teachers. The training for teachers implied designing as well a training path for students that would be implemented at different stages.

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## *Innovation in teaching*

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**Figure 31.** Design of the innovative training for teachers proposed by the Landcare partners.

56

### **LANDCARE Course Aims**

1. To receive comprehensive understanding of personal learning environments and networks and other virtual tools.
2. To design of a bank of materials for independent learning in different areas of knowledge especially basic working and employment related fields of materials of practical skills.
3. Implementation of a plan of virtual training of new technological tools for the training. This will allow to the teachers to be more active in their learning process and learn how to create shared understanding.

The courses' contents included:

- Innovation in Higher education: New teaching methodologies with ICT, changes in teacher and student roles
- Personal learning environments and 2.0 web-based ICT application proposals
- e-learning design
- Development of materials for an autonomous learning
- Implementation and personalization of a flexible environment

The teacher training course developed in the Chamilo platform.

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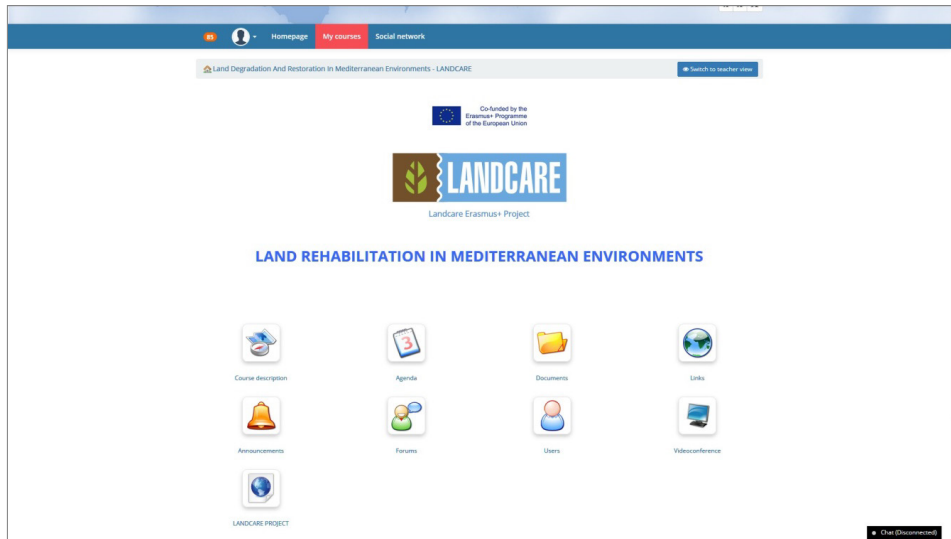


Figure 32. The Chamilo platform. Front page.

57

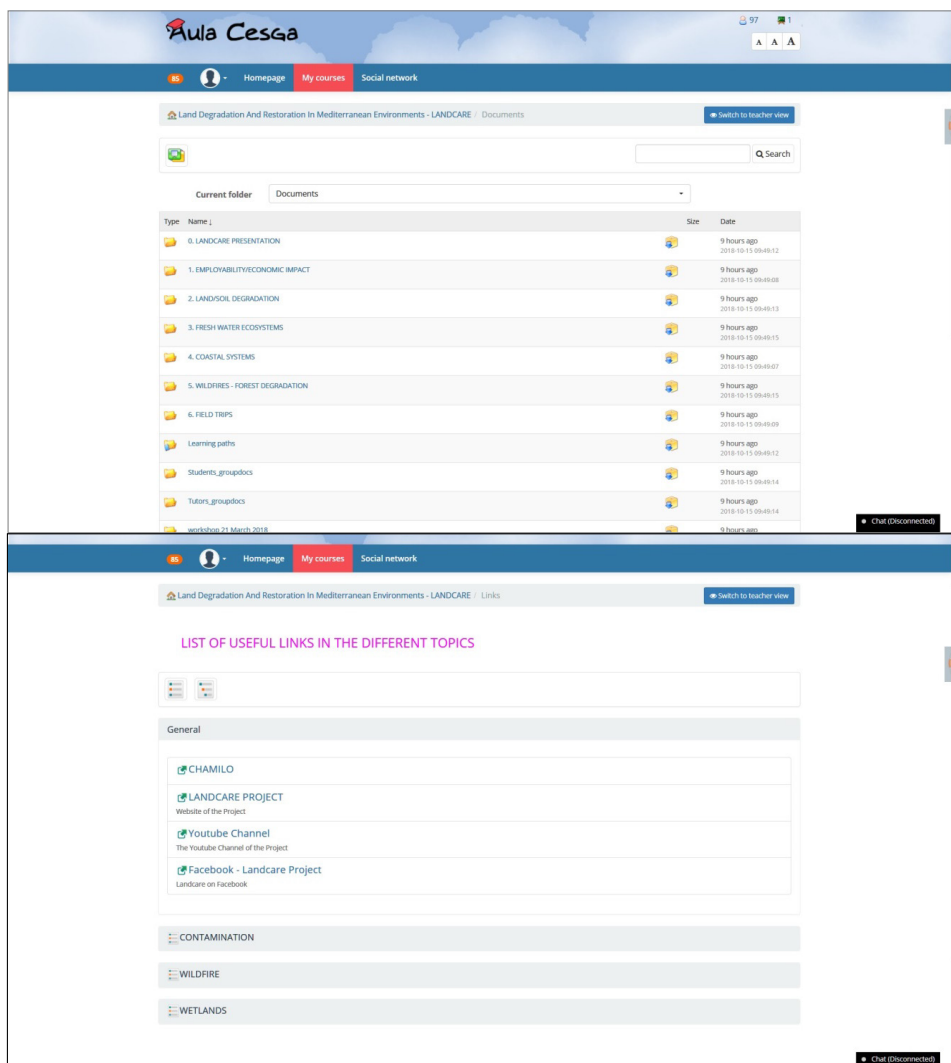


Figure 33. The Chamilo platform. Contents.

The course was divided into three phases:

The first stage took place in December, the second from January to March and the third took place in April. All the aims and contents of the course were able to be completed.

In December training related to personal learning environments, networks and other virtual tools was offered. As well, a virtual training plan was implemented. This plan included new technological tools for training and continued till April. From January to March a bank of materials for independent learning was designed as we shall see afterwards some examples.

STAGES	1st Stage	2nd Stage online	3rd Stage
Date	December	January-March	April
Objetive	1 and 3	2 and 3	3
Contents	1, 2, 3	4, 5	4, 5

58

### Landcare Project Environment

We can find different types of virtual environments when teaching with ICT: the directed environments and the open ones. In the directed environments, we work with structured contents, activities, materials and specified actions that are closed. We ask for correct answers without errors. On the other hand, in the open environments, which is the model that was chosen in Landcare project, we sought to related learning with experience, with daily problems, with daily context so that learning was meaningful. The approach was heuristic, of an exploratory type that allowed multiple perspectives. We learn from our errors.

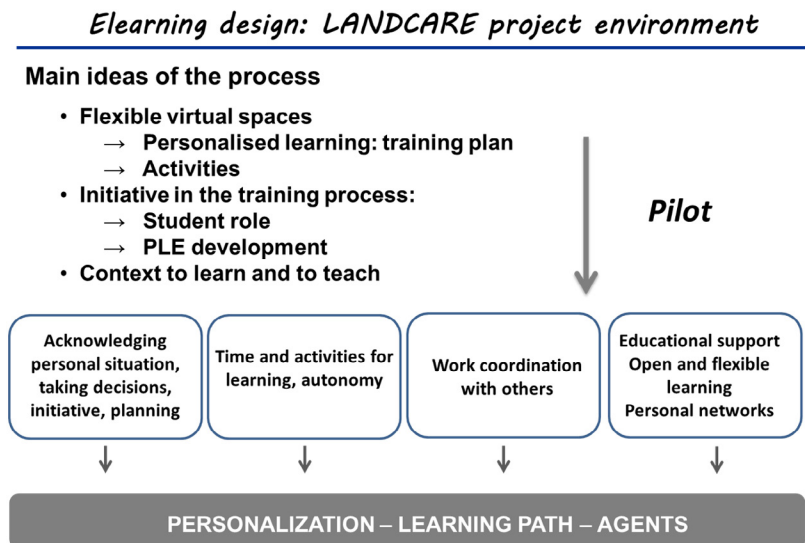


Figure 34. E-learning design: Landcare Project Environment.

During the course we tried to promote students' role as knowledge creators, students had to develop materials, experiment, solve problems and reflect on the work undertaken. Teachers on the other hand, designed the environment, which was an open environment. They also prepared activities, guided the learning process and proposed improvements. Learning was meaningful, related to daily experiences.

The project allowed a greater depth of understanding of concepts, a broader knowledge base, improved communication and interpersonal social skills, enhanced leadership skills, increased creativity and improved writing skills.



Figure 35. Training activity in Santiago, December 2016.

### Pilot course structure

The main ideas of the pilot course were to create a flexible virtual space that allowed a personalised training plan for students. Each student had his/her own learning path. Sometimes by means of autonomous learning, other times, working with others. Students had to take decisions, planning, doing activities but always receiving support.

A total of 3 pilot courses was undertaken: one per year.

### *Pilot course*

To read / to access information	To reflect	To do / To reflect doing
<p><b>Materials:</b> Texts, links</p> <p><b>Activities:</b> Database questions</p> <p><b>Mechanisms:</b> Understanding, structuring</p>	<p><b>Materials:</b> Case study</p> <p><b>Activities:</b> Case analysis</p> <p><b>Mechanisms:</b> Structuring, reflection, dialogue</p>	<p><b>Materials:</b> Video</p> <p><b>Activities:</b> Field work</p> <p><b>Mechanisms:</b> Reality observation research, curiosity, reflection, initiative...</p>
<b>PROJECT</b>		
<p>“a greater depth of understanding of concepts, broader knowledge base, improved communication and interpersonal/social skills, enhanced leadership skills, increased creativity, and improved writing skills “</p>		

Figure 36. Training activity in Santiago, December 2016.

The formative experience for students requires different processes and putting into play different competences in the hand-on activities: working with information, analysing cases and during work field. All this is put into practice in the preparation of the project.

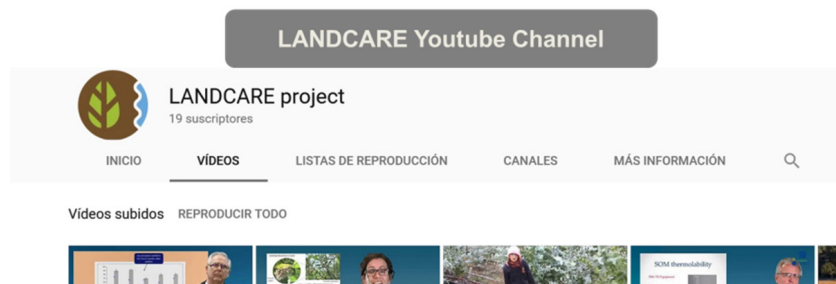
Taking part in an elearning course, involves methodological decisions regarding learning, regarding workload and support. Students had to read/access information so links were provided as well as other materials such as texts. Activities were proposed such as questions to answer. Students had to understand and structure the information.

As well, students had to reflect upon case studies and analyse them. And they had to create videos. During their field work they had to observe their surroundings and reflect upon it. With all the data recollected they designed a script for the video which they themselves edited.

### *LANDCARE Audiovisual Materials*

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1. Professional partners
2. Teaching staff
3. Students
4. Group of students working during the course (“LEARNING BY DOING”)
5. Overview of the intensive course



**Figure 37.** Landcare audiovisual materials developed in the Landcare project.

Audiovisual materials were created during all the pilot course by profesional partners, teaching staff, students by themselves and with other students, which can be seen at the YouTube Channel of the Landcare Project. The materials uploaded to the Channel are free to be used by anyone who wishes.

We'll see now some examples. We have chosen some so you can see the results of the project that we think has been amazing.

#### Professional partners

- Emission monitoring  
<https://www.youtube.com/watch?v=xSifq75aCng>
- Wildfire in Galicia  
<https://www.youtube.com/watch?v=G5ZmRd3vDog>

- Wildfire recovery  
[https://www.youtube.com/watch?v=\\_0lfhVF3T48&t=72s](https://www.youtube.com/watch?v=_0lfhVF3T48&t=72s)
- Cleaning exotic vegetation  
<https://www.youtube.com/watch?v=oqU4BcDLpvQ>
- Stream rehabilitation  
<https://www.youtube.com/watch?v=dcVD1v0xT7k>

### Teaching staff

- Coastal dunes  
<https://www.youtube.com/watch?v=c-HC3HiX4v4>
- Riparian vegetation  
<https://www.youtube.com/watch?v=-Owei1-d3To&t=1s>
- SOM after the wildfire  
<https://www.youtube.com/watch?v=KARiZqhnPd4&t=536s>
- Coastal dunes  
<https://www.youtube.com/watch?v=c-HC3HiX4v4&t=188s>
- Rehabilitation of a riparian forest and a dystrofic lake  
<https://www.youtube.com/watch?v=gKBhVt3bY4g>
- Soil biochemical restoration and monitoring  
<https://www.youtube.com/watch?v=Sc3R4ehn800>
- Dredged sediment valorization  
[https://www.youtube.com/watch?v=Cvo8\\_1uSefE&t=157s](https://www.youtube.com/watch?v=Cvo8_1uSefE&t=157s)
- Phytoremediation of contaminated soil  
<https://www.youtube.com/watch?v=-xoLkoY33pk&t=6s>

61

### Students doing their studies

- Erosion measurements  
<https://www.youtube.com/watch?v=xSifq75aCng>
  - Plantando cara o lume  
[https://www.youtube.com/watch?v=JJ\\_aNFrHgPM](https://www.youtube.com/watch?v=JJ_aNFrHgPM)
  - Soil contamination and decontamination part 1 of 2  
<https://www.youtube.com/watch?v=eKWoaAQ24M9s&t=15s>
  - Soil contamination and decontamination part 2 of 2  
<https://www.youtube.com/watch?v=vlj2EKEAI-Q&t=67s>
  - Dredged sediment decontamination and reuse  
<https://www.youtube.com/watch?v=oZ2bcej7Rp4&t=24s>
-

### Group of students working during the course

- Contamination  
[https://www.youtube.com/watch?v=J-ys2y\\_2sd0](https://www.youtube.com/watch?v=J-ys2y_2sd0)
- Wildfire  
<https://www.youtube.com/watch?v=UtdN6o9Rg4E&t=38s>
- Wetland  
<https://www.youtube.com/watch?v=dk0cUv7Mu8c&t=109s>
- Coastal erosion  
<https://www.youtube.com/watch?v=8cHSeivLPDc>
- Contamination  
[https://www.youtube.com/watch?v=J-ys2y\\_2sd0&t=61s](https://www.youtube.com/watch?v=J-ys2y_2sd0&t=61s)

62

## **III.2. Exchange of good practices on landcare**

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Restoration of degraded lands in response to ecosystems degradation is a relatively new science so teachers need to keep updated on the state-of-the-art knowledge and innovative techniques in order to both provide best training and engage students in active learning. In addition, the fact that ecological restoration stands in the interface of several natural sciences and engineering requires hands-on in real world case studies to permit an effective evolving growth and development of teaching capacities. Exchange of good practices across the Landcare Project addressed these principles and Landcare Teachers took responsibility for their continuous improvement.

The Exchange of Good Practices on Landcare project included two dimensions: exchange of pedagogical approaches and exchange of best practices in land restoration.

### **III.2.1. Exchange of good practices in pedagogical approaches**

#### **Designing the Virtual Technological Resources**

This activity was developed during the entire life of the project. The basis was a virtual interactive platform where the tool structure, the type of content and the interaction channels (blogs) were discussed in the seminar held in Santiago (2-3 December, 2015). Afterwards, all the teachers participated in the final structure and uploaded the materials to the platform during the realization of the different courses. The main results of this experience were presented in the open multiplier event held in Lisboa (E1, 26-27 October 2017). For this purpose, the event included a dedicated Session on "Training Resources in Land Degradation and Rehabilitation" with presentations topics as "A flexible Personal Learning Environment to foster learner-centred pedagogical approaches in Land Rehabilitation" and "Online Learning Tools encouraging interaction between learners, educators and the wider public".

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### ***Designing Intensive courses (Lugo 2016, Naxos 2017, Pisa 2018)***

This activity relied on a fluid collaborative work among teachers and enable to put in practice innovative teaching approaches. After the meeting held in Santiago (1<sup>st</sup> December, 2015), where the organization of those Intensive Courses was outlined, a very intensive exchange activity evolved among the teachers to design and implement the strategies and materials to be tested in the intensive courses. For each of the three events, specific collaborations were established, between the host partner and the visitor teachers, to design and develop the field practices. These collaborative activities included the following:

#### **i. Prior to the courses:**

##### coordination of schedule and teaching contents

- design of techniques to undertake interactive classes shared by professors from different institutions by performing exposition of topics interspersed with discussion and student intervention,
- design of strategies to motivate student participation. In the class, this included coordinated presentations of students from each country illustrating land degradation challenges of their own regions. In the field, this included identification of “topic leader students” responsible for guiding and teaching their peers in specific tasks,
- design of field trips integrating host and incoming teachers expertise: the host provided information in advance about facilities, itineraries and environmental data about the target visits and the incoming teachers collaborated in the design of the field practices according to their respective expertise,
- design of laboratory practices: with the help of the laboratory units, the student carried out some measurements that were evaluated. The training included the update equipment to assess soil and water contamination and certain biological properties.

63



**Figure 38.** Strategy for mine reclamation, Portugal, October 2017.

ii. During the courses:

- implementation of the class and field approaches designed,
- adapting to the on-the-ground conditions in the classroom (student interests, and specificities),
- incorporating opportunities to impact with other stakeholders. During the course there were important interactions with different stakeholders of the region where the course was held. Local and regional politicians, companies focussed on the environment, research centres, teachers from others universities, primary and secondary school),
- experiencing novel evaluation methods across the project (preparation of written reports in 2016; participation in “topic leading” class and field activities in 2017; elaboration of educative videos in 2018).



64

**Figure 39.** Meeting of educator in the pilot course held in Lugo, April 2016.

***Good Practices on Education: Learning Innovative Tools (MOOC)***

On the main challenges of the project was to record and edit educative videos as this was a completely novel tool for most of the participant teachers. After a first training given by the USC (2016), the different partners were able to start creating and developing their pedagogic materials. In addition, during the intensive courses all the partners participated to design, record and edit different videos taking advantages of the study cases in each region. Presentations of the results was given in the open events of Lisboa (2017) and Santiago (2018). In addition, a training “Learning Innovative Tools (MOOC)” was offered in the event of Santiago in July 2018.

***Good Practices on Education: employability and entrepreneurship skills.***

The first activity was carried out in 30<sup>th</sup> of November 2015. The head of the employ unit of the USC gave a short introduction of these subjects. During the intensive courses, the teachers were invited to attend the presentations given to the student by the head of the employment

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units of the different universities. In addition, the teachers participated in the practical training on entrepreneurship offered (CANVAS) to the students in the intensive course. In the event of Santiago (July 2018) a short training was offered.

## II.2.2. Teaching land restoration: Exchange of good practices

During the Project the diverse partners participated in the activities carried out in the classroom, laboratories and field trips with the host organizer or each event. One of the great advantages of this approach was that both academic and professional partners had access to the most updated technologies in the different fields. They also had the opportunity of learning the different strategies carried across regions, and to discuss their challenges by comparing similar issues across the Mediterranean region and also contrasting differences from the point of view of geography, climate, socio-economy and others.

65

### Good practices on rehabilitation after wildfire

In these activities, the following people were involved: a) the partners focused on restoration after wildfires (USC and CIF Lourizan), b) people from the Ministry of Greece (Miltiadis Athanasiou) and the University of Pisa (Andrea Bertacchi), who participated actively both in classroom and in the field trip's activities and c) specialists from the University of Porto, CNR-Firenze and Swansea University, who participating in the handbook as contributors.

The specific sessions about it were held on Monte Pedroso (1<sup>st</sup> of December and intensive course), Naxos island (course in Naxos), Monte Pisano (Course in Pisa) and Monte Faro (second multiplier event).



**Figure 40.** Visit to a burnt area with the CIF Lourizán staff, December 2016.

## Good practices on rehabilitation after wetlands

The participants on this topic included: a) the LandCare partners focused on restoration of wetlands (ULisboa, EDIA), b) researchers from the University of Santiago de Compostela (IBADER and Hydrobiologic Station Encoro do Con) who collaborated in field practices and demonstration of river restoration techniques; c) researchers from the University of Pisa who provided access to Experimental site; d) The protected area of San rossore who provided staff and conditions support for the development of classes an field practices in wetlands inside the protected area.

The specific sessions about this topic were held on River Miño, in Galicia, NW Spain (2016 intensive course), in Naxos island (course in Naxos, 2017), in the Lagoa Pequena, Setubal, Portugal (Multiplier Event in Lisbon, 2017), in S an Niccolo and Parco de San Rossore (Intensive Course in Pisa, 2018) and in the restored Mine of As Pontes (second multiplier event, Santiago de Compostela, 2018).

66



Figure 41. Designing a practice on wetland, July 2017.

## Contamination

The participants on this topic included: a) the LandCare partners focused on restoration of contaminated soil (CNR, West Systems), b) the company owner for marble quarries the manager of Emery mines, and the responsible for waste treatment at Naxos island (Greece, 2017, Intensive course); c) the managers of As Pontes Mine Galicia) that provided access to the Restored space d) Legoli landfill, Belvedere S.p.A'.

The specific sessions about this topic were held in Naxos island (course in Naxos, 2017), the SECIL property, Setubal, Portugal (Multiplier Event in Lisbon, 2017), and As Pontes Mine (second multiplier event, Santiago de Compostela, 2018).

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**Figure 42.** Designing a practice on soil contamination, September 2017.

### **Coastal degradation**

The participants on this topic included: a) the LandCare partners focused on coastal degradation (University of Athens and the NGO Archipelagos b) the Corrubedo Natural park staff (during the first meeting in Santiago de Compostela, and the responsible for waste treatment at Naxos island (Greece, 2017, Intensive course); c) Staff of San Rossore, in Italy.

The specific sessions about this topic were held in Naxos island (course in Naxos, 2017), in the Parque Natural de Arrabida, Setubal , Portugal (Multiplier Event in Lisbon, 2017), and in the Natura 2000 site of Costa Artabra (first transnational meeting Santiago de Compostela, 2015), and in the wetlands naturally fed.



**Figure 43.** Educative paths in the As Pontes mine, September 2017.

### III.3. Teaching, resources and materials developed during the Landcare Project

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#### III.3.1. E-Learning tools

E-learning is defined as instructions delivered on digital devices to support learning (Clark & Mayer, 2016). Many tools are used to support e-learning, which are commonly referred as "Educational Technology": "The tools used in formal educational practice to disseminate, illustrate, communicate, or immerse learners and teachers in activities purposively designed to induce learning" (Garrison & Anderson, 2003).

**E-learning courses** include information but also techniques, to help people learn. This is accomplished with the use of various material (text, images, videos, handbooks etc).

68

There are two main forms of e-learning:

- **Asynchronous.** This form of e-learning is designed for self study of a course, where the student can train at any time, from any place around the world.
- **Synchronous.** This form is designed for real-time training, where a tutor is present (video-conference etc).

The use of technology for learning has some advantages over the typical form of learning:

- Tutors from around the world can cooperate more efficiently, producing a better course.
- Students have access to the course, independent of their location.
- Students have more time to digest the information, and so students of different levels can participate in the same course.
- Communication is easier between tutors and learners.
- The use of multimedia material, helps novice people to learn more efficiently (Clark & Mayer, 2016).
- The use of new technologies can motivate the students to participate in the course more actively.

These days, everyone has access to the Internet, and so e-learning is more important than in the past. This trend will continue, as technology and distant learning capabilities progress.

**LD&R education** is no exception in this trend. It requires learning through real cases, constant updating of knowledge and technologies. Landcare Project focused on **improving teaching and training capacities**, in LD&R, in Southern Europe, to fulfil the demand of an emerging labour market through the enhancement of people's **employability skills** and to contribute to the economy of the region. The required **training** of teachers, staff and students was achieved by combining traditional education methods, sharing of expertise, innovative online learning,

---

short-term international mobility, enhancements of employability skills through blended mobility and synergies between students, educators, researchers, university structures, companies/agencies/NGOs and decision-makers.

The key component of this training is the **online platform**, which was developed in stages during Landcare (2015-2018). This platform is **open access**, and is used for the integration of different technological applications with pedagogic use for the **delivery of interactive courses**.

**The platform** has been already tested on university students that used it during their participation in the Intensive Programms and also in the Internships. For this reason, during the project's duration three separate Learning platforms have been created in the open access platform **Aula Cesga** (<https://aula.cesga.es>), each one dedicated to an Intensive Programm. After this testing period the final form was decided and on the same open access platform, the final Learning Platform was created. This can be used by **online users**, including students, teachers, employees or any other person that has an interest in LD&R.

69

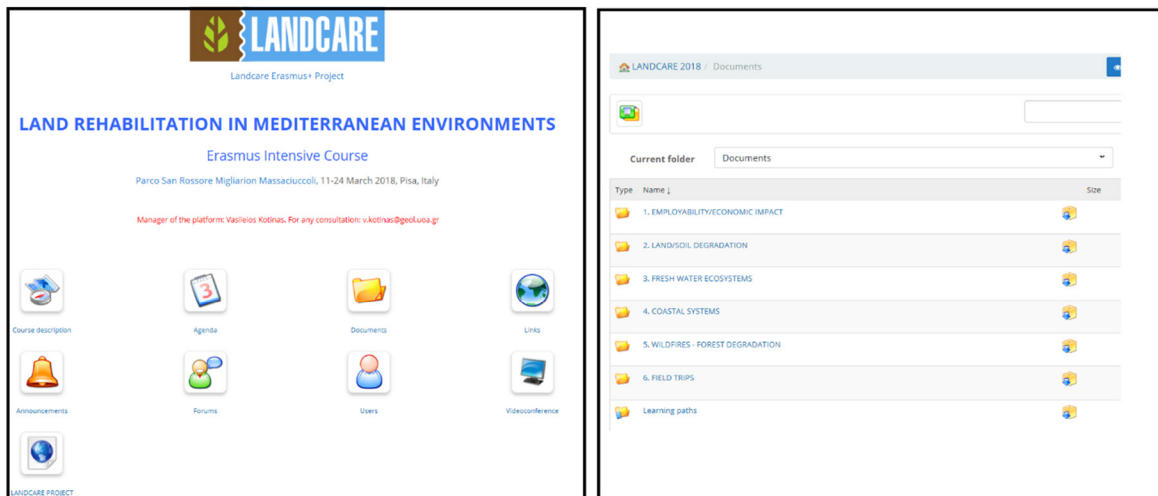
**A digital repository of material** has been created including all the teaching material produced during the project's duration. This material was produced by people all around the Mediterranean region, after exchanging thoughts and their expertise. It was thoroughly checked through the Intensive Programms that were organized during Landcare Project, and all the necessary changes were incorporated to produce the final material.

The material in all the versions of the Learning platform was divided **in thematic categories** that can be presented in an interactive way. The **thematic categories** are related to Land Degradation and Restoration (LD&R) and are the following:

- Wild Fires - Forest Degradation
- Coastal Systems
- Rivers - wetlands
- Land - Soil Degradation
- Contamination

For each of the 5 thematic categories the following **type of material** has been produced, was tested during the testing period and is available in the final form of the Learning Platform, under the documents section (Fig. 1):

- Textbooks
  - Presentations
  - Online exercises
  - Field trip guides
  - Multimedia material (videos, photos)
  - References for further reading
  - External links
-



**Figure 44.** Available tools and organization in thematic categories of the available material, in the E-learning Platform that is available at <https://aula.cesga.es>.

70

The online platform can be used as a place of **communication and exchange of good practices** between teachers, staff, students and any person with interest in LD&R. The extensive use of interactive tools promotes and facilitates this process. The **interactive tools** that were tested and are used are the following:

- Forum
- Videoconference
- Chat
- Assignments
- Groups
- Surveys
- Dropbox

The **online learning environment** was tested during the 3 Intensive Programs, making improvements where needed, to produce the final version of the platform that is available to online users. Any person that is interested in LD&R can use **this online learning environment**, to have a proper training on LD&R, improve their employability skills on this field, and build a stronger professional profile on an emerging labour market.

### III.3.2. Handbook on Best Practices

A large part of the Mediterranean region is affected by land degradation caused by anthropogenic pressure (overexploitation of agricultural and forest land, invasive tourism, wildfires, pollution, and desertification). The degradation is a challenge to the sustainable use of land and affects the provision of important services (food, water, biodiversity, wood, etc.) as well as the livelihoods of the inhabitants. This process has a strong effect on the region, where

part of its economy (agriculture, fishing, tourism) and vital needs (food, water) depends on the conservation of its natural resources (EC, Land Degradation and Desertification). The European Directive 2011/2307(INI) "Our life insurance, our natural capital: an EU biodiversity strategy to 2020", includes as an objective for 2020 the restoration of at least 15% of degraded areas.

The application of appropriate knowledge and techniques can be used to recover disturbed land. However, land Rehabilitation training requires constant updating of knowledge and technologies, as well as study with real cases.

For its strong impact of economy and environment, land rehabilitation is generating an emerging labour market. According to European Directive 2011/2307(INI) "actions to restore ecosystems and biodiversity have significant potential to create new skills, jobs, and business opportunities". However, despite this demand and the opportunity to increase employment, there is a considerable shortage of skilled workers in this field. As a reflection of this problem, the "Green Employment Initiative" has been recently launched by the European Commission.

The current handbook is the result of a three-year Educational project in Southern Europe (2015-1-ES01-KA203-016214), whose overall objective has been to improve teaching and training capacities in relation to Land Degradation and Rehabilitation (LD&R) in this area to fulfil the demand of an emerging labour market and to contribute on to the economy of the region. The material shown is different study cases of best practices discussed by the teachers, managers and students.

71

### **Characteristics of the handbook**

The handbook was designed to gather most updated knowledge on land degradation processes and strategies of land restoration. It is focused on the main environmental problems of Southern Europe: overexploitation of agricultural and forest lands, pollution, wildfires, coastal degradation, and wetland-aquatic systems. One chapter for each of these topics is devoted. These chapters have a common structure: a) a general background explaining land degradation processes and well-tested techniques of land rehabilitation and b) a series of selected study cases which show the application of technologies and tools in different regions.

In addition to these previous technical challenges, one of the chapters is devoted to addressing the impact of land degradation and the advantages of rehabilitation for the development. In this chapter, the conflict between the economic growth and sustainable is discussed, along with other key question that we have to address to carry out a more sustainable activity: the assessment of the ecosystem services and the need of taking into account the ecosystem services in the decision making process.

Finally, in the last chapter, the progress in the "green entrepreneurship" sector in the countries participating in the Landcare project is assessed. On one hand, land degradation affects the primary sector, which has a strong impact on the GDP of the participating countries. However, despite these problems, new business opportunities have arisen in recent years as a result of the application of new technologies and of the increased environmental awareness. Such opportunities can be converted into strategic actions to promote innovation and entrepreneurship. The universities play an important role in this process: a) Promoting the spirit of entrepreneurship, thus providing new business opportunities, b) Supporting innovation in the traditional primary sector, by presenting technological drivers and c) Providing help to professionals who wish to become involved in this sector.

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### III.3.3. Videos

The LANDCARE educational paths have been based on a blended learning approach, combining intensive face-to-face with e-learning tools. The teacher provided the best multimedia resources to complement the core content and extend or reinforce the learning. With blended learning, the emphasis is, in fact, on **active** and **interactive** learning approaches, independent and collaborative assessments, and learning beyond the classroom walls.

In particular, educational videos addressing the project topics have been integrated in the LANDCARE blended courses as a highly effective information-delivery mechanism.

The Erasmus students recorded and edited some videos, as assignment, related to the field work experiences of the intensive courses. In particular, during the field activities of the course 2018 in Pisa some videos related to the four topics of the LANDCARE project were prepared. These videos were recorded in the landfill of Legoli for "Contamination", in the San Rossore park for "Costal erosion", in Monte Pisano for "Wildfire", and finally, in Massaciuccoli lake for "Wetland". The students found the preparation of the videos enjoyable and more satisfying and motivating than traditional learning. They also reported that the video preparation helped them to advance their technology skills and enhance their teaching and learning experience.

72

Similarly, the project partners (teachers and private companies) created some learning videos according to their own skills and knowledge combining the PowerPoint slides with footage, still images, animations, or other media useful to make their videos more visually interesting. They filmed activities and scenes from different perspectives to obtain a structure able to get the student's attention or raise their curiosity.

#### *Scheme of the landcare video:*

- Start with the LANDCARE project (logo, Title, some pictures, etc.) (5-10 sec)
- Title of the study (5-10 sec)
- Introduction (30 sec)
- Objectives (20-30 sec)
- Describe the experimental layout in an easy-to-follow and step-by-step format (2-3 minutes)
- Show the video footage of the degradation/rehabilitation case study (3-4 minutes) and record yourself talking about it
- Conclude with the main results of the study and some study questions (30 sec)

#### *Tutorial for video editing*

- Movie maker tutorial  
In English: <https://www.youtube.com/watch?v=7GREeD2icUo>  
In Spanish: <https://www.youtube.com/watch?v=YXEksrnUDzU>  
In Italian: <https://www.youtube.com/watch?v=rLrc7n8j-NY>  
In Greek: <https://www.youtube.com/watch?v=WWBidugHesI>  
In Portuguese: <https://www.youtube.com/watch?v=fs2MAOITJwE>
-

- IMovie tutorial (for MAC)  
In English: <https://www.youtube.com/watch?v=U63GULMOTcc>

A total of 28 videos have been developed by the project partners (teachers and private companies) and by the students. These videos are about the four topics of the LANDCARE project.

In the videos concerning "Contamination" topic some case studies related to the remediation of contaminated soils and sediments by biological techniques were described. In addition, the recycling of decontaminated sediments in nursery activities was presented. Finally, a video about a "special" landfill in Legoli that in addition to the waste disposal activities, lies in the production of energy from renewable sources, both solar and wind power and a video about the methodology for the evaluation of CO<sub>2</sub> emission from soil were recorded.

For the topic "Costal erosion" some videos which describe the general issue, the main causes of costal erosion and the methodology to evaluate it, the risk assessment and the activity that should be carried out to contrast the erosion were prepared. In these videos several images and movies of costal erosion were reported, as an example the Costal Zone of Marathon in Attica (Greece) was described.

73

In the case of "Wildfire" topic some videos pointed on the thermal analysis to diagnose organic matter in soil and plant and several examples of its application were prepared. Other videos describe two relevant wildfires occurred in Galicia and Montefaro Chantada (Spain); the activities to limit the fire, the environmental impact of the wildfire, and the activities to contrast soil erosion were described in these videos.

For the "Wetland" topics the videos prepared regard: a general overview of the riparian vegetation for ecological restoration, the rehabilitation of a riparian forest and a dystrophic lake in Lugo (Spain) and of a stream, the cleaning of exotic vegetation, and the runoff and erosion measurements in northern Portugal.

The dissemination of the formative videos through internal links in universities, social media and public web sites have contributed to obtain a larger audience on the LANDCARE courses and project outcomes.

#### YOUTUBE

<https://www.youtube.com/channel/UCprzqDSEKrGiYkyzTh7DZdQ/videos>

#### FACEBOOK

<https://www.facebook.com/landcareproject/>

#### Principles for maximizing student learning from video content

- Keep videos brief and targeted on learning goals
  - Use audio and visual elements to convey appropriate parts of an explanation
  - Use signaling to highlight important ideas or concepts
  - Use a conversational, enthusiastic style to enhance engagement
  - Embed videos in a context of active learning by using guiding questions, interactive elements, or associated homework assignments
-

Same examples:

Presentation in the recording study: <https://youtu.be/-Owei1-d3To>



74

Application of restoration techniques in real cases: <https://youtu.be/c1b7J09V7tw>



Videos recorded by the students, as a part of their learning and evaluation: [https://youtu.be/J-ys2y\\_2sd0](https://youtu.be/J-ys2y_2sd0)



## III.4. Applying and improving the resources and materials in the Intensive Training Courses

### III.4.1. Student selection

The academic partners were in charge of the selection of their own students. Between 3 and 5 students of each university was selected. In addition, the organizer could also invite 3-5 recently graduated.

The dissemination was carried out using the mailing lists of the universities, the social media and presentations in different faculties. The selection criteria included personal motivation and level of knowledge in related subjects and languages (English and others).

75

**INTERNATIONAL COURSE**  
**LAND REHABILITATION IN MEDITERRANEAN ENVIRONMENTS**  
Pisa (Tuscany) Italy, 11-24 March 2018 + 1 month internship abroad in a company

Co-funded by the Erasmus+ Programme of the European Union

**COURSE OUTLINE**

- Classroom sessions and online teaching within an integrative learning approach
- Field and laboratory practices with case studies and real world project
- Language of the course: English
- Internship in a company ABROAD

**Topics**

- Freshwater ecosystems
- Coastal areas
- Contaminated soils
- Wildfire areas

**Academic management:** Erasmus Certificates: for course (6 ECTS) & internship (1 month)

**TRAINING BY**

**Universities**  
University of Santiago de Compostela (Spain), University of Lisbon (Portugal), National and Kapodistrian University of Athens (Greece), National Research Council (Italy)

**Companies**  
Forest Research Centre Louizán (Spain), West Systems (Italy), EDIA (Portugal), Archipelagos (Greece).

**Student Selection:** 4-5 Bachelor or Master students per country

- CV evaluation & interview
- English mandatory (minimum B2)

**Funding and Support:** Travel and accommodation covered by Erasmus+ Program

**More information:** <http://landcare.es/>; <https://www.facebook.com/landcareproject>  
Grazia Masciandaro CNR-ISE, Via Moruzzi 1, 56124 Pisa  
e-mail: [grazia.masciandaro@ise.cnr.it](mailto:grazia.masciandaro@ise.cnr.it)  
APPLICATIONS before 8 December 2017 sending the CV by e-mail to Grazia Masciandaro and Cc: [serena.doni@ise.cnr.it](mailto:serena.doni@ise.cnr.it) (Italy); [terferreira@isa.utl.pt](mailto:terferreira@isa.utl.pt) (Portugal); [agustin.merino@usc.es](mailto:agustin.merino@usc.es) (Spain); [v.kotinas@geol.uoa.gr](mailto:v.kotinas@geol.uoa.gr) (Greece)  
Object of the e-mail: LANDCARE STUDENT SELECTION

Figure 44. Dissemination material for the pilot course in Pisa, March 2018.

### III.4.2. Teaching in the classroom

Teaching of the classroom took the advantage of the international environment. The teaching combined presentations of the general concepts (30 min aprox.) and presentation carried out by the students.

For this, the students were distributed in four international groups and each group was focused on specific topic (wildfire, water, coastal areas and erosion). The student presentations were focused on specific problems of their respective countries. Showing the consequences of the problems and the most usual mechanism to prevent or correct the environmental degradation. After this presentation, a debate is promoted.

To complement this task, an specialist of the country is invited. They were teachers from the local university or practitioner of the country.



**Figure 45.** Presentation of Landcare students, in Naxos and Lugo.

### III.4.3. Practices in the laboratory and in the field

76

All the editions the course include 4-5 days in the field. Each day was usually devoted in one of the topic of the course. The different visits were led by regional specialists, usually managers with wide experience in the implementation of restoration techniques.



**Figure 46.** Participative training in San Rossore Park, Pisa, 2018.

### III.4.4. Students tasks and evaluation

During the course all the student should develop a presentation and contribute to other presentations.

The final exercise varied in the different editions. In the first one, all the students submitted a study case about a problem selected. In the second edition, the students participated actively in the recording of four different videos during the field trips; they led the explanation of the processes and organized interviews.

In the last edition, the students edited one video for each of the four topic.



Figure 47. Landcare student interviewing the owner of a mine.

## III.5. Blended education in Landcare

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### III.5.1 Learning about post-fire treatments in the landcare project. University of Santiago de Compostela and Forest Research Centre of Lourizan

Although wildfires have a long history in the Mediterranean and neighbouring Atlantic coastal regions, from the 60's a dramatic increase in fire activity has taken place. Human activity is a major driver of wildfires; afforestation schemes with flammable plantations, the encroachment of shrubs after rural depopulation and urbanization close to forests are identified as main causes. In addition, there are evidences that the global warming favours the occurrence of fires and increased their intensities.

Wildfire causes severe disturbance to ecosystems, increasing erosion, sediment transfer to surface waters and nutrient depletion. Different ecosystem properties and functions, such as ecosystem structure, microbial dynamics and nutrient and cycles, are strongly affected, with strong negative consequences not only for the environment, but also for the economy and rural development.

During the LANDCARE project a group of specialists from four countries have being working to design a series of activities and materials to improve the teaching capacities about this important topic. About the materials, we have written a handbook chapter explaining the main degradative processes and the most common techniques for soil conservation after wildfire. Both educators and students have also recorded different short videos. These materials have been used in three international intensive courses, carried out in Spain (Lugo), Italy (Pisa) and Greece (Samos Island) and in a field trip in Portugal (Lisbon).

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The teaching in the classroom was carried out by promoting the active participation on the students and the participation of teachers from different countries and backgrounds. In the field trips the students developed different practices in burnt areas to learn the about the different strategies of soil conservation. All this learning was applied in internships carried in two professional partners of the Landcare Project, in Greece (Archipelago, NGO focused on environmental conservation) and in Spain (Forest Research Center of Lourizan, focused on wildfires).

The practices were focused on the evaluation of the effects of wildfires of different severity on forest ecosystems (soil-plant systems) as well as to study the implementation of different emergence rehabilitation techniques (seeding and mulching): their efficacy to control post-fire erosion as well as their effects on soil quality.

The students participated in different studies under field conditions in experimental areas affected by fires of different level of severity: wildfires and prescribed or experimental fires and the results of numerous soil burnt properties and vegetation cover as well as the erosion were measured and compared with the corresponding unburnt control soils. The students understood that wildfire effects and the recovery of soil-plant system are variable depending mainly on fire severity. With respect to post-fire stabilization treatments, the students learned that that the straw mulch was the most effective emergence treatment to control post-fire erosion since they reduce soil losses around 70-90% and have no effects on soil quality. Based in this information, the students should predict if the ecosystem will have any chance to recover by means of natural mechanisms, such natural vegetation. They students should be introduced in the techniques usually employed to avoid soil degradation. It is important to understand that the application of these techniques is usually costly and require of a previous planning.

78



**Figure 48.** Landcare activities in the burnt areas, in Samos 2016 and Naxos, 2017.

### III.5.2. Teaching experience in landcare for native vegetation conservation. University of Lisboa and Empresa de Desenvolvimento e Infraestruturas do Alqueva (EDIA)

#### INTRODUCTION: EDUCATIONAL APPROACH

Education for ecological restoration within current environmental threats is such a broad endeavour that it requires the full involvement of different educational organizations and civil society while exposing students to real-world problems. In Natural sciences, case-based teaching enables students to develop skills in analytical thinking and reflective judgment by reading and discussing complex, real-life scenarios.

The case studies involved the characterization, assessment, and design management proposals of Mediterranean vegetation with a special focus on riparian ecosystems. The main principles followed in the educational approach comprised 1) identification of the study problem and discussion of goals through interaction of students and educators; 2) learning of general principles of ecological restoration and scientific tools while applied to the case study; 3) field sampling to characterize plant communities degradation across areas subject to different pressure intensity; 4) collaborative online database creation and data analysis; 5) elaboration of proposals; 6) the assessment of outputs for management and environmental education jointly with students, educators; 7) the incorporation of proposals for environmental management and environmental education activities.

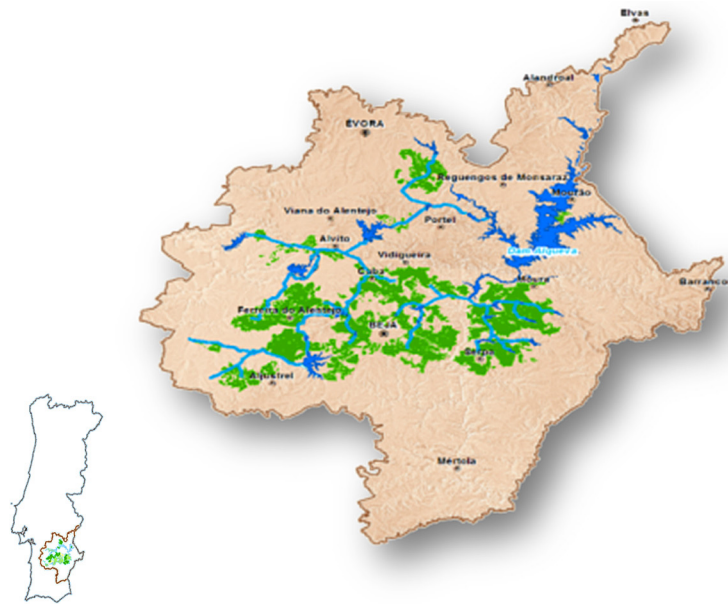
79



Figure 49. Landcare activities in wetlands.

#### CONTEXT OF THE CASE STUDIES: THE EFMA AND ALQUEVA PROJECT

EDIA (Empresa de Desenvolvimento e Infra-Estruturas do Alqueva, SA) is the proponent and manager of the Alqueva Multipurpose Project (EFMA Project), located in Alentejo region, Southern Portugal. The project involves abduction and water storage infrastructures, as well as infrastructures to improve irrigation areas with the intention to expand the irrigated intensive agriculture practice up to 120 000 ha in the region. This large scale project involves impacts particularly in the hydrographic basins, wetland ecosystems and streams in the affected area.



**Figure 50.** Location of the EFMA Project.

The land use intensification translates into greater use of resources and factors of production, resulting in profound changes in the pre-existing extensive agricultural and agroforestry ecosystems. More intensive crop exploitation regime and greater extension of irrigated areas (particularly monoculture), increased the environmental impacts of agricultural activity. The spatial dimension of the Alqueva Project which is affecting substantial part of the region, requires the implementation of measures that minimize or mitigate the related negative impacts emerged. Moreover, these measures might contribute to counteract the negative social perception on irrigated agriculture. In addition, the streams mitigation impacts is a recurring theme related to the Environmental Impact Assessment procedures, namely through the legal obligation referenced in different Environmental Impact Declarations issued for the Alqueva Projects.



**Figure 51.** Examples of impacts in the hydrographic network.

## INTERNSHIP PROGRAM OF THE EFMA PROJECT

### **Hosts:**

Department of Environmental and Patrimonial Impacts (Departamento de impactos Ambientais e Patrimoniais) of Alqueva Project, EDIA, as a partner of the Project, proposed internships for Landcare students during the three years of duration of the project.

### **Number of students received:**

The company received a total of nine students, coming from Universities of 3 different countries, Spain (4 students) Italy (3 students) and Greece (2 students). The figure 3 illustrates the academic and professional partners.

### **Themes developed:**

The proposed internships focused mainly in streams degradation, rehabilitation and management and minimization measures of environmental impacts caused by intensive agriculture (conversion of extensive to irrigation farming). Some of the topics included:

- Water Framework Directive and its application in the EFMA water bodies
- Environmental impact assessment
- Promotion and conservation of nature values
- Challenges for the conservation of European priority habitats (Habitat Directive) such as temporary ponds
- Restoration measures applied on river systems especially on riparian habitats
- Analysis of the effect of management measures on riparian habitats, temporary ponds and agrosystems
- Environmental education

81

### **Organization of the internship:**

Each student had a training programme, assigned tasks and responsibilities to match and stimulate their their knowledge, skills, competencies and training objectives. During the development of practices, students did their stages and works concerning to environmental impact assessment background; analysis of the environmental impact declaration measures and promotion and conservation of various environmental aspects, however, each of the trainees worked on a specific topic who translated into the development of nine projects (see below).

### **Projects developed by the students:**

- 1) *Promoting farmers awareness about the importance of good agricultural practices adoption and a support in environment sensitization area.*

Stage period: 3<sup>th</sup> September to 3<sup>th</sup> October 2016

Trainee: Pietro Bertolotto (University of Pisa, Italy, Agronomy background)

The main goal of this project was producing a framework to promote farmers awareness on the importance of good agricultural practices especially with respect for freshwater ecosystems

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present in the area such as temporary ponds (priority habitats under the Habitat Directive) and riparian habitats. It also included dissemination to farmers on the importance of keeping soil fertility and of a water sustainable management.



**Figure 52.** Practical activities in EDIA: Promoting farmers awareness.

82

2) *Guidelines for the drainage system maintenance and recommendations proposal for the maintenance of the drainage system*

Stage period: 5<sup>th</sup> to 30<sup>th</sup> September 2016

Trainee: Alvaro Pardo (USC, Spain, Hydrologist background)

This work pursued to characterize and assess the drainage system and designing a proposal of guidelines for its management. A report produced by the trainee will be used to improve decision-making on vegetation management along the channels and drainage network.



**Figure 53.** Practical activities in EDIA: drainage system maintenance.

3) *Environmental Education (pedagogical activities preparation) especially in Streams Rehabilitation*

Stage period: 2<sup>th</sup> to 30<sup>th</sup> October 2017

Trainee: Marta Martinez Carril (USC, Spain, Educational background)

The project included focused on the preparation of a program of pedagogical activities aimed at pre-school students, 1st, 2nd and/or 3rd cycles and covered various themes related to the environment and agriculture (water/habitats; soil/biodiversity; soil/water; biodiversity/habitats and freshwater ecosystems). The project included an analysis of potential official recognition of the program to be carried out by the school in the context of Environmental Education/Education for Sustainable Development.

The relevance of this project relies on its alignment with the national instruments on the most relevant strategies on the interface of Environment and Education, namely the National Environmental Education Strategy (*Estratégia Nacional de Educação Ambiental*, ENEA 2020), the National Strategy for Adaptation to Climate Change (*Estratégia Nacional de Adaptação às Alterações Climáticas*, ENAAC 2020), the National Strategy for Sustainable Development (*Estratégia Nacional de Desenvolvimento Sustentável*, ENDS 2015), and the National Conservation Strategy Nature and Biodiversity (*Estratégia Nacional de Conservação da Natureza e da Biodiversidade*, ENCNB).

83



**Figure 54.** Practical activities in EDIA: Environmental Education.

#### 4) Sedimentation pattern in EFMA Agricultural Streams.

Stage period: 2<sup>th</sup> to 30<sup>th</sup> October 2017

Trainee: Aikaterini Giannikopoulou (UoA, Greece, Geology background)

Taking to account the torrential regime and characteristics of the Alqueva Multipurpose Project (EFMA) streams and the type of interventions carried out in the drainage network such as reprofiling and cleaning streams, the project involved: :

- Identifying real cases of streams intervened by reprofiling and cleaning, and respective sedimentation zones;
- Evaluating the drivers of sedimentation in order to propose possible recommendations to avoid periodic interventions;

- Evaluating the factors that influence sediment transport;
- Evaluating the origin of the sediments (sediments vs geology, sediments vs. geomorphology and organic sediments);
- Evaluating/analyzing the sedimentation pattern in clean and reprofiled streams;
- Evaluate the sediments type and bed substrates types;
- Evaluating solutions for contaminated sediments (sediment decontamination processes);
- Evaluating the role of sediments in nutrient cycling;
- Assessing pressures and impacts on freshwater ecosystems;
- Analyzing the consequences of sediment transport on streams.



**Figure 55.** Practical activities in EDIA: Environmental Education: Sedimentation pattern in EFMA Agricultural Streams.

##### 5) *Quercus Compensation*

Stage period: 6th of February 8th of March 2018

Trainee: Noelia Lence Cascudo (USC, Spain, Forest and Natural Resources background)

This project involved the design of compensatory measures for two habitats of the Habitat Directive (habitat 9330 and habitat 9340) dominated respectively by holm oak and cork oak. The *Quercus* species compensation emerges as a measure to minimize the environmental impacts of Primary and Secondary Irrigation Network of the Alqueva Multiple Purpose Enterprise (EFMA) over target *Quercus* species as referred in Environmental Impacts Declarations.



**Figure 56.** Practical activities in EDIA: *Quercus* Compensation.

6) *Environmental Education Area*

Stage period: 14<sup>th</sup> February to 14<sup>th</sup> March 2018

Trainee: Noemí Santiago Parada (USC, Spain, Biology and Educational background)

This project followed up on the activities started by the Department of Environmental and Patrimonial Department Impacts of Alqueva Multi Purpose Project, that has been carrying out environmental educational actions in the schools of the region to promote river ecosystems natural value, reinforce the importance of maintaining and conserving them the calling attention for incorporating sustainability in values and attitudes of society.

In this context the trainee developed the following topics:

- Support in Environmental Education;
- Development of a Streams Rehabilitation Manual for Alqueva Project farmers;
- Preparation of Environmental Education Actions.

85



**Figure 57.** Practical activities in EDIA: Environmental education.

7) *Methodology for verifying the situation and clearing the drainage system in hydraulic passageways, according to the recommended regulation for the EFMA reward perimeters. Impacts of CO<sub>2</sub> emissions into the atmosphere from pipe materials such as cement, steel and HDPE (extraction and supply of materials, production of the pipes, installation and use*

Stage period: 1<sup>th</sup> to 30<sup>th</sup> May 2018

Trainee: Lorenzo Domenichini, (University of Pisa, Italy)

During the internship the student developed a methodology for the unblocking of drainage, troughs and hydraulic passages, in accordance with the one recommended in the regulations for the watering EFMA perimeters; identification and production of technical documentation and report; field visits and photographic survey.

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**Figure 58.** Practical activities in EDIA: hydraulic passageways.

8) *Development of Measures to Minimize Environmental Impacts in Alqueva Irrigate Areas: Hedge Planting, Riparian Galleries and Intercropping*

86

Stage period: 1<sup>th</sup> to 31<sup>th</sup> May 2018

Trainee: Cosimo Righini (University of Pisa, Italy, Agronomy background)

The goal of this internship was developing measures to minimize effects of irrigation such as stream pollution through the establishment of riparian galleries and intercropping. During the internship target arboreal and herbaceous native species were selected for riparian rehabilitation. Herbaceous species were selected to be used as intercrops to increase the fertility of the soil, while preventing erosion and competition for the water with the main culture. In addition, the application of these measures could increase natural pests control and diseases and prevent the application of phytopharmaceuticals, pesticides and other agricultural pollutants.

Another task of this trainee was farmers awareness about the causes and consequences of irrigation and the need to adopt good agricultural practices in the water, soil and biodiversity conservation. The trainer had the opportunity to work on some real cases, more specifically on a hedge for citrus crops and a riparian gallery implementation aiming to put in practice examples of potential compatibilization of agricultural practices with preservation of natural resources and values in order to ensure a sustainable development of Alentejo.



**Figure 59.** Practical activities in EDIA: hydraulic passageways: Measures to Minimize Environmental Impacts in Alqueva Irrigate Areas.

9) *Analysis of potential maintenance/rehabilitation of ecological corridor in the EFMA area*

Stage period: 1<sup>th</sup> to 31<sup>th</sup> May 2018

Trainee: Lida Lakidi (UoA, Greece, Geology and Geoenvironment Background)



**Figure 60.** Practical activities in EDIA: maintenance/rehabilitation of ecological corridor.

87

## **Conclusions**

The practices performed by the hosted students comprised the development of practical tasks and the participation of current responsibilities of the company. They had the opportunity of experiencing the real-world challenges of Environmental mitigation in such a large Irrigation endeavor. The end-point of these internships ranged from obtaining essential skills in Streams Rehabilitation to developing real interaction with stakeholders on Environmental Issues, both with the company itself and with different societal actors (schools, farmers). To support students, EDIA prepared activities, provided documentation, and gave students the opportunity to work on real case studies, enabling them to undergo a professional experience. Overall, the LandCare experience for both the Alqueva company and for the trainees, was very positive.

### **III.5.3. Soil contamination and decontamination in the landcare project. National Research Council, Institute of Ecosystem Study and West Systems**

Innovative means to improve student learning and engagement have been implemented in the LANDCARE project. This educational tool has been based on blended learning courses, in which the student participation has been converted from a passive to an active-learning.

Among the different topics in which the LANDCARE project has been organized, CNR-ISE has been involved in "Soil Contamination and Decontamination", with particular attention to innovative strategies to recover contaminated soils and sediments. The teaching theoretical activity carried out by the CNR-ISE educators has been reinforced by a choral discussion on some soil contamination study cases chosen and presented by the students. A significant part of the soil contamination lessons has been based on visits in contaminated and/or restored

sites, such as As Pontes mine (Spain) and Belvedere landfill (Italy). During these visits, some summary videos about the learning experience were performed by the students, as assignment. In addition, knowledge on soil properties, pollutants behavior and bioavailability affecting the choice of the decontamination technologies, have been transferred to the students through practical activities, such as laboratory analyses (total and available heavy metals in different soil samples) and field work measurements (CO<sub>2</sub> emission from soil). Finally, an orienteering practical activity with study questions at each step has been introduced as a highly innovative and effective educational tool.

West Systems has been operating for over 25 years, both at national and international levels, in the field of Technological Innovation and Research applied to Earth Sciences and Environmental Monitoring. West Systems achieved solid experience in the development of specific instruments for the study of gaseous exchange at the soil-atmospheric level, in many different fields of application such as geothermal science, landfills, polluted sites and seepage. The Company can provide full monitoring systems and the necessary software for the solution of specific customized problems.

88



**Figure 61.** Waste water treatment plant in Naxos.

LANDCARE project has taken place in the West Systems Environment Technical Department, that develops and manages the environment business, including monitoring, analysis and characterization of environmental matrices services, designing and developing systems and measuring instruments, research and development, in more detail:

- Environmental Monitoring, Characterization and Analysis, related to the environmental safeguard and protection through the development and application of monitoring and analysis techniques;
- Engineering, which manages the design and development of innovative systems and tools and the development of prototypes;
- Systems and Instrumentation, which manages technological systems, instruments and equipment assembly and their putting into service;

- Research & Development, operating in the definition of technical project proposals in response to regional, national or EU calls for research funding.

LANDCARE students have acquired knowledge and experience on activities in the field of environmental monitoring, especially within the provision of services for the monitoring of gaseous exchange between soil and atmosphere (soil diffuse flux) of all the main greenhouse gases and volatile organic compounds in various fields of application, as landfill, volcanic, geothermal, contaminated sites, areas destined for agronomic use, wetlands, geological carbon dioxide storage sites (CCS) and strategic storage of natural gas.



**Figure 62.** West System headquarters.

89

The training focused on the above described activities and faced different points of view:

- organizational processes, taking into consideration the flow of activities, the company functions involved, the documents produced, the final results, in detail the following:
- design and development, which includes project inputs collection and analysis (e.g. call for tenders, customer specifications, state of the art analysis, market analysis etc.), project and related documentation development (e.g. technical drawings and manuals, prototyping etc.), progress reports, verification and validation;
- development of systems and products offered to the market, which includes customer requests analysis, customization, hardware assembly, software development, testing and delivery, including the technical delivery documentation (e.g. technical manuals, warranty conditions, etc.);
- installation and technical assistance services, in particular positioning services for monitoring / data collection equipment, which includes customer requests analysis, personalization, services realization, on-site installation and operational testing;
- analysis of diffused soil gas emissions and other environment pollutants, which includes instruments calibration, on site sampling, data processing, laboratory analysis, final report; methodologies applied in carrying out environmental monitoring activities, particularly soil flux measurements. Training regarded the "Guidance on

Monitoring Landfill Gas Surface Emissions", which is the result of the collaboration between Environment Agency, SEPA and representatives of the landfill gas industry to be used in the management of landfill gas in England and Wales, more specifically in the assessment of CH<sub>4</sub> emissions from the surface (Environment Agency Wales, 2010).

Among the most important methodological aspects the survey procedure, involving the steps of establishing a grid system over the area to be sampled, measuring gas versus time and calculating the gas flux, and data analysis, through statistical and geostatistical methods and dedicated software functions, in order to estimate the emission of CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S and VOC and to recognize the presence of zones characterized by anomalous fluxes.



90

**Figure 63.** Measurements of greenhouse gases emissions from the soil in a landfill.

LANDCARE students were also able to approach the environmental risk assessment, a process that engages several competences and consists in the critical collection of data and information useful to estimate, qualitatively and quantitatively, the impact of dangerous substances on the environment and the effect on human health; technological instruments, particularly the flux-meter, a West Systems designed and manufactured portable equipment for the evaluation of gas exchange at interface between soil and atmosphere.

The main flux-meter applications are soil respiration in agronomy, monitoring of volcanic and geothermal areas, determination of biogas emission in landfills, methane and carbon dioxide seepage in wet-lands areas (swamps, rice fields etc.).

This instrumentation uses a technology known as "accumulation chamber method", which is a static not-stationary method based on the determination of concentration gradient of CO<sub>2</sub>, CH<sub>4</sub> and H<sub>2</sub>S measured inside an accumulation chamber laid down on the soil.



**Figure 64.** Belvedere landfill, where greenhouse gasses are being monitored.

A dedicated software package acquires the GPS position and gives the operator the evaluation of the initial slope of the gas concentration - time line which is proportional to the gas emission from soil. Calibration is essential to keeping sensitive measuring equipment accurate, in order to maintain quality control, comply with industry specific regulations and laws and maintain national and international standards.

LANDCARE students carried out a bibliographical study of the measurement techniques of gas flows at the air ground interface focused on static non-stationary accumulation chamber techniques and acquired experience in the use of the portable flux-meter and its calibration procedure; environmental legislation, especially Directive 1999/31/EC, implemented through the Italian Legislative Decree 36/03 concerning waste landfill.

The Directive's overall aim is to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment, including the greenhouse effect, as well as any resulting risk to human health, from the landfilling of waste, during the whole life-cycle of the landfill.



**Figure 65.** Equipment for monitoring greenhouse gasses emissions.

The students were able to compare environmental Italian legislation with their country. For example, in Greece the European Directive 1999/31/EC has been transposed into Greek National Law by the Joint Ministerial Decree 3017/2002.

Portugal has a lack of legislation in terms of soil protection, soil pollution monitoring and soil remediation. However, efforts have been made to legislate this important resource with the Legislative Project on Prevention of Pollution and Remediation of Soils which aims to protect the environment and human health, setting the process of quality assessment and soil remediation and the responsibility for its contamination.

Training activities have given students the opportunity to gain experience in equipment use, instruments calibration in laboratory, measures in the field, data processing, technical documents analysis. Students also had the opportunity to learn about the markets in which West Systems operates and meet some of the key customers with whom West Systems collaborates.

92

#### **III.5.4. Landcare students participating in land restoration, environmental education and marine and terrestrial monitoring projects. University of Athens and Archipelagos Institute of Marine Conservation**

The coastal zone is a naturally dynamic changing environment due to coastal geomorphological processes. At the same time, climate change, sea level rise, the increase of storm surges and other extreme events along with the increasing population have a serious impact on the coastal zone, modifying the system dynamics and balance.

As a consequence a number of coastal features are degraded, e.g. coastal dunes, wetlands, and natural habitats are lost. At the same time, coastal erosion constitutes a global issue, as 70% of the shorelines are retreating), while in Europe it is estimated that 15 km<sup>2</sup> of shorelines are retreating annually. A large variety of activities are hosted in the coastal zone, which support the economy and serve many needs.

During the LANDCARE project, we had a number of activities aiming to improve the teaching capacities about this important topic and to improve the skills of young scientists. Our activities had two main directions: scientific background and training in the field. The scientific background was covered through presentations, educational videos as well as a handbook chapter discussing issues of coastal processes and coastal rehabilitation. During the International training schools (Lugo, Naxos, Pisa), the students were first taught in the classroom the basic theory, and were in the following days trained in the field. The students were encouraged to actively participate in groups during the classroom teaching, aiming to raise discussions in related topics and approach coastal rehabilitation topics from different disciplines and countries. During the international training schools, students were also trained in modelling coastal erosion using Geographic Information Systems and furthermore the process on how to build their own model depending on the topic they wish to address.

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93

The multi-faceted conservation work carried out by Archipelagos Institute involves a combination of research expeditions, field surveys and laboratory work, while closely collaborating with local communities, national and European policy makers, as well as the wider media. Through internships at Archipelagos Institute, students have the opportunity to enrich their knowledge with practical hands-on experience in field research and conservation projects. Interns develop their leadership and role model skills, allowing them to develop a variety of key skills, useful for future job prospects.

The collaboration between Archipelagos Institute of Marine Conservation and the Landcare program provides students with the opportunity to take part in multi-disciplinary environmental projects with a clear conservation aim. These took part on the islands of Samos and Lipsi.

### **Project 1. Land Restoration**

During the past decades, many different areas and habitats within the Mediterranean region are under threat or have already succumb to occurrences of land degradation (soil erosion, over-grazing, wildfires etc), which in turn affects important sectors of the economy (agriculture, fishing, tourism) and the supply of vital goods (drinking water, food). This was one such project that provided an important opportunity for students to work along scientists on research focusing on land degradation.





The project included the monitoring of the vulnerability and the recovery rate of the areas which had been impacted by a recent fire. Our priority to address the effects of erosion in the islands of the eastern Aegean, as the human influence over the past decades in many of these regions, causes the non-reversible loss for fertile ground which required many centuries to form. This also included assessment of flora coverage and biodiversity, as well as analysis of the nutrient content of the soil in the zones where the fire was put off using seawater.



## Project 2. Environmental Education

The main project Landcare students engaged in was the design of educational programs, including lesson plans, interactive activities and education games for school groups of various ages. The aim of these activities was the engagement of children in several environmental topics, such as wildlife conservation and awareness of microplastics in the environment. Furthermore, the education team also worked with children of refugee families, who were

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living in a nearby hotel as part of the EU Humanitarian Program. These activities designed by the Landcare students included nature walks, arts and crafts, beach clean-ups and English lessons. The Education programs led by the Landcare students have been of great success: local schools and communities gave excellent feedback and are willing to come back for more activities. On the other side, the activities program with the refugee families is still ongoing as there was a very good acceptance from themselves as well as from their coordinators.



95

Figure 69. Educational activities, Archipelagos.

### Project 3. Water Quality

Another project that Landcare students got involved in was the Water Quality project. The project consisted in analyzing chemical and biological parameters of different water bodies of public access: the public network, mountain springs, saltmarsh and bathing waters. This study gave some valuable information on the quality of the drinkable and bathing water in the islands of Samos and Lipsi, as this information is not available from the authorities. Besides, microplastic analyses were also conducted to understand their presence and abundance in drinkable water, including bottled water. One of the Landcare students presented the results of the Water Quality study in a poster in the Annual Program's Conference, an opportunity to develop her analysis and critical-thinking skills to produce a scientific poster, as well as to strengthen her communication skills.

### Project 4. GIS Applications

Archipelagos Institute also uses mapping for its conservation purposes, especially for the marine environment, as it is very useful and powerful tool. GIS projects involve kayak-based survey transects with a sonar in order to detect the *Posidonia oceanica* meadows around the islands of Samos and Lipsi. Remote sensing is also used to create maps as satellite images are enough detailed to provide accurate maps of the coastline once corrected. Landcare students also took part in the GIS projects, allowing them to get familiar with field work and gain expertise in the use of particular equipment and software, applied to conservation goals.

## Project 5. Linking Research to Applied Conservation

In addition to the aforementioned project, Landcare students part of the terrestrial and marine mammal teams had the opportunity to assist in research projects focusing on the golden jackal (*Canis aureus*), the Mediterranean chameleon (*Chamaeleo chamaeleon*), as well as endangered marine mammals, including various dolphin, whale and sea turtle species. In these projects, they took part in terrestrial and marine surveys, monitoring local populations, habitat preferences and related conservation issues. In addition, data on several anthropogenic impact factors (deliberate killings, fishing activity, debris) was also collected, with the aim to better understand and monitor the status of marine and terrestrial wildlife around the eastern Aegean islands.



Figure 70. Marine surveys activities, Archipelagos.

## Project 6. Eco-Navigation

Finally, the Landcare students were actively involved in the Eco-Navigation project, a major project of the organization that consists in engaging locals and tourists to collaborate with research through a citizen-science platform. The students were going to the marinas of different towns in order to meet boat owners, sailors and other sea users (foreigners and Greek natives) and encouraging them to share with us any marine life (cetaceans, monk seals, marine turtles, invasive species, jellyfish) sighting they may have during their trips. With this project the students gain confidence in speaking to citizens and improve their communication skills.



Figure 71. Eco-Navigation activities, Archipelagos.

## III.5.5. Employment and entrepreneurship

### III.5.5.1. EMPLOYABILITY

The general objective of LANDCARE is to improve educational and training capacities in relation to the recovery of degraded lands by different activities. This work is necessary to preserve our environment, to meet the demands of an emerging labor market within the framework of ecological restoration and to create new job opportunities in a world in constant change where the learning needs extend throughout life.

Based on this premise, we also understood that it is necessary to train our students in transversal competences for employment and give them an adequate job orientation to the new needs of the international labor market.

To fulfill this objective, we carry out different training activities throughout the project addressing the different topics related to employability, entrepreneurship and skills / abilities for employment. The transversal training for employment, theoretical and practical methodologies were employed. The appropriate techniques for job search, tools and resources (at their disposal) were practiced. In order to favor the transition to the labor market, training activities enhanced the knowledge, skills and attitudes related to Job Search Techniques, Social Skills, etc., (outside of conventional curricula). Throughout the project the students also enjoyed the support and tutoring in their job search.

97

The training activities on employment carried out in the Landcare project were the following:

Diciembre 2015. USC Campus Santiago de Compostela

Abril 2016 USC Campus Lugo.

Marzo 2017 Grecia

Marzo 2018 Pisa (Italia)

Julio 2018 USC Campus Santiago de Compostela

#### Contents

- Job search and internships
- Situation of the labor market
- Labor market demands. University Profiles
- Create your: Curriculum Vitae Europass, European Skills Passport (The language passport) and Cover letter
- European resources for employment, professional practice and training

#### Voluntary tasks:

##### 1. Europass Documents:

Curriculum Vitae: <https://europass.cedefop.europa.eu/editors/en/cv/compose>

European Skills Passport <https://europass.cedefop.europa.eu/editors/en/esp/compose>

Languages Passport: <https://europass.cedefop.europa.eu/editors/en/lp/compose>

Cover letter: <https://europass.cedefop.europa.eu/editors/en/cl/compose>

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2. Make a speech about your (hard and soft) skills and the main points of your professional profile. A maximum of 10 minutes

Presentation: in the classroom

**Job search**

**SKILL SET**  
Is a particular category of skills or abilities necessary to perform a job.  
Employers require soft skills and hard skills when considering for a job

**HARD SKILLS**  
Are part of the skill set that is required for a job that include specific knowledge and abilities

**SOFT SKILLS**  
Are attributes and personality traits that affect interpersonal interactions and while different.  
Are the personal attributes, personality traits, inherent social cues, or communication abilities needed for success on the job.  
These include characteristics such as leadership, empathy, communication, etiquette and more skills that aren't as quantifiable as hard.

**Job search**

**5 MUST -HAVE CAREER SUCCESS SOFT SKILLS FOR ENGINEERS**

Technical acumen alone is insufficient for successful engineering career . "  
Soft skills " play an increasingly important role in the differentiation of professional, employment and advancement.

COMMUNICATION    CREATIVITY    ADAPTABILITY

COLLABORATION    LEADERSHIP

98

Figure 72. Employment module. Example of a presentation.

### III.5.6. Training on entrepreneurship

The training actions were given by the technicians of creation of companies of the Valorization, Transfer and Entrepreneurship Area.

Justification of the sessions:

The agroforestry sector is one of the main economical sectors of the economy of various European countries, especially in the Mediterranean area. However, there are several factors that hampering the business creation and innovation in this sectors. In the last years there

has been a change in this dynamic, with the introduction of new technologies and R & D developed in research centers, companies and universities. Some this R & D focuses on the recovery of degraded soils either by industrial activities or by climatic effects.

Therefore, certain actions are necessary to a) Foster the entrepreneurial spirit among university graduates from related areas of knowledge and b) Provide entrepreneurs and companies already created with tools that facilitate innovation, the creation of companies and the improvement of processes.

The training session organized in the LANDCARE project aimed to contribute to these purposes.

The general objectives of the sessions were:

1. Discuss the Lean Start-up methodology for the design of new business models.

The message behind this methodology is to eliminate unnecessary tasks in the creation of a start-up. That is, it seeks to reduce the risk of failure of a start-up, providing a series of concepts and tools that will help us define a business model adjusted to what the market demands. The most important concepts are the pivot and Minimum Viable Product (MVP), being the main tool used Lean Canvas.

99

The methodology was based on a scientific method of validating hypotheses about business and learning model.

2. Apply this methodology to land reclamation projects.

## **LEAN CANVAS WORKSHOPS**

The training was offered in the intensive course held in Lugo and Naxos.

The content of the courses was the following:

**Start-up concept. Business Model Concept:** In this thematic block, an attempt was made to define what a start-up is, emphasizing its characteristics and highlighting the differences it presents with more traditional companies or established companies, giving special importance to the scalable nature of these organizations.

At the same time, it explained what a business model consists of, when to design it and the importance it has for the success of the future start-up.

**A new philosophy: Lean Start-up:** It was explained how this philosophy arises, the objectives that it pursues and which are the most important concepts that are behind it and that constitute the following thematic blocks.

An entry is given to the tools used to design a business model: Business Model Canvas, Value Proposition Canvas and Empathy Map.

Afterwards, the first two tools are explored and the most used.

**Definition of Minimum Viable Product (MVP):** It will be the first "usable" version of our product or service and our potential customers are willing to test or test to offer us feedback on their utilities and functionalities.

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**Concept of pivoting:** If that feedback offered by potential customers reflects that the solution provided by our product or service does not fit with what they are looking for, we must pivot, that is, reformulate the initial hypotheses in our business model.

**Presentation of the work tool: the Lean Canvas:** The Lean Canvas is a canvas divided into a series of blocks that describe the basic and most important aspects that will define the business model of our company. In each of these blocks, the hypotheses with which we believe that our business model will be the right one we applied.

All these concepts were applied in a second phase of the session, totally practical, in which attendees worked on three real cases in teams, as shown in the images.

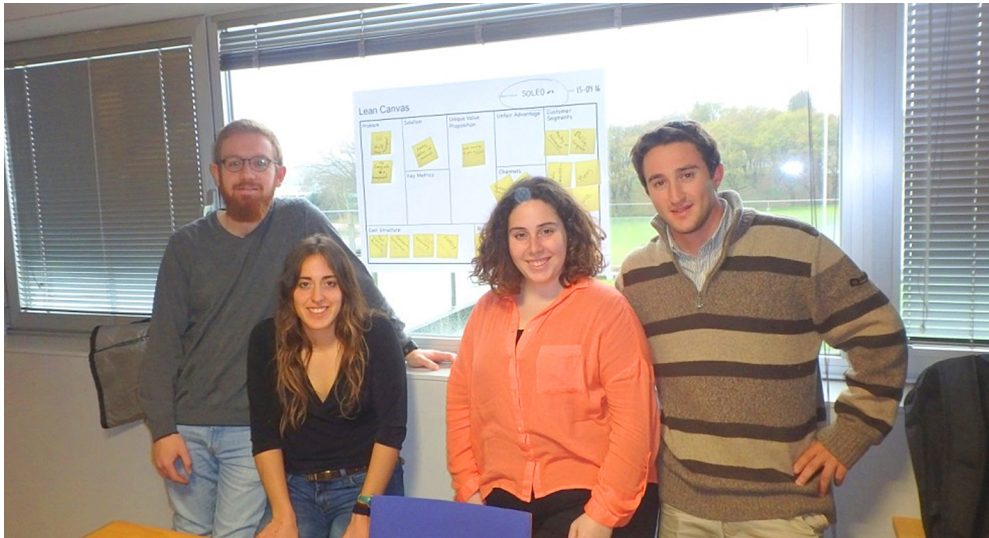


Figure 73. One of the team in one of the lean canvas workshop.

## ENTREPRENEURSHIP

This training was offered in a specific workshop held in the Multiplier event, in Santiago de Compostela (E3).

### Contents

**Introduction to Start-up and Business Model concepts:** In this thematic block, an attempt was made to define what a start-up is, emphasizing its characteristics and highlighting the differences it presents with more traditional companies or established companies, giving special importance to the scalable nature of these organizations.

At the same time, it explained what a business model consists of, when to design it and the importance it has for the success of the future start-up.

**A new philosophy: Lean Start-up:** It was explained how this philosophy designed by Eric Ries arose, the objectives pursued and which are the most important concepts behind it and that are the thematic blocks. It delves into the pillars on which this methodology is based, which is based on the cycle of creating, measuring and learning and on the development of a viable minimum product (MVP).

**Introduction to the Business Model Canvas tool:** The design canvas of Business Model or Business Model Canvas is a tool designed by Alex Osterwalder that allows us to work on a business model from an integrated point of the company.

The 9 blocks that make it up are explained and through which we can work on the key aspects that will define the business model of our company.

In each of these blocks we will apply the hypotheses with which we believe that our business model will be the right one.

**Introduction to the Value Proposition Canvas tool:** To validate these hypotheses in the market with potential clients we will use the canvas of the value proposition map or Value Proposition Canvas. Also designed by Alexander Osterwalder, the attendees were able to deepen the value proposal they are going to offer the client and analyze it from the client's point of view and feeling.

Through this tool, it was deepened in two of the most important blocks of the Business Model Canvas, the customer segment (identification of the profile, needs and problems of the client) and value proposal (covering the client's needs through the creation of value) where the characteristics of the product or solution were defined.

101

This tool allows finding the Product-Market Fit, detecting what the market really needs, our customers.

**Practical application of the tools with real case studies:** All these concepts were applied in the practical session and case studies.

Four teams of 4-5 people were formed, and attendees worked on these tools through 3 case studies and 1 real case of a participating team of entrepreneurs, as shown in the images.



**Figure 74.** Workshop on Employment, in the Landcare for the Future.

## IV

# Impact of the Landcare Project

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The hypothesis of the LANDCARE project was that the improvement of the teaching capacities would result in an improvement of the training, both theoretical and applied, of the students. This aspect, in turn, would facilitate the labour insertion of recent graduates, and in the long term it would contribute to mitigate land degradation and improve environmental conditions.

This hypothesis has been tested through two main surveys. The first survey focused on evaluating the impact of intensive courses on student training. The second survey is specific about practical training and professional skills, which can be considered important for employability.

## IV.1. Impacts and quality criteria of the Landcare Project: Indicators

### IV.1.1. Intellectual outputs

All these results are available in: <http://www.ibader.gal/landcare-project.html>

#### O2 DEVELOPMENT OF VIRTUAL TOOLS FOR LD & R TEACHING (PERSONAL LEARNING ENVIRONMENT-PLE, SMALL PRIVATE ONLINE COURSE-SPOC)

- **IMPACT:** Teachers using the virtual platform: more than 18 / course. Students: 13-18 / course. Consultations: more than 500 / course. The final version, ONLINE PERMANENT COURSE is freely available.
  - **QUALITY CRITERIA:** The resource is designed with ICT specialists. It is improved over three years of testing. The tool used is free software, and allows the open use of people, which ensures an impact on a large number of people. Educational resource developed after a trial period of 3 three years. The design of the virtual platform was made with the collaboration of the Department of Education of the USC, ICT specialists, and its coordinator was a person from the University of Athens.
  - **SHORT DESCRIPTION.** The platform includes a digital repository that includes all the didactic material produced during the duration of the project: text, presentations, online exercises, excursion guides, multimedia material (videos, photos), references for additional
-

reading, external links. In addition to the repository, the tool includes the following resources: Forum, Videoconference, Chat, Assignments, Groups, Surveys, Dropbox. The online version of the platform, however, does not allow blogs (this resource is only allowed if the course is not in open access).

### O3. DEVELOPMENT OF TRAINING MODULES FOR L & D INCLUDING ONLINE LEARNING AND SPOC

- **IMPACT:** The material has been used in the intensive courses and in the regular courses of the teachers participating in the project. Part of the text developed in this section is part of the book that is being edited in open access. The videos have been uploaded to the youtube platform (landcare Project). So far, the videos have had more than 3000 displayed. More than 25 specialists contributed.
- **QUALITY CRITERIA:** Elaborated by professionals with proven experience. The material has been tested and improved over a three-year process.
- **BRIEF DESCRIPTION:** Material prepared by the teachers of the pilot courses. It includes texts, presentations, field guides, study questions and videos.

103

### O4. IMPACT ANALYSIS OF BLENDED MOBILITY ON "GREEN EMPLOYMENT"

- **IMPACT:** The report is available in open access. It has been shared with other big initiatives on environmental restoration: Cambridge Conservation Initiative (<http://www.endangeredlandscapes.org/>) and Society for Ecological Restoration (<https://www.ser.org/>). It will be included in the Restoration Resource Center (<https://www.ser-rrc.org/>).
- **QUALITY CRITERIA:** Collaboration of the 8 project partners. It includes interviews with professionals from 21 countries, and with the students participating in the activities. It includes a valuable review about the offer of studies on restoration in southern Europe.
- **BRIEF DESCRIPTION:** Review and analysis on the factors that limit the restoration work in southern Europe. Review of the offer of studies on restoration. Analysis of the activities carried out in the Landcare project. Analysis of the impact of project activities.

### O5. PUBLICATION OF HANDBOOK ON LD & R, BEST PRACTICES FOR TEACHING AND EMPLOYMENT / LAUNCH OF PEER-TEACHING NETWORK

- **IMPACT:** Participants of the project: 25. External collaborators: 25. Collaborating countries: 10. External evaluators: 2. Publication in open access.
  - **QUALITY CRITERIA:** Peer review. Collaborators of recognized experience. The review by Dr James Aronson (Missouri Botanical Garden's Center for Conservation and Sustainable Development) reports on the interest of the material for possible publication on Island Press. However, the cost of publishing in open access is excessive. The book will be published by the University of Santiago, after a process of peer review.
  - **DESCRIPTION.** The book includes the material developed in the O2 result, together with a series of case studies from different countries in southern Europe and other countries with similar climates: Land use and management (4 cases), pollution (9), fires (5), wetlands (7), coasts (4), rural development (4), entrepreneurship (1).
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## IV.1.2. Multiplier events

### E2. INTERNAL DISSEMINATION OF LANDCARE AND CONFERENCE ON TECHNOLOGICAL RESOURCES FOR LANDCARE (PROMOTION OF MOOC AND SPOC)

- **IMPACT:** Participants: 66 (Nationals: 42; Internationals: 11; partners: 13). Students involved in the organization: 8. Number of presentations: 17. Countries participating: 6. Speakers representing important centers and national and international associations (CIREF, SERE). Other universities (LEAF Research Center) involved local, regional and national administrations: Câmara Municipal de Sesimbra, Instituto de Conservação da Natureza e das Florestas (ICNF), ONGs (Sociedade Portuguesa para o Estudo das Aves, SPEA), y empresas (SECIL-Outão).
- **QUALITY CRITERIA:** A book of abstracts is generated.
- **BRIEF DESCRIPTION:** The activity consisted of a day of lectures, during which the project was described and the results related to the e-learning tools were shown. At the exit to the field, in which these tools were applied.

104

### E3. INTERNAL DISSEMINATION AND CONFERENCE ON IMPACT OF LANDCARE IN TRANSVERSAL COMPETENCES (VIRTUAL AND EMPLOYABILITY SKILLS)

- **IMPACT:** Participants: 81 (Nationals: 52; Internationals: 16; Partners: 13). Estudiantes implicados en la organización: 11. Número de contribuciones: 121. Países participando: 7.
- **QUALITY CRITERIA:** Representatives of National Associations (Presidents of the Spanish Society of Soil Science, Spanish Terrestrial Ecology Society, FIRE Foundation) and international representatives (Chair of the Society for Ecological Restoration Europe, President of the European Federation for Soil Bioengineering) participated in the organization). Participation of people from other countries: Hungary, Mexico, Chile, United Kingdom, Australia. Different companies and NGOs participated. The institutional support of the University of Santiago and the Regional Government (Xunta de Galicia) was important.
- **BRIEF DESCRIPTION:** The activity consisted of 1 day of conferences, during which the Landcare project was described and the results related to e-learning tools and the impact on employment were discussed. On the second day, courses on the use of online learning and employment tools were organized. In the field trip these tools were applied.

### OTHER MULTIPLIER EVENTS ORGANIZED BY THE CONSORTIUM, BUT NOT FINANCED BY THE PROJECT

#### INTERNAL DISSEMINATION OF LANDCARE AND CONFERENCE ON TECHNOLOGICAL RESOURCES FOR LANDCARE (PROMOTION OF MOOC AND SPOC)

- **IMPACT:** 35 people at the USC, along with the partners of the project.
  - **QUALITY CRITERIA:** Chair: Vicerrectorate of International Relations. Dean of the Faculty of Biology.
  - **DESCRIPTION:** Presentation of the project at the USC.
  - **OBSERVATIONS:** This event did not get specific funding.
-

## WORKSHOP ON EDUCATION AND TRAINING ON ECOLOGICAL RESTORATION

This event was organized within the SER congress (<https://sere2018.org/wp-content/uploads/2018/09/Tuesday.png>), in September, 2018, Iceland.

- **IMPACT:** Participants: 50. Organizations involved in the organization: 5. Number of contributions: 10. Countries participating: 21. Speakers representing important international centers and associations.
- **QUALITY CRITERIA:** Organizers: 1) University of Santiago de Compostela, 2) Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade de Lisboa, 3) International Foundation for the Restoration of Ecosystems, Ecology Department, Alcalá University, Alcalá de Henares, Spain, 3) European Federation for Soil Bioengineering, 4) Sangalli Coronel y Asociados S.L, Spain. 5) Department of Civil Engineering and Natural Hazards, BOKU, Vienna, Austria. 6) Kaye Academic College of Education, Beer Sheva, Israel. 7) School of Biological Sciences, The University of Western Australia, 8) Kings Park Science, Department of Biodiversity, Conservation and Attractions, Kings Park, WA, Australia, 9) School of Biological, Earth and Environmental Sciences, The University of New South Wales, Sydney. NSW, Australia. 10) Northern Arizona University, San Diego, United States of America, 11) Soil Conservation Service of Iceland, 12) Landvernd Icelandic Environment Association. Iceland, 13) Univ Rennes, CNRS, LETG, France, 14) Agricultural University of Iceland, 15) Chair of the Society Ecological Restoration-Europe.
- **BRIEF DESCRIPTION:** The activity consisted of 1 day of conferences on education and training. The landcare project was described. The handbook "Best practices on Land Degradation and Rehabilitation in Mediterranean Environments is presented. The network on Education and Training on Land Restoration, hosted in the Society for Ecological Restoration is launched.

105

### IV.1.3. Learning and teaching activities

#### C1. INTENSIVE PROGRAMS FOR TEACHING STAFF. INTENSIVE TRAINING PROGRAM IN THE USE OF VIRTUAL TECHNOLOGICAL RESOURCES (PLE, SPOC)

- **IMPACT:** 26 attendants. 4 tutors.
  - **QUALITY CRITERIA:** Teaching staff specialized in ICT of the USC and CESGA. Facilities with adequate means are used. This course was recognized by the "Training and Teaching Innovation Program" (<http://www.usc.es/gl/servizos/pfid/pfid.html>) at the USC and, therefore, the attendant will get a certificate including the contents and hours of learning.
  - **BRIEF DESCRIPTION:** The purpose of this course was to clarify and substantiate the concepts of personal learning environments and networks. During this training the participants: a) received comprehensive understanding of personal learning environments and networks and other virtual tools. b) designed educative materials for independent learning in different areas of knowledge, such as: design of pathways for learning on specific theoretical topics, practical skills on applied issues and employment and entrepreneurship. c) Implement a plan of virtual training of new technological tools for the training. This allowed teachers to be more active in their learning process and learn how to create shared understanding.
-

C2, C5, C8. INTENSIVE PROGRAM FOR LEARNERS COMBINING ONLINE LEARNING (PLE, MOOC, SCOP)

- IMPACT:
  - C2. 4-15<sup>th</sup> April, 2016, Lugo, Spain  
Attendants: 16: 6 (Spain), 4 (Portugal), 3 (Italy), 3 (Greece)  
Teachers: 26: 19 (Spain), 3 (Portugal), 2 (Italy), 2 (Greece)
  - C5. 20-31<sup>th</sup> March, 2017, Naxos, Greece  
Attendants: 13: 4 (Spain), 3 (Portugal), 2 (Italy), 4 (Greece)  
Teachers: 16: 2 (Spain), 1 (Portugal), 2 (Italy), 11 (Greece)
  - C6. 11-24<sup>th</sup> March, 2018, Pisa, Italy  
Attendants: 18: 5 (Spain), 4 (Portugal), 3 (Italy), 6 (Greece)  
Teachers: 22: 3 (Spain), 1 (Portugal), 16 (Italy), 2 (Greece)
- QUALITY CRITERIA: Numerous teachers and specialists involved. The methodologies and tools tested in the previous course are applied. The activities are interactive. New teaching and evaluation techniques are used. Concepts of employability and entrepreneurship are incorporated. Support from: Councils of A Coruña and Lugo, City Council of Naxos and Cyclades pequñas, Board of San Rossore
- BRIEF DESCRIPTION: The purpose of this activity is to eliminate shortages in human and technical resources by pooling transnational teaching expertise and online learning. The students will have access to real study cases provided by the academic partners, but specially, professional partners which will offer a high quality training.

106

C3, C6, C9. JOINT SHORT-TERM TRAINING EVENTS FOR STAFF. SHORT-TERM JOINT STAFF TRAINING EVENT + INTERNAL TRAIN-THE TRAINERS SESSIONS

- IMPACT:
    - C3. 4-15<sup>th</sup> April, 2016, Lugo, Spain  
Attendants: 26: 19 (Spain), 3 (Portugal), 2 (Italy), 2 (Greece)
    - C6. 20-31<sup>th</sup> March, 2017, Naxos, Greece  
Attendants: 16: 2 (Spain), 1 (Portugal), 2 (Italy), 11 (Greece)
    - C9. 11-24<sup>th</sup> March, 2018, Pisa, Italy  
Attendants: 22: 3 (Spain), 1 (Portugal), 16 (Italy), 2 (Greece)
  - QUALITY CRITERIA: Numerous teachers and specialists involved. The methodologies and tools tested in the Intensive courses were applied in these training events. The activities were interactive promoting dynamic and blended learning of staff. A special effort was dedicated to the application of novel teaching and evaluation techniques. In addition, concepts of employability and entrepreneurship were incorporated. This activity had support from: Council of A Coruña (Spain) and Council of Lugo (Spain), Naxos and Naxos and Small Cyclades Municipality, Board of San Rossore Natural Park.
  - BRIEF DESCRIPTION: Restoration of degraded lands in response to ecosystems degradation is a relatively new science so teachers need to keep updated on the state-of-the-art knowledge and innovative techniques in order to both provide best training and engage students in active learning. Exchange of good practices across the Landcare
-

Project addressed these principles and Landcare Teachers took responsibility for their continuous improvement. The Exchange of Good Practices on Landcare project included two dimensions: exchange of pedagogical approaches and exchange of best practices in land restoration.

#### C4, C7, C10. COMBINED MOBILITY OF STUDENTS OF HIGHER EDUCATION. DEVELOPING EMPLOYABILITY SKILLS IN THE GREEN ECONOMY

- IMPACT:  
C4, 2016  
Destinations of the mobility: 9: 1 (Spain), 2 (Portugal), 3 (Italy), 3 (Greece)  
  
C7, 2017  
Destinations of the mobility: 6: 2 (Spain), 2 (Portugal), 1 (Italy), 1 (Greece)  
  
C10, 2018  
Destinations of the mobility: 19: 3 (Spain), 5 (Portugal), 3 (Italy), 8 (Greece)
- QUALITY CRITERIA: The students are included in real cases of land restoration.
- BRIEF DESCRIPTION: After the academic phase, a real-world work experience was offered by means of a blended mobility combining short-term internship and virtual training on employment and entrepreneurship.

107

## **IV.2. Impact on Landcare in other organizations and sustainability of the results**

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The impact of LANDCARE in other organizations were organized at three different levels: a) Multiplier Events planned in the proposal, involving different stakeholder, b) Active participation as guests collaborators in the materials an resources, and c) Dissemination of the project in National and International conferences and d) Dissemination of the project in the soil media.

### **IV.2.1. Multiplier events planned in the proposal**

Among the dissemination events, two International Workshops and Conferences were organized, developed Lisboa and Santiago de Compostela (<http://www.ibader.gal/seccion/470/Transnational-Meetings.html>), which functioned as multiplier events, and pursued to achieve extended societal impact by involving a large audience into the activities and outputs of the project.

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**Figure 75.** Multiplier events organized in the Landcare project

### IV.2.2. Active participation as guest collaborators

108

In addition to social organizations, other beneficiary groups got benefit from the project. Educators, scientists, professionals from other universities and countries, companies, and organizations were invited to be involved in the organization of activities, in the preparation of materials and in the training courses. Even as external evaluators and observers in key activities and meetings. This strategy was useful for the results of the project to be durable.

The main contributions were the following:

- National Autonomous University of Mexico (Felipe García-Oliva, Julio Campo): External consultants at transnational meetings. Organization of the conferences in Lisbon and Santiago (E2 and E3). Organization of the course in Santiago (C2). Collaboration in the book (O4) and videos (O3).
- Postgraduate School (Jorge Etchevers, Claudia Hidalgo): External consultants at transnational meetings. Organization of the conferences in Lisbon and Santiago (E2, E3). Collaboration in the book (O4) and videos (O3).
- CSIC (Montserrat Díaz-Raviña): Organization of the Conference in Santiago (E3).
- The University of Western Australia (Miriam Muñoz-Rojas): Organization of the conference in Santiago (E2). Collaboration videos (O3).
- Indian Institute of Science (Shanmugam Mani): External consultant at the transnational meeting in Santiago. Organization of the course in Santiago (C2).
- University of Tehran (Parvaneh Sayyad-Amin): Organization of the course in Samos (C5). Observer at the Coordination meeting in Samos.
- Bioterra University of Bucharest (Nicole Livia Petculescu, Irena D. Atanassova). Organization of the course in Pisa (C8).
- Ministry of Agriculture of Greece (Xara Braxou): Organization of the course in Samos (C5). Observer at the Coordination meeting in Samos.
- Fire fighting service of Greece (Miltiadis Athanasiou): Organization of the course in Samos (C5).

- ENDESA AND FOUNDATION ENDESA (4 people): Organization of the course in Lugo (C2). Organization of the multiplicative event (E3).
- Secondary education centers of the Island of Samos (more than 100 people): Organization of the course in Samos (C5).
- Personnel of the San Rossore Park (5 people): Organization of the course in Samos (C8).
- University of Swansea (Stefan Doerr, Cristina Santín): Collaboration in the book (O4). Collaboration, as organizers, in the E3 event.
- University of Pisa (Vittoria Giannini, Nicola Silvestri, Andrea Bertacch, Alessandro Pistoia): Organization of the course in Pisa (C8). Collaboration in the book (O5).
- University of Vila Real (Rui Manuel Vitor Cortes, Luís Filipe Sanches Fernandes, António Augusto, Sampaio Pinto): Organization of the multiplicative event in Lisbon (E2). Collaboration in the book (O5).
- University of Porto (Francisco Moreira): Organization of the multiplicative event in Lisbon (E2). Collaboration in the book (O5).
- CEDEX (Fernando Magdaleno): Organization of the multiplicative event in Lisbon (E2). Collaboration in the free (O5).
- Society for Ecological Restoration (Jordi Cortina): Organization of multiplicative events in Lisbon and Santiago (E2 and E3). Organization of the workshop, in Reykjavik. External evaluator at the transnational meeting in Lisbon. Collaboration Creation Network (O5). Prologue of the handbook (O5).
- Iberian Center for River Restoration- CIREF (Evelyn Garcia Burgos). Organization of the multiplicative event in Lisbon (E2).
- University of Alcala de Henares (José María Rey-Benayas): Organization of multiplicative events in Santiago (E3).
- Hellenic Center for Marine Research (Amvrakikos Greece, Stamatis Zogaris). Collaboration book (O5).
- Spanish Society Soil Science (Jorge Mataix): Organization of multiplicative events in Santiago (E3). Collaboration creation Network (O5).
- Association for Terrestrial Ecology (Carolina Martínez): Organization of multiplicative events in Santiago (E3). Collaboration Creation Network (O5).
- European Federation for Soil Bioengineering (Paola Sangalli): Organization of multiplicative events in Santiago (E3). Collaboration Creation Network (O5).
- ECOMED Project (more than 30 people from different European countries): LANDCARE-ECOMED meeting. May 2018, Évora.
- Madrid Polytechnic University (José Luis García Rodríguez, Martin C. Giménez S.). Collaboration creation Network (O5). Encounter LANDCARE-ECOMED.
- Spanish Association of Landscape Engineering (Albert Sorolla): Collaboration Creation Network (O5).

- Technological Educational Institute of Eastern Macedonia and Thrace, Greece (George Zaimes): Collaboration Creation Network (O5).
- Xunta de Galicia (Cecilia Vázquez, M. Jesús López Cernadas): Organization of the multiplicative event in Santiago (E3).
- Kaye Academic College of Education, Israel (Eli Zaady): Collaboration Creation Network (O5).
- Northern Arizona University, San Diego (Maxwell Benning): Collaboration Creation Network (O5).
- Soil Conservation Service of Iceland (Rannveig Magnúsdóttir): Creation Network collaboration (O5).
- Landvernd Icelandic Environment Association, Iceland (Guðrún Schmidt): Collaboration Creation Network (O5).
- Univ Rennes, CNRS, LETG, France (Simon Dufour): Collaboration Creation Network (O5).
- Department of Civil Engineering and Natural Hazards, BOKU, Vienna (Rosemarie Stangl): Collaboration Creation Network (O5). Encounter LANDCARE-ECOMED.
- United Nations University (Berglind Orradottir): Collaboration Creation Network (O5).
- The University of Montana (Daniel T. Spencer): Collaboration Creation Network (O5).
- University of Belgrade (Nina Nikolic). Collaboration creation Network (O5).
- University of Évora (C. Alexandre, P. Simões, L. Gazarini): Collaboration creation Network (O5).

110



**Figure 76.** Transnational meeting in Lisboa, with two external observers (Jordi Cortina-SER, Julio Campo-UNAM).



**Figure 77.** Attendants from Mexico, Hungría, Chile, Greece, Italy and Spain (Salamanca, Leon) in one of the field trip carried out in the Landcare for the future conference.

111



**Figure 78.** Educational activities carried out by Landcare students in primary school from in Naxos, Greece.

### **IV.3. Participation in other forums**

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Representatives of the project partners participated in other important forums, such as the Spanish Soil Science Society Conference (June 2018 San Sebastian, Spain), EGU Conference (April 2018, Vienna), IV Joint Meeting SECF AEE (Alcázar de San Juan, October 2018). One of the most relevant participations was the invitation to present the LANDCARE project in one of the meetings of the ECOMED project (<http://ecomedbio.eu/evora-workshop-critical-analysis-soil-water-bioengineering>).

In addition, a Workshop on Education, Training, Knowledge transfer and Communication in Ecological Restoration was organized during the SER Europe Conference: Restoration in the Era of Climate Change which took place in Reykjavik, Iceland from 9-13 September 2018 (<https://sere2018.org/>).

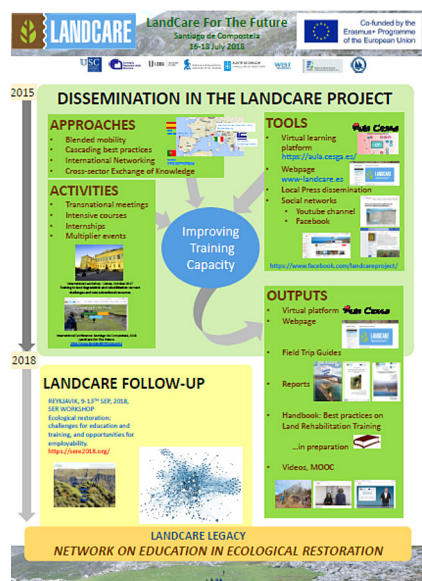
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**Figure 79.** Joint activity with ECOMED project (Evora, April 2018).  
Workshop. critical analysis of soil and water bioengineering

### IV.3.1. Landcare in social media

Knowledge sharing and outreach is at the foundation of LANDCARE overall objectives about improving training capacities in relation to Land Degradation and Rehabilitation (LD&R). For this purpose, the project developed an integrated dissemination strategy by combining different innovative tools and approaches while developing a diverse range of educational activities, and producing several outputs intended to reach the largest target audience. Dissemination events were open to all academic community (LANDCARE partners and non-partners), educators, employers, civil society and decision-makers dealing with hot issues on LD&R (research priorities, education innovation, educational awareness).



**Figure 80.** Dissemination strategy in the LANDCARE Project. Poster presented at the Final Conference LandCare for the Future (<http://www.landcareforfuture.com/>).

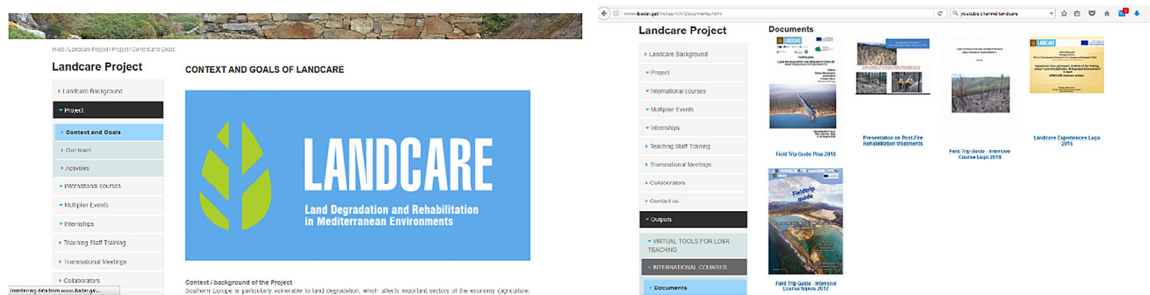
## Internal dissemination

The first level of this strategy involved the cascading dissemination of best practices and innovative tools through partnership and collaborator organizations, comprising academic, professional and civil society. This dissemination component was rooted on the development of the **International Intensive courses**, and the **Teaching Staff Training activities**, carried out in Santiago (Spain), Naxos (Greece) and Pisa (Italy). Also, the development of blended mobility, through **Internships** across professional partners settled in the partner countries of the consortium Greece, Italy, Spain and Portugal served to enhance the outreach of LANDCARE goals while promoting young employability.

## Website

The Dissemination strategy includes a main tool based in the **website** ([www.landcare.es](http://www.landcare.es)), that serves the dissemination of activities and events and provides free access to several educational resources (Field Trip Guides, Workshop presentations, Videos etc.), which are resulting outputs of this project.

113

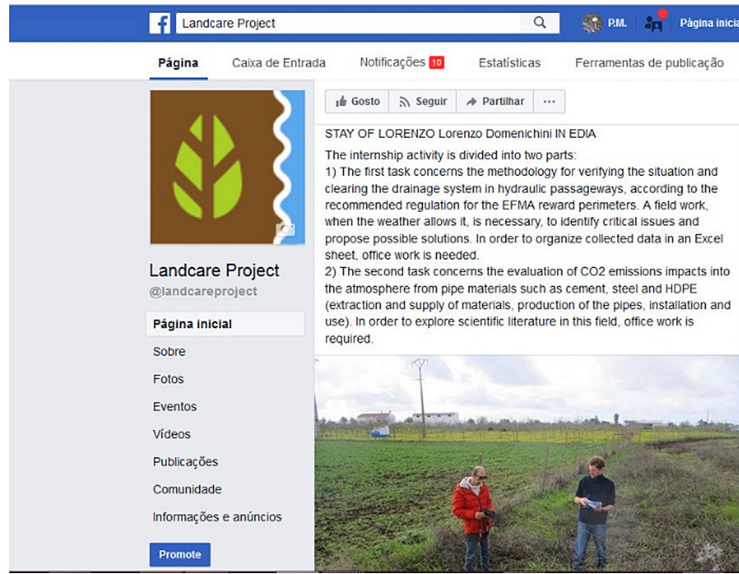


**Figure 81.** Appearance and example of resources available (Field trip guides) from the LANDCARE website ([www.landcare.es](http://www.landcare.es)).

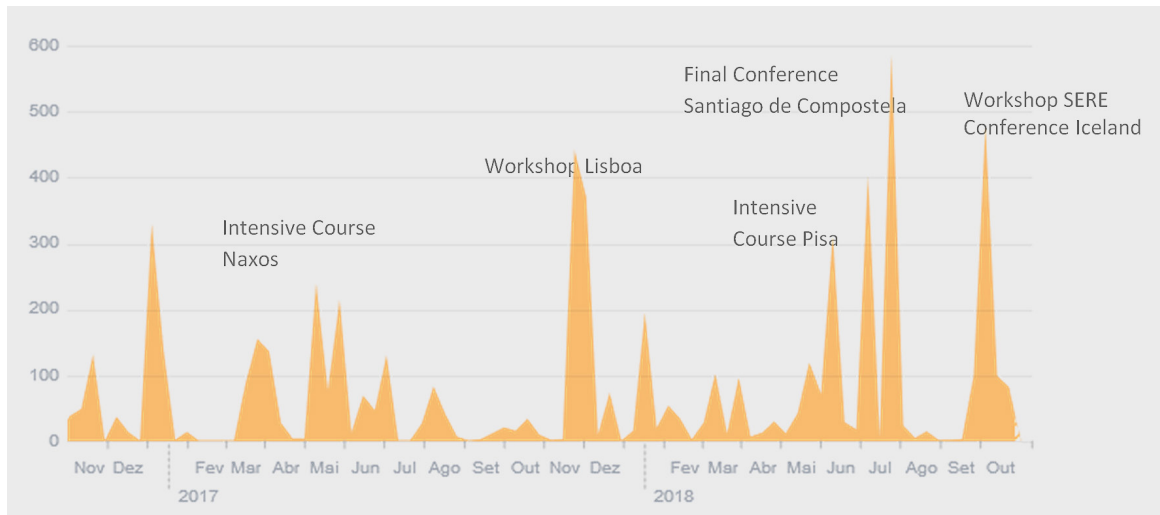
## Facebook

The website functioning is complemented and coordinated with the **social media** (<https://www.facebook.com/landcareproject/>) where all information related with the project, activities, events and outputs are regularly updated. Students participating in the different editions of the Landcare project Courses are encouraged to participate publishing their activities in the Facebook webpage, such as courses, internships etc.

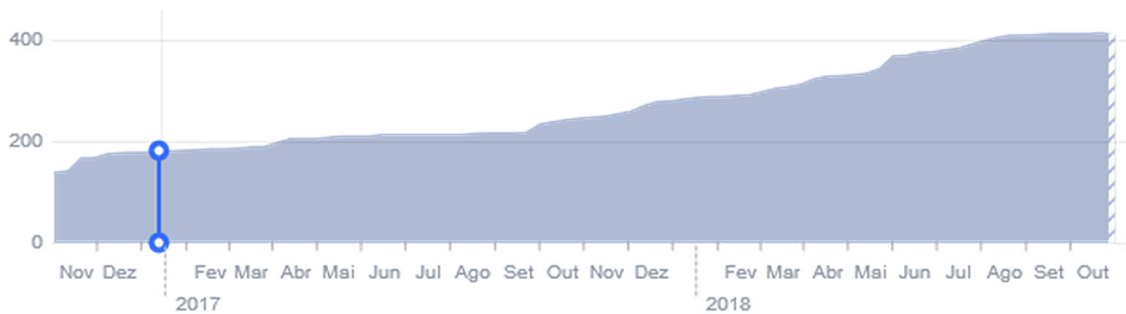
The Facebook webpage reflects the impact of training activities and multiplier events dissemination by 1) showing peaks during the main project activities, and by showing a steady increase in the number of followers and "likes".



**Figure 82.** Appearance of Landcare Project Facebook page (<https://www.facebook.com/landcareproject/>).



**Figure 83.** Trends in Organic reach (number of people) in Landcare Project Facebook page since the launch of the Facebook webpage (<https://www.facebook.com/landcareproject/>).



**Figure 84.** Trends in number of followers in Landcare Project Facebook page since the launch of the Facebook webpage (<https://www.facebook.com/landcareproject/>).



Figure 85. Trends in number of Likes in Landcare Project Facebook page since the launch of the Facebook webpage (<https://www.facebook.com/landcareproject/>).

### Local press

In addition, every activity was published in **local press** of the respective member countries of the consortium (Greece, Italy, Portugal and Spain). <http://www.ibader.gal/seccion/475/Dissemination.html>

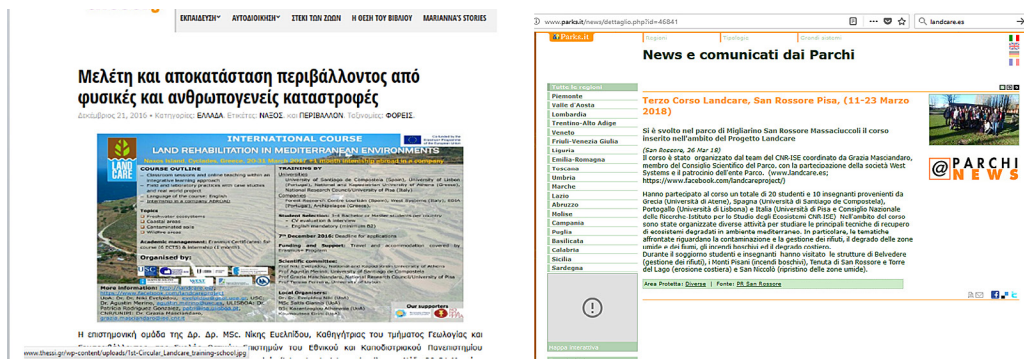


Figure 86. Dissemination of International Course in Naxos 2017 (Greece) and Pisa 2018 (Italy) in local press.

### Youtube and USC TV

The **dissemination outputs** include diverse formats, including an open access virtual platform for LD&R teaching, videos (MOOC) and documents such as the publication of the first Handbook linking Land Restoration Educational challenges and Employability Opportunities.

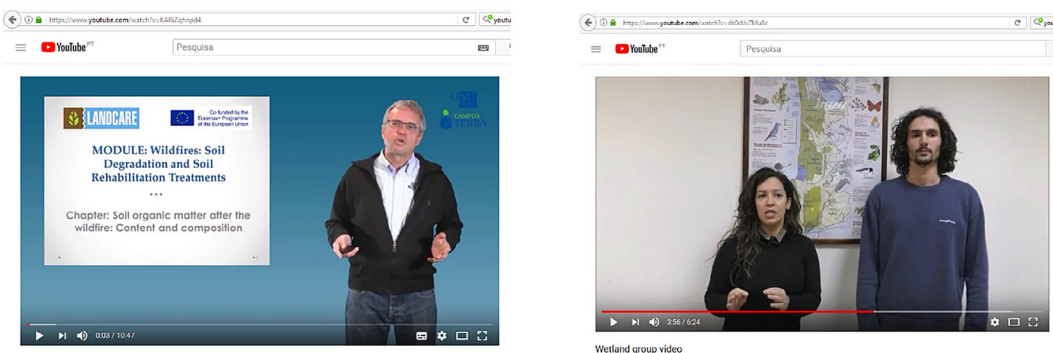


Figure 87. Dissemination outputs, left MOOC; right; videos performed by students.

### IV.3.2. Landcare forever: Network on education and training

The follow-up contribution of LANDCARE is towards the creation of a **Network for Education and Training in LD&R** with peer-teachers and experts. This network was presented during the workshop on Education for Ecological Restoration organized on the SER Europe Conference: Restoration in the Era of Climate Change which took place in Reykjavik, Iceland from 9-13 September 2018 (<https://sere2018.org/>). This network will contribute to raise awareness on the correct use of the land by society, and will also become a forum for educators and researchers by improving training capacities on ecological restoration and land rehabilitation, including sharing of knowledge and educational materials.



116

**Figure 88.** Workshop on Education for Ecological Restoration (Reykjavik, Iceland from 9-13 September 2018).

## IV.4. Testing the resources, materials and activities in the training (Annex 2)

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This survey was filled by all students participating in the short-intensive courses, in which the strategies, resources, tools and materials developed in the previous steps were tested. The surveys were done after each course, and the results were used to improve the activity for the following year. The questions in the survey addressed i) an evaluation of the institution (management and administrative issues); ii) an assessment of the academic appraisal of the contents, materials and approaches; iii) a balance of expectations fulfilment; iv) identification of needs for future.

Number of participants: 46.

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## EVALUATION OF THE INSTITUTION

According with the results showed below, most of the attendants were satisfied with the management and support given by the institutions. The support are related with the procedure for the student selection, logistics and facilities (accommodation, laboratories, classrooms and others).

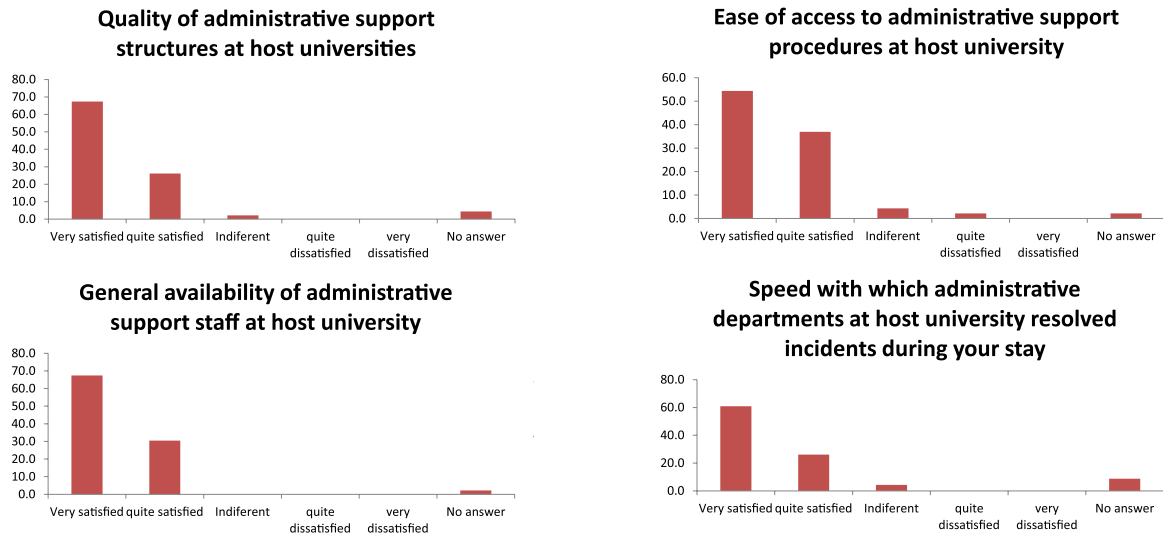


Figure 89. Evaluation of the institutions.

## ACADEMIC APPRAISAL

This part of survey considerers academic aspects throughout the course, such as organization of the teaching in the classroom, learning materials, virtual platform, quality of practices and academic support. In this point, the surveys show a consistent response across all participating students reflecting a high level of satisfaction with respect all the academic activities and procedures.

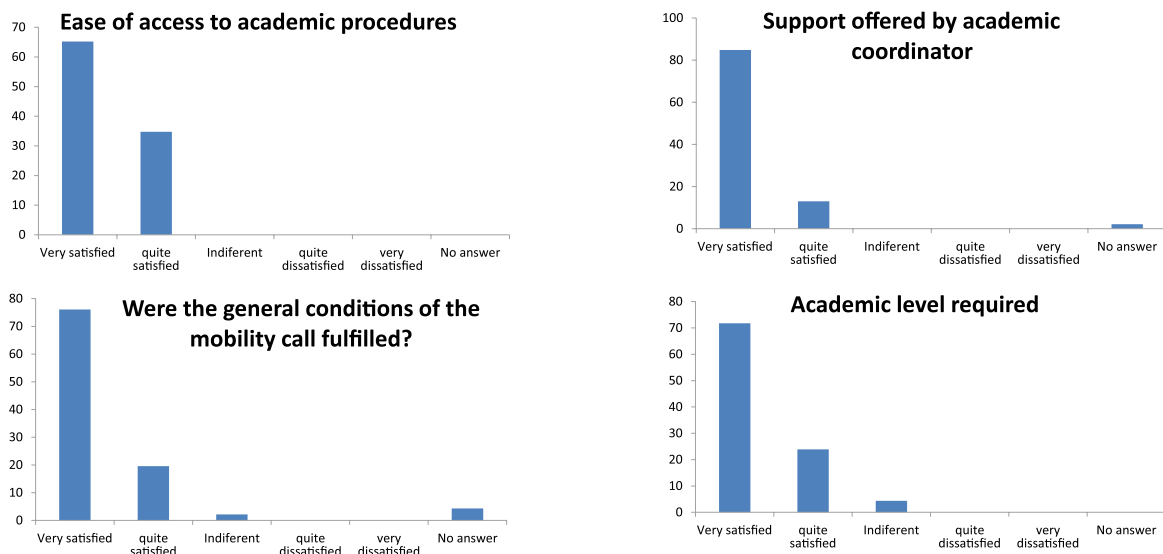


Figure 90. Academic appraisal.

Similarly the human resources and the study plan were generally positively considered by participant students.

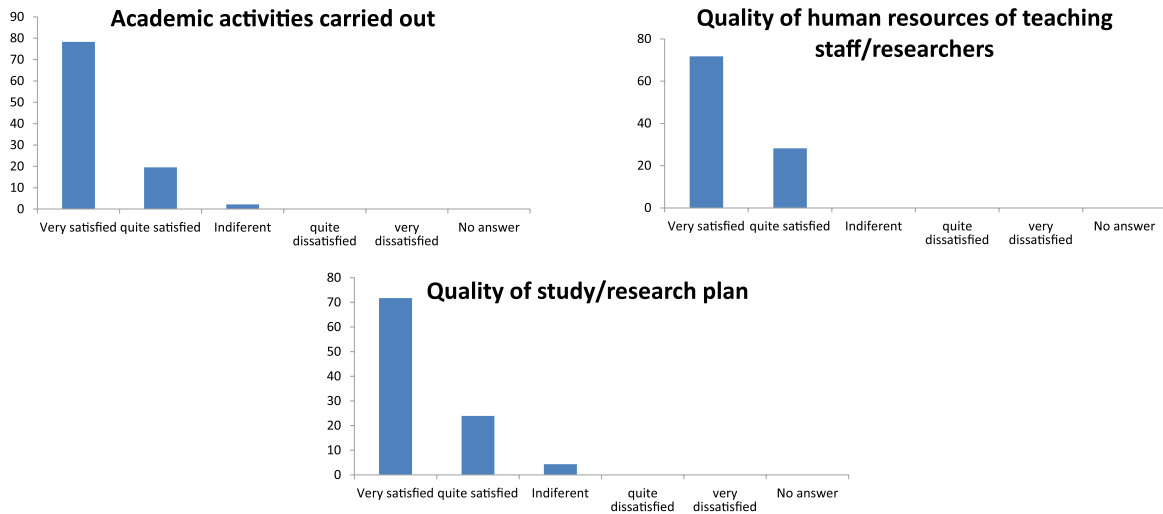


Figure 91. Academic appraisal 2.

### EXPECTATIONS NOT FULFILLED

The most criticized aspects were those related to the trade-offs involved in the organization of a course of these characteristics, which should find a good balance between facilitating access to a diverse range of real-world experiences, covering the four topics of the project (rivers and wetlands, coastal erosion, soil contamination, wildfires) in the environment), and simultaneously enabling minimum infrastructures for hosting laboratory and technology needed in classes. In some cases, the course was far from the laboratories (Naxos Island) and outside the university's own facilities (San Rossore-Pisa and Naxos Island Park), so the access to the internet and the laboratories was not always optimal. Given the type of issues involved in Landcare, in the interface of natural science, engineering, the selection of course locations was made so that to prioritize field work.

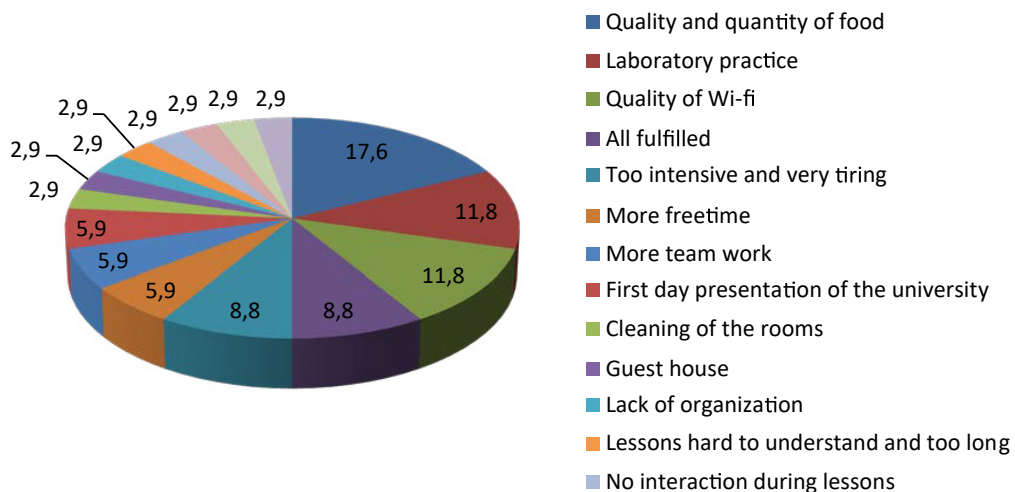


Figure 92. Expectations not fulfilled.

## MORE POSITIVE ASPECTS OF YOUR EXPERIENCE

The previous analysis conducted in this report (section II.2) showed the need to improve the most practical training, considering the regional differences. In this sense, these results show that the objectives that the project pursued were achieved. Indeed, the students specially valued the international and multidisciplinary environment of activities as it favoured higher exchange among both learners and teachers. They also gave especial importance to the realization of outdoor and field activities.

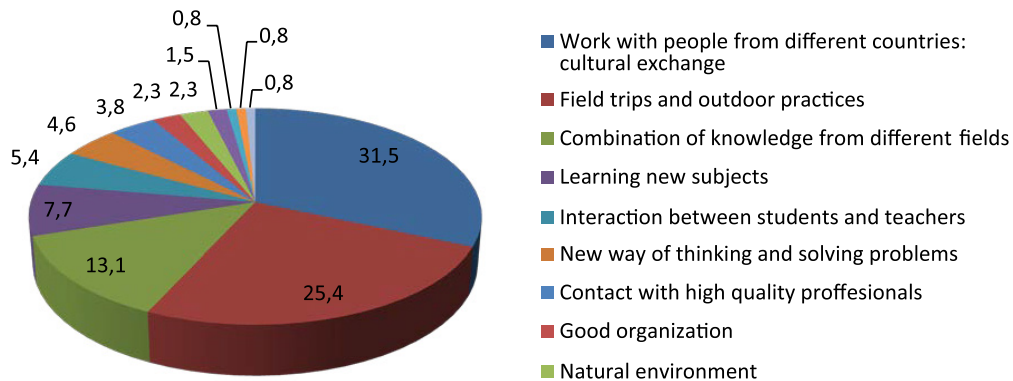


Figure 93. Positive aspects of the experience.

119

## ASPECTS TO BE IMPROVED IN THE DEVELOPMENT OF THE PROGRAMME

The survey shows that the dedication was, as already planned, intensive. The course allowed 4-5 days of practical activities, which imposed some organizational challenges. The answers of students are quite diverse. Among them, 20% of respondents highlighted the need to improve schedule and around 15% require more time dedicated to the field work or laboratory.

The results of the survey show very interesting points that were used every year to improve the next edition. Social aspects, getting involved in complementary activities such as organizing for example, a walk along the Camino de Santiago, cultural visits in Italy or concert of traditional music in Greece. Some students were involved in the organization of the congress in Santiago and others were registered as publishers of the website in Facebook.

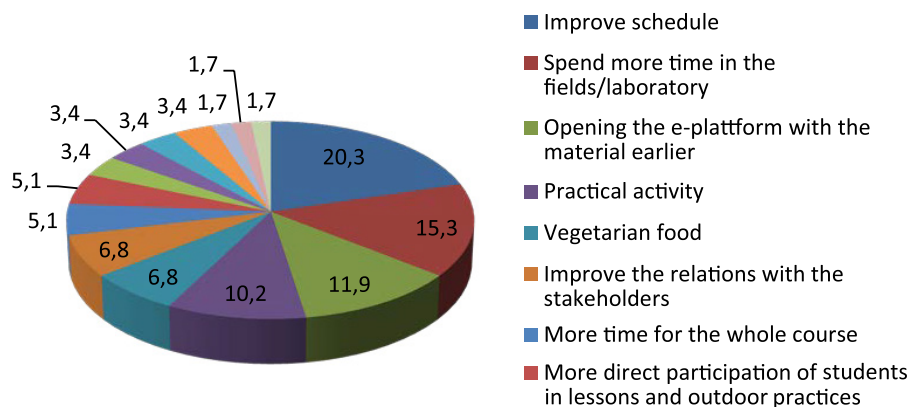


Figure 94. Aspects to be improved in the development of the programme.

## RECOMMENDATIONS TO IMPROVE THE EXPERIENCE

Finally the survey included a free section for comments and suggestions of the students to improve the experience. The general experience was positively evaluated, they recognized that participative and dynamic activities contributed to them being motivated. They propose to reduce class activity and to increase the field trips and visits and to enlarge the experience, as well as promote social aspects and team work. This is an interesting point as those aspects were dedicated an especial effort across the courses, so they indirectly indicate the degree of satisfaction of students after their participation.

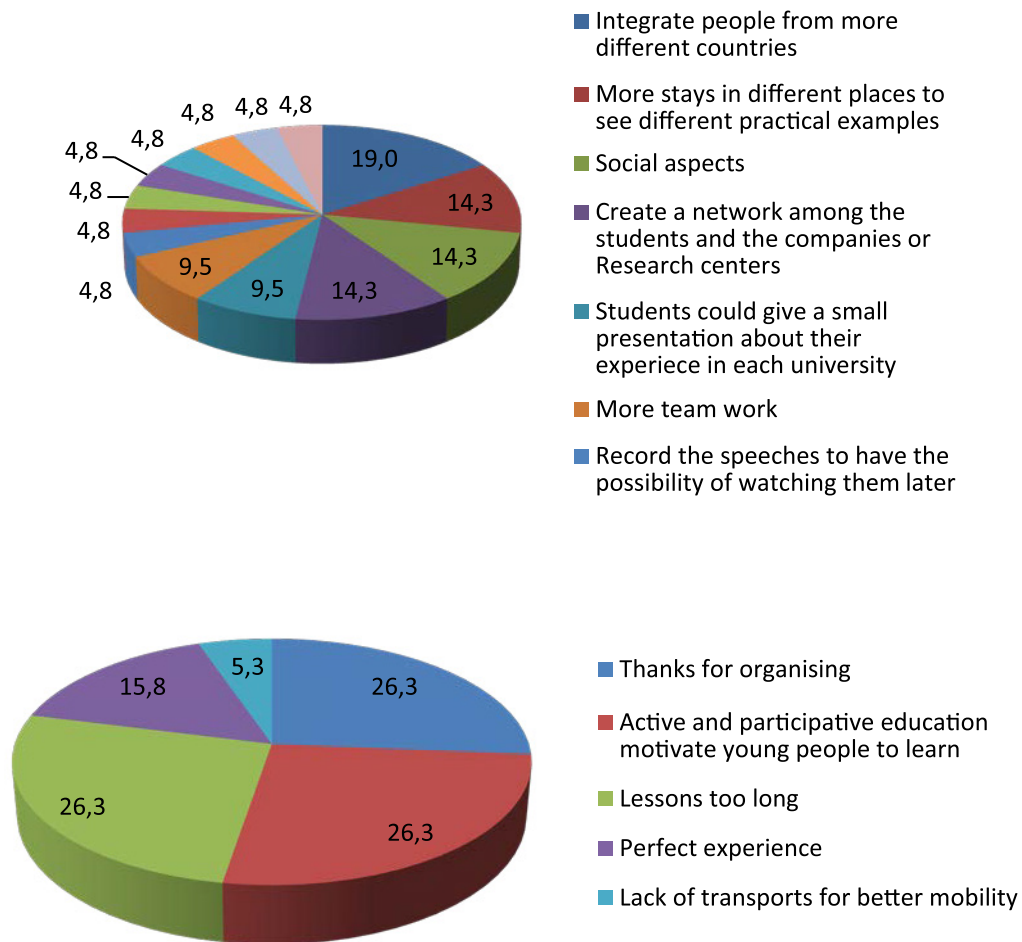


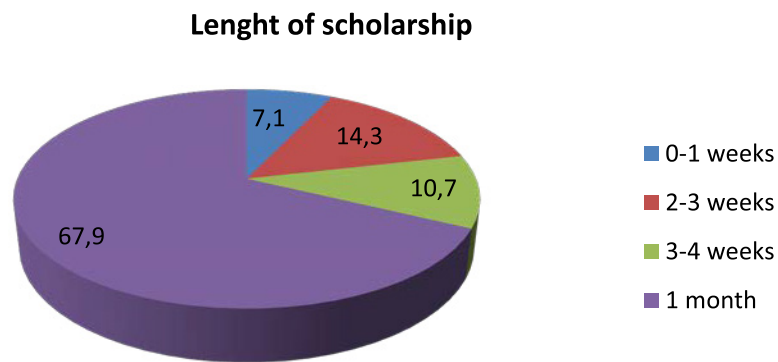
Figure 95. Recommendations to improve the experience.

## IV.5. Testing the impact of the blended training on the employment skills (Annex 3)

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To assess the impact of the blended training in the future employment, a specific survey was designed. This survey was filled by the Landcare students who attended the course and also carried out an internship in one of the professional partners. The survey was sent in July 2018, which allowed to find out the impact of the training after 2 (training in 2016), 1 (training in 2017) or 2 months (training in 2018).

Number of participants: 31.



121

Figure 96. Length of scholarship.

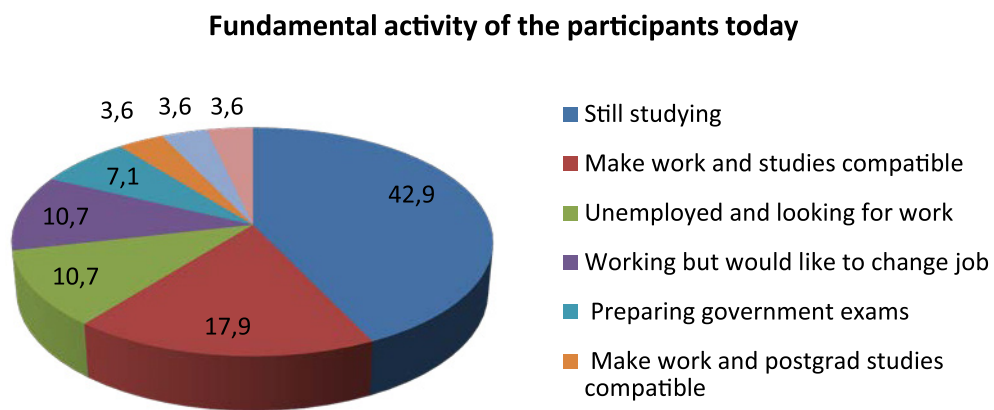
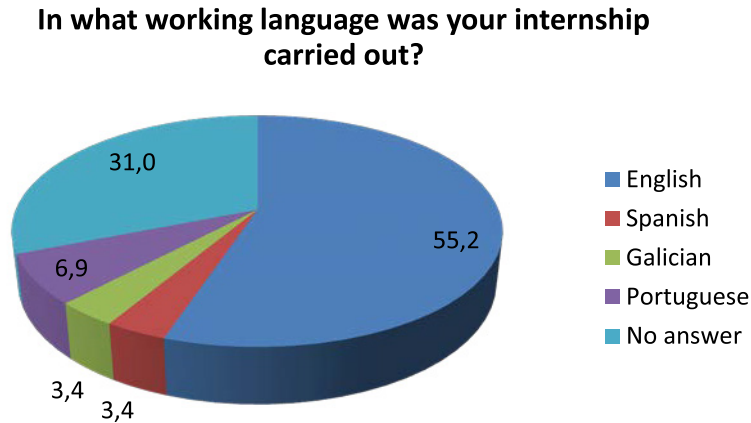


Figure 97. Fundamental activity of the participants today.

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## LINGUISTIC COMPETENCY

The training received was a general improvement of the language skills, but not only in English. Some people could also practice other languages.

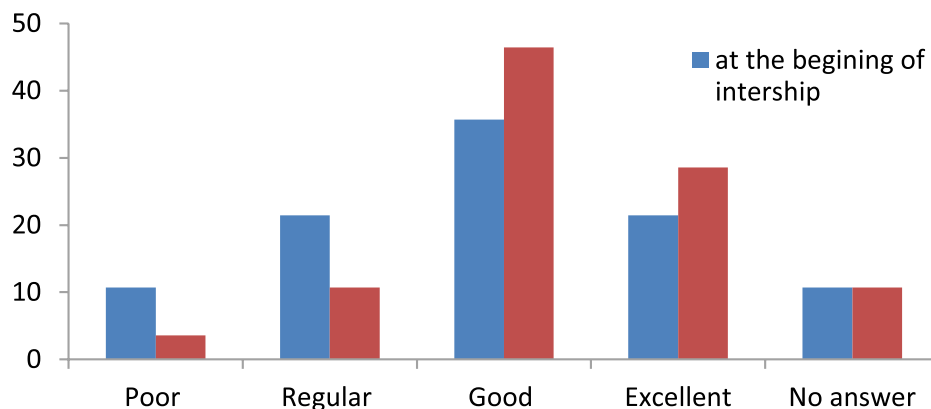


122

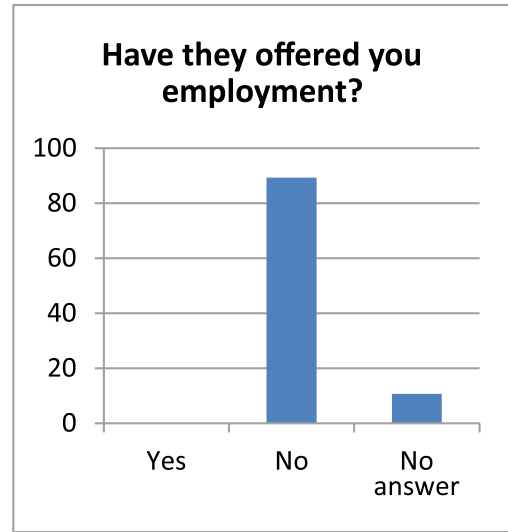
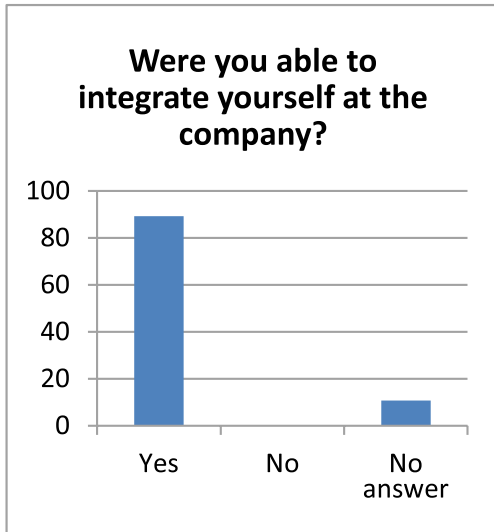
**Figure 98.** Language was your internship.

## EVALUATION OF THE STAY IN THE COMPANY

Despite the fact that most of the people were integrated in the company, none of them were offered to continue. However, there were people who could extend their period of stay. For most of the interviewees, the experience has been positive, the participants were able to integrate in the company, and the respondents had the perception that the experience would increase their employment perspectives so they would recommend it to other colleagues.



**Figure 99.** Evaluation of the stay in the company.



123

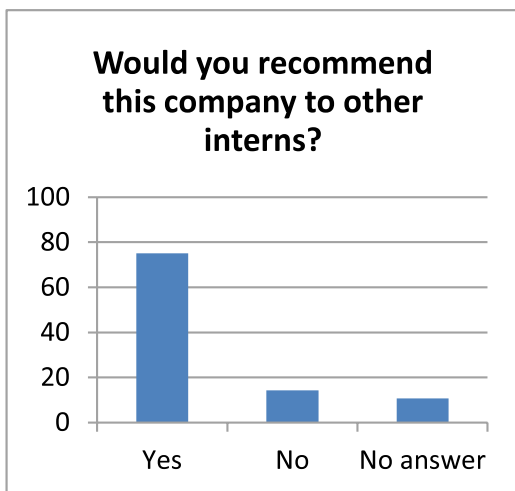
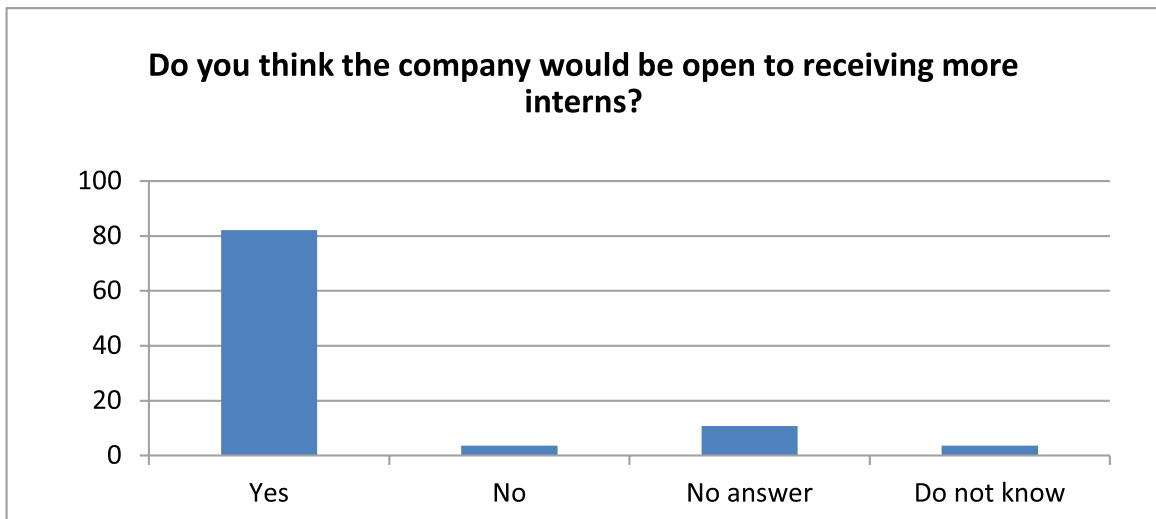
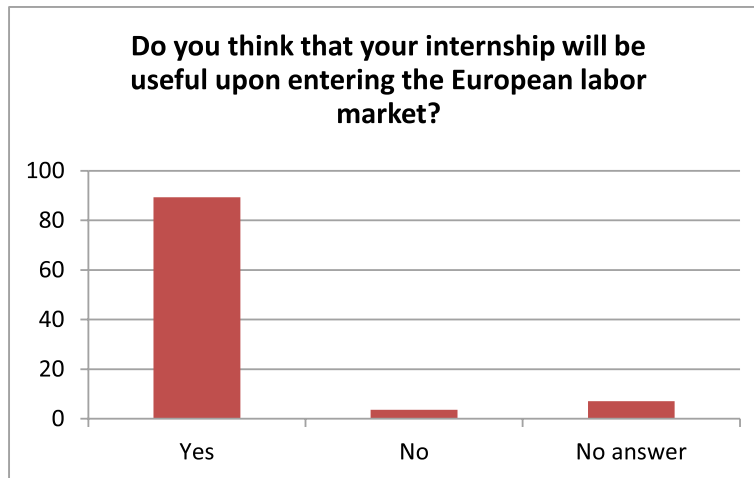


Figure 100. Evaluation of the stay in the company 2.

## ADAPTATION TO EUROPEAN COMPANIES

The main objective of this part of the survey, was to assess the adaptation of the acquired knowledge to the needs of European companies. All interviewed considered that the stay was useful to acquire practical knowledge to be hired by companies in the future. In some cases (18%) the effect is very positive.



124

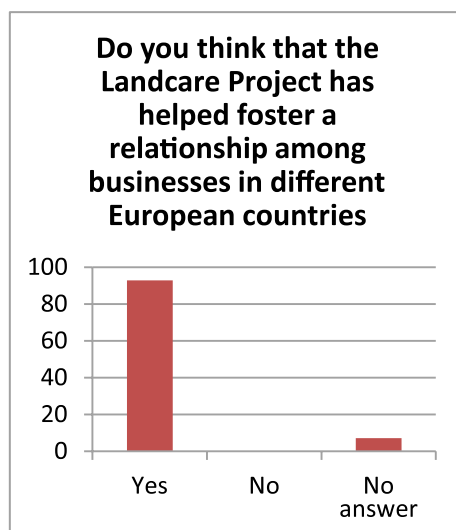
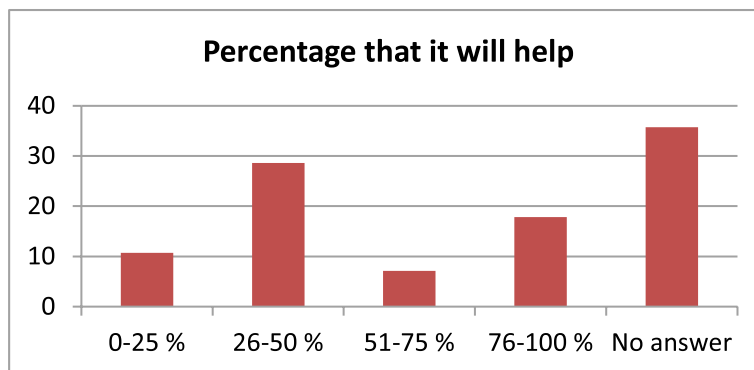
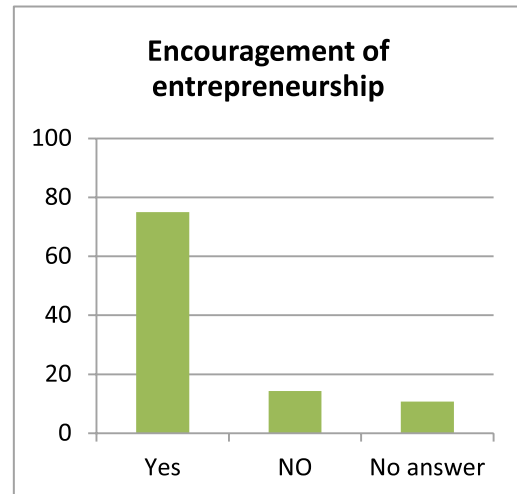
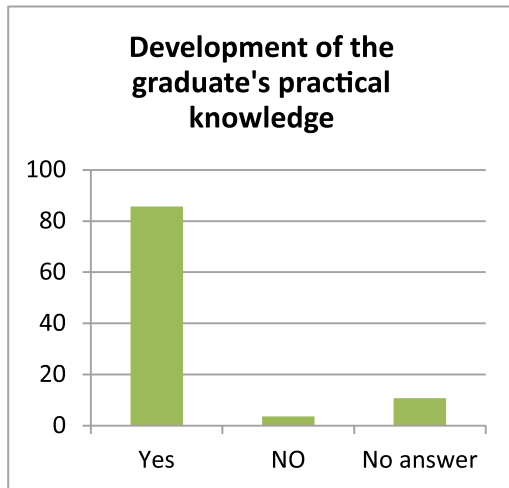


Figure 101. Labor market.

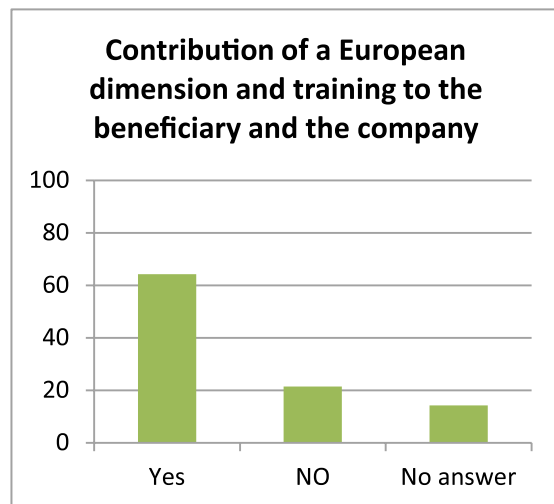
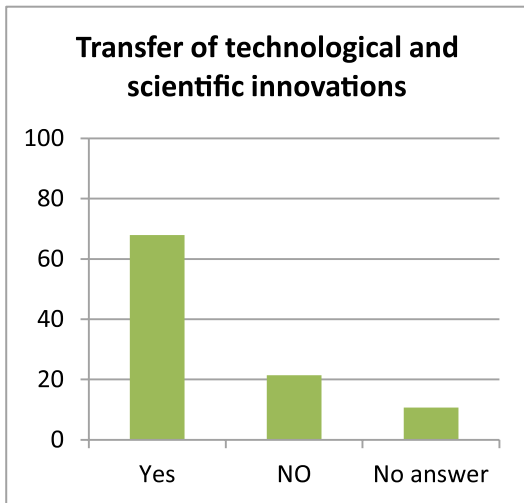
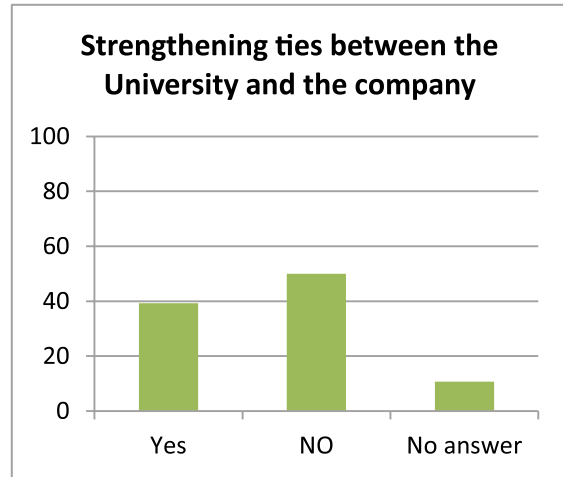
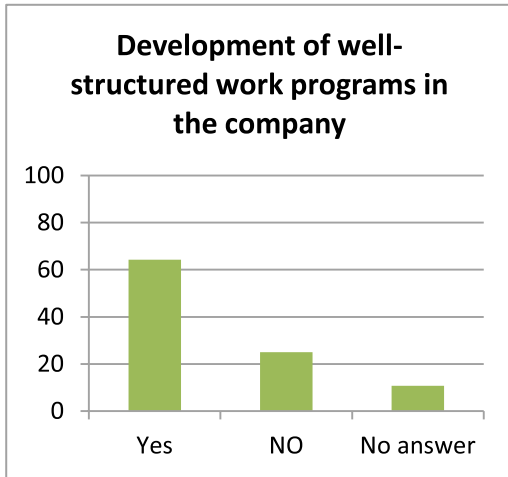
## RESULTS OF THE INTERNSHIP

The stay improved practical skills and entrepreneurship and this was a consistent response across participants. On the other hand, although the development of the activities was well organized, in some cases the collaboration between the academic and professional partners was not well defined so the cross-sectoral links remain to be improved. A strong point was that, in most cases, the interviewees had access to technological innovations of the companies that may be necessary for technological competitiveness.



125

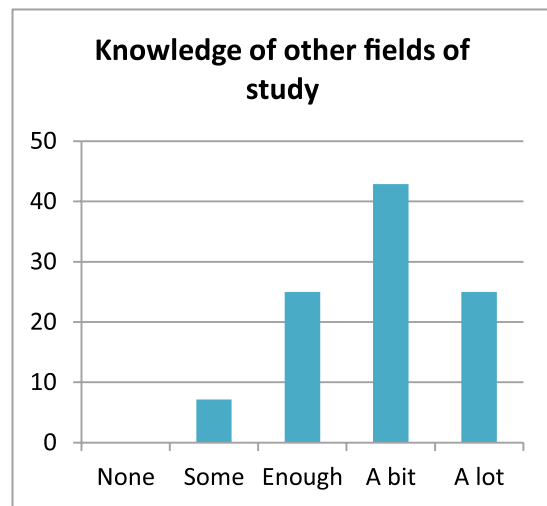
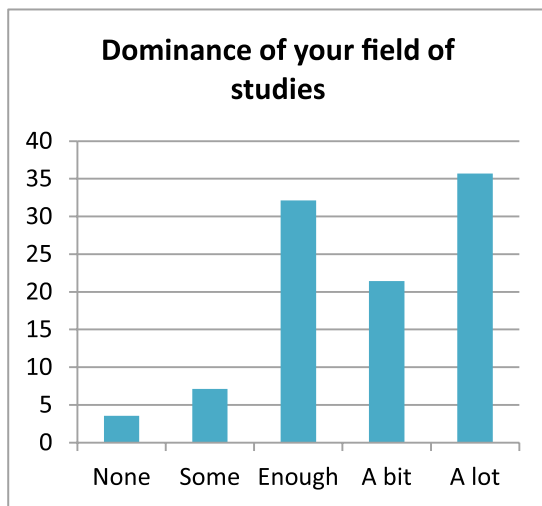




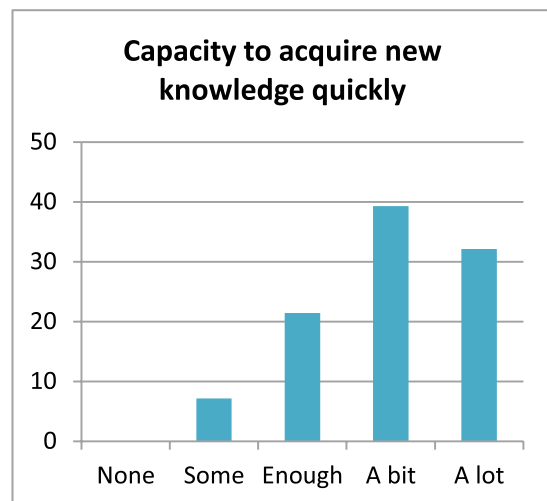
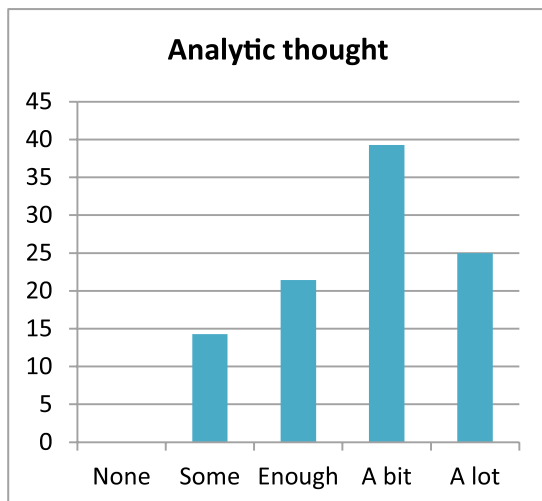
**Figure 102.** Abilities developed as a consequence of the blended training.

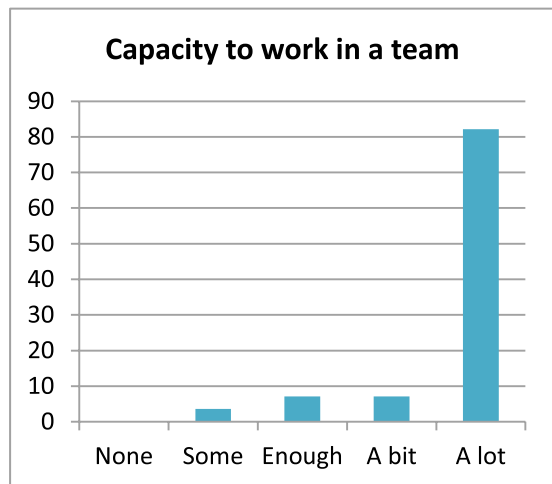
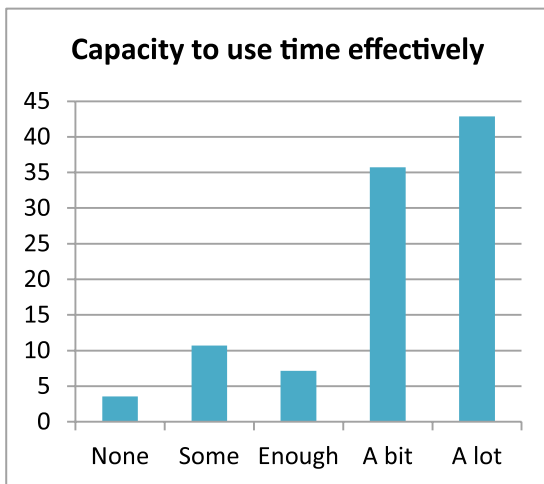
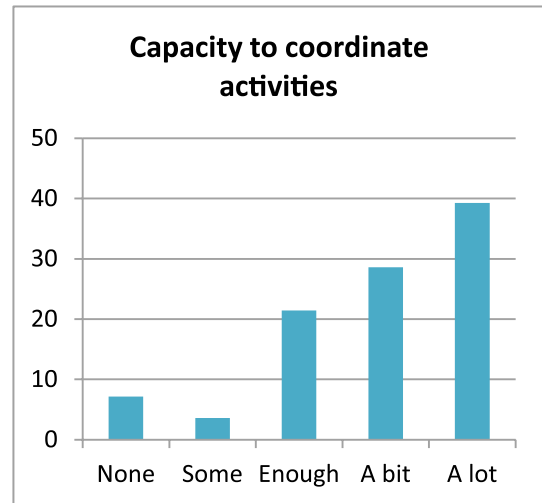
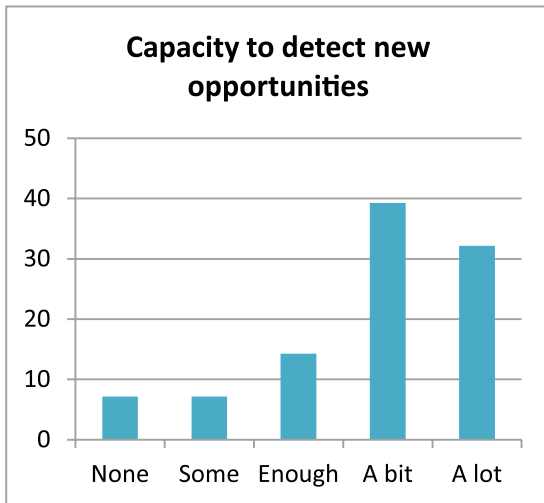
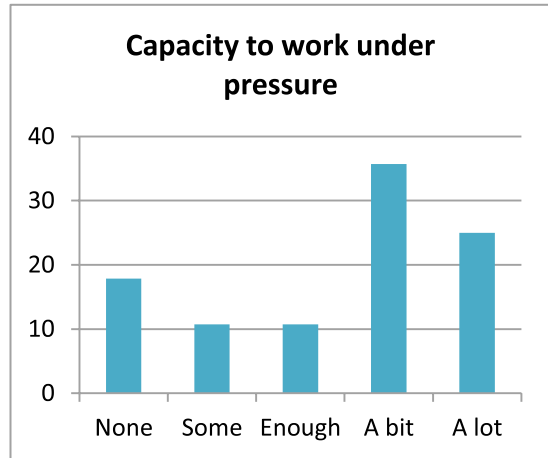
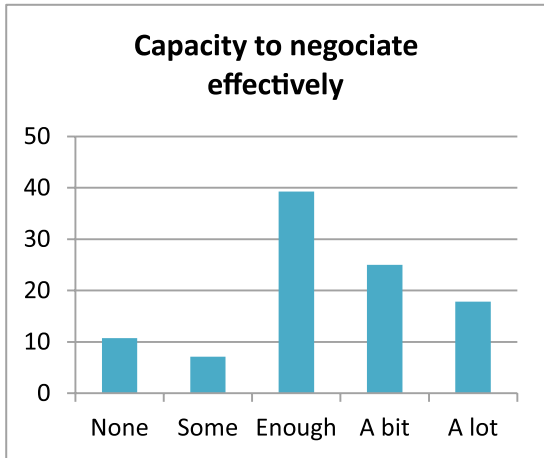
## ACQUIRED COMPETENCIES IN THE LANDCARE PROJECT

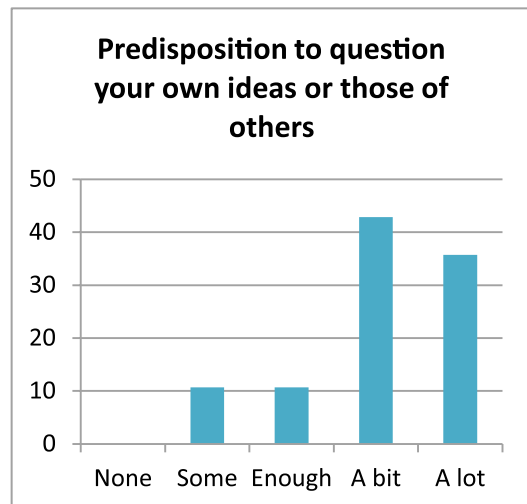
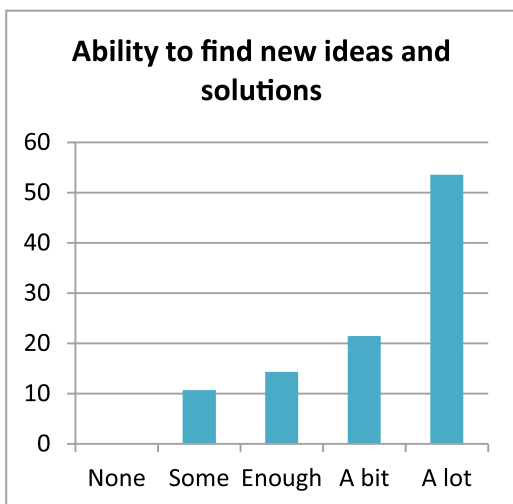
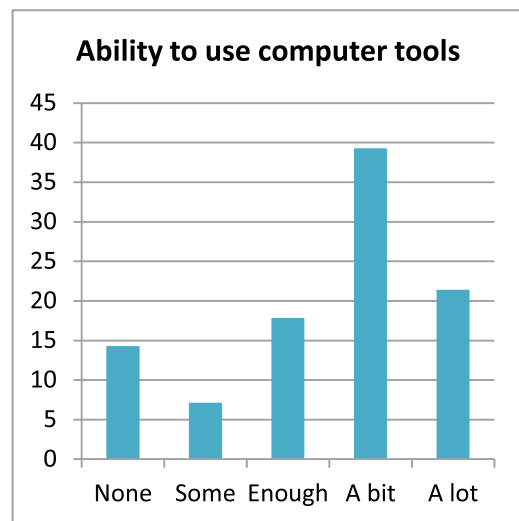
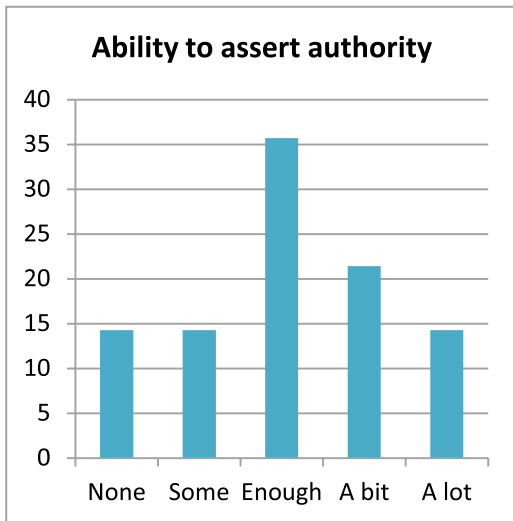
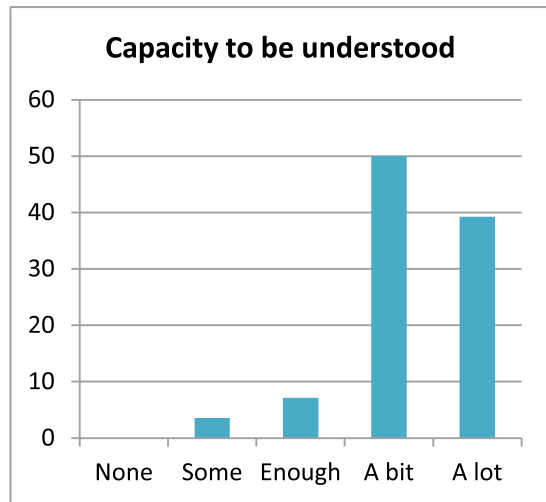
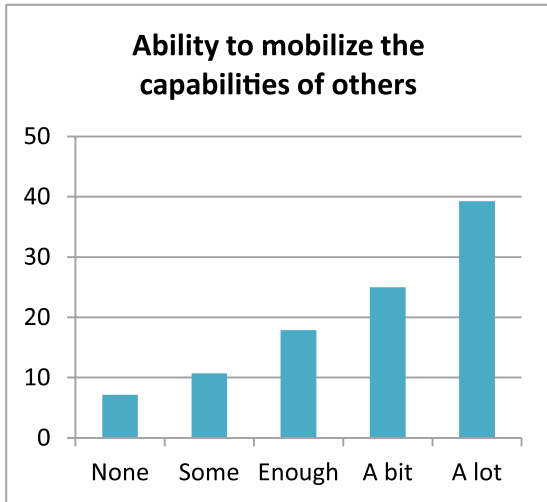
The labour market demands from the university graduates a series of competences. The acquisition of these competences contributes to improving the employability of graduates. From the point of view of their labour insertion, it was analysed to what extent the theoretical and practical training received in the Landcare Project contributed for the acquisition of these competences: From the following data it is possible to emphasize that the internship served to improve the technical and knowledge competences. It was also useful to encourage the work in team. Other skills that could be developed were the opportunity to contribute to the improvement of some aspects, and also the possibilities for communication and reporting.

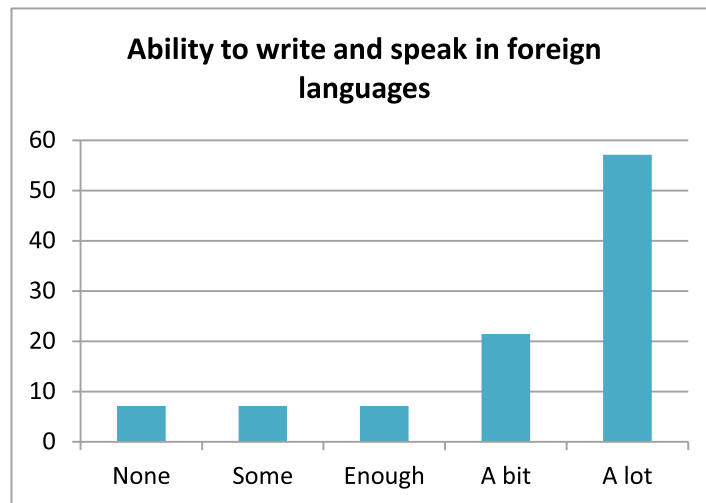
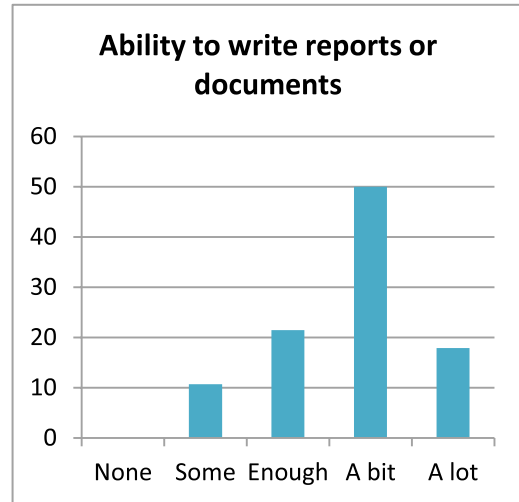
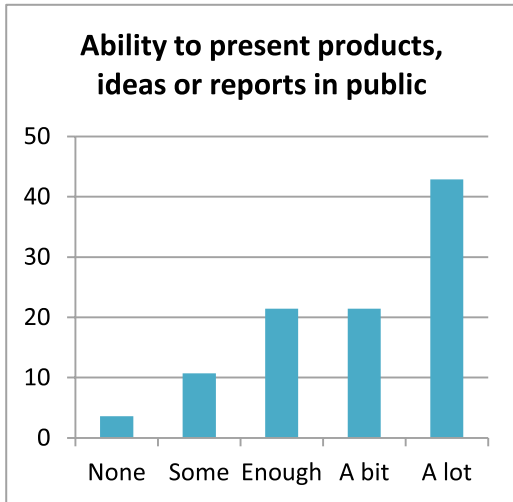


127





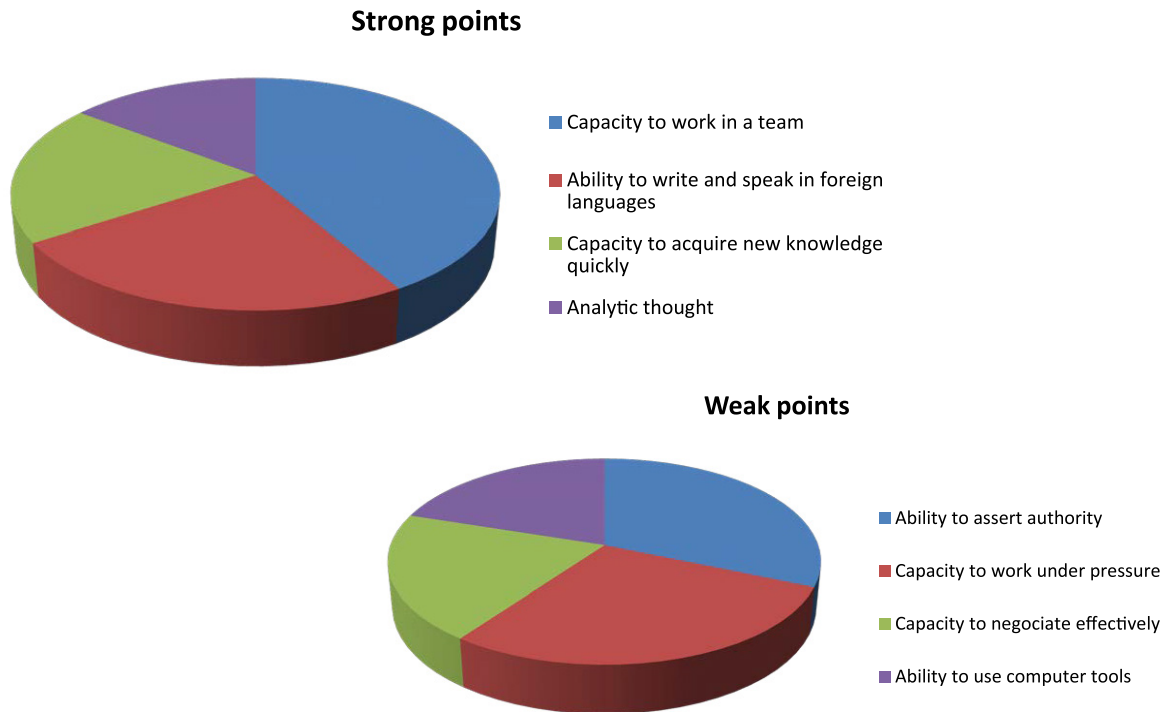




**Figure 103.** Acquired competencies in the landcare project.

## COMPETENCES THAT WERE CONSIDERED BY THE STUDENTS "STRONG POINTS" AND "WEAK POINTS"

The points most positively considered were the ability to work in groups and the ability to write and speak in foreign languages followed by the acquisition of new knowledge.

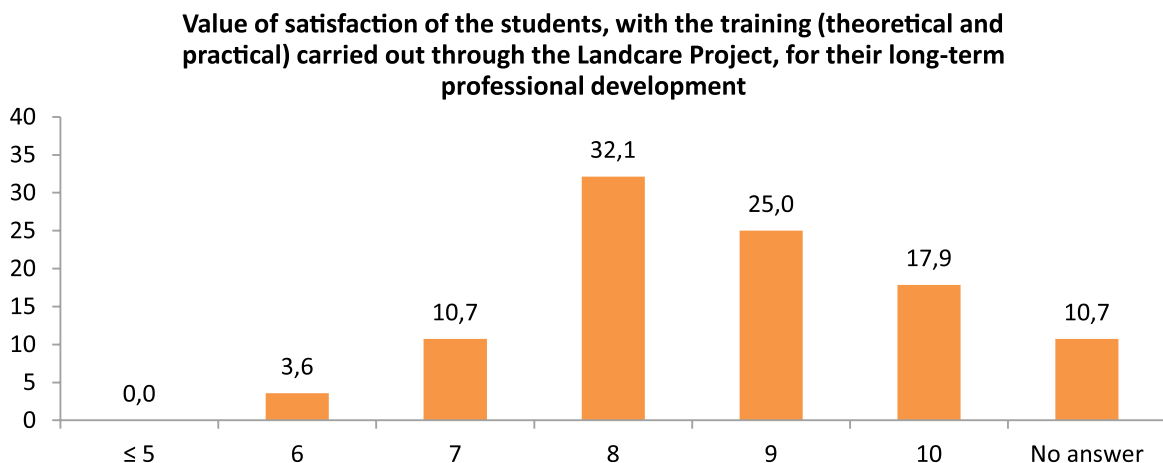


131

**Figure 104.** Strong and weak points of the training in the Landcare project.

## GENERAL SATISFACTION WITH THE STAY

The degree of satisfaction of the students participating in the internship was very high. More than 75% of them put a rating over 8 (scale between 0 and 10).



**Figure 105.** General satisfaction of the students with training in the Landcare project.

## IV.6. Testing the impact of the blended training on the employment skills. Campfire session for Landcare students and collaborators

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This activity was carried out in the Multiplier Event E3 (Landcare for the Future: the meeting point between students and educators): <http://www.landcareforfuture.com/seccion/38/Campfire-session-for-LandCare-students.html>.

### What is a campfire session?

Moving away from traditional meeting formats, the Campfire Session aims to bring our student participants an engaging learning experience where interactivity and horizontal participation is encouraged. The Student delegates each introduced different topics and then drive discussion incorporating feedback from attendants. The session provided an excellent forum for students and collaborators to learn from their peers by sharing their own experiences. This interactive session was also an excellent opportunity for students to make new contacts.

132

### What was the purpose of the Campfire session?

The Campfire was used a "final Evaluation" of students after LANDCARE project. Acting as group leaders of the Campfire session, they learned but also exhibited the skills they have gained during the project: both scientific/technical skills (critical thinking and analysis of the environmental/educational topics under discussion) and social/communication skills (being able to present in real time the ideas of a large group discussion, synthetise and present a summary to the public, expressing properly in English, and collaborate in multidisciplinary and multicultural teams in a coordinated and autonomous way)".

### IV.6.1. Campfire session management

#### Group management

The discussion was launched with **the questions previously agreed**. The **facilitator/responsible student introduced each question** speaking for few minutes and then helped foster a **group discussion**. The questions were the following:

- Land degradation and their causes and consequences are properly perceived by the society?
  - There is enough restoration effort of degraded lands carried out in your country?
  - Is the teaching of land restoration properly addressed (university/country/...)?
  - Are the available teaching material appropriated to address the current environmental problems in Europe. What do you miss.
  - Might Land restoration be an emerging labor market and source on employment?
  - What should be the role of stakeholders (companies, NGO, research center, universities, association, administration...)?
  - Do you think that an international network for education and training might contribute to improve the environment quality and fulfil the demands of an emerging labour market.
-

For each group, the facilitator/responsible student **wrote down a summary of the main ideas of each survey question in a separate paper sheet**. All summaries for the same question were fixed in a panel for the final synthesis.

The total allotted time for the discussion of these questions, by groups, and point by point was 1h.

### General discussion

At the end, the facilitators, student and educators did a **wrap-up of the main conclusions** for all questions from the campfire discussion. The total allotted time for the general discussion was 0.5h.

The facilitator/responsible student used creativity to **keep the fire burning** (free flow of ideas and brainstorming, encouraging participants to come up with "off the wall" ideas, to enrich and stimulate discussion) and to **light the fire up** in case the group is stuck (i.e. by Reverse brainstorming", by looking at the problem you are trying to resolve from a different/opposite angle).

133

The facilitator/responsible student observed the participants to get a feel of your group. Participant's communication styles may vary, along with their quantity of verbal contributions. Draw out the quieter participants through small groups. Try asking a 'safe' question or establishing their opinion, once the topic has been initially debated. **Ensure group has a balance of participants with different communication styles.**

## IV.6.2. Campfire session session results

After a brief introduction in the main Auditorium, participants moved to a more comfortable room, where they formed 6 groups led by a student and an educator. Each group seated in a round table and was composed by between 5 and 7 people.

The leaders were as follows:

Student			Educator	
Group	Name	Country	Name	Country
1	Pablo Ríos Joana Marinheiro	Spain Portugal	Paola Sangalli	Italy
2	Ignatios Bafas	Greece	Cristina Santín	UK
3	Colleen Fugate	Spain/USA	Felipe García Oliva Jordi Cortina	México Spain
4	Pietro Bertolotto	Italy	Carolina Martínez	Spain
5	Madalena Dias	Portugal	Julio Campo	México/Uruguay
6	Rita Marau	Portugal	Jorge Etchevers	México/Chile

During 45 minutes, each group reflected, discussed and wrote the summary for each of the 7 questions proposed writing the notes in a separate paper for each question.



**Figure 106.** Development of the Campfire session.

134

After the first stage of separate work by groups, all papers for a single question were collected by each one of the 7 leader students. They were exposed in the clipboard organized by questions and a synthesis was presented by each leader student.

Each leader student kept the notes of the question they were responsible and after the conference they wrote a summary of the main conclusions, for each question, which are detailed below.

#### SUMMARY OF QUESTIONS

- **Land degradation and their causes and consequences are properly perceived by the society?**

Summary of question across all groups (collected by Pablo Rios):

#### Answers by group:

- Group: Joana, Pablo, Sara, Antonio, Gabriela, Paola, Noemi  
We don't acknowledge our contribution to the impacts.  
Land degradation is associated to all degradation even cultured. There is a cultural gap, not coming out of our comfort zone.  
People see the degradation as something normal. There is no perception of degradation.
  - Group: Madalena, Vicente, Marina, Eva, Irene, Julio  
Dicotomia, Urban versus rural, Empiric versus Scientific.  
Too much information versus little knowledge. Break in the communication of the scientific knowledge.
-

- Group: Isabel Diez, Adrian Gonzalez, Felipe Garcia, Colleen Fugate, Jordi Cortina  
Dilema work. development, employment versus nature.  
Diversity of perception: I know, I don't care. I know but social degradation-need to survive-  
relation social development-perception.  
Developed versus developing countries.  
Problem in perceiving the problem, when is diffuse (ej. climate change).  
We all contribute to the system (problem) although we pretend we do not accept it.  
We may perceive problem but not the rate of change or magnitude.
- Group: Jorge, Rita, Marisa, Antonio, Anna, Sara  
We need more environmental education. It should start when we are children.  
Environment is seen as a resource (economic twisting) it should be changed.
- Group: Pietro, Martinez Ruiz, Winardi, Desiderio  
Lack of awareness, lack of education, lack of information.  
People not take enough attention on local degradation. Not enough public money, so  
remediation is expensive.  
Not enough education. Society is not aware enough. Life style.  
Conscience in new generations. Recycle waste.  
New way to communicate with geral people.
- Group: Ignatios Bafas  
Interest of the people. Knowing and care. Knowing and not care.  
No perception of the problem. Is not direct, so it won't affect us.  
Educational level.  
Economic prospects. Every country has different problems.

135

*Final conclusions of question 1, synthesis of all groups:*

1. No perception of the problem (reality).
  2. Education from young ages (new generations).
  3. Economic system.
- **There is enough restoration effort of degraded lands carried out in your country?**

Summary of question across all groups (collected by Ignatios Bafas):

Restoration effort of degraded lands is a concerning issue for all the countries that they were involved in the session. All the countries have done bigger or smaller steps in order to achieve land restoration. Common opinion from the groups is that there are many more

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things to be done. The main obstacles for land degradation are the lack of funds and the lack of information. Multiple and multi-scale efforts should be organized from many organisations (Governments, NGO, Universities) as well as priorities should be established in order to overcome the difficulties and reach better results.



Figure 107. Development of the Campfire session 2.

136

- **Is the teaching of land restoration properly addressed (university/country/...)?**

Summary of question across all groups (collected by Colleen Fugate):

- The teaching of land restoration is not properly addressed in most contexts.
- One of the main issues is a lack interdisciplinary or multidisciplinary perspectives. We also reflected on the limitations of studies being too specialized or too broad. There is a need to find a balance in this.
- There need to be more practical applications of land restoration. There needs to be a space to grow, to fail, to experiment in different contexts with practical application.
- Other groups discussed the importance of environmental education initiatives starting with children of a younger age.
- Finally, there was discussion of the importance of global and local solutions, of networking, and collaborating with individuals from different backgrounds.

- **Are the available teaching material appropriated to address the current environmental problems in Europe. What do you miss**

Summary of question across all groups (collected by Pietro Bertolotto):

The available teaching material about the current environmental problems in Europe seems to be not enough updated and efficient. One of the problem is that sometimes we have many specialists who don't have a global point of view of an environment issue because they don't join together their own knowledge and experience. That's the why it's so important to foster multidisciplinary specialist team working on environmental problems.

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We would like to underline that the educational process should provide first a global background and be more specific and technical only in the following educational steps.

Moreover, from the campfire session seems that the knowledge arrives to the ones that already know about the problem they are working on.

One of the main lack of the teaching on these topics is that it needs more practical and on field activities. The equilibrium between theoretical and practical knowledge is a key point.

It is remarkable that it's very important to juxtapose to the traditional teaching technique the innovative ones and help in the spending of online app and platforms.



Figure 108. Development of the Campfire session 3.

- **Might Land restoration be an emerging labor market and source on employment?**

Summary of question across all groups (collected by Madalena Dias):

This is a question that everyone answers yes without thinking at first (because it is a question of human survival), but some minutes after the "but" starts to appear.

Some say that the economy has to change so it can become a profitable market, the enterprises need to stop giving out money to fund some projects, and instead it should be an independent market that sustains itself.

Other say that exists a bad management of the professionals. Yes, there are few out there, and we should invest in teaching this issue, but the ones that exist, most of the time are not well placed, or have their places taken by professionals that are not formed in this area.

- **What should be the role of stakeholders (companies, NGO, research center, universities, association, administration, ...)?**

Summary of question across all groups (collected by Rita Marau):

Stakeholders must focus on sustainability, solving the problems of the present with the future in mind. Issues like land degradation, high carbon emissions and energetic inefficiency should be taken in consideration.

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Probably, the best way stakeholders can use to find solutions to these issues is promote and hold multidisciplinary teams, where people can collaborate and share knowledge gained in their different studies and work experiences.

To be possible to create these teams is extremely important to fostering better education. Universities have a major roll here. They must create the necessary conditions to provide more practical learning to their students and to encourage them to use their critical thinking. In addition, the environmental education must start not in University but in the first years of school, using different materials and preparing different activities suitable to children of different ages.



138

Figure 109. Development of the Campfire session 4.

- **Do you think that an international network for education and training might contribute to improve the environment quality and fulfil the demands of an emerging labour market.**

Summary of question across all groups (collected by Joana Marinheiro):

International networks are important for education in every kind of field. Networks that are able to generate other networks allow the sharing of experiences between people from different backgrounds, specially if it's direct contact.

These networks allow the global thinking and encourages the local acting.

# V

## Conclusions

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The Landcare project has served as a real-world laboratory of experiences to test breakthrough pedagogical approaches aiming to address current challenges of higher education and global socio-ecological threats.

### **Trends in the green economy and employment: need for trained staff**

The evaluation revealed a growing interest and increased investment in all activities related to environmental protection and recovery in Europe, particularly in Southern Europe. Although it is not known which specific activities will be in greatest demand in the future, the data indicate that there will be an increased demand for skilled workers in the next few years.

Although useful techniques for recovering degraded areas are widely available, restoration tasks have scarcely been implemented in most Mediterranean countries. A lack of awareness in the general population and the shortage of trained professionals were identified as some of the main possible causes of this problem. As these factors are related to education and training, higher education can therefore play an important role in the environmental protection. In addition, other causes, such as the socio-economic situation and political strategies could also be considered. This suggests the other stakeholders should also be involved in the training process.

### **Activities for educators: training in e-learning and exchange of good practices**

Training in virtual learning and the subsequent design of the virtual teaching tools clearly expanded the training capacities and scope of educators (both academic and professional partners involved in the project). The tools developed will also be useful for subsequent educational projects, especially for those requiring flexibility in organization.

The exchange of good practices was useful for comparing and contrasting how the different techniques are applied in different areas of the Mediterranean region characterized by different conditions. Collaboration in the different educational activities has also improved innovation in teaching strategies, both in the classroom and in the field.

### **Teaching products developed**

The educational materials developed in the project address the main problems related to the most frequent degradation processes in the Mediterranean region. A novel style of handbook (teaching manual) that includes different case studies has been published. Recording videos

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proved a valuable way of complementing the training. In some cases, use of audiovisual tools complemented the training at two stages, i.e. both during the preparation of videos (i.e. those made by students to reinforce the learning of specific topics) and presentation of these.

### **Interactive teaching carried out by academic and professional partners**

The greatest innovation in educational activities involved the incorporation of interactive learning between teachers of all partners (academic and professional) and between teachers and students, both in the classroom and the field. The incorporation of employability and entrepreneurship concepts proved useful for identifying possible business plans which could lead to the development of economic activities. In addition, this exercise was also very useful for discussing profitable solutions to solve important environmental problems.

### **Impact of the strategies on training and employment**

Although the analysis provided a preliminary view of the impact on employment, the assessment period was restricted to the duration of the project. The students positively evaluated the activities developed by the academic and professional educators on their training. The aspects considered most positive were the internationalization and the field practicals carried out during the course and at the headquarters of the professional partners.

140

The engagement of professional partners has improved the professional prospects for future generations. The blended training has had positive impacts on analytical thinking, language skills and the ability to carry out team work, as well as improving technical knowledge and encouraging entrepreneurship.

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## ANNEX 1. SURVEY SECTION II.2 EVALUATION THE MAIN NEEDS FOR LANDCARE STUDIES: SURVEY ON LAND RESTORATION EDUCATION CAPACITIES

### INNOVATIVE TEACHING IN LAND DEGRADATION AND REHABILITATION

Erasmus + LANDCARE PROJECT (<http://www.landcare.es>)

#### Survey on Land Restoration Education Capacities

Multiple drivers are causing a dramatic increase in the extent of degraded lands across Europe and all over the World. Overexploitation, wildfires, pollution, and degradation of rivers and coastal areas cause severe ecological disturbances, with strong negative and pervasive consequences for the environment, the economy, the development of rural areas and human health.

The LANDCARE PROJECT aims at fostering the restoration of degraded lands by supporting innovative education and training actions in this area. We'd like to identify the main needs and priorities in this area. **Please, take some minutes to fill this survey and deliver it at the SER Europe booth/Conference desk or send it to [landcare.project@usc.es](mailto:landcare.project@usc.es) (SUBJECT: SURVEY).**

145

Optional: Surname: \_\_\_\_\_ Name: \_\_\_\_\_

Email: \_\_\_\_\_

– Gender (F/M) \_\_\_\_ Age \_\_\_\_

– Country of work \_\_\_\_\_ Geographical region/State of work \_\_\_\_\_

#### 1. About you:

**1a. Your main expertise/interest:** Croplands \_\_\_\_ Forests \_\_\_\_ Mining areas \_\_\_\_  
Rivers and lakes \_\_\_\_ Wetlands \_\_\_\_ Coastal areas \_\_\_\_ Fisheries \_\_\_\_ Grasslands \_\_\_\_  
Other (describe) \_\_\_\_\_

**1b. Are you** Lecturer \_\_\_\_ Researcher \_\_\_\_ Manager \_\_\_\_ NGO \_\_\_\_ Policy-maker \_\_\_\_ Student \_\_\_\_  
Other (describe) \_\_\_\_\_

**1c. University** \_\_\_\_ **Public administration** \_\_\_\_ **Company** \_\_\_\_  
**NGO** \_\_\_\_ Other (specify) \_\_\_\_\_

**1d. If you are involved in teaching, mention the titles of the courses or topics related to ecological restoration that you teach, indicating if they are at the level of undergraduate (U), Master (M), doctorate (D) or non-formal education (N):** \_\_\_\_\_  
\_\_\_\_\_

**2. Do you think that the reinforcing of teaching on land restoration might contribute to improve the implementation of ecological restoration in your country of work?**

YES \_\_\_\_ NO \_\_\_\_

Comments (optional): \_\_\_\_\_

---

**3. Do you think **ecological restoration studies** are properly addressed in your country of work?**

YES \_\_\_ NO \_\_\_

If not, could you point out the main limitations?

- Syllabus \_\_\_\_\_
- Teaching materials \_\_\_\_\_
- Practices in the field \_\_\_\_\_
- Real-world restoration examples \_\_\_\_\_
- Practices in the laboratory \_\_\_\_\_
- Resources \_\_\_\_\_
- Internationalization \_\_\_\_\_
- Social engagement (companies, administration, NGOs...) \_\_\_\_\_
- Other: \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

146

**4. Are the available **teaching materials (bibliographic audiovisual materials) and real-world restoration examples** appropriate for teaching?**

YES \_\_\_ NO \_\_\_

If not, could you please point out the main limitations:

- Not related with the main problems of the region \_\_\_\_\_
- Not updated \_\_\_\_\_
- Lack of local case studies \_\_\_\_\_
- Language limitations (translation required) \_\_\_\_\_
- Other: \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

**5. Which are the main barriers hampering the development of the employment sector in ecological restoration?**

- Lack of awareness of the population \_\_\_\_\_
- Disparate interests and expectations across actors \_\_\_\_\_
- Lack of staff with enough expertise \_\_\_\_\_
- Lack of funds/incentives \_\_\_\_\_
- Lack of coordination among public administrations \_\_\_\_\_

Comments (optional): \_\_\_\_\_  
\_\_\_\_\_

**6.** A group of educators/researchers are currently promoting an international **network for training and education in ecological restoration**. The objective is to improve the training capacities on ecological restoration by sharing training opportunities, tools and projects.

**6a.** Would you be interested in becoming an active member of such network? YES \_\_\_ NO \_\_\_

**6b.** Would you be interested in receiving updates on the advances of this network?

YES \_\_\_ NO \_\_\_

If you answered YES, please indicate your contact (email): \_\_\_\_\_

**6c.** SER Europe organizes and supports summer courses, workshops and other education activities. Please identify, for future activities:

147

– the priority **topic(s)** that should be addressed: \_\_\_\_\_

– the optimum **duration** of such activities: \_\_\_\_\_

– Additional suggestions: \_\_\_\_\_

**The results of this survey will be published in <http://www.landcare.es>**

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## ANNEX 2 SURVEY SECTION IV.3. TESTING THE RESOURCES, MATERIALS AND ACTIVITIES IN THE TRAINING

### ACADEMIC SURVEY for Erasmus + Strategic partnerships

**Name of project: Landcare**

#### 1.A. Beneficiary details

Name and Surname	Marina Riesco
Home University	USC
Host University	West Systems
Level of studies (Bachelor, Doctorate, Post-doctorate, Academic Staff)	2018 summer
Length of stay (indicate start and end date)	25 junio-20 julio
Name and surname of the local coordinator	Ilaria
Contact details (address, email, telf)	
SIGNATURE	Marina Riesco

148

#### 2.B. Evaluation

##### 1. Evaluation of institutions

Judge the following aspects of the instjtutions involved in your mobility stay:					
	Very satisfied	Quite satisfied	Indifferent	Quite dissatisfied	Very dissatisfied
Quality of administrative support structures at host university		+			
Ease of access to administrative support procedures at host university		+			
General availability of administrative support staff at host university		+			
Speed with which administrative departments at host university resolved incidents during your stay		+			

## 2. Academic appraisal

Rate the following academic aspects of your mobility stay:					
	Very satisfied	Quite satisfied	Indifferent	Quite dissatisfied	Very dissatisfied
Academic activities carried out		+			
Quality of human resources of teaching staff/ researchers		+			
Quality of study/ research plan		+			
Ease of access to academic procedures		+			
Support offered by academic coordinator		+			
Were the general conditions of the mobility call fulfilled?		+			
Academic level required			+		

149

## 3. Your expectations concerning the mobility stay

Indicate below which expectations (concerning your stay) were not fulfilled. Please state reasons why not:

- 1) \_\_\_\_ Improving english \_\_\_\_\_  
Reason:  
There wasn't a high level between the staff
- 2) \_\_\_\_\_  
Reason:
- 3) \_\_\_\_\_  
Reason:
- 4) \_\_\_\_\_  
Reason:
- 5) \_\_\_\_\_  
Reason:

## 4. Highlight the three aspects of your experience you consider most positive:

1. \_\_\_\_ Been accepted by the enterprise one more
2. \_\_\_\_ Having the schedule of a employed
3. \_\_\_\_ Working out to have the opportunity of managing different situations in another language

**5. Highlight three aspects which would improve the development of this programme:**

1. \_\_\_\_\_ Giving the opportunity of a three-months experience
2. \_\_\_\_\_ Giving the opportunity of keeping in touch to the future with the enterprise
3. \_\_\_\_\_ Finding more destinations ... more over out of Europe

**6. Recommendations**

**State any recommendations you consider useful to improve the diffusion/exploitation of the experience and results of your mobility stay**

**I think that It would be fantastic to have a trainig period for at least three months wich could give us a real impression of working.**

---

150

**7. Observations**

**Offer any observations you consider appropriate concerning the whole process of your mobility stay:**

**I think that it was fantastic,only the money to get the flight ticket should be offered first,because as students we don't have a lot of money in advance.**

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**ANNEX 3. SURVEY SECTION IV.3. TESTING THE IMPACT OF THE BLENDED TRAINING ON THE EMPLOYMENT SKILLS**

**LANDCARE PROJECT-IMPACT ON LANDCARE INTEGRATION**

**PERSONAL INFORMATION OF THE SCHOLARSHIP RECIPIENT**

Surname: \_\_\_\_\_

First name: \_\_\_\_\_

Date of birth: \_\_\_\_\_

Address: \_\_\_\_\_

Nationality: \_\_\_\_\_

Email: \_\_\_\_\_

Phone number: \_\_\_\_\_

---

## ACADEMIC INFORMATION

University: .....

University studies: .....

## LENGTH OF SCHOLARSHIP

Start date: .....

End date: .....

## INFORMATION ABOUT THE INTERNSHIP COMPANY

Name of the center/company: .....

Department in which the internship was carried out: .....

Supervisor of the scholarship: .....

Position of supervisor in the company: .....

151

## ECONOMIC-BUYESNESS STRUCTURE OF THE REGION IN WHICH THE INTERNSHIP WAS CARRIED OUT

Indicate the reference data of at least 5 of the most important companies and/or organizations in the business sector of the region (company name, address, telephone, fax, activity...).

## LINGUISTIC COMPETENCY

At the present time, the command of a foreign language is essential and to be able to develop the professional activity in that language.

In what working language was your internship carried out?

What was your language level:	Poor	Regular	Good	Excellent
At the beginning of the internship?				
At the end of the internship?				

## EVALUATION OF YOUR STAY IN THE COMPANY

¿How long was your internship at the company?

Were you able to integrate yourself at the company?  YES  NO

Why or why not? .....

Have they offered you employment?  YES  NO

Do you think the company would be open to receiving more interns?  YES  NO

Would you recommend this company to other interns?  YES  NO

Why or why not? .....

Indicate the impact of the stay in the company with regard to the acquisition of additional professional qualifications and the European dimensions that have contributed to your training.

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Indicate the impact of the stay in the company with regard to the acquisition of additional professional qualifications and the European dimension contributed to their training.

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152

Indicate the contribution of the stay for the host company with regard to the transfer of technological innovations, the promotion of the application of technologies and the development of new products and services.

---

¿Do you think that this experience has improved your professional prospects?

YES  NO

¿Why or why not?

---

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## ADAPTATION TO EUROPEAN COMPANIES

Adaptation of the acquired knowledge to the needs of European companies

Do you think that your internship will be useful upon entering the European labor market?

YES  NO  Percentage that it will help %

Do you think that the Landcare Project has helped foster a relationship among businesses in different European countries  YES  NO

Do you know any Galician companies that would be available to hire you for an internship period in a European Company?  YES  NO

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## RESULTS OF THE INTERNSHIP

	YES	NO
Development of the graduate's practical knowledge		
Encouragement of entrepreneurship		
Familiarization of the graduate with professional perspectives		
Satisfactory qualification for the development of the internship		
Development of well-structured work programs in the company		
Strengthening ties between the University and the company		
Transfer of technological and scientific innovations		
Improvement of access to training by skilled workers		
Development of qualified human resources		
Contribution of a European dimension and training to the beneficiary and the company		

153

## ACQUIRED COMPETENCIES IN THE LANDCARE PROJECT

The labor market demands of the university graduates a series of competences. The acquisition of these competences contributes to improving the employability of graduates. From the point of view of their labor insertion, to what degree has the theoretical and practical training received in the Landcare Project contributed, for the acquisition of these competences:

COMPETENCIES	None	Some	Enough	A bit	A lot
Dominance of your field of studies					
Knowledge of other fields of study					
Analytic thought					
Capacity to acquire new knowledge quickly					
Capacity to negotiate effectively					
Capacity to work under pressure					
Capacity to detect new opportunities					
Capacity to coordinate activities					
Capacity to use time effectively					

Capacity to work in a team	
Ability to mobilize the capabilities of others	
Capacity to be understood	
Ability to assert authority	
Ability to use computer tools	
Ability to find new ideas and solutions	
Predisposition to question your own ideas or those of others	
Ability to present products, ideas or reports in public	
Ability to write reports or documents	
Ability to write and speak in foreign languages	

Indicate a maximum of three competences from the previous list that you consider "strong points" and three others that you consider "weak points" in your career (Indicate it by putting the corresponding letter of the previous list):

STRONG POINTS	WEAK POINTS

Value your satisfaction with the training (theoretical and practical) carried out through the Landcare Project, for your long-term professional development (0 nothing - 10 max.):

What is your fundamental activity today? (indicate only one option):

- Trabaja por cuenta ajena
- Make work and studies compatible
- Make work and postgrad studies compatible
- Unemployed and looking for work
- Still studying
- Working but would like to change job
- Preparing government exams
- Creating own company/project
- Other activities (please specify):

In the case that you are currently working:

- Indicate where you are working (country, región, province, etc.)  
-----
- Indicate how long you have been working:  
-----
- To what extent does your work relate with the LandCare training you have received?  
-----
- Indicate the name of your current job  
-----
- How satisfied are you with your current job? (on a scale of 1-10)  
-----
- In what sector do you work?  
-----
- What type of contract do you have?  
-----
- To what extent does your job relate with your studies?  
-----
- Do you think that LandCare contributed to your getting this job?



# Recursos Rurais

Revista do Instituto de Biodiversidade Agraria e Desenvolvemento Rural (IBADER)

## Proceso de selección e avaliación de orixinais

Recursos Rurais publica artigos, revisións, notas de investigación e reseñas bibliográficas. Os artigos, revisións e notas deben ser orixinais, sendo avaliados previamente polo Comité Editorial e o Comité Científico Asesor. Os traballos presentados a Recursos Rurais serán sometidos á avaliación confidencial de dous expertos alleos ao equipo editorial, seguindo criterios internacionais. Caso dos avaliadores propoñeren modificacións na redacción do orixinal, será de responsabilidade do equipo editorial —unha vez informado o autor— o seguimento do proceso de reelaboración do traballo. Caso de non ser aceptado para a súa edición, o orixinal será devolto ao seu autor, xunto cos ditames emitidos polos avaliadores. En calquera caso, os orixinais que non se suxeiten ás seguintes normas técnicas serán devoltos aos seus autores para a súa corrección, antes do seu envío aos avaliadores.

## NORMAS PARA A PRESENTACIÓN DE ORIXINAIS

### Procedemento editorial

A Revista Recursos Rurais aceptará para a súa revisión artigos, revisións e notas vinculados á investigación e desenvolvemento tecnolóxico no ámbito da conservación e xestión da biodiversidade e do medio ambiente, dos sistemas de produción agrícola, gandeira, forestal e referidos á planificación do territorio, tendentes a propiciar o desenvolvemento sostible dos recursos naturais do espazo rural. Os artigos que non se axusten ás normas da revista, serán devoltos aos seus autores.

### Preparación do manuscrito

#### Comentarios xerais

Os manuscritos non deben exceder de 20 páxinas impresas en tamaño A4, incluíndo figuras, táboas, ilustracións e a lista de referencias. Todas as páxinas deberán ir numeradas, aínda que no texto non se incluíran referencias ao número de páxina. Os artigos poden presentarse nos seguintes idiomas: galego, castelán, portugués, francés ou inglés. Os orixinais deben prepararse nun procesador compatible con Microsoft Word®, a dobre espazo nunha cara e con 2,5 cm de marxe. Empregarse a fonte tipográfica "arial" a tamaño 11 e non se incluíran tabulacións nin sangrías, tanto no texto como na lista de referencias bibliográficas. Os parágrafos non deben ir separados por espazos. Non se admitiran notas ao pé. Os nomes de xéneros e especies deben escribirse en cursiva e non abreviados a primeira vez que se mencionen. Posteriormente o epíteto xenérico poderá abreviarse a unha soa letra. Debe utilizarse o Sistema Internacional (SI) de unidades. Para o uso correcto dos símbolos e observacións máis comúns pode consultarse a última edición do CBE (Council of Biology Editors) Style manual.

#### Páxina de título

A páxina de título incluíra un título conciso e informativo (na lingua orixinal e en inglés), o nome(s) do autor(es), a afiliación(s) e a dirección(s) do autor(es), así como a dirección de correo electrónico, número de teléfono e de fax do autor co que se manterá a comunicación.

#### Resumo

Cada artigo debe estar precedido por un resumo que presente os principais resultados e as conclusións máis importantes, cunha extensión máxima de 200 palabras. Ademais do idioma orixinal no que se escriba o artigo, presentarase tamén un resumo en inglés.

#### Palabras clave

Deben incluírse ata 5 palabras clave situadas despois de cada resumo distintas das incluídas no título.

#### Organización do texto

A estrutura do artigo debe axustarse na medida do posible á seguinte distribución de apartados: Introducción, Material e métodos, Resultados e discusión, Agradecementos e Bibliografía.

Os apartados irán resaltados en negra e tamaño de letra 12. Se se necesita a inclusión de subapartados estes non estarán numerados e tipografiarase en tamaño de letra 11.

## Introdución

A introdución debe indicar o propósito da investigación e prover unha revisión curta da literatura pertinente.

## Material e métodos

Este apartado debe ser breve, pero proporcionar suficiente información como para poder reproducir o traballo experimental ou entender a metodoloxía empregada no traballo.

## Resultados e discusión

Neste apartado expóranse os resultados obtidos. Os datos deben presentarse tan claros e concisos como sexa posible, se é apropiado na forma de táboas ou de figuras, aínda que as táboas moi grandes deben evitarse. Os datos non deben repetirse en táboas e figuras. A discusión debe consistir na interpretación dos resultados e da súa significación en relación ao traballo doutros autores. Pode incluírse unha conclusión curta, no caso de que os resultados e a discusión o propicien.

## Agradecementos

Deben ser tan breves como sexa posible. Calquera concesión que requira o agradecemento debe ser mencionada. Os nomes de organizacións financiadoras deben escribirse de forma completa.

## Bibliografía

A lista de referencias debe incluír unicamente os traballos que se citan no texto e que se publicaron ou que foron aceptados para a súa publicación. As comunicacións persoais deben mencionarse soamente no texto. No texto, as referencias deben citarse polo autor e o ano e enumerar en orde alfabética na lista de referencias bibliográficas.

Exemplos de citación no texto:

Descricións similares danse noutros traballos (Fernández 2005a, b; Rodrigo et al. 1992).

Andrade (1949) indica como...

Segundo Mario & Tinetti (1989) os factores principais están... Moore et al. (1991) suxiren iso...

Exemplos de lista de referencias bibliográficas:

#### Artigo de revista:

Mahaney, W.M.M., Wardrop, D.H. & Brooks, P. (2005). Impacts of sedimentation and nitrogen enrichment on wetland plant community development. *Plant Ecology*. 175, 2: 227-243.

#### Capítulo nun libro:

Campbell, J.G. (1981). The use of Landsat MSS data for ecological mapping. En: Campbell J.G. (Ed.) *Matching Remote Sensing Technologies and Their Applications*. Remote Sensing Society. London.

Lowel, E.M. & Nelson, J. (2003). Structure and morphology of Grasses. En: R.F. Barnes et al. (Eds.). *Forrages. An introduction to grassland agriculture*. Iowa State University Press. Vol. 1. 25-50

#### Libro completo:

Jensen, W (1996). *Remote Sensing of the Environment: An Earth Resource Perspective*. Prentice-Hall, Inc. Saddle River, New Jersey.

#### Unha serie estándar:

Tutin, T.G. et al. (1964-80). *Flora Europaea*, Vol. 1 (1964); Vol. 2 (1968); Vol. 3 (1972); Vol. 4 (1976); Vol. 5 (1980). Cambridge University Press, Cambridge.

#### Obra institucional:

MAPYA (2000). Anuario de estadística agraria. Servicio de Publicaciones del MAPYA (Ministerio de Agricultura, Pesca y Alimentación), Madrid, España.

#### Documentos legais:

BOE (2004). Real Decreto 1310/2004, de 15 de enero, que modifica la Ley de aprovechamiento de residuos ganaderos. BOE (Boletín Oficial del Estado), nº 8, 15/1/04. Madrid, España.

#### Publicacións electrónicas:

Collins, D.C. (2005). Scientific style and format. Disponível en: <http://www.councilscience.org/publications.cfm> [5 xaneiro, 2005]

Os artigos que fosen aceptados para a súa publicación incluíranse na lista de referencias bibliográficas co nome da revista e o epíteto "en prensa" en lugar do ano de publicación.

## Ilustracións e táboas

Todas as figuras (fotografías, gráficos ou diagramas) e as táboas deben citarse no texto, e cada unha deberá ir numerada consecutivamente. As figuras e táboas deben incluírse

ao final do artigo, cada unha nunha folla separada na que se indicará o número de táboa ou figura, para a súa identificación. Para o envío de figuras en forma electrónica vexa máis adiante.

Debuxos lineais. Por favor envíe impresións de boa calidade. As inscricións deben ser claramente lexíbeis. O mínimo grosor de liña será de 0,2 mm en relación co tamaño final. No caso de ilustracións en tons medios (escala de grises): Envíe por favor as impresións ben contrastadas. A ampliación débese indicar por barras de escala. Aceptanse figuras en cores.

## Tamaño das figuras

As figuras deben axustarse á anchura da columna (8,5 centímetros) ou ter 17,5 centímetros de ancho. A lonxitude máxima é 23 centímetros. Diseñe as súas ilustracións pensando no tamaño final, procurando non deixar grandes espazos en branco. Todas as táboas e figuras deberán ir acompañadas dunha lenda. As lendas deben consistir en explicacións breves, suficientes para a comprensión das ilustracións por si mesmas.

Nas mesmas incluírase unha explicación de cada unha das abreviaturas incluídas na figura ou táboa. As lendas débense incluír ao final do texto, tras as referencias bibliográficas e deben estar identificadas (ex: Táboa 1 Características...). Os mapas incluírán sempre o Norte, a latitude e a lonxitude.

## Preparación do manuscrito para o seu envío

### Texto

Grave o seu arquivo de texto nun formato compatible con Microsoft Word.

### Táboas e figuras

Cada táboa e figura gardarase nun arquivo distinto co número da táboa e/ou figura. Os formatos preferidos para os gráficos son: Para os vectores, formato EPS, exportados desde o programa de debuxo empregado (en todo caso, incluíran unha cabeceira da figura en formato TIFF) e para as ilustracións en tons de grises ou fotografías, formato TIFF, sen comprimir cunha resolución mínima de 300 ppp. En caso de enviar os gráficos nos seus arquivos orixinais (Excel, Corel Draw, Adobe Illustrator, etc.) estes acompañaranse das fontes utilizadas. O nome do arquivo da figura (un arquivo diferente por cada figura) incluíra o número da ilustración. En ningún caso se incluíra no arquivo da táboa ou figura a lenda, que debe figurar correctamente identificada ao final do texto. O material gráfico escaneado deberá aterse aos seguintes parámetros: Debuxos de liñas: o escaneado realizárase en liña ou mapa de bits (nunca escala de grises) cunha resolución mínima de 800 ppp e recomendada de entre 1200 e 1600 ppp. Figuras de medios tons e fotografías: escanearanse en escala de grises cunha resolución mínima de 300 ppp e recomendada entre 600 e 1200 ppp.

### Recepción do manuscrito

Os autores enviarán un orixinal e dúas copias do artigo completo ao comité editorial, xunto cunha copia dixital, acompañados dunha carta de presentación na que ademais dos datos do autor, figuren a súa dirección de correo electrónico e o seu número de fax, á seguinte dirección:

IBADER

Comité Editorial da revista Recursos Rurais

Universidade de Santiago

Campus Universitario s/n

E-27002 LUGO - Spain

Enviar o texto e cada unha das ilustracións en arquivos diferentes, nalgún dos seguintes soportes: CD-ROM ou DVD para Windows, que irán convenientemente rotulados indicando o seu contido. Os nomes dos arquivos non superarán os 8 caracteres e non incluíran acentos ou caracteres especiais. O arquivo de texto denominarase polo nome do autor.

Ou ben enviar unha copia dixital dos arquivos convenientemente preparados á dirección de e-mail:

ibader@usc.es

Cos arquivos inclúa sempre información sobre o sistema operativo, o procesador de texto, así como sobre os programas de debuxo empregados nas figuras.

### Copyright

Unha vez aceptado o artigo para a publicación na revista, o autor(es) debe asinar o copyright correspondente.

Décembro 2015

# Recursos Rurais

Revista do Instituto de Biodiversidade Agraria e Desenvolvimento Rural (IBADER)

## Proceso de selección y evaluación de originales

Recursos Rurais publica artículos, revisiones, notas de investigación y reseñas bibliográficas. Los artículos, revisiones y notas deben ser originales, siendo evaluados previamente por el Comité Editorial y el Comité Científico Asesor. Los trabajos presentados a Recursos Rurais serán sometidos a la evaluación confidencial de dos expertos ajenos al equipo editorial, siguiendo criterios internacionales. En el caso de que los evaluadores propongan modificaciones en la redacción del original, será responsabilidad del equipo editorial —una vez informado el autor— el seguimiento del proceso de reelaboración del trabajo. Caso de no ser aceptado para su edición, el original será devuelto a su autor, junto con los dictámenes emitidos por los evaluadores. En cualquier caso, los originales que no se ajusten a las siguientes normas técnicas serán devueltos a sus autores para su corrección, antes de su envío a los evaluadores.

## NORMAS PARA LA PRESENTACIÓN DE ORIGINALES

### Procedimiento editorial

La Revista Recursos Rurais aceptará para su revisión artículos, revisiones y notas vinculados a la investigación y desenvolvimiento tecnológico en el ámbito de la conservación y gestión de la biodiversidad y del medio ambiente, de los sistemas de producción agrícola, ganadera, forestal y referidos a la planificación del territorio, tendientes a propiciar el desarrollo sostenible de los recursos naturales del espacio rural y de las áreas protegidas. Los artículos que no se ajusten a las normas de la revista, serán devueltos a sus autores.

### Preparación del manuscrito

#### Comentarios generales

Los manuscritos no deben exceder de 20 páginas impresas en tamaño A4, incluyendo figuras, tablas, ilustraciones y la lista de referencias. Todas las páginas deberán ir numeradas, aunque en el texto no se incluirán referencias al número de página. Los artículos pueden presentarse en los siguientes idiomas: galego, castellano, portugués, francés o inglés. Los originales deben prepararse en un procesador compatible con Microsoft Word®, a doble espacio en una cara y con 2,5 cm de margen. Se empleará la fuente tipográfica «arial» a tamaño 11 y no se incluirán tabulaciones ni sangrías, tanto en el texto como en la lista de referencias bibliográficas. Los párrafos no deben ir separados por espacios. No se admitirán notas al pie. Los nombres de géneros y especies deben escribirse en cursiva y no abreviados la primera vez que se mencionen. Posteriormente el epíteto genérico podrá abreviarse a una sola letra. Debe utilizarse el Sistema Internacional (SI) de unidades. Para el uso correcto de los símbolos y observaciones más comunes puede consultarse la última edición de CBE (Council of Biology Editors) Style manual.

#### Página de título

La página de título incluirá un título conciso e informativo (en la lengua original y en inglés), el nombre(s) de los autor(es), la afiliación(s) y la dirección(s) de los autor(es), así como la dirección de correo electrónico, número de teléfono y de fax del autor con que se mantendrá la comunicación.

#### Resumen

Cada artículo debe estar precedido por un resumen que presente los principales resultados y las conclusiones más importantes, con una extensión máxima de 200 palabras. Además del idioma original en el que se escriba el artículo, se presentará también un resumen en inglés.

#### Palabras clave

Deben incluirse hasta 5 palabras clave situadas después de cada resumen, distintas de las incluidas en el título.

#### Organización del texto

La estructura del artículo debe ajustarse en la medida de lo posible a la siguiente distribución de apartados: Introducción, Material y métodos, Resultados y discusión, Agradecimientos y Bibliografía. Los apartados irán resaltados en negrita y tamaño de letra 12. Si se necesita la inclusión de subapartados estos no estarán numerados y se tipografiarán en tamaño de letra 11.

## Introducción

La introducción debe indicar el propósito de la investigación y proveer una revisión corta de la literatura pertinente.

## Material y métodos

Este apartado debe ser breve, pero proporcionar suficiente información como para poder reproducir el trabajo experimental o entender la metodología empleada en el trabajo.

## Resultados y discusión

En este apartado se expondrán los resultados obtenidos. Los datos deben presentarse tan claros y concisos como sea posible, si es apropiado en forma de tablas o de figuras, aunque las tablas muy grandes deben evitarse. Los datos no deben repetirse en tablas y figuras. La discusión debe consistir en la interpretación de los resultados y de su significación en relación al trabajo de otros autores. Puede incluirse una conclusión corta, en el caso de que los resultados y la discusión lo propicien.

## Agradecimientos

Deben ser tan breves como sea posible. Cualquier concesión que requiera el agradecimiento debe ser mencionada. Los nombres de organizaciones financiadoras deben escribirse de forma completa.

## Bibliografía

La lista de referencias debe incluir únicamente los trabajos que se citan en el texto y que estén publicados o que hayan sido aceptados para su publicación. Las comunicaciones personales deben mencionarse solamente en el texto. En el texto, las referencias deben citarse por el autor y el año y enumerar en orden alfabético en la lista de referencias bibliográficas.

Ejemplos de citación en el texto:

Descripciones similares se dan en otros trabajos (Fernández 2005a, b; Rodrigo et al. 1992).  
Andrade (1949) indica como...  
Según Mario & Tinetti (1989) los factores principales están...  
Moore et al. (1991) sugieren eso...

Ejemplos de lista de referencias bibliográficas:

#### Artículo de revista:

Mahaney, W.M.M., Wardrop, D.H. & Brooks, P. (2005). Impacts of sedimentation and nitrogen enrichment on wetland plant community development. *Plant Ecology*. 175, 2: 227-243.

#### Capítulo en un libro:

Campbell, J.G. (1981). The use of Landsat MSS data for ecological mapping. En: Campbell J.G. (Ed.) *Matching Remote Sensing Technologies and Their Applications*. Remote Sensing Society. London.

Lowel, E.M. & Nelson, J. (2003). Structure and morphology of Grasses. En: R.F. Barnes et al. (Eds.). *Forages. An introduction to grassland agriculture*. Iowa State University Press. Vol. 1. 25-50

#### Libro completo:

Jensen, W (1996). *Remote Sensing of the Environment: An Earth Resource Perspective*. Prentice-Hall, Inc. Saddle River, New Jersey.

#### Una serie estándar:

Tutin, T.G. et al. (1964-80). *Flora Europaea*, Vol. 1 (1964); Vol. 2 (1968); Vol. 3 (1972); Vol. 4 (1976); Vol. 5 (1980). Cambridge University Press, Cambridge.

#### Obra institucional:

MAPYA (2000). *Anuario de estadística agraria*. Servicio de Publicaciones del MAPYA (Ministerio de Agricultura, Pesca y Alimentación), Madrid, España.

#### Documentos legales:

BOE (2004). Real Decreto 1310/2004, de 15 de enero, que modifica la Ley de aprovechamiento de residuos ganaderos. BOE (Boletín Oficial del Estado), nº 8, 15/1/04. Madrid, España.

#### Publicaciones electrónicas:

Collins, D.C. (2005). Scientific style and format. Disponible en: <http://www.councilscience.org/publications.cfm> [5 enero, 2005]

Los artículos que fuesen aceptados para su publicación se incluirán en la lista de referencias bibliográficas con el nombre de la revista y el epíteto «en prensa» en lugar del año de publicación.

## Ilustraciones y tablas

Todas las figuras (fotografías, gráficos o diagramas) y las tablas deben citarse en el texto, y cada una deberá ir nume-

rada consecutivamente. Las figuras y tablas deben incluirse al final del artículo, cada una en una hoja separada en la que se indicará el número de tabla o figura, para su identificación. Para el envío de figuras en forma electrónica vea más adelante. Dibujos lineales. Por favor envíe impresiones de buena calidad. Las inscripciones deben ser claramente legibles. El mínimo grosor de línea será de 0,2 mm en relación con el tamaño final. En el caso de ilustraciones en tonos medios (escala de grises): Envíe por favor las impresiones bien contrastadas. La ampliación se debe indicar mediante barras de escala. Se aceptan figuras en color.

## Tamaño de las figuras

Las figuras deben ajustarse a la anchura de la columna (8,5 centímetros) o tener 17,5 centímetros de ancho. La longitud máxima es de 23 centímetros. Diseñe sus ilustraciones pensando en el tamaño final, procurando no dejar grandes espacios en blanco. Todas las tablas y figuras deberán ir acompañadas de una leyenda. Las leyendas deben consistir en explicaciones breves, suficientes para la comprensión de las ilustraciones por sí mismas. En las mismas se incluirá una explicación de cada una de las abreviaturas incluidas en la figura o tabla. Las leyendas se deben incluir al final del texto, tras las referencias bibliográficas y deben estar identificadas (ej: Tabla 1 Características...). Los mapas incluirán siempre el Norte, la latitud y la longitud.

## Preparación del manuscrito para su envío

### Texto

Grave su archivo de texto en un formato compatible con Microsoft Word.

### Tablas y figuras

Cada tabla y figura se guardará en un archivo distinto con número de tabla y/o figura. Los formatos preferidos para los gráficos son: Para los vectores, formato EPS, exportados desde el programa de dibujo empleado (en todo caso, incluirán una cabecera de la figura en formato TIFF) y para las ilustraciones en tonos de grises o fotografías, formato TIFF, sin comprimir con una resolución mínima de 300 ppp. En caso de enviar los gráficos en sus archivos originales (Excel, Corel Draw, Adobe Illustrator, etc.) estos se acompañarán de las fuentes utilizadas. El nombre de archivo de la figura (un archivo diferente por cada figura) incluirá el número de la ilustración. En ningún caso se incluirá en el archivo de la tabla o figura la leyenda, que debe figurar correctamente identificada al final del texto. El material gráfico escaneado deberá atenderse a los siguientes parámetros: Dibujos de líneas: el escaneado se realizará en línea o mapa de bits (nunca escala de grises) con una resolución mínima de 800 ppp y recomendada de entre 1200 y 1600 ppp. Figuras de medios tonos y fotografías: se escanearán en escala de grises con una resolución mínima de 300 ppp y recomendada entre 600 y 1200 ppp.

### Recepción del manuscrito

Los autores enviarán un original y dos copias del artículo completo al comité editorial junto con una copia digital, acompañados de una carta de presentación en la que además de los datos del autor, figuren su dirección de correo electrónico y su número de fax, a la siguiente dirección:

IBADER

Comité Editorial da revista Recursos Rurais  
Universidade de Santiago  
Campus Universitario s/n  
E-27002 LUGO - Spain

Enviar el texto y cada una de las ilustraciones en archivos diferentes, en alguno de los siguientes soportes: CD-ROM o DVD para Windows, que irán convenientemente rotulados indicando su contenido. Los nombres de los archivos no superarán los 8 caracteres y no incluirán acentos o caracteres especiales. El archivo de texto se denominará por el nombre del autor.

O bien enviar una copia digital de los archivos convenientemente preparados la dirección de e-mail:

ibader@usc.es

Con los archivos incluya siempre información sobre el sistema operativo, el procesador de texto, así como sobre los programas de dibujo empleados en las figuras.

### Copyright

Una vez aceptado el artículo para su publicación en la revista, el autor(es) debe firmar el copyright correspondiente.

Diciembre 2015

# Recursos Rurais

Revista do Instituto de Biodiversidade Agrária e Desenvolvimento Rural (IBADER)

## Selection process and manuscript evaluation

The articles, reviews and notes must be original, and will be previously evaluated by the Editorial Board and the Scientific Advisory Committee. Manuscripts submitted to Recursos Rurais will be subject to confidential review by two experts appointed by the Editorial Committee, which may also consider choosing reviewers suggested by the author. In cases of dispute the intervention of a third evaluator will be required. Finally it is for the Editorial Committee's decision on acceptance of work. In cases in which the reviewers suggest modifications to the submitted text, it will be the responsibility of the Editorial Team to inform the authors of the suggested modifications and to oversee the revision process. In cases in which the submitted manuscript is not accepted for publication, it will be returned to the authors together with the reviewers' comments. Please note that any manuscript that does not adhere strictly to the instructions detailed in what follows will be returned to the authors for correction before being sent out for review.

## INSTRUCTIONS TO AUTHORS

### Editorial procedure

Recursos Rurais will consider for publication original research articles, notes and reviews relating to research and technological developments in the area of sustainable development of natural resources in the rural and conservation areas contexts, in the fields of conservation, biodiversity and environmental management, management of agricultural, livestock and forestry production systems, and land-use planning.

### Manuscript preparation

#### General remarks

Articles may be submitted in Galician, Spanish, Portuguese, French or English.

Manuscripts should be typed on A4 paper, and should not exceed 15 pages including tables, figures and the references list. All pages should be numbered (though references to page numbers should not be included in the text). The manuscript should be written with Microsoft Word or a Word-compatible program, on one side of each sheet, with double line-spacing, 2.5 cm margins on the left and right sides, Arial font or similar, and font size 11. Neither tabs nor indents should be used, in either the text or the references list. Paragraphs should not be separated by blank lines. Species and genus names should be written in italics. Genus names may be abbreviated (e.g. *Q. robur* for *Quercus robur*), but must be written in full at first mention. SI (Système International) units should be used. Technical nomenclatures and style should follow the most recent edition of the CBE (Council of Biology Editors) Style Manual.

#### Title page

The title page should include a concise and informative title (in the language of the text and in English), the name(s) of the author(s), the institutional affiliation and address of each author, and the e-mail address, telephone number, fax number, and postal address of the author for correspondence.

#### Abstract

Each article should be preceded by an abstract of no more than 200 words, summarizing the most important results and conclusions. In the case of articles not written in English, the authors should supply two abstracts, one in the language of the text, the other in English.

#### Key words

Five key words, not included in the title, should be listed after the Abstract.

#### Article structure

This should where possible be as follows: Introduction, Material and Methods, Results and Discussion, Acknowledgements, References. Section headings should be written in bold with font size 12. If subsection headings are required, these should be written in italics with font size 11, and should not be numbered.

### Introduction

This section should briefly review the relevant literature and clearly state the aims of the study.

### Material and methods

This section should be brief, but should provide sufficient information to allow replication of the study's procedures.

### Results and discussion

This section should present the results obtained as clearly and concisely as possible, where appropriate in the form of tables and/or figures. Very large tables should be avoided. Data in tables should not repeat data in figures, and vice versa. The discussion should consist of interpretation of the results and of their significance in relation to previous studies. A short conclusion subsection may be included if the authors consider this helpful.

### Acknowledgements

These should be as brief as possible. Grants and other funding should be recognized. The names of funding organizations should be written in full.

### References

The references list should include only articles that are cited in the text, and which have been published or accepted for publication. Personal communications should be mentioned only in the text. The citation in the text should include both author and year. In the references list, articles should be ordered alphabetically by first author's name, then by date.

Examples of citation in the text:

Similar results have been obtained previously (Fernández 2005a, b; Rodrigo et al. 1992  
Andrade (1949) reported that...  
According to Mario & Tinetti (1989), the principal factors are...  
Moore et al. (1991) suggest that...

Examples of listings in References:

*Journal article:*

Mahaney, W.M.M., Wardrop, D.H. & Brooks, P. (2005). Impacts of sedimentation and nitrogen enrichment on wetland plant community development. *Plant Ecology*. 175, 2: 227-243.

*Book chapter:*

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*Electronic publications:*

Collins, D.C. (2005). *Scientific style and format*. Available at: <http://www.counckjnec.org/publications.cfm> [5 January 2005]

*Articles not published but accepted for publication:*

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December 2015

# Monografías do IBADER

Instituto de Biodiversidade Agraria e Desenvolvemento Rural

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