SUPERB
Upscaling Forest Restoration

Spain – Castille & Léon

Restoration Workplan

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1 Restoration goals

One of the main limitations for the expansion of the brown bear in Castilla y León is the existence of anthropic barriers, mainly the A-6 motorway which limits the dispersion of the species towards the southwest of the community, as well as the degradation of many hectares of forest included within its habitat due to poor forest management and the recurrence of forest fires, which means that the natural corridors are very limited. Large scale shrublands, grasslands and open forests of *Quercus pyrenaica* affected by recurrent forest fires (more

than 300.000 ha) become an inappropriate habitat for brown bear dispersion from breeding areas.

It is necessary to adopt measures that contribute to reducing the degradation of forest through forestry and the recovery of management, but above all those that contribute to the diversification and promotion of natural corridors, increasing their effective surface area and improving their state of conservation through the planting of species typical of the habitat and which serve as a trophic resource for the fauna.

Big challenge is to make cost effective restoration activities because of the large area available. Long term restoration of 5000 ha will happen through implementation activities in 205 ha. These strategic restoration activities will be conducted in the medium term to the restoration of the whole unit of 5,000 ha. The objective is to implement restoration activities in 10 to 15% of the available land.

1.1 General site description

The Demo area is located in the northwest of Spain, at the western end of the Cantabrian Mountains in the province of León, bordering Lugo to the west and the Principality of Asturias to the north. It includes almost the entire Sierra de los Ancares Leoneses Regional Hunting Reserve and the Ancares Leoneses Biosphere Reserve. It is also included in the ZEC/ZEPA ES4130010 - Sierra de los Ancares. It includes 37 municipalities in the province of León, between the Puerto de Manzanal and the provincial boundary between León and Lugo in Piedrafita, with a total area of 307.778,47 has.

Land uses

In El Bierzo it is possible to distinguish two different physiographic environments which have influenced human occupation, land use and the formation of the landscape: mountain and valley. In the mountain areas, forestry, extensive livestock farming and mining predominate (mainly slate mining and coal mining, which has recently disappeared), while in the valley areas, agriculture is the most important, leaving agriculture oriented towards self-consumption to the mountains. This fact is reflected in the Land Use Map of the study area prepared with data from the Spanish Land Use Information System (SIOSE) 2014 (Figure 1.1).

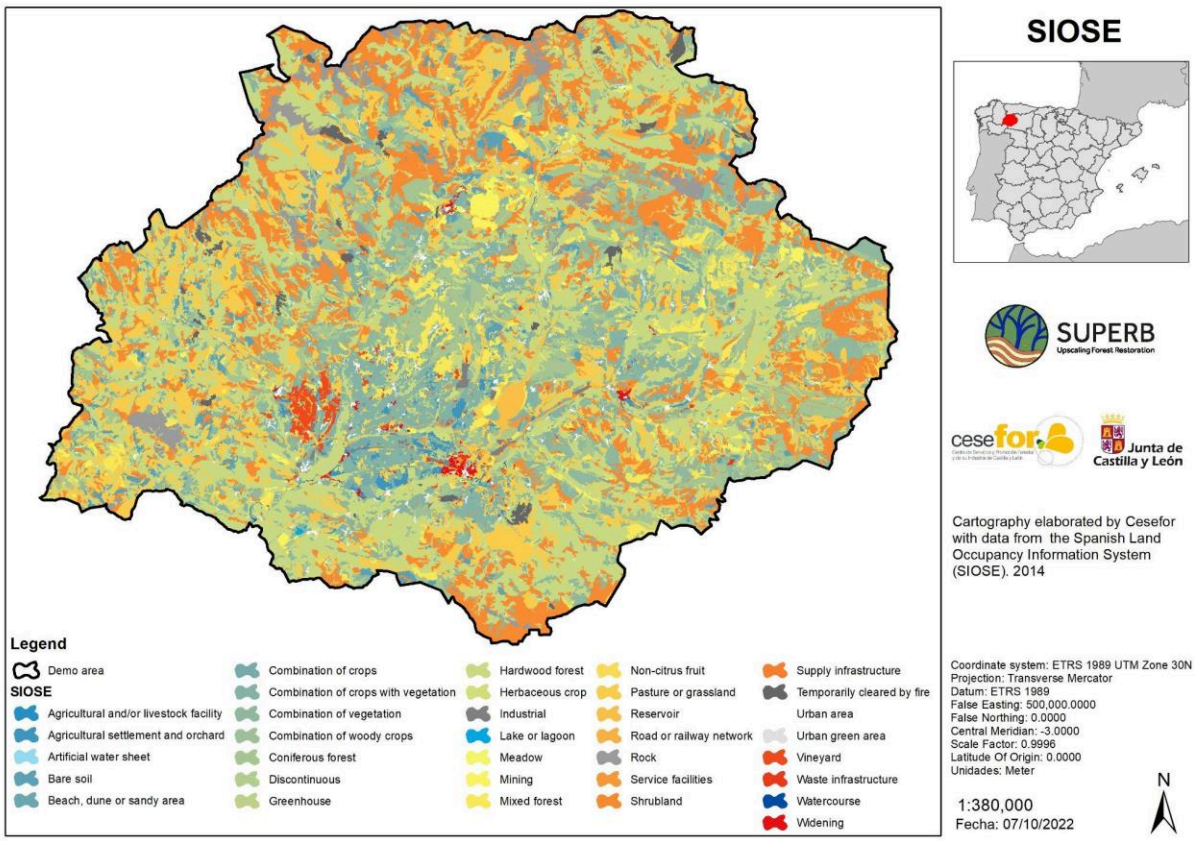


Figure 1.1 Map of the Demo land uses elaborated with data from the Spanish Land Occupancy Information System (SIOSE) 2014.

The predominant areas are hardwood forests (29%), scrublands (17%), grasslands (14%), and mosaic vegetation (11%), these formations being mainly in the mountain area or in the transition between the mountain and the valley area. Coniferous forests (7%) and mixed forests (3%) also stand out in the mountain zone (Table 1.1).

Table 1.1 Land uses in the Demo area according to the Spanish Land Occupancy Information System (SIOSE) 2014.

Land uses categories	Area (Ha)	Relative area (%)
Hardwood forest	90.281,50	29,34
Shrubland	53.192,98	17,28
Pasture or grassland	42.713,36	13,88
Combination of vegetation	34.508,52	11,21
Combination of crops with vegetation	21.917,55	7,12
Coniferous forest	21.313,92	6,93
Mixed forest	9.039,84	2,94

Land uses categories	Area (Ha)	Relative area (%)
Rock	7.800,00	2,53
Bare soil	7.088,93	2,30
Mining	3.537,83	1,15
Temporarily cleared by fire	2.217,40	0,72
Vineyard	1.883,01	0,61
Urban area	1.882,05	0,61
Agricultural settlement and orchard	1.633,49	0,53
Reservoir	1.229,11	0,40
Road or railway network	1.225,96	0,40
Herbaceous crop	1.037,65	0,34
Industrial	905,51	0,29
Discontinuous	775,61	0,25
Non-citrus fruit	645,66	0,21
Combination of crops	605,01	0,20
Widening	598,56	0,19
Service facilities	334,97	0,11
Combination of woody crops	324,00	0,11
Meadow	314,59	0,10
Supply infrastructure	306,79	0,10
Waste infrastructure	222,59	0,07
Watercourse	69,33	0,02
Urban green area	65,81	0,02
Lake or lagoon	54,06	0,02
Agricultural and/or livestock facility	18,99	0,01
Beach, dune or sandy area	1,64	0,00
Artificial water sheet	1,13	0,00
Greenhouse	0,91	0,00
Total general	**307.748,26**	**100**

In the valley area and the transition between valley and mountain, there is a predominance of eminently agricultural land, industrial land and the main urban areas. Vineyards stand out among the agricultural surface area, and El Bierzo is a region where wines have undergone a revolution in recent years, placing its production on the world map of great wines. The main factor in this success is due to the region's native varieties: the mencía and godello grapes. Other crops of great importance, most of which are also located in the valley area, are apple, pear and cherry trees. It is also a region with an important production of chestnuts, although this product must be included as an agroforestry product, as most of the chestnut trees in El Bierzo form part of the forest landscape.

It is also important to highlight mining. The Bierzo region has been one of the key areas of Spanish industrialisation, being, along with the rest of the Spanish mining basins, a strategic area for the supply of national coal, a fundamental energy resource during the industrialisation of the 20th century. Although nowadays coal mining has disappeared with the recent closure of the two thermal power stations in the area, this use is still evident in the landscape through the remains of coal mining dumps and their infrastructures. Areas degraded by mining have been reclaimed, but there is still a considerable area to be restored. In addition to coal mining, there are also open-cast slate mines, a product which is still mainly extracted from the mountains located further south-west of El Bierzo, together with the regions of "La Cabrera" (León) and "Valdeorras" (Ourense).

Since the 1950s, in the region of El Bierzo, as in the rest of Spain and developed countries in general, there has been a phenomenon of rural-urban migration which has led to profound changes in land use. Due to the abandonment of agrosilvopastoral uses, the area of scrubland and young forests has increased on former arable and pasture land, and has contributed to the increase in forest fires, diseases and pests, damage from meteorological phenomena, etc.

The forest area and its management

The demo area has more than 250,000 hectares covered by forest land[1], which represents more than 80% of its total surface area, of which around 130,000 hectares are woodlands (approximately 50% of the forest surface area). The responsibility for the management of the natural environment of a large part of the area lies with the public administration, specifically with the Regional Ministry of Development and the Environment (*Consejería de Fomento y Medio Ambiente*), which, through the General Directorate of Natural Heritage and Forestry Policy (*Dirección General de Patrimonio Natural y Política Forestal*), is responsible for the management of forests and their planning (Decree 23/2019, of 1 August).

It is important to note that the intervention of the forestry administration in forest land is different depending on the characteristics of the ownership and domain of the land. There are different types of ownership of the land, which determine different administrative powers in relation to the investments made in them. Specifically, among all the land in the study area, certain groups can be distinguished from the point of view of this administrative intervention:

1. Land owned by the General Administration of the Junta de Castilla y León.

[1] Forest land: by "forest land" we mean the Spanish word "monte". The word "monte", according to the "Ley 43/2003, de 21 de noviembre, de Montes", is any land on which tree, shrub, bush or herbaceous forest species grow, either spontaneously or as a result of sowing or planting, and which fulfil or may fulfil environmental, protective, productive, cultural, landscape or recreational functions. Also considered as "monte" are wastelands, rocky and sandy areas.

2. Land with economic participation of the General Administration of the Junta de Castilla y León ("contracted" land).

3. Land catalogued as public utility land owned by local authorities (in Spanish *Montes de Utilidad Pública*).

4. Land under private management: other forest land not included in the previous sections, which in turn may be public (if the owner is a public entity) or private.

The regional administration extends its control powers derived from forestry legislation to all of them, and can provide them with public aid. The public utility lands (in Spanish *Montes de Utilidad Pública*) are jointly managed by this Regional Ministry and by the public entities that own them, under the terms set out in Law 3/2009, of 6 April, which essentially assigns to the former the technical management of the forests and to the latter the economic management; the income they generate corresponds to them, without prejudice to the obligation to reinvest 15% of this income in improvement activities in the same forests (Improvement Fund). On these lands and on those in groups 1 and 2, the Regional Ministry can make direct investments with its budgets.

Most of the land in the study area belongs to groups 3 and 4, with a large part of the forest area in group 3 (more than 155,000 hectares) (Figure 1.2). Therefore, the Directorate General for Natural Heritage and Forestry Policy manages about 60% of this forest area. The remaining belongs to local authorities or private owners, and its management is considered private, with the administration exercising only a control and tutelage role.

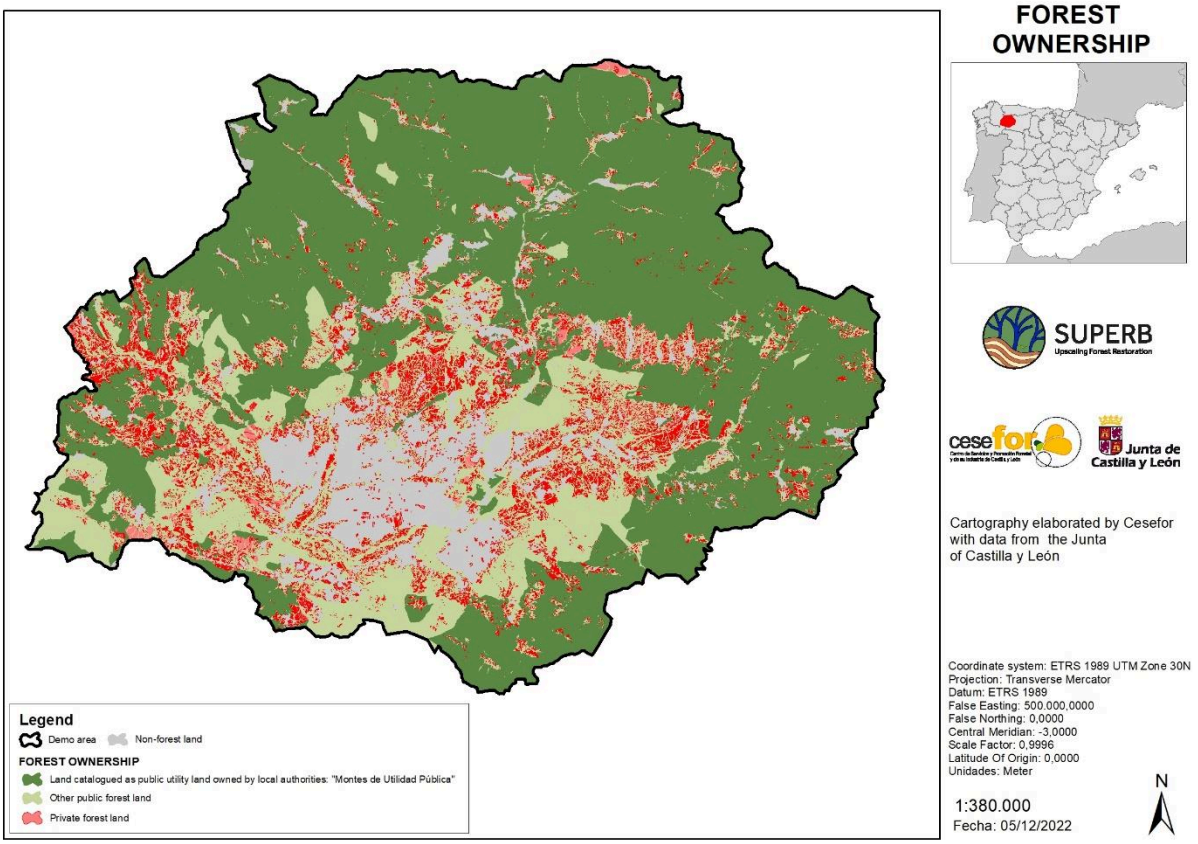


Figure 1.2 Forest ownership map. Most of the land is found in groups 3 an d 4 described.

1.2 Problems and restoration goals

Main problems

The abandonment of the rural environment in general, and in particular of the livestock farming practices that constituted the most important traditional activity in the study area, accentuates the processes of scrubbing of the landscape and homogenisation of the territory. This leads to an increment in the forest fuel, which improves the fire risk resulting in recurrent forest fires. Furthermore, the use of fire, one of the historical conflicts in El Bierzo, is still frequent, and this practice can easily result in episodes of large forest fires.

In this scenario of dominance of scrubland, numerous reforestation activities have been carried out to recover forest cover, improve connectivity, reinforce the natural stands that still persist today or to improve the habitat of the Cantabrian capercaillie and the brown bear. However, there is still a long way to go to achieve more resilient forests in El Bierzo. Our vision for increasing forest resilience necessarily involves improving forest management to change the fuel model of the forest.

The Cantabrian brown bear (*Ursus arctos*) is one of the most endangered mammals in Europe. It currently lives in two small and apparently isolated subpopulations (Palomero et al. 2007). This isolation is attributed to anthropogenic pressure and loss of suitable habitat (Nores and Naves 1993; Wiegand et al. 1998). The Cantabrian brown bear has been under strict protection for more than three decades and most of the known habitat of the species is within areas with different types of protection (e.g. Natura 2000 network, Natural Parks and Recovery Plans for the species in the different Autonomous Communities involved in its management). The decrease in genetic diversity and the small size of the subpopulations hinder the recovery of the species and threaten its viability (García-Garatigoitia et al. 2007). The recovery of the Cantabrian brown bear is tightly linked to the improvement of its habitat.

We have, therefore, three main problems to solve that are connected: to face the rural abandonment, to change the fuel model of the forest and to improve brown bear habitat.

Restoration goals

The main goal is to create a more resilient landscape that protects and extends brown bear corridors.

- Specifically, we aim to achieve a restoration of degraded areas such as shrublands and low quality forests of *Quercus pyrenaica*, which are a result of recurrent forest fires. This restoration, through silviculture activities, will improve the fuel model and will decrease the forest fire risk.
- We also aim to improve the brown bear habitat by planting species suitable for bear feeding and creating mixed forests.
- At the same time, this planting will also increase carbon sequestration, contribute to climate change mitigation and improve the forest biodiversity.
- Both restoration activities, silviculture and planting, will enhance other ecosystem services, such as improvement in water regulation or soil conservation.
- Finally, for the restoration to be successful, it is essential to engage the rural population in the Demo area. To cover this aim chestnut productive plantations will be established in the surroundings of rural communities.

In summary, the mission is that while we will enhance biodiversity through wildlife corridors, chestnut plantations will serve as economic pillars.

2 Current situation

2.1 Monitoring initial situation

Land cover

According to the CORINE land cover 2018, 44.69% are areas with shrub and/or herbaceous vegetation and 39.14% are woodland, making it a largely forested area (more than 80% of the total area), with the exception of land for agricultural use, small industrial or mining areas, and the metropolitan area of Ponferrada, (Figure 2.1, Table 2.1).

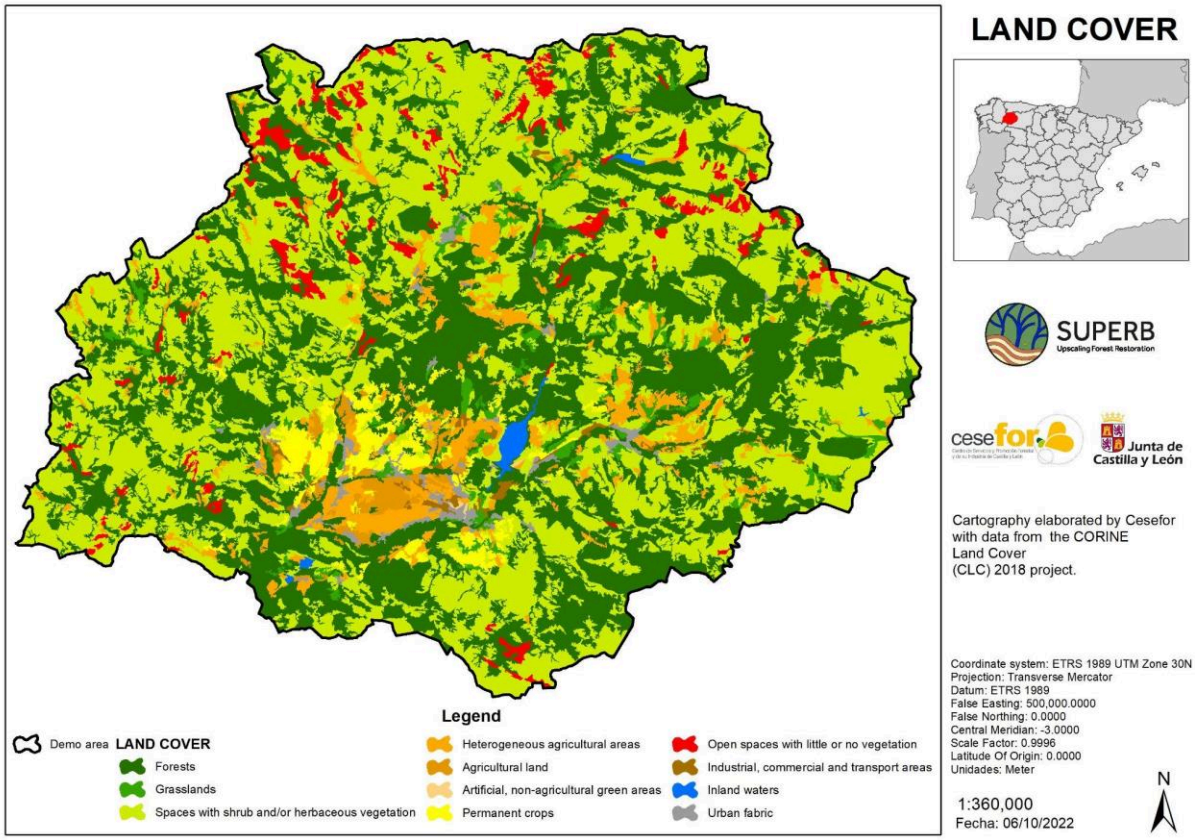


Figure 2.1 Land Cover Map according to CORINE 2018.

Table 2.1 Areas of land cover according to CORINE 2018.

Land cover categories	Area (Ha)	Relative area (%)
Spaces with shrub and/or herbaceous vegetation	137.550,67	44,69
Forests	120.453,27	39,14
Heterogeneous agricultural areas	16.716,69	5,43

Open spaces with little or no vegetation	9.172,48	2,98
Permanent crops	7.773,36	2,53
Grasslands	6.596,43	2,14
Agricultural land	3.475,56	1,13
Urban fabric	3.280,56	1,07
Industrial, commercial and transport areas	1.457,79	0,47
Inland waters	1.204,44	0,39
Artificial, non-agricultural green areas	97,22	0,03
Total	**307.778,47**	**100**

There is a predominance of areas without trees or open woodland. Within the forest area, a significant surface area of degraded woodland comes into focus. The main reason arises from the woodland management in this area: mainly pasture for livestock, clearing for crops such as cereal (mainly rye) and the recurrent fires that for centuries the people of El Bierzo have used as a tool to manage the vegetation, and which in recent decades have become a major problem due to depopulation and abandonment of the land.

Type of tree formation

According to the Forestry Map of Spain, the vegetation formations are dominated by treeless areas (53%), mostly occupied by ericaceous scrubland, the main source of which is forest fires (Figure 2.2, Table 2.2). In the areas protected from fire, which are difficult to access or have a higher degree of humidity, there are valuable forests, which, in order of abundance, are: “melojo” oak groves (*Quercus pyrenaica*) (14%), Sessile pine forest (*Pinus sylvestris*) (5%), chestnut groves (*Castanea sativa*) (5%), holm oak (*Quercus ilex*) (4%) and mixed native hardwood forests in the Atlantic and Mediterranean biogeographical regions (3% of each). There are also, to a lesser extent, stands of radiata pine, oak woods of *Quercus robur* and/or *Q. petrae*, riparian forests, poplar groves, pine forests of *Pinus pinaster* and *Pinus nigra*, birch groves (*Betula spp.*), etc.

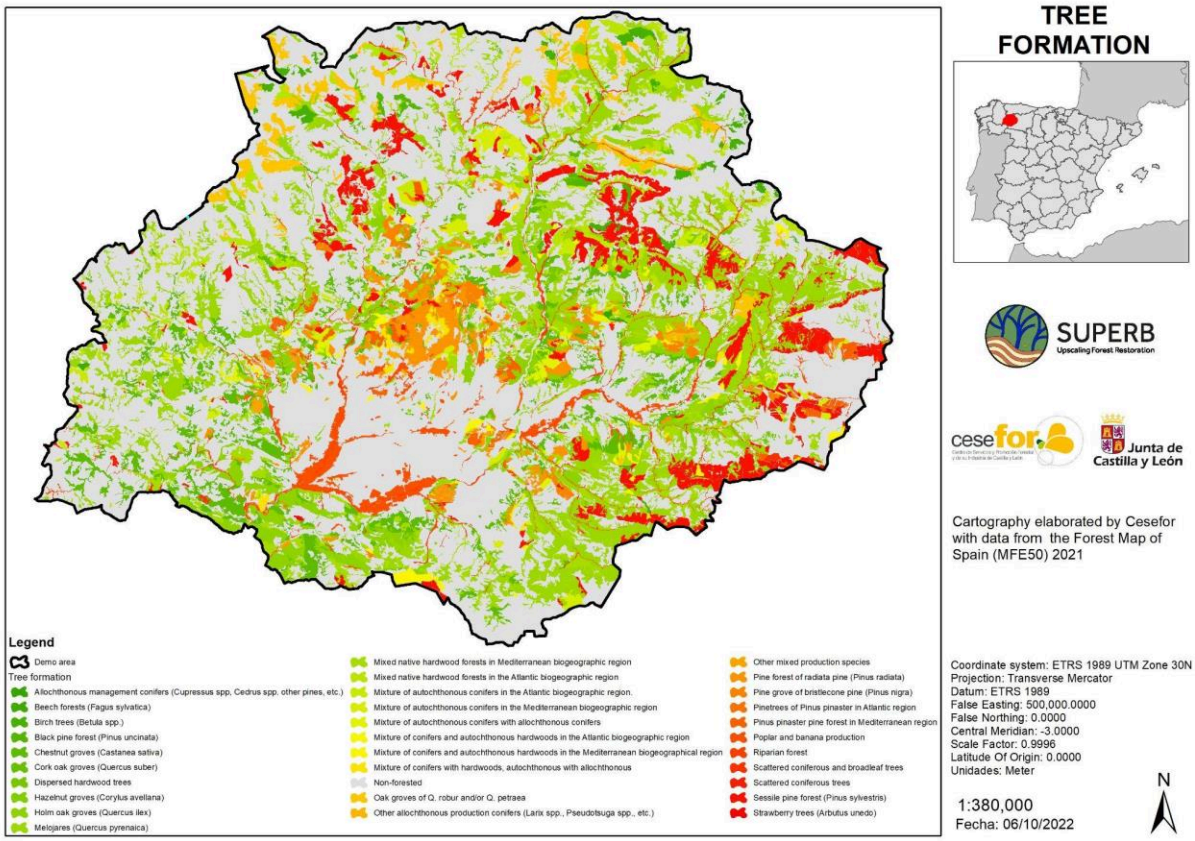


Figure 2.2 Tree formation according to the Forest Map of Spain (MFE50) 2021.

The pine forests (monospecific or mixed with broadleaves) come from reforestation carried out in recent decades and have become an important part of the area's landscape. These formations, together with peat bogs, rocky areas, lagoons (including the Wetland of Special Interest: Laguna del Miro) and river courses, complete a mosaic that provides environments of high floristic and faunistic richness.

Table 2.2 Tree formation areas in the demo area of El Bierzo according to the Forest Map of Spain (MFE50) 2021.

Habitat type	**Area (Ha)**	**Relative Area (%)**
Allochthonous management conifers *(Cupressus* spp*, Cedrus* spp. other pines, etc.)	78,07	0,03
Beech forests (*Fagus sylvatica)*	57,27	0,02
Birch trees (*Betula* spp.)	1.900,21	0,62
Black pine forest (*Pinus uncinata)*	675,47	0,22
Chestnut groves *(Castanea sativa)*	14.144,67	4,60
Cork oak groves (*Quercus suber)*	107,69	0,03

Dispersed hardwood trees	1.103,09	0,36
Hazelnut groves (*Corylus avellana)*	58,88	0,02
Holm oak groves (*Quercus ilex)*	11.336,77	3,68
Melojares (*Quercus pyrenaica)*	42.286,95	13,74
Mixed native hardwood forests in Mediterranean biogeographic region	10.469,99	3,40
Mixed native hardwood forests in the Atlantic biogeographic region	8.001,77	2,60
Mixture of autochthonous conifers in the Atlantic biogeographic region	1.339,55	0,44
Mixture of autochthonous conifers in the Mediterranean biogeographic region	3.216,11	1,04
Mixture of autochthonous conifers with allochthonous conifers	1.352,37	0,44
Mixture of conifers and autochthonous hardwoods in the Atlantic biogeographic region	191,65	0,06
Mixture of conifers and autochthonous hardwoods in the Mediterranean biogeographical region	1.818,13	0,59
Mixture of conifers with hardwoods, autochthonous with allochthonous	1.212,99	0,39
Non-forested	164.603,47	53,48
Oak groves of *Q. robur* and/or *Q. petraea*	6.138,83	1,99
Other allochthonous production conifers *(Larix* spp., *Pseudotsuga* spp., etc.)	160,88	0,05
Other mixed production species	627,87	0,20
Pine forest of radiata pine *(Pinus radiata)*	6.872,37	2,23
Pine grove of bristlecone pine *(Pinus nigra)*	2.481,48	0,81
Pinetrees of Pinus pinaster in Atlantic region	62,60	0,02
Pinus pinaster pine forest in Mediterranean region	2.799,95	0,91
Poplar production	4.324,28	1,41
Riparian forest	4.428,79	1,44
Scattered coniferous and broadleaf trees	198,68	0,06
Scattered coniferous trees	590,16	0,19
Sessile pine forest *(Pinus sylvestris)*	15.080,36	4,90
Strawberry trees (*Arbutus unedo)*	50,47	0,02
Total	**307.771,84**	**100**

Fires

Analysing the fire series since 2007, it is possible to verify the high number of fires in the demo, burning more than 1,000 ha of forest land annually. Since 2007, more than 32,000 ha have been burned in the demonstration area, with 2009 being the year in which the most burned area occurred. Since 2017, which was also an important year for fires, the burned area has been decreasing (Figure 2.3).

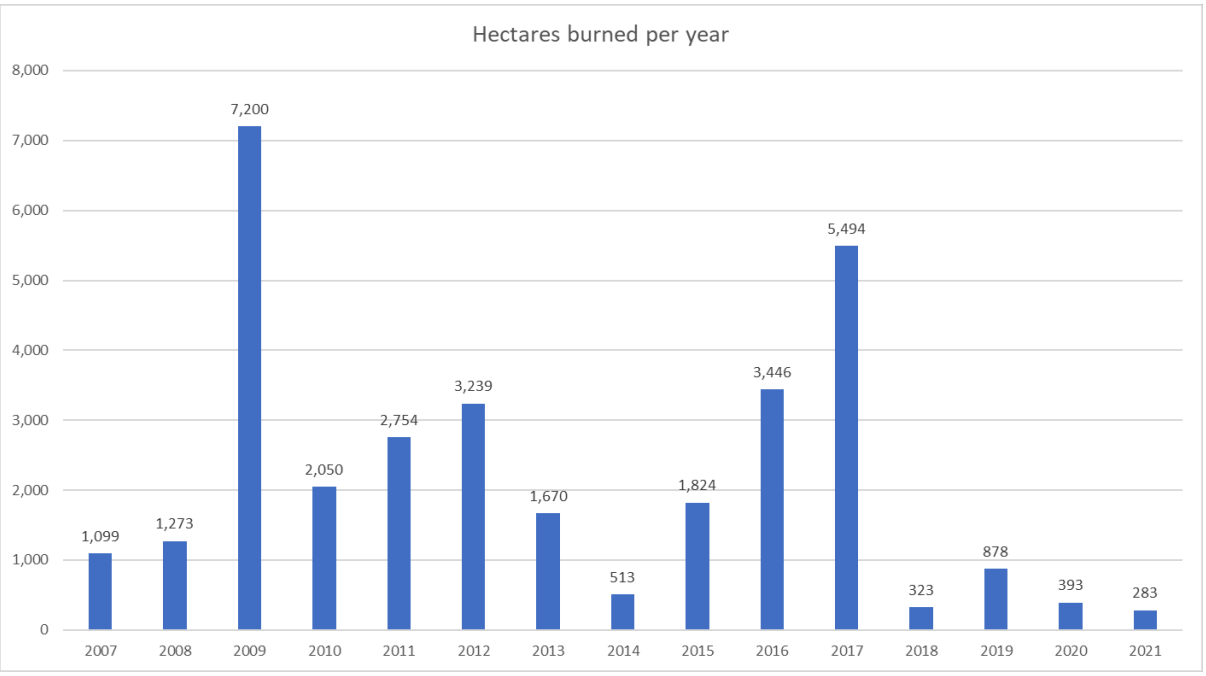


Figure 2.3 Hectares burned per year in the Demo area (2007 - 2021).

The number of fires has also decreased significantly since 2017 (Figure 2.4).

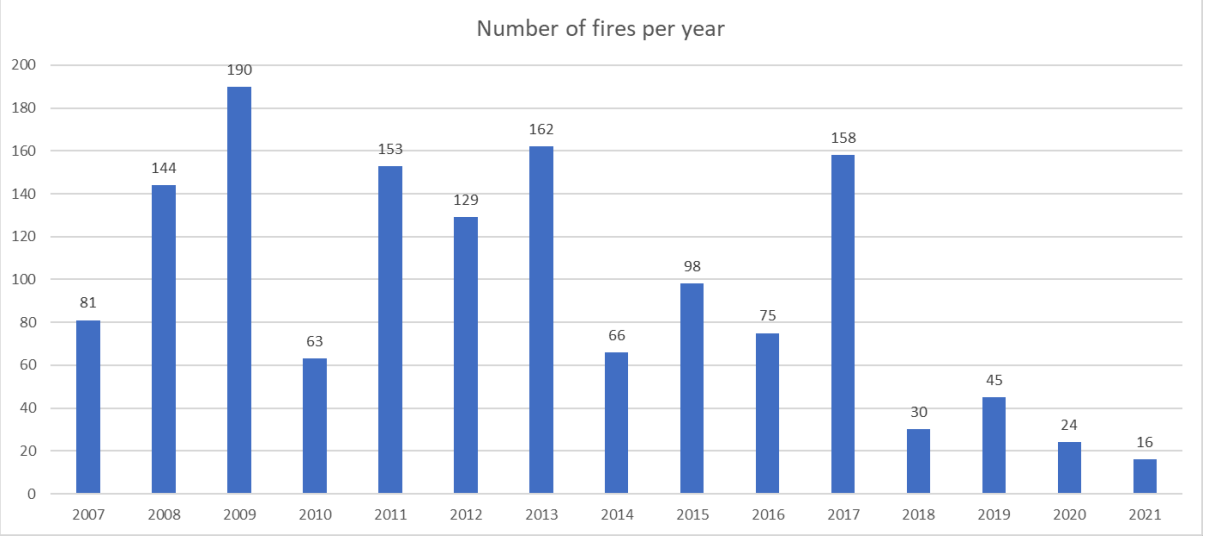


Figure 2.4 Number of fires per year in the Demo area (2007 - 2021).

Since 2007 there have been 8 major fires (more than 500 ha) (Figure 2.5):

- Tremor de arriba with 721 ha in 2009.

- Toreno with 2,081 ha in 2009
- Barjas with 1,009 ha in 2010
- Ponferrada with 514 ha in 2012
- Fabero with 2,549 in 2016
- Ponferrada with 1,251 ha in 2017
- Benuza with 798 ha in 2017
- Palacios del Sil with 574 ha in 2017

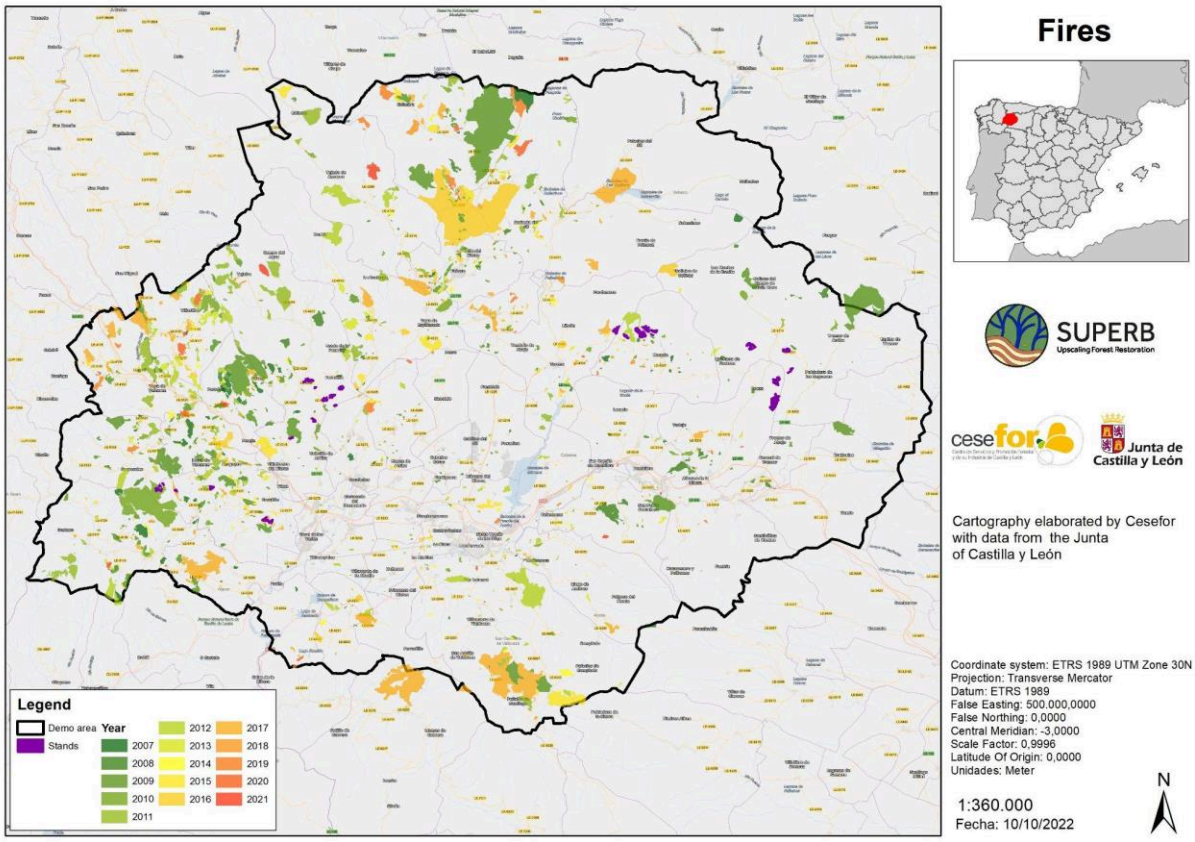


Figure 2.5 Map of forest fires in the Demo area since 2007 to 2021.

Regarding the current year 2022, there is no definitive data, but the area burned so far is extraordinary, with large fires (over 500 hectares), such as the one that occurred in July in the municipality of Ponferrada. The cause of the fires is usually man-made (intentional or due to negligence), but this year, extreme weather conditions have caused most of these fires (drought and dry storms). These weather conditions, together with rural abandonment and the consequent continuity of the vegetation, have made extinguishing them very difficult.

An effective solution would be proper forest management to achieve the sustainable use of forests, to fix the population in rural areas and to contribute to a mosaic landscape that reduces the continuity of vegetation.

3 Restoration activities inside the Demo

Restoration activities will be carried out in all four sites of the demo. These will consist globally of the reforestation of 40 hectares by native species seedlings, scattered in existing stands and/or bare land. In order to promote rural development, 5 ha will be planted with fruit rich chestnut (*Castanea sativa*) plants, mostly in one of the sites, quite prone to chestnut recollection. Besides this, tending and thinning will be performed in 100-150 ha of the four sites, mainly in oak (*Quercus pyrenaica*).

The area defined here (Figure 3.1, Figure 3.2, Figure 3.3, Figure 3.4, Table 3.1 Restoration activities and timing to be carried out in each stand and site in the Demo area.) is a proposal of maximums, i.e. the proposed area is the potential area where restoration activities are possible to be done. The actual area will be calculated according to the established budget (Table 3.3) within the defined stands. It is important to note that stands where enrichment plantings are carried out will also require silvicultural treatments.

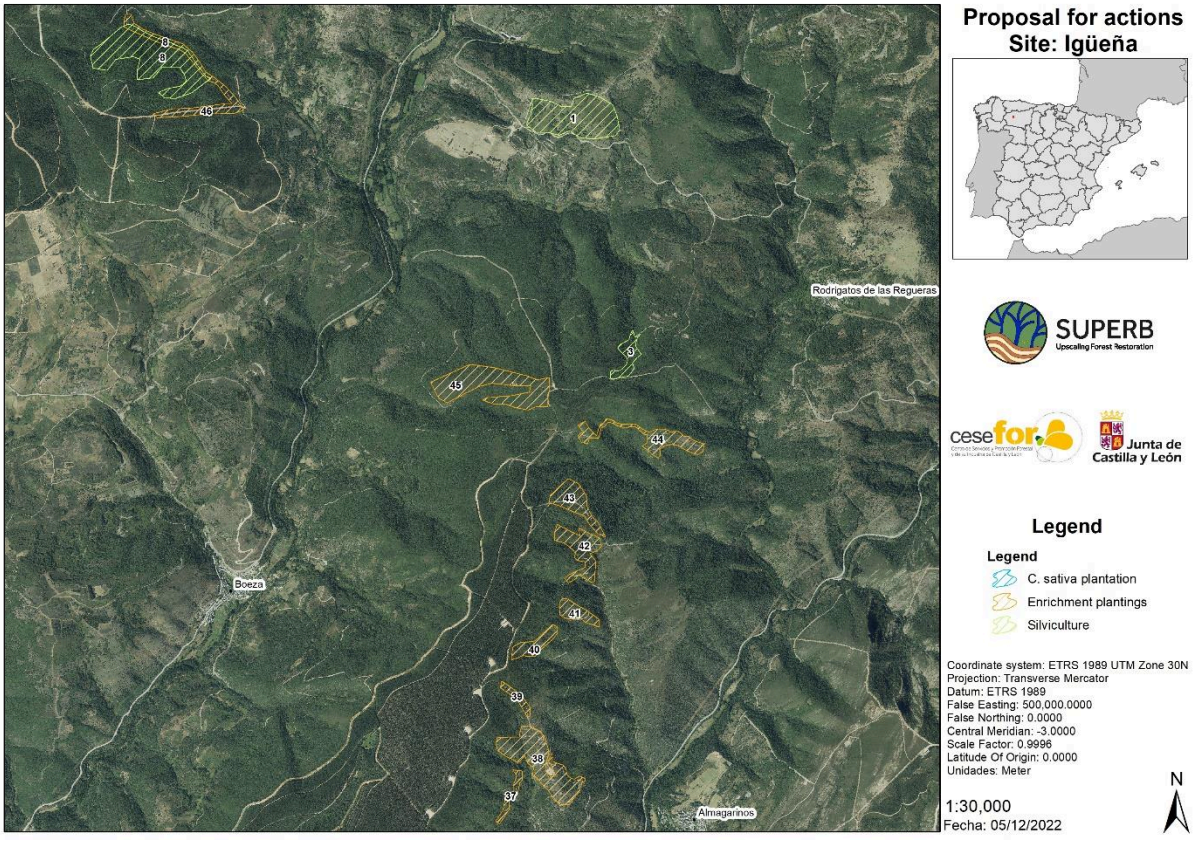


Figure 3.1 Map of the restoration activities in the Igüeña site.

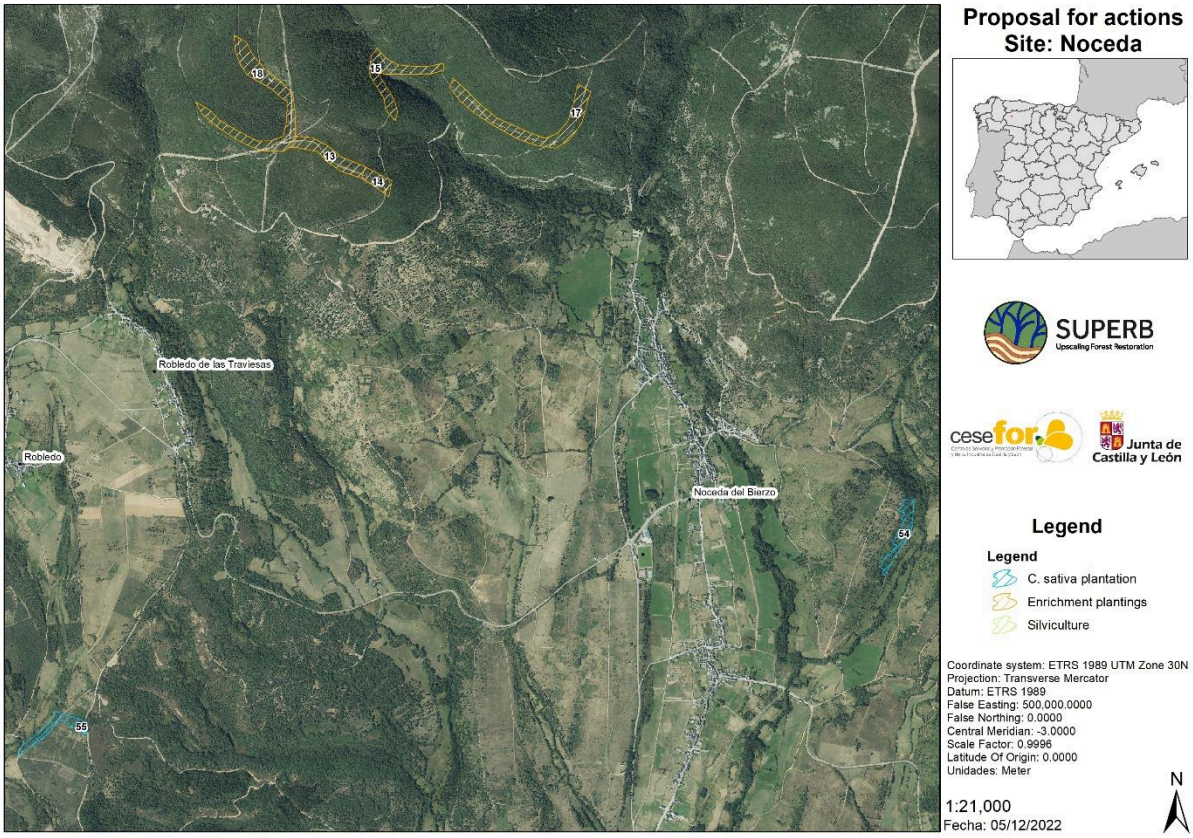


Figure 3.2 Map of the restoration activities in the Noceda site.

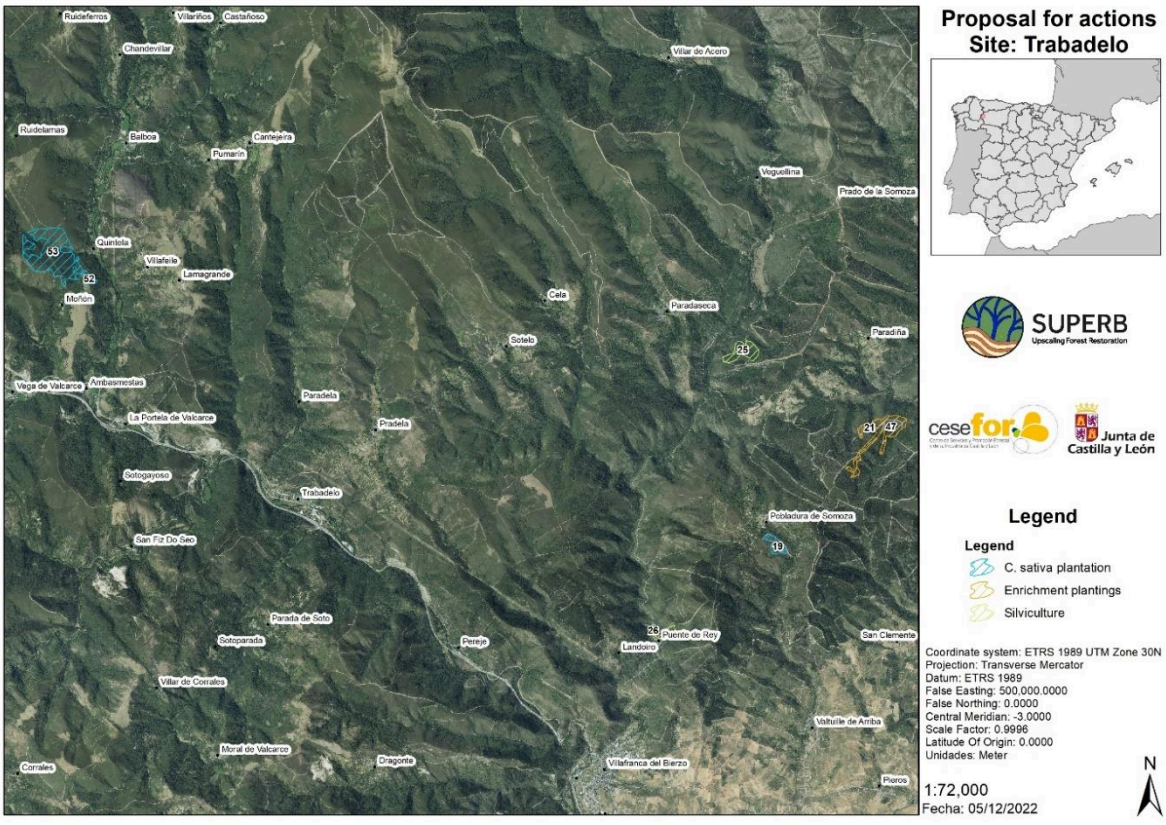


Figure 3.3 Map of the restoration activities in the Trabadelo site.

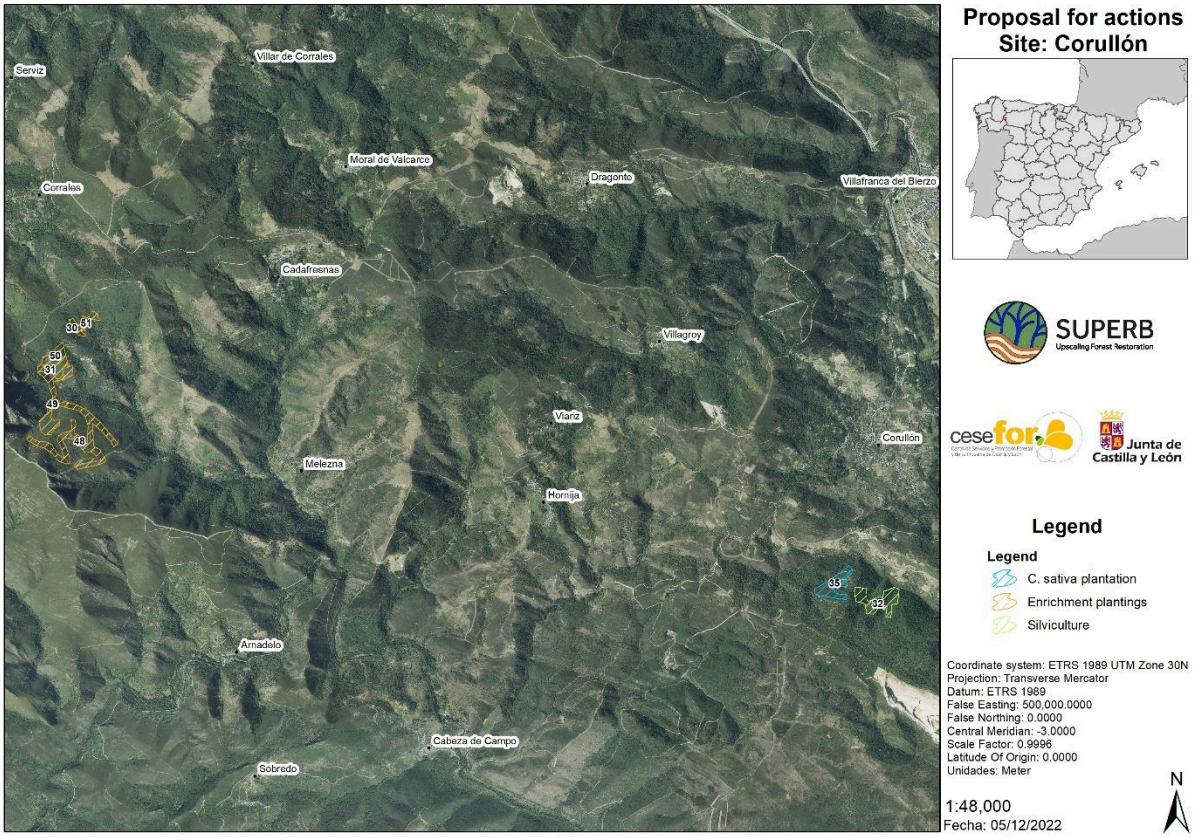


Figure 3.4 Map of the restoration activities in the Corullón site.

Table 3.1 Restoration activities and timing to be carried out in each stand and site in the Demo area.

Restoration activity	Stand	Site	Area (has)	Year
C. sativa plantation	19	Trabadelo	7,25	2024-2025
C. sativa plantation	35	Corullón	7,33	2024-2025
C. sativa plantation	52	Trabadelo	3,62	2024-2025
C. sativa plantation	53	Trabadelo	59,90	2024-2025
C. sativa plantation	54	Noceda	1,92	2024-2025
C. sativa plantation	55	Noceda	1,62	2024-2025
Enrichment plantings	8	Igueña	3,84	2023-2025
Enrichment plantings	13	Noceda	2,56	2023-2025
Enrichment plantings	14	Noceda	1,08	2023-2025
Enrichment plantings	15	Noceda	3,46	2023-2025
Enrichment plantings	17	Noceda	5,57	2023-2025
Enrichment plantings	18	Noceda	6,33	2023-2025
Enrichment plantings	21	Trabadelo	4,25	2023-2025
Enrichment plantings	30	Corullón	1,11	2023-2025
Enrichment plantings	31	Corullón	4,17	2023-2025

Enrichment plantings	37	Igueña	1,66	2023-2025
Enrichment plantings	38	Igueña	14,10	2023-2025
Enrichment plantings	39	Igueña	1,46	2023-2025
Enrichment plantings	40	Igueña	3,47	2023-2025
Enrichment plantings	41	Igueña	2,95	2023-2025
Enrichment plantings	42	Igueña	6,95	2023-2025
Enrichment plantings	43	Igueña	5,74	2023-2025
Enrichment plantings	44	Igueña	7,33	2023-2025
Enrichment plantings	45	Igueña	15,68	2023-2025
Enrichment plantings	46	Igueña	5,05	2023-2025
Enrichment plantings	47	Trabadelo	23,98	2023-2025
Enrichment plantings	48	Corullón	20,49	2023-2025
Enrichment plantings	49	Corullón	9,25	2023-2025
Enrichment plantings	50	Corullón	4,00	2023-2025
Enrichment plantings	51	Corullón	2,27	2023-2025
Silviculture	1	Igueña	16,55	2023-2025
Silviculture	3	Igueña	3,17	2023-2025
Silviculture	8	Igueña	20,33	2023-2025
Silviculture	25	Trabadelo	13,94	2023-2025
Silviculture	26	Trabadelo	4,01	2023-2025
Silviculture	32	Corullón	9,63	2023-2025

3.1 Chestnut plantations

In order to boost rural areas and their development, involving local people in forest management not only revitalises the economy, but also makes landscapes more resilient and less vulnerable to external disturbances.

In this sense, within the project, taking advantage of the fact that some of the selected sites have a historical tradition in the management and use of chestnut stands for the production of fruit, it is intended to encourage the perpetuation of such management, in the short to medium term by the local population, through the development of small chestnut tree plantations.

3.1.1 Targeted improvement

The aim of the improvement is focused on promoting rural development, through the enhancement of a high added value resource such as chestnuts, which contributes to the energisation and revitalisation of disadvantaged rural areas and, ultimately, to prevent depopulation.

3.1.2 Location

The present improvement is mainly aimed at land strategically selected for its importance in the chestnut sector and the predisposition of its population to perpetuate it. In total, an area of around 5 hectares will be treated.

3.1.3 Treatment

The work to be carried out will be specifically detailed in the project corresponding to each intervention stand. The general work to be carried out is shown below, without going into the technical specifications, which are linked to the intrinsic characteristics of the area of action.

3.1.3.1 Clearing

Bearing in mind that the land on which these planting actions are to be carried out has a marked forestry character, and all of it is currently without any type of management or land use, the first work to be carried out involves clearing the vegetation on the total target area.

In this sense, most of the areas are covered to a greater or lesser degree by bush formations (broom and heather) as well as other accompanying shrub species, so the treatment to be carried out will preferably have an intensity of between 75-100%, in order not to limit the subsequent planting work.

Occasionally there may be trees of autochthonous species, which will be respected as far as possible in order to promote biodiversity and the integration of the plantation at an environmental and landscape level.

The execution will be carried out mechanised in order to achieve not only good results in terms of shredding the forest residues and incorporating them into the soil, but also optimum efficiency.

3.1.3.2 Stake out and signposting

Once the clearing has been carried out, the trees distribution will be selected. For *Castanea sativa*, the typical planting distances for fruit production in forest land range is between 8x8 and 10x10 metres, following a regular distribution, although this can sometimes be reduced to 6x8 metres in the best sites qualities.

Once the definitive planting distances have been defined, the plantation will be designed with the help of GIS, in order to optimise the planting space, and then it will be staked out in the field by manually signposting the location of each of the future plants. The whole process will be carried out manually in order to obtain the greatest possible precision.

3.1.3.3 Soil preparation

The soil shall be prepared mechanically by means of hole digging, seeking to achieve the largest possible hole size, in order to facilitate the expansion of the root system of the future seedling.

In this sense, the recommended dimensions for planting holes are set at a minimum of 80x80x80 cm, although the depth of the dig will vary depending on the characteristics of the soil at each site.

During the soil preparation, the sides of the hole should be compacted as little as possible and the soil horizons shouldn't be turned over. At the same time small tree wells will be created that allow rainfall retention, especially in areas with a steep slope, which will allow a higher survival rate of the plants during the first few years.

3.1.3.4 Plantation

The planting density is defined by the previously selected planting distances, ranging from 100 to 156 plants/hectare. Planting shall be carried out by hand at the same time as the soil preparation, or, if recommended due to weather or soil conditions, a few months after this.

3.1.3.5 Protection

In view of the high rates of herbivory, as well as the susceptibility of young chestnut plants to heat stress and long periods of sun exposure, especially during the summer season, individualised plant protection is considered necessary to ensure the survival of the plants.

Protection will be carried out manually after planting, by installing wooden stakes 1.2 m high and cactus-type protectors 1.2-1.5 m high.

3.1.4 Materials

During the different works to be carried out for the planting, human and mechanical means will be available to guarantee the achievement of the objectives set. In this sense:

- **Clearing**: Mechanical means will be used to carry out the preliminary clearing, either a forestry tractor (wheels or caterpillar tracks) or, failing that, a excavator or walking excavator, depending on the characteristics and needs of the terrain, as well as the availability of the machinery on the part of the company awarded the project. In any case, the clearing will be carried out using a chain brush cutter.
- **Stake out and signposting:** the staking out and the signposting shall be carried out entirely by manual means, the setting through ropes and/or master lines, and the marking through spray paint so that it is visible from the machinery in charge of the soil preparation.
- **Soil preparation**: It will be carried out mechanised through excavator or walking excavator, depending on the particularities of the terrain in each intervention area.
- **Plantation**: Planting shall be carried out manually, in order to ensure that the seedling takes root correctly in the ground.
- **Protection**: It will be carried out manually after planting, by installing wooden stakes 1.2 m high and cactus-type protectors 1.2-1.5 m high.

3.1.5 Plants

The plant material used for the plantations will be developed in the Central Forest Nursery of the Junta de Castilla y León in Valladolid, from seed collected from seed sources located within the scope of the project.

All Forest Reproductive Material generated will comply with minimum quality standards based on the sectoral regulations in force, particularly in Spain (Royal Decree 289/2003) and Castilla y León (Decree 54/2007). In this respect, for *Castanea sativa*, the plants to be used will be 1-2 years old, which means 30-70 cm in height and at least 4 mm at thin tip, which will be supplied in >350 cc container.

The priority region of provenance shall be 2 "*Montañas y mesetas interiores de Galicia*", although 4 "*Vertiente septentrional cantábrica*" shall also be eligible.

Plant distribution, densities and other technical considerations will be established and justified in the corresponding project. In any case, the plantation will be made by hand method, and the work will be executed by an independent contractor following public procurement rules and through the Junta de Castilla y León.

3.1.6 Post-treatment

3.1.6.1 Replanting

In order to achieve the objectives set for this improvement, it is necessary that the plantation retains the maximum possible tree density, so that in the two years following the execution of the improvement, all plants that have perished will be replanted. Due to the one-off nature of this type of work, it is expected to be carried out by manual means, removing the previous plant, reopening the hole, planting the new seedling and protecting it.

In cases of high mortality, the agent causing the mortality shall be evaluated, and if it cannot be identified and/or remedied by adopting specific measures, the perished plants shall be replanted, this time by mechanical and manual means, if possible, to optimise the work of digging the holes.

Similarly, the presence of staff in the planting area shall be used to inspect the state of the individual protection elements, repositioning and/or replacing them depending on their degree of deterioration.

3.1.6.2 Regular clearing

In order to maintain the plantation in optimal conditions against forest fires and to ensure a rapid development of the plants, 1-2 regular annual clearing operations shall be carried out during the first years after planting, so as to substantially reduce the competition for resources between the established plants and the surrounding herbaceous and shrub vegetation.

This clearing will be carried out mechanised in the rows between planting lines, in order to optimise costs, while in the planting lines themselves and especially in the areas closest to the trees, it will be carried out manually using a brush cutter, for greater precision and to avoid physical damage to the trees.

3.1.6.3 Graft

Since that one of the objectives of this improvement is rural development through the promotion of chestnut tree growing and the use of the fruit, it is necessary that the fruits comply with a minimum quality standard, so it is necessary to implement varieties suitable for consumption and marketing, that which will be achieved through the execution of grafting.

In this sense, the most suitable varieties for each area will be selected on the basis of criteria such as higher productivity, adaptability, fruit quality and size, resistance to pests and diseases, etc.

This work shall be carried out once the establishment of the plant to the soil is guaranteed, which is normally considered to be the second year after planting, and depending on the type of graft to be used, a minimum basal diameter of the rootstock of 2 cm shall be required.

3.2 Planting

The expansion of the brown bear in Castille & León is limited by the existence of anthropic barriers, mainly the A-6 motorway which limits the dispersion of the species towards the southwest of the community. In addition, brown bear's habitat is threatened by the degradation of the forests caused by a poor forest management and recurrent forest fires in the area.

To improve the quality of bear habitat and strengthen and expand bear corridors, it is necessary to adopt specific measures that contribute to the diversification and promotion of natural corridors, increasing their effective surface area and improving their state of conservation. An important activity is planting species typical of bear habitat that serve as a trophic resource for the bear and wildlife.

3.2.1 Targeted improvement

The aim of the improvement is to diversify the forests and woodlands that are included within the brown bear habitat, restoring and extending the main corridors of the same, through the implementation of mixed plantings with species adapted to the climate and that serve as a trophic resource for the wildlife.

There will be two types of plantation: plantings under the canopy and perimeter plantings, the latter being the predominant ones.

3.2.2 Location

The present improvement is mainly aimed at stands strategically selected for their importance as a nexus, patch or corridor between different brown bear habitat areas. In total, an area of around 40 hectares will be treated.

3.2.3 Treatment

The work to be carried out will be specifically detailed in the project corresponding to each intervention stand. The general work to be carried out is shown below, without going into the technical specifications, which are linked to the intrinsic characteristics of the area of action.

3.2.3.1 Clearing

Since the land on which these planting actions are to be carried out has a marked forestry character and has different origins, degrees of management and degradation, the first work to be carried out involves clearing the vegetation on the target area.

Most of the areas are covered to a greater or lesser degree by scrub formations (broom and heather) as well as other shrub species accompanying these formations, so the treatment to be carried out in the case of perimeter plantings, will preferably have an intensity of between 75-100%, and of a one-off nature and lower intensity in the case of enrichment plantings in the interior of the stands.

Occasionally there may be trees of autochthonous species, which will be respected as far as possible in order to promote biodiversity and the integration of the plantation at an environmental and landscape level.

This will be carried out mechanised in those areas where this is possible, in order to achieve not only good results in terms of shredding and incorporation of the remains into the soil, but also optimum yields. In plantations in the interior of stands, clearing is limited to manual clearing using a brush cutter.

3.2.3.2 Soil preparation

The soil preparation and planting work to be carried out will be specifically detailed in the project corresponding to each intervention area, based on the characteristics of the soil, densities and technical requirements of the plant to be used. In general terms, plants of native species characteristic of the brown bear's habitat will be used, as well as those present in near areas and with a high degree of adaptability to the particular conditions of the terrain.

The tree distances will depend on the species to be used in the case of perimeter plantings, while in enrichment plantings inside stands, due to their punctual nature, they will have a random distribution.

3.2.3.3 Plantation

Density should be low, in the order of 400-700 plants/hectare to avoid excessive competition with each other, although for each situation, the suitability of a higher or lower density should be assessed according to interests and planting costs. In the case of enrichment plantings within the stands, densities of less than 350 plants/hectare shall be used, balancing the spacing according to the possibilities of light, soil and competition.

Planting will be carried out manually, while soil preparation will depend on the characteristics of the terrain, the accessibility of the machinery and the species to be planted.

3.2.3.4 Protection

In view of the high herbivory rates, individual plant protection is considered necessary to ensure the survival of the plants. Protection shall be carried out manually after planting by installing 1.2 m high wooden stakes and 1.2-1.5 m high opaque plastic protectors.

3.2.4 Materials

During the different works to be carried out for the planting, human and mechanical means will be available to guarantee the achievement of the objectives set. In this sense:

- **Clearing**: Manual and mechanical means will be combined if possible, to carry out the preliminary clearing, either a forestry tractor (wheels or caterpillar tracks) or, failing that, an excavator or walking excavator, depending on the characteristics and needs of the terrain, as well as the availability of the machinery on the part of the company awarded the project. In any case, the clearing will be carried out using a chain brush cutter.
- **Soil preparation:** Soil preparation method will depend on the characteristics of the terrain and the requirements of the species to be planted. In general terms, for perimeter plantings, provided that accessibility allows it, the use of machinery will prevail for these operations, while for within stands plantings, this work will be carried out exclusively by hand.
- **Plantation**: Planting shall be carried out manually, in order to ensure that the seedling takes root correctly in the ground. This will be carried out after the execution of the soil preparation, taking into account the weather conditions and the terrain itself in order to choose the optimum moment.
- **Protection**: It will be carried out manually after planting, by installing wooden stakes 1.2 m high and 1.2-1.5 m high opaque plastic protectors, or alternatively wire netting.

3.2.5 Plants

The plant material used for the plantations will be developed in the Central Forest Nursery of the *Junta de Castilla y León* in Valladolid, from seed collected from seed sources located within the scope of the project.

All Forest Reproductive Material generated will comply with minimum quality standards based on the sectoral regulations in force, particularly in Spain (Royal Decree 289/2003) and Castilla y León (Decree 54/2007). In this respect, for *Castanea sativa*, the plants to be used will be 1-2 years old, which means 40-70 cm, which will be supplied in >250 cc container.

In general, for perimeter plantings, 2-year old plants with the average height mentioned above are recommended. However, in plantations under the canopy and in order to avoid competition with some of the understorey species, it is advisable to use 2-3 year old plants with a slightly higher average height of between 80 cm and 1 m, if possible, as this allows the plant canopy to be freed from direct competition in a shorter time and thus ensures a higher survival rate of the plant.

The recommended region of provenance for each selected species is detailed below, although this may vary depending on the availability of plants in the nursery, being admissible to other provenances with similar characteristics to those present in the target area, in order to meet the deadlines established in the schedule.

Plant distribution, densities and other technical considerations will be established and justified in the corresponding project. In any case, the plantation will be made by hand method, and the work will be executed by an independent contractor following public procurement rules and through the *Junta de Castilla y León*.

Table 3.2 Important species for the restoration activities in the Demo area.

Common name	Scientific name	Important species in demo area	Preferred species for planting	Preferred species for natural regeneration	Year	Seed breeding	Provenance region
Scots Pine	*Pinus sylvestris*	Yes	No	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 1, 8 or 10
Pedunculate oak	*Quercus petraea*	Yes	No	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 2
Black Pine	*Pinus nigra*	Yes	No	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 10
Sycamore maple	*Acer pseudoplatanus*	Yes	No	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 4
Wild service tree	*Sorbus torminalis*	Yes	No	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	-
Chestnut	*Castanea sativa*	Yes	Yes	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 2 or 4
Wild cherry	*Prunus avium*	Yes	Yes	Yes	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 2, 4 or 5
Common hawthorn	*Crataegus monogyna*	Yes	Yes	No	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	-
European Crab Apple	*Malus sylvestris*	Yes	Yes	No	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 2, 4 or 5
Whitebeam	*Sorbus aria*	Yes	Yes	No	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 5
European mountain ash	*Sorbus aucuparia*	Yes	Yes	No	2023-2025	Breeding will take place at Central Forestry Nursery of Castilla y León regional government	Reg. 4 or 5

3.2.6 Post-treatment

3.2.6.1 Replanting

In order to achieve the objectives set for this improvement, it is necessary that the plantation retains the maximum possible tree density, so that in the two years following the execution of the improvement, all plants that have perished will be replanted. Due to the one-off nature of this type of work, it is expected to be carried out by manual means, removing the previous plant, reopening the hole, planting the new seedling and protecting it.

In cases of high mortality, the agent causing the mortality shall be evaluated, and if it cannot be identified and/or remedied by adopting specific measures, the perished plants shall be replanted, this time by mechanical and manual means, if possible, to optimise the work of digging the holes.

Similarly, the presence of staff in the planting area shall be used to inspect the state of the individual protection elements, repositioning and/or replacing them depending on their degree of deterioration.

3.2.6.2 Monitoring and canopy gaps opening

In order to guarantee the adequate establishment of the plants in the field and the viability of the plantations to be carried out, it is necessary to carry out regular monitoring to evaluate the evolution of the plants and to foresee the appearance of any type of problem that could compromise the achievement of the objectives set, adopting the appropriate measures to correct it in time and form.

In this sense, the particular case of enrichment plantings inside forest stands requires more intense monitoring, as due to the competition with existing trees for both resources and light, it is common for the vast majority of plants to perish if measures are not taken. For this reason, in these cases, after planting, small clearings or gaps in the canopy should be opened up by gradually thinning to encourage the development of these plants and at the same time prevent the sudden appearance of shrub and/or the induction of regrowth, especially in stands of *Quercus pyrenaica.*

3.3 Silvicultural treatments

Most stands of *Quercus pyrenaica* have been intensively managed since ancient times, but due to that management, external disturbances and socio-economic changes, there has been a profound alteration of their natural forest structures (*Ruiz de la Torre, 2006*), often resulting in their degradation.

Therefore, in order to increase the resilience of forest stands to external disturbances, improve their conservation status and reverse and/or minimise degradation processes, the search for adaptive forest management alternatives has begun.

To this end, the project proposes the implementation of multipurpose silvicultural treatments to restore and improve conservation of certain forest stands, based on the observation of previous experiences after decades of forest management.

3.3.1 Targeted improvement

The actions described in this section aim to contribute to the improvement of the conservation status of forests and habitats associated with the brown bear, increasing their resilience to external disturbances.

3.3.2 Location

The present improvement is mainly aimed at *Quercus pyrenaica* stands in various stages of degradation. In total, an area of around 100-150 hectares will be treated, mainly on those stands with evident signs of degradation, but reversible through the application of correct silviculture, discarding those very degraded stands, where the success and the achievement of the expected results after the intervention are questionable.

3.3.3 Treatment

The work to be carried out will be specifically detailed in the project corresponding to each intervention stand. The general work to be carried out is shown below, without going into the technical specifications, which are linked to the intrinsic characteristics of the area of action.

3.3.3.1 Clearing

It's common in forest stands, and particularly in oak groves in degradation process or those that have been subjected to previous forestry treatments, generally inappropriate, the proliferation of a shrub layer in the understorey, predominantly associated with heliophilous species.

In order to break the horizontal and vertical continuity of the forest fuel present on this understorey and reduce the risk of forest fires spreading, it has been planned to clear those areas where the density of the fuel makes it advisable to do so.

The work will be carried out almost entirely by hand using a brush cutter, and during its execution, smaller tree species other than the main one in the stand will be respected, as well as fruit-bearing shrub species that could serve as a trophic resource for wildlife.

3.3.3.2 Thinning

In essence, oak groves thinning plan, sometimes is accompanied by pruning and clearing, which aims at the future conversion to coppice, passing through a coppice on stump as an intermediate situation.

These thinnings have a rotation of around 5-15 years, depending on the site quality, and are applied 3 to 4 times throughout the shift, until a well-developed mature forest over stump and canopy covers close to 80% are obtained.

The weight of the interventions will depend on the initial situation in each forest stand, and will be specifically defined in the corresponding project. However, it should be taken into account that the density reduction in oak groves commonly induces resprouting, so it is necessary to

carry out this type of treatment in gradual interventions and taking into account the following considerations:

- In the first interventions, avoid felling all the stems of the same stump in order to ensure the viability of this.

- Treatments shall be carried out selectively by removing dominated, deformed, twisted, bent, dying trees, from the inside to the outside of the stump, but also felling dominant or codominant trees to create canopy gaps that will allow the development of the remaining trees.

- Interventions will be necessary even if there is no canopy tangency between trees, as competition occurs between stems on the same stump.

- The intervention weight should be between 50-70% of the initial density, and the reduction of the basal area should be less than 50%.

3.3.3.3 Pruning

In order to break the vertical continuity of the forest fuel present in the forest stands and reduce the risk of surface fire spreading to the canopy in the event of a possible forest fire, pruning of the trees present in the stands has been considered.

This not only breaks the vertical continuity of the fuel, but also improves the transit inside the stands, which facilitates the access of the extinguishing means and favours the subsequent execution of other works.

This treatment will be carried out in most cases over the entire intervention area, in the form of penetration pruning or low pruning, with an effective height of up to 2.5 metres. However, in certain stands, particularly those that have undergone previous treatments or have a good natural pruning, this height range can be increased to 3.5-4 metres if it is considered appropriate, for the development of a future timber harvest.

3.3.3.4 Treatment of forest residues

During pruning and thinning, a considerable volume of forest residues of various kinds is generated, the management and/or disposal of which is necessary as a preventive measure in terms of forest fires and the spread of possible pathogens.

In this sense, residue treatment methods are diverse and vary from one forest stand to another depending on the weight of treatment applied, the volume of residues generated, the type of this and, in particular, accessibility. For this reason, the following aspects will be taken into account and the type of treatment and destination will be decided on the basis of these for each particular case of intervention:

- In the event that there is no use derived from the forestry operations carried out, the total elimination-extraction of the remains generated must be carried out, the methods and procedures being subject to the criteria of the awarded entity based on technical and economic aspects, or failing this, to that stipulated in the specific action proposal.

- If, on the other hand, it is possible to use the remains from the point of view of biomass for energy production purposes, the extraction of the residues from the thinning is conditional on the method of using whole trees, so that if there are pruning residues, it is important to plan these correctly in time and space, so that the residues from both operations can be used together.

In either situation, smaller debris (Ø 2-5 cm) has a higher preference in terms of removal, since from the point of view of forest fire prevention it poses a higher risk, being fuels composed of fine elements that fluctuate their moisture content more rapidly and can therefore lead to higher rates of spread during a fire.

In case of high operating costs that make it unfeasible to extract the residues from the area in question, the residues will be treated in situ by shredding the smaller debris with a brush cutter and cutting up and stacking the thicker pieces.

3.3.4 Materials

During the different works to be carried out for the restoration, human resources will be available to guarantee the achievement of the objectives set. In this sense, the clearing, pruning and thinning work will be carried out manually using chainsaws and brush cutters.

In the particular case of the treatment of forest residues, the execution may be manual or mechanised depending on the particular circumstances of each stand and the type of treatment to be carried out.

3.3.5 Post-treatment

3.3.5.1 Resprouting control. Clearing

In order to maintain the stands in optimal conditions against forest fires and depending on the degree of shrub and the possible resprouting of *Quercus pyrenaica*, induced by the execution of the silvicultural treatments, clearing will be carried out after the intervention if deemed necessary, the temporary execution of which will be subject to the optimum moment.

3.3.5.2 Resprouting control. Silvopastoral systems

One of the main solutions to control the excessive resprouting of *Quercus pyrenaica* in the Cantabrian areas after forestry treatments, is the introduction of livestock in the treated areas, although this is not always possible due to the lack of nearby farms and the economic impossibility of transporting livestock from other areas of the national territory.

As has been seen in other areas of Castille & Leon where the oak groves have a silvopastoral vocation and livestock roam constantly through the stands, resprouting is practically non-existent in most of the area they occupy, as the livestock initially consume the resprouting that gradually appears and inhibits its subsequent development.

The key aspect to take into account is the stocking rate to be introduced in the treated areas, as an insufficient stocking rate will inevitably lead to the appearance of resprouting, although this will be less than before the introduction of livestock.

Due to the surface area of the oak groves and the common extension of the forestry treatments carried out, the maintenance of high stocking rates would mean the need for an enormous volume of livestock, so that in order to obtain such a load while optimising resources, rotational grazing and meticulous planning of the same must be used.

In this sense, cattle have a strong predilection for the *Quercus pyrenaica* resprouting, and their greater ease of management makes them an excellent candidate to take into account. In addition, the presence of cattle in the treated stands not only contributes to the reduction of resprouting, but also through their excretions they make an organic contribution to the soil and contribute to improving its structure.

3.4 General cost assessment

Table 3.3 General cost assessment of the restoration activities in the Demo area.

Restoration activity	Area (has)	Cost (€)
C. sativa plantation	5	30,000
Enrichment plantings	40	120,000
Silviculture	100-150	225,000

3.5 Planning by year

Table 3.4 Planning of restoration activities for 2023 in the Demo area.

Improvement	Task	Year 1 - 2023											
		J	F	M	A	M	J	J	A	S	O	N	D
Planification	Interventions planning												
	Clearing												
Plantations	Soil preparation												
	Plantation												
	Protection												

Table 3.5 Planning of restoration activities for 2024 in the Demo area.

Improvement	Task	Year 2 - 2024

		J	F	M	A	M	J	J	A	S	O	N	D
Chestnut plantation	Clearing												
	Stake out & signposting												
	Soil preparation												
	Plantation												
	Protection												
Plantations	Clearing												
	Soil preparation												
	Plantation												
	Protection												
Forest restoration	Clearing												
	Thinning												
	Pruning												
	Treatment of forest residues												

Table 3.6 Planning of restoration activities for 2025 in the Demo area.

Improvement	**Task**	**Year 3 - 2025**											
		J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**

Chestnut plantation	Clearing												
	Stake out & signposting												
	Soil preparation												
	Plantation												
	Protection												
Plantations	Clearing												
	Soil preparation												
	Plantation												
	Protection												
Forest restoration	Clearing												
	Thinning												
	Pruning												
	Treatment of forest residues												

The work schedule shown above is an estimate that should be taken as a guideline, as all work is subject to possible temporary variations depending on the availability of means for its execution, as well as the weather conditions existing in each area and period, so it is possible that there may be slight delays with respect to what is indicated above

3.6. Initial assessment of restoration sites

3.6.1. Objectives

The purpose of the initial forest inventory is to describe the state of the forest trees (if desired dead wood) and optionally herb layer and to be able to assess future effects (success and failures) of the measures on the ecosystem biodiversity and functions. The observations are

conducted and recorded at plot scale, in a sample design laid out over the restored areas involving several aspects of the stand structure.

The initial assessment includes measurements of the adult trees, saplings and seedlings (and optionally ground vegetation inventory of non-tree species). These aspects are described in these guidelines.

In case the restoration stand is located within the chronosequence stand, the forest inventory information is retrieved from the WP6. However, for the restoration stands that are not inside of the chronosequence stand, assessment of the initial forest state needs to be done.

3.6.2. Sampling design

The measurements are conducted at the sampling point (plot) scale. A regular sample design of measurement plots is laid out depending on size of restoration site (Table 3.7).

Table 3.7 The criteria table of number of plots established accordingly to the size of the restoration site.

Size of restoration site (ha)	Number of plots
<1 ha	3
1 – 5 ha	10
5 – 20 ha	20
20 – 100 ha	30
100 – 1000 ha	50

Overall, the initial assessment is a simplified design of the chronosequence monitoring design. It only has a central sampling point. In order to avoid biasing the location of the sampling points (for example, by establishing them in the middle of a clearing, or seeking equidistance to trees nearby), the location of the centre is randomly determined within the stand.

The random selection of plot positions is secured by walking a fixed number of steps in a fixed direction from the stand border. This is a way to eliminate perception biases and tendencies to position plot centres at a best spot, which could yield biased estimations of the total stand density.

Concentric subplot design

Around each selected sampling point, concentric plots of different sizes will be used to measure the different components of forest structure, to ensure efficiency in the inventory effort (Figure 3.5). Accordingly, characteristics that require larger effort are measured over smaller plots, whereas larger plots are employed to record rarer events only. To quickly decide in the field which trees belong to each subplot type1, you may simultaneously measure diameter at breast height (dbh) and distance to plot centre. The different plot sizes (Figure 3.535) are designed to be integer divisions of a hectare, to facilitate rapid in situ assessment of within-stand variability (i.e. whether more than 3 plots are needed to capture the range of stand heterogeneity). The different subplots involved are:

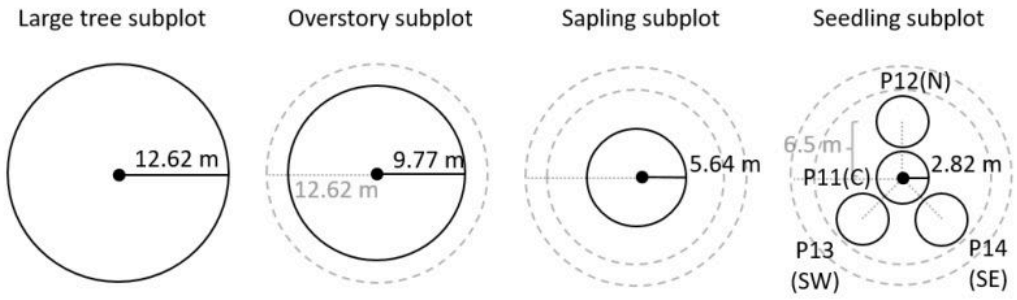


Figure 2. Field plot design for multilayered forest following a circular subplot design.

1. One large tree subplot (12.62 m radius) where only large adult trees (>27 cm dbh) will be measured;
2. One overstory subplot (9.77 m radius) where all adult trees (> 7cm dbh) will be measured;
3. One sapling subplot (5.64 m radius) where the smaller trees (saplings) will be measured and deadwood biomass will be assessed;
4. Four seedling subplots (2.82 m radius) where seedlings will be counted.
5. In addition, aground vegetation inventory of non-tree species will be done over 1-m quadrats within seedling subplots.

Figure 3.5 Plot size to measure different components of forest structure.

In case bare land is afforested (stand after bark beetle calamity, or restoration focuses on forest area expansion on former cropland), then only assessment of seedlings and sapling subplots is established and recorded. In the subplots it is possible to make an additional assessment of herb layer and dead wood. In case of an existing stand in which group or selective fellings are carried out in combination with introducing new tree species, then the large tree to seedling plots are established.

3.6.3. Timing

Data can be collected during a short campaign, as well as in third year of the project. Since the initial assessment is a singular measurements campaign, it is possible to combine it with other field measurements (e.g. WP6 monitoring).

3.6.4. Measurements

General information

The recorded data are collected in the Excel spreadsheet provided. General information is recorded under the tab ‘Stand’. The tab ‘Stand’ include information of country, stand, stand size and number of plots for the initial assessment. Second tab ‘Plot’ include the GPS coordinates, specifying in the comments which is the geographical system employed for them (please, use ESPG codes for national systems). Optionally, we can record approximate terrain slope and aspect in the site. Relevant observations on the plot environment and location can also be recorded (e.g., proximity to roads or infrastructure, recent management interventions, previous land use) in the field ‘Comments’. Additionally, we add approximate percentages of coverage for each of the tree, shrub and the herbaceous layers, assessed visually and expressed separately and not relatively to each other (their sum may therefore be higher than 100%). Tab ‘Species’ includes the species codes that are used across all demo areas. If possible we provide suitable allometric models for the species in the demo area which can make the best biomass predictions according to the local knowledge. There are additional

fields to add any relevant information concerning allometry: height or below ground biomass, relevant references, etc.

Adult tree inventory (Large tree and overstory subplot)

The tree inventory includes all the standing, living or optionally dead adult trees (dbh > 7 cm). Intermediate-sized trees (dbh between 7 and 27 cm) are measured on a 9.77-m radius plot, whereas large trees (dbh > 27 cm) are measured on a 12.62 m-radius plot (Figure 3.5). In each case, the species and dbh of all the corresponding trees are recorded. If decided to do the optional assessment of dead trees, when the species of dead trees cannot be determined, it should be recorded whether these are hardwood or softwood species.

Tree heights is determined for few living trees (only 3 measurements for each of the dominant species present) trying to approximately cover the full range of tree heights and giving measurement of one small, median and one tall tree. Height measurements are conducted either on the intermediate sized trees from the 9.77 m-radius plots, or on the large trees from the 12.62 m-radius plots. It is however important that each height measurement is linked to a dbh measurement, and thus recorded at the row corresponding to the same tree (the rest of rows can be left empty for height measurement). If dead top broken trees are found within the plot their decay class is recorded according.

Saplings inventory (Saplings subplot)

Trees with dbh < 7 cm are also measured individually and recorded, as long as they are higher than 1.30 m (saplings). These trees are measured only when they are at a distance within 5.64 m from the plot centre, to limit the surveying effort needed for these smaller trees. Individual tree codes for saplings are start the count from “101”, to aid their distraction from the bigger trees and facilitate the combination of overstory and sapling layers. If the height measurement of the smaller tree was taken from one of these saplings, add its corresponding height here alongside its dbh.

Lying deadwood (Saplings subplot)

For all lying deadwood pieces (diameter > 7 cm) found within the 5.64 m-radius saplings subplot (Figure 3.5), the diameter at mid-length, total length, and decay class will be recorded. For pieces of deadwood intersecting the borderline, the criterion for inclusion will be whether any part of it within the 5.64 m distance of the plot centre as a diameter > 7 cm. It is recommended to use a tree calliper for measuring lying deadwood diameter.

Seedlings inventory (Seedlings subplots)

For trees with height below 1.30 m measurement is based on counting each individual. The counting is done over 4 different subplots of 2.82 m radius, which should be distributed according to Figure 3.5. Using a telescopic pole, rapid counts of seedlings can be carried out around each subplot centre. Record seedling counts per subplot grouped by species and height class. The height classes only need to be determined approximately: below 20 cm (class 1), 20 – 80 cm (class 2), or above 80 cm (class 3).

Optional additions to the initial assessment in the restoration stands

Richness of ground vegetation using iNaturalist (Central quadrats at seedling subplots)

Each species of non-tree vascular plants (herbs, ferns, shrubs) present in each if the 1-m quadrats within each seedlings subplots are identified using the iNaturalist application. To be included in this list, plants can originate either within the quadrat, or outside it, as long as some part of them is present either directly on the quadrat floor, or on its vertical projection, up to a height of 5 m.

Before going in the field requires:

- Download the iNaturalist app for iPhone or Android.
- Create an account using the app or the website (https://www.inaturalist.org/home)
- Transmit your user information to SUPERB Wageningen team by email (gert-jan.nabuurs@wur.nl, sara.filipek@wur.nl, silke.jacobs@wur.nl, bas.lerink@wur.nl).

Once in the field, you should follow the steps depicted in Figure 3.5 for any species you observe in each quadrat and repeat the process for every seeding subplot (i.e., 4 quadrats per plot). Use the Subplot codes to identify them as in Tables in Initial_forest_assessment protocol. More information can be found on the web (https://www.inaturalist.org/pages/getting%252Bstarted) or checking the tutorials of the iNaturalist App (https://www.inaturalist.org/pages/video%252Btutorials) where explanations are given on how to add an observations using different devices or the website.

Lying deadwood (Saplings subplot)

For all lying deadwood pieces (diameter > 7 cm) found within the 5.64 m-radius saplings subplot (Figure 3.5), the diameter at mid-length, total length, and decay class is recorded. For pieces of deadwood intersecting the borderline, the criterion for inclusion is whether any part of it within the 5.64 m distance of the plot centre as a diameter > 7 cm. It is recommended to use a tree calliper for measuring lying deadwood diameter. The decay class is determined according to the following categories: 1 –Sound (recently dead); 2 –Intermediate (partially rotten); or 3 –rotten.

4 Monitoring

4.1 Site and stand selection for Monitoring, Reporting and Verification of Biodiversity and Ecosystem Services

4.1.1 Sampling design

Within the demo several relatively homogeneous landscape units have been selected. These are “sites”. On each site, multiple stands represent a restoration chronosequence and within each stand, up to 5 inventory plots are selected. Within this design, plots are the smallest scale and minimum spatial unit of study. Plots therefore represent nested replicates within a stand (or habitat) at a single point of restoration. A stand encompasses an area of continuous habitat in the same condition (i.e. same stage of restoration). The area used for samplings within a stand is approximately 1 ha. This is a size that is also used in a number of other large projects quantifying biodiversity in forests (e. g. LIFEPLAN, Biodiversity Exploratories) and thus ensures comparability of results. This size can capture much of stand level structural heterogeneity. Similarly, several spatial replicates of soil samples capture and represent soil conditions and biodiversity of the whole stand. A site is a relatively homogenous landscape unit in terms of climate, topography, geomorphology and soil type and encompasses stands across a restoration gradient. The chronosequence consists of 6 stands within the same site that represent the same forest type and cover a gradient from ‘disturbed or degraded/before restoration’ towards a ‘reference ecosystem’ representing target conditions for restoration. In between these two end-members of the restoration sequence, there are stands that have been restored in the past and represent a chronosequence of stand development since restoration.

4.1.2 Description of chronosequence sites

The entire Demo area has been affected by recurrent forest fires, which has shaped the landscape. In some cases, these fires have resulted in degraded stands or areas of scrubland, therefore our degradation factor is forest fire.

The most relevant gradient that we have identified is the evolution of forest dynamics and tree stand stability related to fire degraded areas. The degradation chronosequence identified is the time since the fire.

We have adopted the terminology of sites, stands and plots. Within a landscape we anticipate there to be multiple sites (where a site is a relatively homogenous landscape unit in terms of climate, topography, geomorphology and soil type). Each site could include multiple stands representing a restoration chronosequence, and within those there will be up to 5 inventory plots within each stand, depending on stand structural and compositional heterogeneity.

We have selected four sites with 9 stands each: Igüeña (1 - 9), Noceda (10 - 18), Trabadelo (19 - 27) and Corullón (28 - 36). In total we monitor 36 stands (Table 4.1; Figure 4.1).

Depending on the chronosequence and the state of degradation of the forest, we have classified the stands into four categories:

- Very degraded: stand with forest fire occurred less than 2 years ago and/or apparently poor soil.
- Degraded: stand with forest fire occurred from 2 to 20 years ago and apparently medium to rich soil.
- Reference forest: stand with no recent forest fire and apparently rich soil.
- Reforested: conifer reforested stands.

Table 4.1 Chronosequence stands with the area and stand description of the degradation.

Stand	Site	Area (has)	Stand degradation
01	Igüeña	16,55	Very degraded
02	Igüeña	1,04	Very degraded
03	Igüeña	3,17	Reference forest
04	Igüeña	1,11	Degraded
05	Igüeña	1,00	Degraded
06	Igüeña	64,56	Reforested
07	Igüeña	2,16	Very degraded
08	Igüeña	20,33	Reference forest
09	Igüeña	26,43	Degraded
10	Noceda	16,37	Very degraded
11	Noceda	3,00	Very degraded
12	Noceda	8,38	Very degraded
13	Noceda	21,25	Reforested
14	Noceda	1,14	Degraded
15	Noceda	14,87	Reference forest
16	Noceda	1,07	Very degraded
17	Noceda	10,69	Very degraded
18	Noceda	16,56	Reforested
19	Trabadelo	7,25	Very degraded
20	Trabadelo	2,02	Very degraded
21	Trabadelo	12,51	Reforested
22	Trabadelo	13,30	Reforested
23	Trabadelo	3,27	Reforested
24	Trabadelo	3,72	Degraded
25	Trabadelo	13,94	Degraded
26	Trabadelo	4,01	Degraded
27	Trabadelo	12,23	Very degraded
28	Corullón	1,37	Degraded
29	Corullón	3,21	Very degraded
30	Corullón	2,10	Degraded
31	Corullón	9,23	Very degraded
32	Corullón	9,63	Reference forest
33	Corullón	4,72	Degraded
34	Corullón	4,18	Degraded
35	Corullón	7,33	Degraded
36	Corullón	3,58	Very degraded

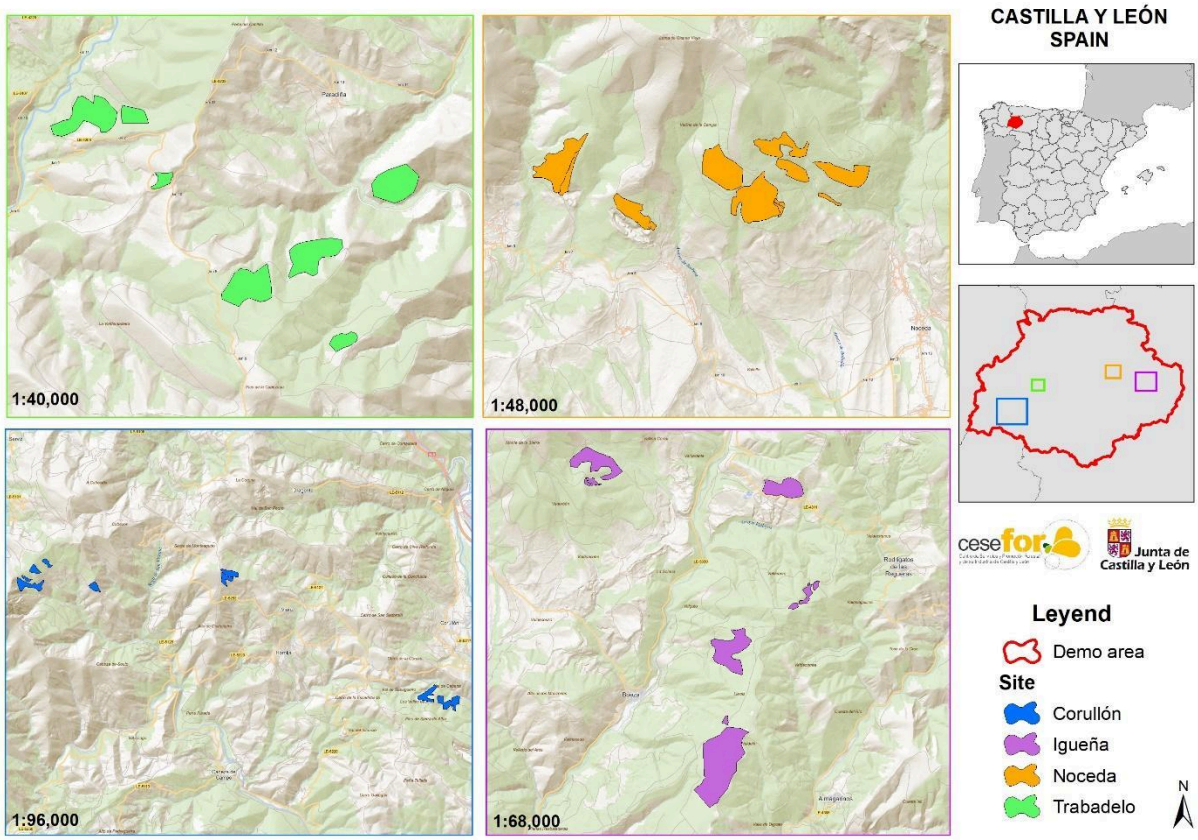


Figure 4.1 Map of the chronosequence stands and sites inside the Demo area in Castilla y León.

The development stage of the species within each stand is widely variable, with a range of development defined by the previously chosen degradation chronosequence (Table 4.2).

Table 4.2 Surface area of each development state of the forest in the chronosequence stands.

Sps per stand	Timber stage (ha)	Pole stage (ha)	Thicket stage (ha)	Reforestation (ha)	Other (ha)	Total (ha)
Stand 01		**9,18**			**7,37**	**16,55**
Quercus pyrenaica		9,18				9,18
Shrubland					7,37	7,37
Stand 02		**0,27**	**0,78**			**1,04**
Quercus pyrenaica		0,27				0,27
Quercus robur			0,78			0,78
Stand 03		**3,15**	**0,02**			**3,17**
Quercus pyrenaica		3,15				3,15

Quercus robur			0,02			0,02
Stand 04				**1,11**		**1,11**
Pinus sylvestris				1,11		1,11
Stand 05		**0,97**			**0,03**	**1,00**
Pinus sylvestris		0,97				0,97
Non-forested					0,03	0,03
Stand 06	**64,38**	**0,04**			**0,14**	**64,56**
Pinus sylvestris	64,38	0,04				64,42
Non-forested					0,14	0,14
Stand 07		**0,12**	**2,04**			**2,16**
Pinus sylvestris			2,04			2,04
Quercus pyrenaica		0,12				0,12
Stand 08		**20,33**				**20,33**
Quercus pyrenaica		20,33				20,33
Stand 09	**26,25**				**0,18**	**26,43**
Quercus robur	26,25					26,25
Non-forested					0,18	0,18
Stand 10	**0,38**			**15,95**	**0,03**	**16,37**
Castanea sativa	0,02					0,02
Pinus sylvestris				15,95		15,95
Quercus pyrenaica	0,37					0,37
Shrubland					0,02	0,02
Non-forested					0,02	0,02
Stand 11	**0,36**			**2,64**	**0,01**	**3,00**
Castanea sativa	0,03					0,03
Pinus sylvestris				2,64		2,64
Quercus pyrenaica	0,33					0,33
Non-forested					0,01	0,01
Stand 12				**8,37**	**0,01**	**8,38**
Mix of conifers				8,37		8,37
Non-forested					0,01	0,01

Mining, landfills and dumps				0,01	0,01
Stand 13			**21,25**	**0,00**	**21,25**
Pinus sylvestris			21,17		21,17
Quercus pyrenaica			0,08		0,08
Non-forested				0,00	0,00
Stand 14			**1,14**		**1,14**
Pinus sylvestris			0,61		0,61
Quercus pyrenaica			0,54		0,54
Stand 15	**11,32**		**3,56**		**14,87**
Quercus pyrenaica	11,32		3,56		14,87
Stand 16	**0,69**		**0,38**		**1,07**
Quercus pyrenaica	0,69		0,38		1,07
Stand 17			**10,69**		**10,69**
Pinus sylvestris			0,14		0,14
Quercus pyrenaica			10,55		10,55
Stand 18		**16,12**	**0,18**	**0,26**	**16,56**
Pinus sylvestris		16,12	0,00		16,13
Quercus pyrenaica			0,17		0,17
Non-forested				0,26	0,26
Stand 19	**0,02**			**7,23**	**7,25**
Castanea sativa	0,02				0,02
Shrubland				7,23	7,23
Stand 20				**2,02**	**2,02**
Shrubland				2,02	2,02
Stand 21	**1,19**	**3,15**		**8,17**	**12,51**
Pinus pinaster	1,19	3,15			4,34
Shrubland				8,17	8,17
Stand 22		**13,29**			**13,30**
Pinus sylvestris		13,29			13,29
Stand 23	**2,08**	**1,19**			**3,27**

Pinus pinaster	2,08	1,19			3,27
Stand 24		**3,49**		**0,23**	**3,72**
Pinus pinaster		2,64			2,64
Quercus pyrenaica		0,85			0,85
Non-forested				0,23	0,23
Stand 25		**13,64**		**0,30**	**13,94**
Quercus pyrenaica		13,64			13,64
Shrubland				0,12	0,12
Non-forested				0,17	0,17
Stand 26	**0,12**	**3,89**			**4,01**
Castanea sativa	0,12				0,12
Quercus ilex		3,89			3,89
Stand 27				**12,23**	**12,23**
Shrubland				12,23	12,23
Stand 28			**1,37**		**1,37**
Quercus pyrenaica			1,37		1,37
Stand 29			**2,85**	**0,36**	**3,21**
Quercus pyrenaica			2,85		2,85
Shrubland				0,36	0,36
Stand 30			**2,04**	**0,06**	**2,10**
Quercus pyrenaica			2,04		2,04
Shrubland				0,06	0,06
Stand 31			**2,83**	**6,40**	**9,23**
Quercus pyrenaica			2,83		2,83
Shrubland				6,40	6,40
Stand 32	**9,63**				**9,63**
Castanea sativa	9,63				9,63
Stand 33			**4,71**		**4,71**
Pinus sylvestris			4,71		4,71
Stand 34			**4,18**		**4,18**
Pinus sylvestris			4,18		4,18

Stand 35	**0,17**				**7,16**	**7,33**
Castanea sativa	0,17					0,17
Shrubland					7,16	7,16
Stand 36					**3,58**	**3,58**
Shrubland					3,58	3,58
General total	**116,59**	**88,84**	**58,02**	**28,07**	**55,78**	**347,32**

Table 4.3 Surface burned area (ha) by forest fires occurred inside some stands from 2000 to 2022.

Sps per stand	2000	2005	2007	2010	2012	2015	2016	2017	2022	Total (ha)
Stand 01									**16,55**	**16,55**
Quercus pyrenaica									9,18	9,18
Shrubland									7,37	7,37
Stand 02	**1,04**									**1,04**
Quercus pyrenaica	0,27									0,27
Quercus robur	0,78									0,78
Stand 04	**1,11**									**1,11**
Pinus sylvestris	1,11									1,11
Stand 05		**1,00**								**1,00**
Pinus sylvestris		0,97								0,97
Non-forested		0,03								0,03
Stand 10									**16,37**	**16,37**
Castanea sativa									0,02	0,02
Pinus sylvestris									15,95	15,95
Quercus pyrenaica									0,37	0,37
Shrubland									0,02	0,02
Non-forested									0,02	0,02
Stand 11							**3,00**			**3,00**
Castanea sativa							0,03			0,03
Pinus sylvestris							2,64			2,64
Quercus pyrenaica							0,33			0,33

Non-forested			0,01	0,01
Stand 12		**8,38**		**8,38**
Mix of conifers		8,37		8,37
Non-forested		0,01		0,01
Mining, landfills and dumps		0,01		0,01
Stand 13	**21,25**			**21,25**
Pinus sylvestris	21,17			21,17
Quercus pyrenaica	0,08			0,08
Stand 14	**1,14**			**1,14**
Pinus sylvestris	0,61			0,61
Quercus pyrenaica	0,54			0,54
Stand 20		**2,02**		**2,02**
Shrubland		2,02		2,02
Stand 28	**1,37**			**1,37**
Quercus pyrenaica	1,37			1,37
Stand 29	**3,21**			**3,21**
Quercus pyrenaica	2,85			2,85
Shrubland	0,36			0,36
Stand 30	**2,10**			**2,10**
Quercus pyrenaica	2,04			2,04
Shrubland	0,06			0,06
Stand 31	**9,23**			**9,23**
Quercus pyrenaica	2,83			2,83
Shrubland	6,40			6,40
Stand 32			**9,63**	**9,63**
Castanea sativa			9,63	9,63
Stand 35			**7,33**	**7,33**
Castanea sativa			0,17	0,17
Shrubland			7,16	7,16
Stand 36			**3,58**	**3,58**

Shrubland								3,58		3,58
General total	**2,16**	**1,00**	**22,40**	**15,91**	**8,38**	**2,02**	**3,00**	**20,54**	**32,92**	**108,33**

4.1.3 Description of monitoring measures

Plot based forest inventory:
Over the three forthcoming years, regular plot-based inventory of trees is conducted once in several inventory plot for evaluation of the success of natural regeneration. It includes identifying causes of tree mortality, and assessment of biodiversity. For ground vegetation, we mainly follow the ICP Forest guidelines (Canullo et al. 2011), which in short means that herb layer species richness and abundance is assessed. Temporal replicates are not needed for regular forest inventory work, so the data are acquired during a short campaign. It would be desirable to also survey tree-related microhabitats as indicators for the potential presence of certain taxa of forest-dwelling species. This survey, which follows a catalogue developed by Kraus et al. (2016), is an optional component. In addition, data on non-tree species are collected using iNaturalist app, to compare the benefit from citizen science approaches in ecosystem regeneration projects. See protocol below for more information.

Soil carbon and soil biological activity
In all inventory plots a single assessment of soil carbon and soil biological activity/diversity takes place in the first two years of the project. For this purpose, the KU Leuven team is carrying out the soil sampling.

High-throughput biodiversity data: DNA metabarcoding & bioacoustics
In addition, sampling of flying insects, soil fungi and plants, bioacoustics recording of animals takes place each year because these are taxonomic groups that most likely show a rapid response to restoration activities. Used approach requires that surveying and sampling are more spread in space and time over each of the three years. The reason for carrying out campaigns over several years is to capture temporal variability in the abundance and activity of different species, and to assess the effectiveness of methods employed to assess biodiversity. This enable a power analysis to determine the level of evidence that the sampling scheme can prove. Soil samples are collected during a single field visit, but acoustic recordings require at least a week, and we are limited by the number of recorders we can provide. Malaise traps do not require maintenance before collection but should be deployed for a minimum of one week.

Remote sensing
Finally, multispectral drone surveys and ground-based LiDAR surveys is carried out once over the project time spam.

5 Stakeholders

Throughout the course of the SUPERB project the demo leaders are guided and supported by Prospex Institute (PI, leader of WP2) in their work on stakeholder engagement.
The following activities are at the centre of this guidance and support:

- Stakeholder mapping at the demo level
- Serie of at least 3 co-creative Stakeholder Workshops
- Co-development and implementation of a stakeholder engagement strategy

The coordination of requests for stakeholder input from the demos:

1. *Stakeholder mapping at the demo level*

In March and early April 2022, the demo carried out an initial mapping of their stakeholders, with stakeholders defined as all those actors (groups and individuals) who affect or are affected by the restoration work in the demo. The demo leaders applied the Prospex-CQI methodology and collected the stakeholders' information and contact details in the QUIP database set up by PI (allowing for GDPR-related exceptions). The demo leaders aimed to map at least 50 individuals at this stage and to fill in at least 2-3 entries for all the stakeholder (sub-) categories identified by PI together with the demo. Throughout the project, they will continue adding individual stakeholders to the database across the different categories.

2. *A series of at least 3 co-creative stakeholder workshops in each demo*

Throughout the project time (2022-2025) demo leaders will organise and facilitate at least the following 3 co-creative workshops for the full range of their diverse stakeholders:

- The *vision and design workshop* in August/September 2022, in which the demo leaders with representatives set of stakeholders inform and co-decide on demo's restoration vision, goals and workplans.
- The *implementation workshop* in January 2024, in which the demo leaders consult representative set of stakeholders on the current project implementation and will engage them to inform and co-decide on the further implementation.
- The *review and upscaling workshop* in May 2025, in which the demo leaders will engage representatives set of stakeholders on evaluating the demo restoration results achieved and on devising an approach to upscaling.

Prospex Institute guides and supports the demo leaders in the design and organisation of the workshops. The participants to the workshops are invited based on the stakeholder mapping conducted in the demo. Employing the Prospex-CQI methodology, the demo leaders aim to fulfil the quota recommended by PI for each of the stakeholder (sub-) categories.

The demo leaders report on each of the stakeholder workshops to SUPERB and to the participating stakeholders, also on how the stakeholder input is used in the restoration process. The demo make sure that the input at each stage is effectively incorporated into the decision-making on the latter. PI supports and monitors the demo leaders on this point.

The demo leaders are strongly encouraged to organise further stakeholder events besides the three workshops listed above. PI, the demos and leaders of WP7 collaborate on conceptualising additional stakeholder workshops and events as part of developing the demo-specific stakeholder engagement strategies.

3. *The co-development and implementation of a stakeholder engagement strategy for each demo*

In August-September 2022 the demo leaders, PI and WP7 collaborated on drafting the first version of the demo-specific stakeholder engagement strategies. These strategies explain the ways in which the demo engaged full range of diverse stakeholders and especially beyond the three stakeholder workshops over the course of the project. The strategies are based on *inter alia* the following input:

- An analysis of the pool of stakeholders emerging from the stakeholder mapping
- Initial insights from the online mapping through direct stakeholder interaction online (Task 2.2, led by WP2 partner Kings College London and WP2 co-lead EFI).
- Any relevant insights from the SUPERB Hackathon (a co-creative laboratory for all SUPERB partners that took place on 9-11 March 2022 with the aim of identifying common challenges to success in the demos and devising approaches for solutions).
- The outcomes of the 1st stakeholder workshop (on vision and design) to be inserted in this workplan, and how it has affected the design or implementation
- Close dialogue between the demo leaders and PI on demo-specific stakeholder engagement needs

The demo-specific stakeholder engagement strategies will be finalised by PI in May 2023. Throughout the course of the project PI guides, supports, and monitors the demo leaders in the implementation of the strategies, and will collaborate on their revision whenever such is considered desirable and/or necessary.

5.1 Opportunities and challenges identified at the stakeholder workshop

Regarding the challenges, there are some common issues among the participants. An important one relates to the social component. There is a concern about consensus and acceptance in some sectors of society, such as those whose interaction with the bear is detrimental to them. There is also a worry about the connection between social and environmental sectors. On the other hand, participants expressed concern regarding the long-term maintenance of forest management. In this respect, it would be desirable to be able to count on the commitment of the appropriate stakeholders to continue the management of the demo area in the long term. The above, upscaling also emerged as a challenge. Therefore, it is hoped to have an upscaling plan, developed together with WP8 within SUPERB, that will allow the restoration project to be expanded to other areas. And finally, a challenge considered by the participants is adequate communication and dissemination. In this respect, we can consider that a strong quality communication campaign is being and will be carried out, both locally by Cesefor, the Junta de Castilla y León and the local media, and internationally by the European Forest Institute.

In terms of opportunities, several common topics expressed by the participants have also been identified. Participants consider that the project can be an opportunity for the fixation of the rural population and its development. They also consider that the project can improve ecosystem services and increase forest resilience, as well as provide visibility and opportunity to disseminate ecosystem services. As the project aim is a convergence of both forest conservation and rural development, it has the potential to improve the interactions between the environment and inhabitants. Lastly, the participants remain hopeful that restoration in the demo area of El Bierzo can be a good example for upscaling.

5.2 Target ecosystems based on stakeholder workshops

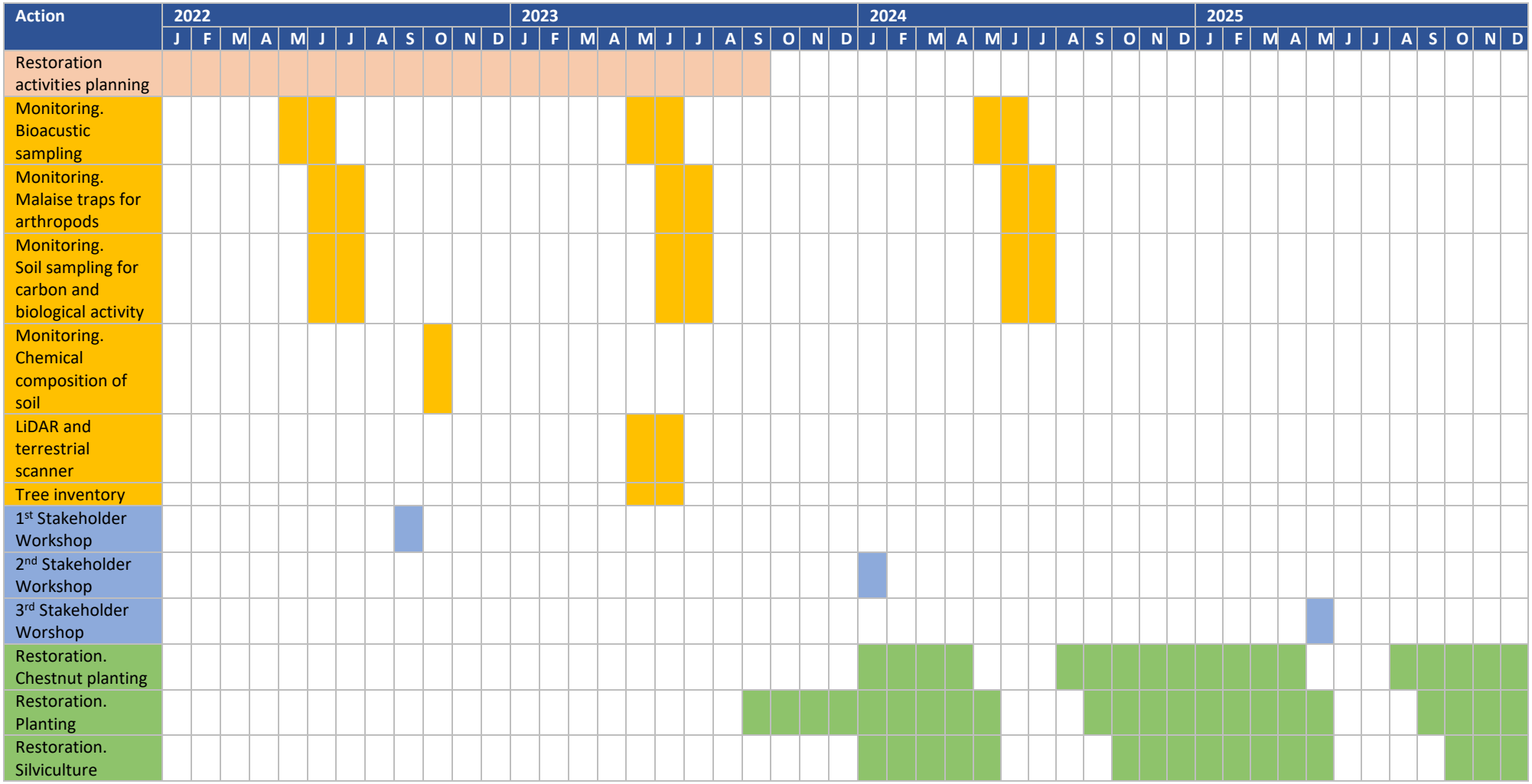
From the first workshop of the Spanish demo-region, only one survey was received that partly contributed to identifying preferences regarding restoration goals. From this single survey, however, only a few observations could be synthesized, in particular on the composition of the ecosystems to restore. According to the respondent's view, in the future forest landscape, both chestnut stands and open areas with herbaceous species for grazing should be part of a mosaic of different land uses.

5.3 Conclusions of the stakeholder workshop

As a result of the participants' views during the workshop, we can conclude that more investment and capacity building in forestry communication is needed to increase the understanding of sustainable forest management and its benefits. Along the same line, is essential to have more education and research to support this process. In addition, it is important to give greater visibility to the notion of forest multifunctionality. Problems with administrative delays slow down decisions and discourage private managers from undertaking initiatives for forest improvement. It would also be desirable to establish forward-looking management plans, to continue restoration actions a posteriori and to follow them up. Furthermore, the opportunity to generate a boost to carbon offsetting and the contribution provided by ecosystem services was identified based on the discussion with the participants. Of particular interest is the opportunity for the project to maintain the population by keeping young people in their village

6 Planning

Figure 6.1 Planning by year



7 Photos of initial situation

Figure 7.1 Stand 11 in Noceda site. It is a very degraded stand for chronosequence measurements.

Figure 7.2 Stand 10 in Noceda site. It is a very degraded recently burned stand for chronosequence measurements.

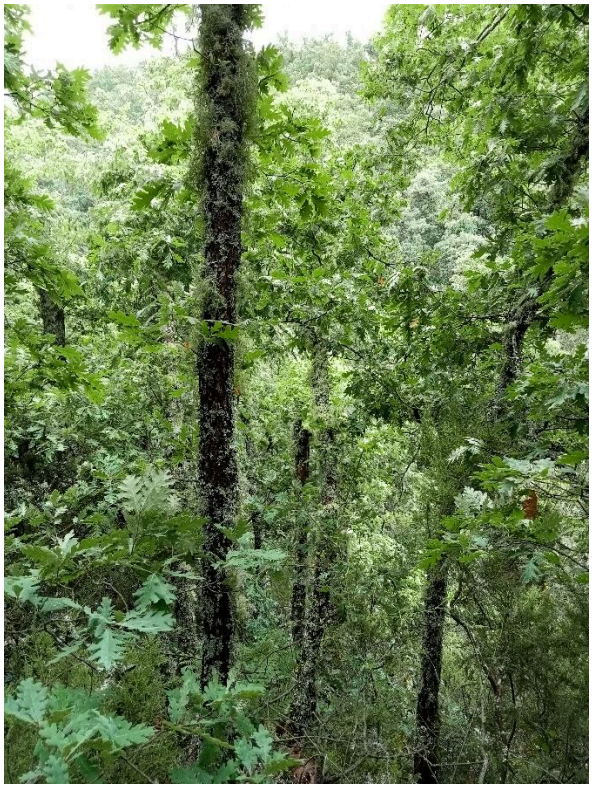


Figure 7.3 Stand 14 in Noceda site. It is a degraded stand for chronosequence measurements and where silvicultural treatments and enrichment planting will also be carried out.

Figure 7.4 Stand 08 in Igüeña site. It is a reference stand for chronosequence measurements.

8 References

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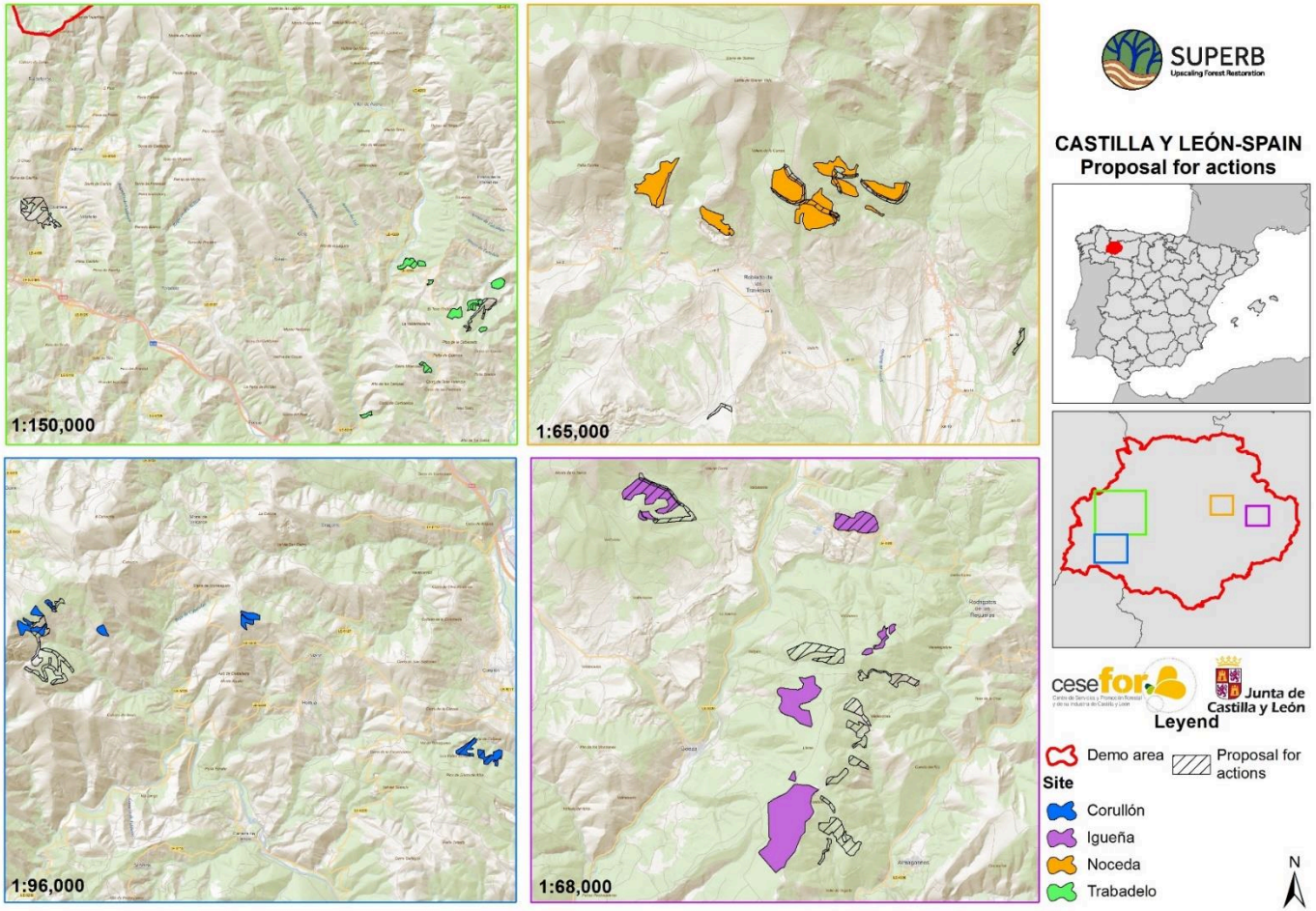
9 Annex

9.1 General map of chronosequence and restoration stands



9.2 General table of chronosequence and restoration stands

Stand number	Site	Chronosequence	Restoration activity	Activity area (has)	Total stand area (has)
01	Igüeña	Yes	Silviculture	16.55	16.55
02	Igüeña	Yes	No		1.04
03	Igüeña	Yes	Silviculture	3.17	3.17
04	Igüeña	Yes	No		1.11
05	Igüeña	Yes	No		1.00
06	Igüeña	Yes	No		64.56
07	Igüeña	Yes	No		2.16
08	Igüeña	Yes	Silviculture	20.33	20.33
			Enrichment plantings	3.84	
09	Igüeña	Yes	No		26.43
10	Noceda	Yes	No		16.37
11	Noceda	Yes	No		3.00
12	Noceda	Yes	No		8.38
13	Noceda	Yes	Enrichment plantings	2.56	21.25
14	Noceda	Yes	Enrichment plantings	1.08	1.14
15	Noceda	Yes	Enrichment plantings	3.46	14.87
16	Noceda	Yes	No		1.07
17	Noceda	Yes	Enrichment plantings	5.57	10.69
18	Noceda	Yes	Enrichment plantings	6.33	16.56
19	Trabadelo	Yes	*C. sativa* plantation	7.25	7.25
20	Trabadelo	Yes	No		2.02
21	Trabadelo	Yes	Enrichment plantings	4.25	12.51
22	Trabadelo	Yes	No		13.30
23	Trabadelo	Yes	No		3.27
24	Trabadelo	Yes	No		3.72
25	Trabadelo	Yes	Enrichment plantings	13.94	13.94
26	Trabadelo	Yes	Enrichment plantings	4.01	4.01
27	Trabadelo	Yes	No		12.23
28	Corullón	Yes	No		1.37
29	Corullón	Yes	No		3.21
30	Corullón	Yes	Enrichment plantings	1.11	2.10
31	Corullón	Yes	Enrichment plantings	4.17	9.23
32	Corullón	Yes	Silviculture	9.63	9.63
33	Corullón	Yes	No		4.72
34	Corullón	Yes	No		4.18
35	Corullón	Yes	*C. sativa* plantation	7.33	7.33
36	Corullón	Yes	No		3.58
37	Igüeña	No	Enrichment plantings	1.66	1.66
38	Igüeña	No	Enrichment plantings	14.10	14.10
39	Igüeña	No	Enrichment plantings	1.46	1.46
40	Igüeña	No	Enrichment plantings	3.47	3.47
41	Igüeña	No	Enrichment plantings	2.95	2.95
42	Igüeña	No	Enrichment plantings	6.95	6.95
43	Igüeña	No	Enrichment plantings	5.74	5.74
44	Igüeña	No	Enrichment plantings	7.33	7.33
45	Igüeña	No	Enrichment plantings	15.68	15.68
46	Igüeña	No	Enrichment plantings	5.05	5.05
47	Trabadelo	No	Enrichment plantings	23.98	23.98
48	Corullón	No	Enrichment plantings	20.49	20.49
49	Corullón	No	Enrichment plantings	9.25	9.25
50	Corullón	No	Enrichment plantings	4.00	4.00
51	Corullón	No	Enrichment plantings	2.27	2.27
52	Trabadelo	No	*C. sativa* plantation	3.62	3.62
53	Trabadelo	No	*C. sativa* plantation	59.90	59.90
54	Noceda	No	*C. sativa* plantation	1.92	1.92
55	Noceda	No	*C. sativa* plantation	1.62	1.62