GREENChainSAW4Life

Project n° LIFE18 CCM/IT/001193

"GREEN energy and smart forest supply CHAIN as driverS for A mountain action plan toWards climate change"

Deliverable DL.C5.1

Description of selected forest plots and Forest Harvesting Plans

Action Number and Title	Selection of Demo Forest Plots and Pilot Forest Harvesting
Task	C5.1 Selection of pilot forest plots
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ABSTRACT

This deliverable contains results from Task C5.1: Two pilots forest plots were identified by the Forest Information System developed in WP4. The Forest Information System is able to identify forest areas characterized by the most critical condition, in agreement with local stakeholders, private forest owners, Unione Monviso and Comune di Barge.
Walden planned forest harvesting operations with climate smart forest management approaches. Part of the timber obtained will be transformed with a cascade use in Action C6.

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1. INTRODUCTION

The pilot forest plots described below are used to test the climate smart forestry approaches. To do so we applied the climate smart forestry approaches to the most common and most endangered by climate change forest in Valle Po: the unmanaged chestnut coppices mixed with other hardwood species. The proposed approach prescribes one or two forest thinnings every 10 or 15 years, aiming to ensure a transition of coppice into high forest, ultimately increasing the complexity of forest plots. Specifically, the objectives of the thinning operations are: (i) facilitate the renewal of local species: (ii) decrease fire risk; (iii) increase the complexity of the forest structure. In addition to the silvicultural objectives above, this approach aims to improve the timber quality over time. Lastly, to take in account biodiversity the Index of Biodiversity Potential (IBP) 1 was used.

1.1 CONFIDENTIALITY

This document is the result of a planning process that involves public bodies, and the approval of forest harvesting operation is public. Thus, the document is meant to be of public access and it will be realized entirely.
It is the property of WALDEN, MONVISO and BARGE.

2. PILOT FOREST PLOTS

2.1 SELECTION PROCESS AND FOREST SURVEYS

The selection process of the pilot forest plots can be divided in two steps:

1. using the Forest Information System developed in WP4, the forest areas where forest management operations had the highest priority were identified.
2. in accordance with local stakeholders (Unione Monviso, Comune di Barge, private forest owners and landowners association as AsFo Valle Infernotto) the initial selection of step 1 was further refined.

At the end of this process, two pilot forest plots were selected: (*i*) in Pagno (5.1 ha) loc. Santa Cristina (CN); (*ii*) Barge (4.9 ha) loc. Borgata Capoloira (CN). In each pilot forest plot, the following parameters were identified: (*i*) total woodland volume, (*ii*) species composition; (*iii*) average age of forest stand. In both pilot forest plots, trees designed to be harvested were measured and marked by spay. This process is useful to provide guidelines to contracting forest companies and calculate the wood volume that will be harvested. To analyze and preserve biodiversity during forest planning and sylvicultural operations, the Index of Biodiversity Potential (IBP)[1] has been applied in network with the LIFE GoProFor. The IBP was created in 2008 in order to enable forest managers to evaluate easily the capacity of a stand to accept diverse species and to identify the factors that management policy and methodology could improve. The IBP is an indirect indicator which evaluates not the actual presence of species but the capacity of a stand to host them. Thus, the index is built up from the characteristics of the trees, the stand and the biotope and not from a taxonomic inventory. The IBP is based on an analysis of ten key factors observed in the field showed in table below:

Factors related to stands and forestry management	Factors related to context
1. Native species; 2. Vertical structure of the vegetation; 3. Snags; 4. Lying deadwood; 5. Large trees; 6. Trees hosting microhabitats; 7. Openings.	1. Woodland continuity over time; 2. Aquatic habitats; 3. Rocky habitats.

Table 1 - The ten factors of the IBP.

[1] LARRIEU, L., GONIN, P. 2008. L'indice de Biodiversité Potentielle (IBP): une méthode simple et rapide pour évaluer la biodiversité potentielle des peuplements forestiers. Revue Forestière Française (6), pp. 727-748.

2.2 PRELIMINARY DOCUMENTS AND HARVESTING PLANS

Forest harvesting projects were permitted by previous agreement with their public and private owners.
The forest pilot area selected in Pagno (CN) is totally owned by a private owner. Unione Monviso made an agreement with the owner for a multi-annual forest stand management plan. Differently, the forest pilot area in Barge (CN) includes both public and private owners. All the land parcels were conferred to the local landowner's association (called AsFo Valle Infernotto). Consequently, AsFo Valle Infernotto made an agreement with BARGE for a multiannual agreement in order to allow public tender for forest operations, similarly to what has been done with Pagno's pilot area. For both pilot forested areas Walden has prepared the forest harvesting plans approved by Regione Piemonte and the documents required by public tender. All the documents are listed below and are considered annexes to the deliverable (see Chapter 6 -Annexes)

Public tender documents	**Forest Plot "A"** **Pagno (CN)** Annex Title	**Forest Plot "B"** **Barge (CN)** Annex Title
Forest Harvesting Plans	A1-Intervento di Miglioramento Forestale nel Comune di Pagno, Loc. Santa Cristina	B1-Intervento di Miglioramento Forestale nel Comune di Barge, Loc. Capoloira
Cost Estimate and Economic Outlook	A2-Elenco Prezzi, Computo Metrico Estimativo e Quadro Economico	B2- Computo Metrico Estimativo e Quadro Economico
Price Analysis	A2-Elenco Prezzi, Computo Metrico Estimativo e Quadro Economico	B3-Elenco Prezzi Unitari e Analisi prezzi
Tender Dossier	A3-Capitolato Speciale d'Appalto	B4-Capitolato Speciale d'Appalto
Risk assessment for Forestry Operation	A4-Valutazione specifica dei rischi di cantiere	B5- Valutazione specifica dei rischi di cantiere

Table 2 – Documents drawn up for the entire authorization process and publics tenders.

3. FOREST PLOT "A" – PAGNO

The forest harvesting plan resumed below is detailed in the annex "Intervento di Miglioramento Forestale nel Comune di Pagno, Loc. Santa Cristina" approved by Regione Piemonte on 16 September 2021.

3.1 FOREST PLOT FEATURES

3.1.1 FOREST PLOT SURFACE

The area is located at 800 m.a.s.l. in Pagno (CN) close to the Sanctuary of Santa Cristina di Verzuolo; the side has an average slope of 14 ° and North - West exposure. The area belongs to a private owner.

3.1.2 FOREST STAND DESCRIPTION

The forest stand belong to the Forest Category of Chestnut Forest. It is an aged coppice, characterized by presence of tree species born in gamic way such as *Fagus sylvatica*, *Quercus petraea, Prunus avium, Sorbus aria* and *Sorbus aucuparia*. The chestnut coppice is aged with an average age of the shoots of 40 years, that causes declining of trees in addition to the action of the pathogen *Cryphonectria parasitica*, agent of chestnut blight.

3.1.3 DENDROMETRIC DESCRIPTION

Dendrometric data of the stand were detected by 2 circular areas with a radius of 15 m. The forest is homogeneous in specific composition, however there are two areas with different densities. The higher density area is characterized by chestnut with smaller shoots size, while the lower density area is characterized by larger plants and more presence of beech and oak. The table below shows the main dendrometric parameters, classified by species as follows: BP - *Betula pendula*, CS - *Castanea sativa*, FS - *Fagus sylvatica*, QR - *Quercus petraea* and SA - *Sorbus aria*

Specie	N°/ha %	G (m^2) %	V (m^3) %	V (m^3/ha)	V (m^3)
BP	4,3	4,9	4,6	17,9	92,4
CS	52,0	65,3	63,3	245,3	1263,2
FS	41,2	27,2	29,1	112,7	580,5
QR	1,3	2,2	2,6	10,2	52,4
SA	1,3	0,4	0,3	1,1	5,8
Tot				**387,3**	**1994,4**

Table 3 - Main dendrometric parameters expressed in percentage ratio, volume per hectare and volume on total surface.

3.1.4 FOREST STAND BIODIVERSITY

The IBP analysis was carried out by covering two areas (high density stand and lower density stand) each corresponding to 0.5 ha, near the dendrometric measurement areas. The observations were related to the hectare obtaining the results summarized in the graphs below.

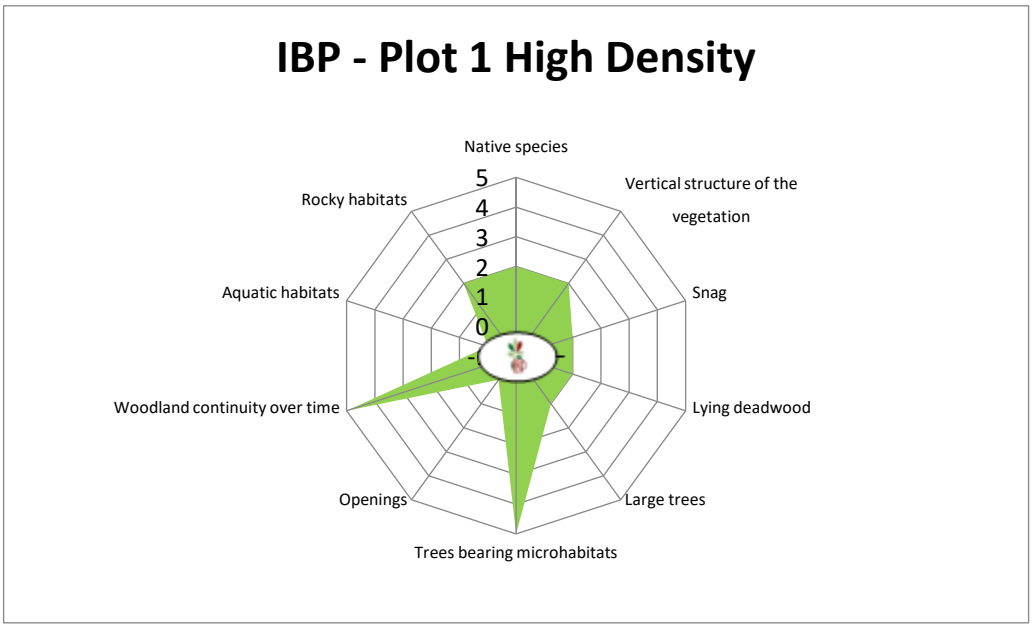

Figure 1 – Summary graph of IBP key factors observed in plot 1 with high density stand.

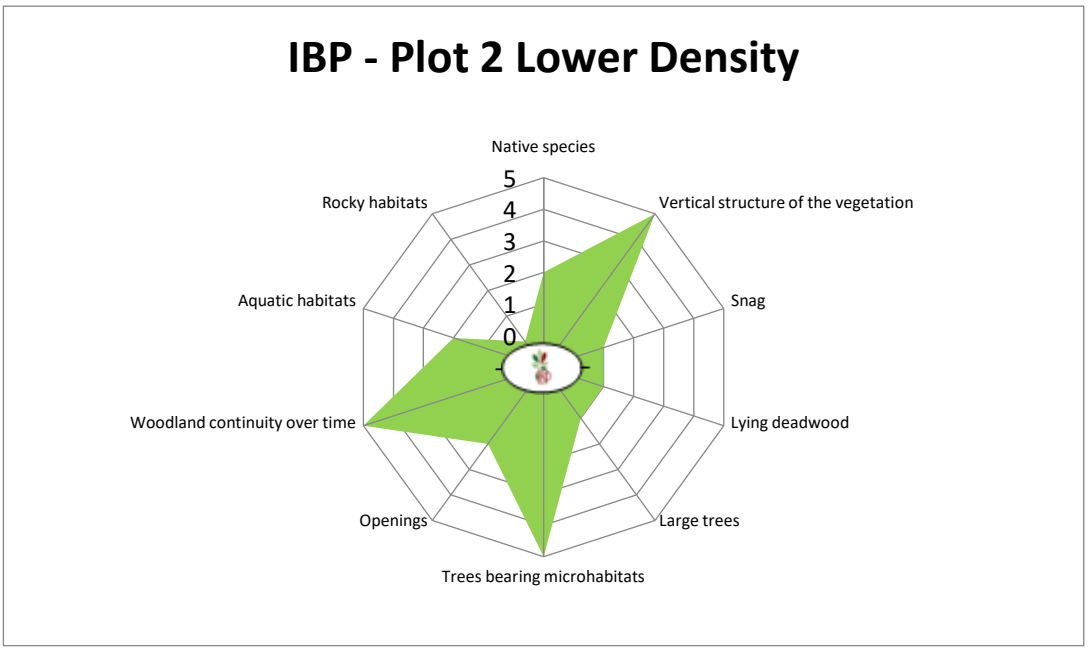

Figure 2 – Summary graph of IBP key factors observed in plot 2 with lower density stand.

Comparison of the graphs shows better IBP values for the coppice area with lower density. The thinning will improve the potential biodiversity factors in area with high density and preserving and improving IBP factors in area with lower density, all that by silvicultural operations.

3.2 FOREST MANAGEMENT OBJECTIVES

The main purpose of forest stand is productive-protective. However, the proximity with Sanctuary of Santa Cristina di Verzuolo and its accessibility suggest a good touristic fruition of the area.

3.2.1 SYLVICULTURAL OBJECTIVES

The long-term goal of this forest harvest plan is to obtain a high forest composed by *Fagus sylvatica, Quercus petraea and Prunus avium*, with a residual coppice of *Castanea sativa*. The silvicultural goals are achievable thanks to two sylvicultural interventions, carried out 10-15 years apart:

1. In the first forest harvesting operation, object of this report, the chestnut stumps will be totally coppiced, or coppiced with a release of 1 - 2 shoots per stump.
2. In the second forest harvesting operation, the residual chestnut stumps will be coppiced by releasing of 1-2 shoots per stump, the mature shoots already released in the first forest harvesting operation, will be removed; a part of mature high forest should be harvested.

In both forest operations, competitors of gamic candidate trees will be harvested, creating forest regeneration plots. Forest operations will release a canopy cover greater than 50%.

3.2.2 STAND VOLUME HARVESTED

Two areas were carried out to estimate the volume and quality of timber harvested by measures and paint mark on trees designed to be removal. The table below shows the average withdrawal parameters per hectare, total surface and in percentage.

Specie	N°/ha	G (m^2/ha)	V (m^3/ha)	V (m^3/ha) harvested	V (m^3) harvested	% harvested
BP	50,5	2,4	17,9	0	0	0
CS	613,8	31,9	245,3	191,3	985	78,0
FS	486,0	13,3	112,7	14,5	75	12,9
QR	14,9	1,1	10,2	0,3	2	3,1
SA	14,9	0,2	1,1	0	0	0
	1180,1	**48,9**	**387,3**	**206,1**	**1062**	**53,2**

Table 4- Main dendrometric parameters expressed in percentage ratio, harvested volume per hectare, per total surface and percentage.

3.2.3 EVALUATING TIMBER QUALITY SELECTION

Tables below reports the main estimated timber quality that can be harvested.

Chestnut selection	%	m^3	q
Woodchip	65%	640,3	6083
Firewood	35%	344,8	3275
	Tot.	**985,1**	**9358**

Table 5 - Quality assortments of chestnut.

Other hardwood selection	%	m^3	q
Woodchip	11%	8,2	82
Firewood	80%	66,7	667
	Tot.	**74,9**	**749**

Table 6- Quality assortments of other hardwood.

3.2.4 TIME LINE CHART

Operations	1°Month				2° Month				3° Month				4° Month				5° Month			
	Week				Week				Week				Week				Week			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Safety signs																				
Skidding tracks adaptation																				
Trees felling and bucking																				
Timber concentration																				
Skidding																				
Wast residual branches management.																				
Restoration of area																				

4. FOREST PLOT "B" – BARGE

The forest harvesting plan resume below is detailed in the annex "Intervento di Miglioramento Forestale nel Comune di Barge, Loc. Capoloira" approved by Regione Piemonte on 12 October 2021.

4.1 FOREST PLOT FEATURES

4.1.1 FOREST PLOT SURFACE

The forest plot surface consists of 4.94 ha of which 4.06 ha are privately owned and 0.88 ha are owned by the municipality of Barge (CN), the net surface is 4.71 ha.

4.1.2 FOREST STAND DESCRIPTION

The Forest stand is a chestnut coppice where *Quercus petraea* represents the dominant layer; in the clears there is presence of *Betula pendula* and *Robinia pseudoacacia*. Chestnut coppice is aged, with an average age of the shoots of 45 years. The herbaceous layer is composed by *Rubus* spp. and *Pteridium aquilinum*. Stand is characterized by declining and overturning of old chestnut stumps.

4.1.3 DENDROMETRIC DESCRIPTION

Dendrometric characteristics of the stand were detected by 3 circular areas with a radius of 15 m. The table below shows the main dendrometric parameters, classified by species as follows: AR – Arbusti, BP – *Betula pendula*, CS – *Castanea sativa*, QR – *Quercus petraea*, RP - *Robinia pseudoacacia e* SA – *Sorbus aria.*

Specie	N°/ha %	G (m^2) %	V (m^3) %	V/ha (m^3)	V (m^3)
AR	6	0,1	0,3	3,4	16,8
BP	14	9,2	7,8	27,52	136,1
CS	43	57,9	55,6	196,54	972,0
QR	9	20,7	27,2	96,22	475,8
RP	15	7,6	6,4	22,58	111,7
SA	14	3,1	2,1	7,49	37,0
Tot				**353,76**	**1749,5**

Table 7 - Main dendrometric parameters expressed in percentage ratio, volume per hectare and volume on total surface

4.1.4 FOREST STAND BIODIVERSITY

The IBP analysis was carried out by covering two areas each corresponding to 0.5 ha. The observations were related to the hectare obtaining the results summarized in the graphs below.

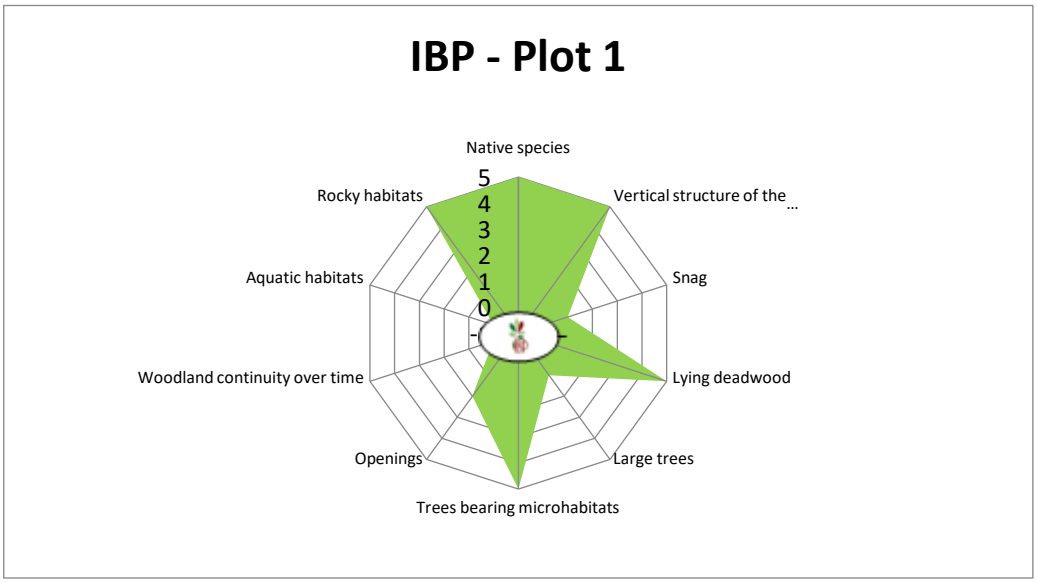

Figure 3 – Summary graph of IBP key factors observed in plot 1.

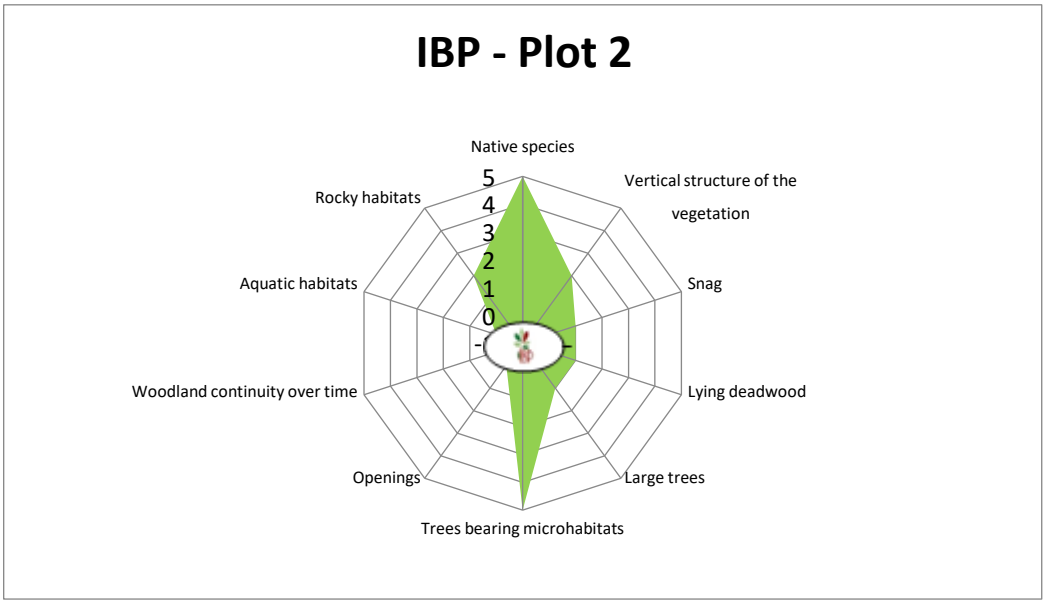

Figure 4 – Summary graph of IBP key factors observed in plot 2.

The comparison between the graphs shows better IBP index values for AdS 1. In Ads 1 the potential biodiversity is better thanks to the complexity of the vertical structure (with trees taller than 20 m), in the presence of lying deadwood and openings. The comparison between the graphs also showed the presence of rocky habitat in AdS 1. In both areas there is an absence of large trees (diameter greater than 67.5 cm) and a low presence of lying deadwood with a diameter greater than 37.5 cm.

4.2 FOREST MANAGEMENT OBJECTIVES

The main purpose of forest stand is productive-protective. However, the absence of infrastructure leads to a low economic value of this forest plot. Furthermore, the forest plot is in an area of high cultural-historic value, with many paths and buildings used during the Resistance. Thus, the management approach follows as well touristic-cultural valorization objectives.

4.2.1 SILVICULTURAL OBJECTIVES

This forest harvest plan aims to:

1. Contain invasive species and preserve/improve potential biodiversity;
2. Improve the tourist function of the stand, thanks to the better practicability of the forest stand close to historical-cultural artifacts, reducing the risk of crashes and damage to the artifacts.

A thinning from below will be carried out aimed at enhancing the species as *Quercus petraea*, *Sorbus aria* and *Prunus avium*. Depending on the quality and vigor of the shoots, the chestnut stump will be coppiced again or converted to temporary high forest by release of 1-2 shoots per stump. Forest operation will release a canopy cover greater than 50%.

4.2.2 STAND VOLUME HARVESTED

A sample plot was carried out to estimate the volume and quality of timber harvested by measures and paint mark on trees designed to be removal. The table below shows the average withdrawal parameters per hectare, total surface and in percentage.

Specie	N°ha	G/ha (m^2)	V/ha (m^3)	V (m^3/ha) harvested	V (m^3) harvested	% harvested
AR	75	0,7	3,4	3,1	15,6	92,6
BP	181	4,2	27,52	4,2	20,8	15,3
CS	549	26,7	196,54	137,4	679,7	69,9
QR	116	9,6	96,22	7,1	35,3	7,4
RP	192	3,5	22,58	21,5	106,4	95,2
SA	177	1,4	7,49	1,4	6,8	18,3
Tot	**1290**	**46,1**	**353,76**	**174,8**	**864,6**	**49,4**

Table 8- Main dendrometric parameters expressed in percentage ratio, harvested volume per hectare, per total surface and percentage.

4.2.3 EVALUATING TIMBER QUALITY SELECTION

The tables below report the main estimated timber quality related to the harvested area (1,29 ha).

Chestnut selection	%	m^3	q
Woodchip	20%	35,4	336
Firewood	70%	123,9	1177
Timber log	10%	17,7	168
	Tot.	**177,0**	**1681**

Table 7 - Quality assortments of chestnut.

Other hardwood selection	%	m^3	q
Woodchip	20%	8,8	84
Firewood	80%	35,3	335
	Tot.	44,1	419

Table 8 - Quality assortments of other hardwood.

4.2.4 TIME LINE CHART

Operations	1°Month				2°Month				3°Month				4°Month			
	Week				Week				Week				Week			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Safety signs																
Skidding tracks adaptation																
Trees felling and bucking																
Timber concentration																
Skidding																
Wast residual branches management																
Restoration of area																

5. NEXT ACTIONS

Next steps will be:

- Entrust the forest works by municipal acts (Comune di Barge, Unione Monviso);
- Work management of the forest operations (Walden srl);
- Selection, classification and stock of wood material required in Action C6 (Walden srl).
- Selection of further forest areas for new operations

6. LIST OF ANNEXES

Public tender documents	Forest Plot "A" Pagno (CN) Annex Title	Forest Plot "B" Barge (CN) Annex Title
Forest Harvesting Plans	A1-Intervento di Miglioramento Forestale nel Comune di Pagno, Loc. Santa Cristina	B1-Intervento di Miglioramento Forestale nel Comune di Barge, Loc. Capoloira
Cost Estimate and Economic Outlook	A2-Elenco Prezzi, Computo Metrico Estimativo e Quadro Economico	B2- Computo Metrico Estimativo e Quadro Economico
Price Analysis	A2-Elenco Prezzi, Computo Metrico Estimativo e Quadro Economico	B3-Elenco Prezzi Unitari e Analisi prezzi
Tender Dossier	A3-Capitolato Speciale d'Appalto	B4-Capitolato Speciale d'Appalto
Risk assessment for Forestry Operation	A4-Valutazione specifica dei rischi di cantiere	B5- Valutazione specifica dei rischi di cantiere