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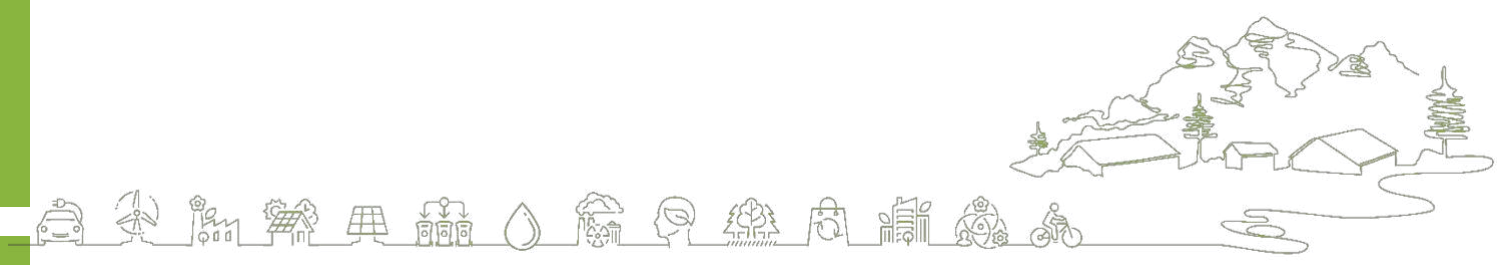
Forest EcoValue

METHODOLOGICAL GUIDELINES AND TOOLS TO ASSESS FES AND DEVELOP MARKETS IN ALPINE COMMUNITIES

D.I.3.2

RESPONSIBILE PARTNERS:
PP2 - LOMBARDY FOUNDATION FOR THE ENVIRONMENT
PP8 - UNIVERSITY OF GRAZ, INSTITUTE OF ENVIRONMENTAL SYSTEMS SCIENCES



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Carbon neutral and resource sensitive Alpine region
SO 2.2: Promoting the transition to a circular and resource efficient economy

Forest EcoValue:
Supporting multiple forest ecosystem services through new circular/green/bio markets and value chains

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List of the Forest EcoValue project partners

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PP3. Lombardy Green Chemistry Association – Cluster Lombardo della Chimica Verde [LGCA]
PPS. University of Graz, lnstitute of Environmental Systems Sciences [UNlGRAZ]
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Authors:	Deliverable drafted by the Forest EcoValue project partners under the supervision of PP2 and PP8
Main contributor(s):	Luca Cetara (PP2) Victoria Yavorskaya (PP8) Carlotta Pellegrino (PP2)
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Summary

Introduction

This deliverable presents user guidelines for the tools presented and developed in the report of the WG ECO. It gives instructions on the economic valuation of FES and the identification of the conditions for efficiently developing business models within FES markets. This is meant for use at the local level, specifically within the Living Labs. The methodological foundations and relevant definitions are provided at length in the D.I.2.I. Working Group ECO - Report.

In the following sections, each of the tools will be shortly introduced along with the instructions of their application.

1. Direct value transfer based on the economic valuation studies conducted in Europe

The direct value transfer approach allows for estimating an approximate value for the policy based on already existing valuation studies. As this method produces an economic value of relatively low precision, the valuation exercise serves strictly informative and communicative purposes and supports priority-setting. If elicited value sparks an interest in a specific FES or a FES bundle, users are invited to refer to section 'Economic valuation approaches and methods' in **D.1.3.1 Working Group ECO – Report** to choose a methodology for a subsequent primary study. More details on the methodological background of the tool as well as general theory around FES valuation is provided in **D.1.3.1 Working Group ECO – Report**, pp. 9-20.

The following tool is useful for various stakeholders of the forest-based sector: forest owners, businesses, public officials and policy makers.

The tool can be accessed via the excel spreadsheet '**D.1.3.2_Database-of-FES-values_Europe.xlsx**'. The first sheet titled 'User guide' provides an overview of the content of the spreadsheet, legend of the colour coding applied within the tool, selected methodological details, full names of abbreviations used for approaches and methods in the database, as well as external data sources. Finally, the decision tree developed to support in the use of the tool is provided on the righthand-side of the 'User guide' sheet and below (Figure I).

The decision tree provides step-by-step guidance for searching monetary values relevant for the respective Living Labs in the database. Generally, there are two approaches for estimating a value proxy:

I) By ecosystem relevance ("yes" to the first question in Figure I): Not all project partner (PP) countries are represented in the database, as well as not all FES were assessed for all the PP countries due to the unavailability of the studies; in that case, economic values and / or studies could be searched based on the ecosystem services of interest. However, when applicable, bio-geographical aspects could be integrated into the search strategy in the later stage (see below).

2) By geographical relevance ("no" to the first question in Figure I): If the purpose of the assessment is getting an overview of general FES potential for a specific country, biogeoregion, ecoregion and

/ or biome, then a search based on the bio-geographical aspects could be performed. This requires identifying a forest type according to all or one of the classifications (biogeoregion, ecoregion and/or biome, according to Table 6 in **D.1.3.1 Working Group ECO – Report**). For the studies conducted on regional and local scales, it might be relevant to have a look at the site description, as there could be a study conducted directly in the area of the respective LL, close to it, or in a similar area.

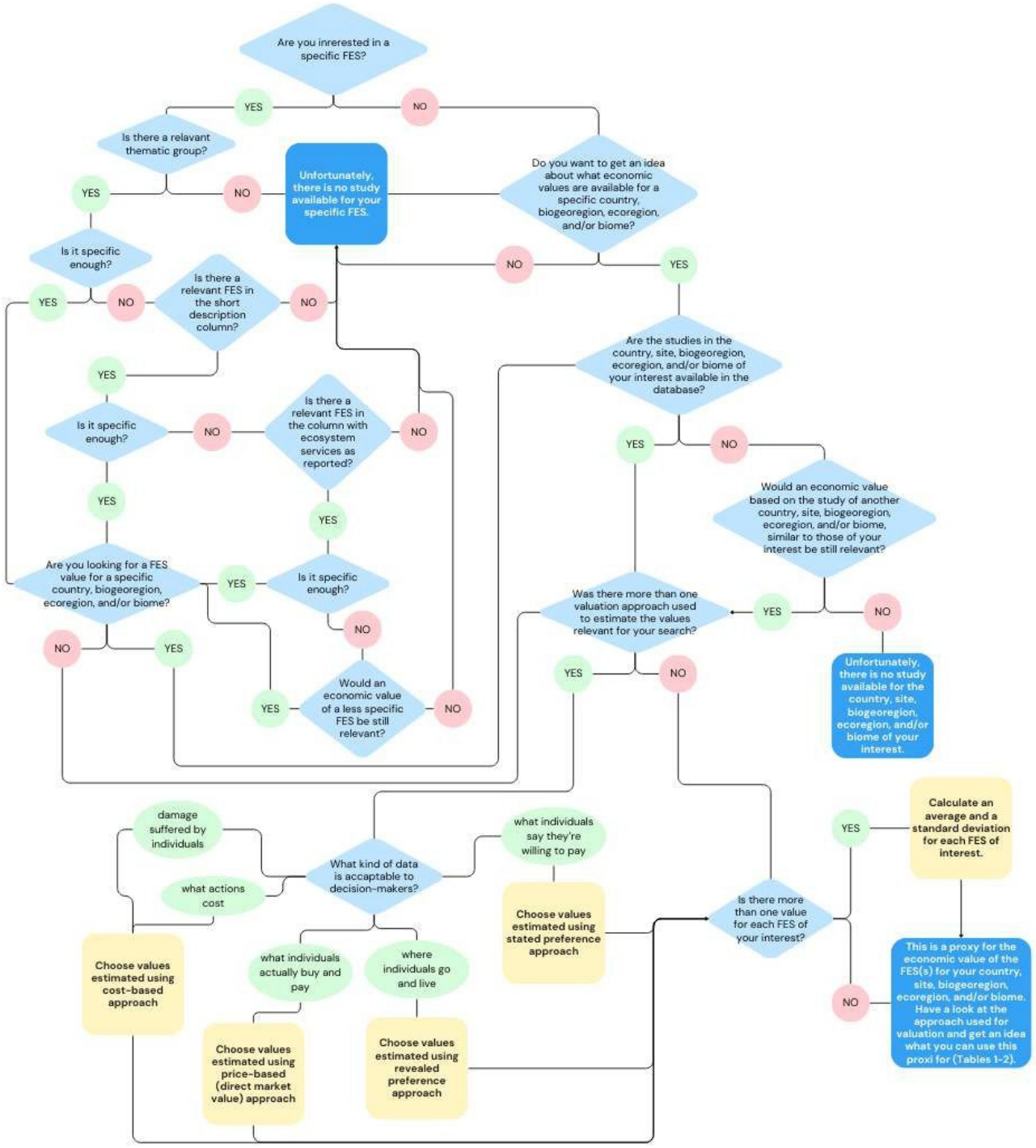


Figure 1. Direct value transfer decision tree. Partially based on: Harrison et al. (20l8).

After determining studies that are relevant for the inquiry of the user, respective filters must be applied in the 'Values and studies' sheet and all filtered values should be copied from the column 'Value in constant prices 2023 (international $) (value/ha/year)' (AP in Excel). Then, they should be pasted in the column D in 'Calculator' sheet (peach block). After that, an average value and a standard deviation will be calculated. A blue block is provided as an example of the calculation for the fuelwood proxy value in Europe.

As a result, a proxy value of a FES is acquired, adjusted to the purpose of the assessment and/or to the bio-geographical context. This value could be used for communication purposes, identifying beneficiaries and potential trade-offs, as well as raising awareness about the FES potential in the area of the Living Lab. For a more precise value, it is recommended to perform a primary study with a method, most suitable to the purpose and the context of the assessment.

2. A multi-criteria approach to the provision of market and non-market FES

A survey for the private forest owners and a multi-objective, robust optimization model was developed to apply a multi-criteria approach to the analysis of forest management objectives of private forest owners and their relevance for the provision market and non-market FES.

Private forest owners constitute an impressive proportion of forests in Europe – about 60% (Weiss et al., 2019; Živojinović et al., 2015). The share of private forest owners as well as the forest holding size distribution varies from country to country. Nevertheless, large industrially owned holdings are uncommon in Europe (Weiss et al., 20l9). Simultaneously, economic literature shows that private forest owners are more prone to base their forest management decisions on multiple objectives (Garcia et al., 20l8), which indicates their massive potential for the FES provision. To design effective incentives and ensure the success of the Pilot Action, it is important to understand what factors play a role in the decision-making and what are the core management drivers of the forest owners. The following tool was developed to address exactly this gap.

The tool presented in this section mainly addresses policy makers and public officials who are interested in optimizing FES potential of private forest owners in their regions.

The tool consists of a survey and a multi-objective, robust optimization model. The survey is available in English, German, Italian, French, and Slovenian languages (see 'D.l.3.2_**Multi-criteria-approach** _Sruvey.pdf'). Data collected with the survey is used as an input for the model. A model is available in the spreadsheet titled '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**'. This spreadsheet should be used with an open source OpenSolver (version 2.9.3), which is freely available via http://opensolver.org/ (Mason, 20l2). The methodological foundations of the model and the survey developed to collect the data for the model, as well as an illustrative example of interpretation of the results are provided in **D.1.3.1 Working Group ECO – Report**, pp. 21-31.

Box l provides a methodological outline for the application of the tool. Table l lists all the variables and indexes relevant to the description of each step.

Step 0: Draw a baseline in the area of the Living Lab

- Assess actual forest composition based on the data from the Living Labs
- Evaluate ownership structure and forest holdings/enterprises size range

Step l: Measure stakeholder perceptions and survey additional information

- Online survey for forest owners in German, Italian, French, and Slovenian languages.

Step 2: Determine optimal forest composition

- Mean performance scores for each forest type and the associated variation of each indicator for
  - Forest owner type (e.g., according to the ownership length and property size)
  - Living Lab
  - Country
  - Alpine space

  ➔ Robust, multi-objective optimization for:
  - Each forest owner type
  - Living Lab
  - Country
  - Alpine Space

  Against:
  - All indicators
  - Market objectives
  - Non-market objectives
  - Management effort objectives
  - All possible combinations of objectives/indicators
  - Most important indicators
  - Single indicators
- Sensitivity analysis:
  - Uncertainty level
  - Weighing
- Assess the performance of the optimized forest composition

Step 3: Identify factors driving forest management decisions

Which of the optimized forest compositions are most similar to the current forest composition in the area of the Living Lab and/or respective forest holdings/enterprises? What forest management objectives could best describe actual forest management decisions of the forest owners?

- Compare optimal and current forest composition: Bray-Curtis measure of dissimilarity

Step 4: Validation of results

- Interviews with the participants of the survey to validate the conclusions drawn from the analysis

Box 1. Methodological outline.

Table 1. Outline of variables and indexes in multi-objective, robust optimization model.

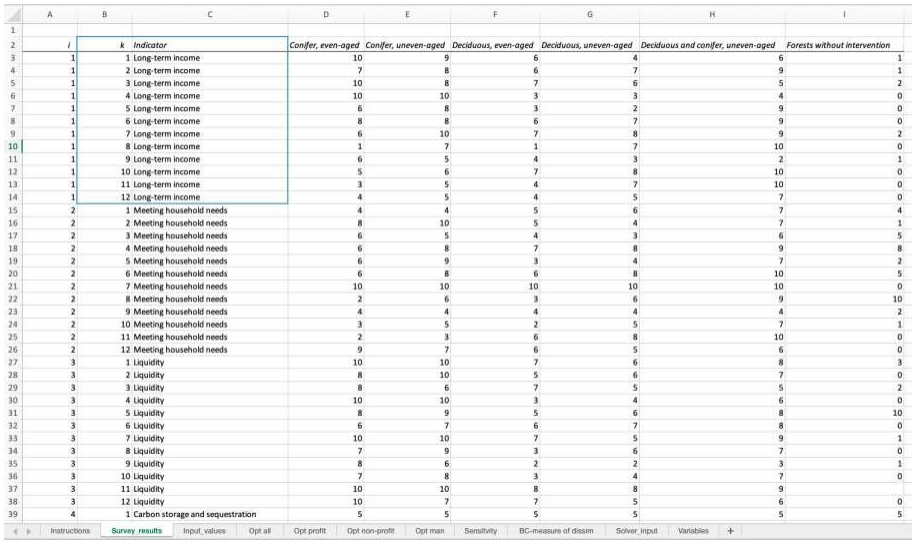
Variable	Description	Index	Description
i	Indicator	$\mathbf{f}$	Forest stand type
u	Uncertainty scenario	k	Individual respondent (forest owner)
$D_{i,u}$	Distance between the target and achieved performance level of a given forest composition for a given indicator, i	k_t	Forest owner type[l], where t is a type

[l] To be determined during the analysis

Variable	Description	Index	Description
a_f	Allocated share of each forest stand type, f	l	Living Lab
$p_{i,f}$	Performance score of each forest stand type, f, for each indicator, *i*; p̂ is an estimated performance score	fr	France
$SEM_{i,f}$	Standard error of the mean	at	Austria
SD	Standard deviation	it	Italy
m_u	Uncertainty factor to determine deviation from the performance score	slo	Slovenia
$p_{i,f,u}$	Uncertainty adjusted performance score, where $p^*_{i,u}$ is the highest uncertainty adjusted performance score, and p_{i,u^*} is the lowest uncertainty adjusted performance score, given by the forest stand type	de	Germany
U_i	Uncertainty Set	alp	Alpine Space
F	Number of forest stand types	o	optimal
w_i	Weight derived from the indicator importance ranking	e	current
n	Sum of all "best" and "second best" rankings across all forest stand types		
r_f	Relative frequency of the rankings "best" and "second best" for a given forest stand type, f		
$P_{i,u}$	Forest property level performance		

After drawing a baseline (Step 0) and conducting the survey (Step l), we are ready for the Step 2, i.e., working with the model.

First, the data collected with the survey must be passed to the 'Survey_results' sheet in the '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' in the dedicated columns, namely individual scores for each forest type against all indicators (columns C-E) (Figure 3), weighing of all indicators (column K) (Figure 4), and the actual forest composition of each respondent (columns N-T) (Figure S). lf a respondent did not provide the score (i.e., answered "not applicable"), the corresponding cell should remain empty, as demonstrated in Figure 6. lt is important to adjust the number of rows for the number of respondents (*k*). ln the survey sample presented as an example in the sheet, l2 responses were included, i.e., each indicator was listed l2 times (i.e, l2 rows) before the scores collected on the next indicator is presented (Figure 3, highlighted in blue).



	A	B	C	D	E	F	G	H	I
1									
2	*i*	*k*	*Indicator*	*Conifer, even-aged*	*Conifer, uneven-aged*	*Deciduous, even-aged*	*Deciduous, uneven-aged*	*Deciduous and conifer, uneven-aged*	*Forests without intervention*
3	1	1	Long-term income	10	9	6	4	6	1
4	1	2	Long-term income	7	8	6	7	9	1
5	1	3	Long-term income	10	8	7	6	5	2
6	1	4	Long-term income	10	10	3	3	4	0
7	1	5	Long-term income	6	8	3	2	9	0
8	1	6	Long-term income	8	8	6	7	9	0
9	1	7	Long-term income	6	10	7	8	9	2
10	1	8	Long-term income	1	7	1	7	10	0
11	1	9	Long-term income	6	5	4	3	2	1
12	1	10	Long-term income	5	6	7	8	10	0
13	1	11	Long-term income	3	5	4	7	10	0
14	1	12	Long-term income	4	5	4	5	7	0
15	2	1	Meeting household needs	4	4	5	6	7	4
16	2	2	Meeting household needs	8	10	5	4	7	1
17	2	3	Meeting household needs	6	5	4	3	6	5
18	2	4	Meeting household needs	6	8	7	8	9	8
19	2	5	Meeting household needs	6	9	3	4	7	2
20	2	6	Meeting household needs	6	8	6	8	10	5
21	2	7	Meeting household needs	10	10	10	10	10	0
22	2	8	Meeting household needs	2	6	3	6	9	10
23	2	9	Meeting household needs	4	4	4	4	4	2
24	2	10	Meeting household needs	3	5	2	5	7	1
25	2	11	Meeting household needs	2	3	6	8	10	0
26	2	12	Meeting household needs	9	7	6	5	6	0
27	3	1	Liquidity	10	10	7	6	8	3
28	3	2	Liquidity	8	10	5	6	7	0
29	3	3	Liquidity	8	6	7	5	5	2
30	3	4	Liquidity	10	10	3	4	6	0
31	3	5	Liquidity	8	9	5	6	8	10
32	3	6	Liquidity	6	7	6	7	8	0
33	3	7	Liquidity	10	10	7	5	9	1
34	3	8	Liquidity	7	9	3	6	7	0
35	3	9	Liquidity	8	6	2	2	3	1
36	3	10	Liquidity	7	8	3	4	7	0
37	3	11	Liquidity	10	10	8	8	9	
38	3	12	Liquidity	10	7	7	5	6	0
39	4	1	Carbon storage and sequestration	5	5	5	5	5	5

Instructions | Survey_results | Input_values | Opt all | Opt profit | Opt non-profit | Opt man | Sensitivity | BC-measure of dissim | Solver_input | Variables | +

Figure 3. A screenshot from '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' showcasing where the surveyed data must be transferred.

K	L
w_i	*average* w_i
80	36.08
25	36.08
0	36.08
30	36.08
0	36.08
35	36.08
50	36.08
50	36.08
0	36.08
40	36.08
80	36.08
43	36.08
0	10.67
50	10.67
0	10.67
10	10.67
0	10.67
10	10.67
0	10.67
25	10.67
0	10.67

Figure 4. A screenshot from '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' ('Survey_results' sheet) showcasing where the weights derived from the question on the indicator importance ranking must be inserted

N	O	P	Q	R	S	T
				Actual forest composition		
k	*Conifer, even-aged*	*Conifer, uneven-aged*	*Deciduous, even-aged*	*Deciduous, uneven-aged*	*Deciduous and conifer, uneven-aged*	*Forests without intervention*
1	0.40	0.30	0.20	0.00	0.05	0.05
2	0.45	0.30	0.10	0.05	0.05	0.05
3	0.00	0.50	0.00	0.00	0.00	0.50
4	0.60	0.35	0.05	0.00	0.00	0.00
5	0.12	0.40	0.22	0.07	0.13	0.06
6	0.50	0.40	0.10	0.00	0.00	0.00
7	0.10	0.10	0.80	0.00	0.00	0.00
8	0.58	0.30	0.02	0.05	0.04	0.01
9	0.80	0.00	0.00	0.00	0.20	0.00
10	0.60	0.10	0.30	0.00	0.00	0.00
11	0.00	0.00	0.60	0.00	0.35	0.05
12	0.20	0.30	0.30	0.10	0.10	0.00
Average	0.36	0.25	0.22	0.02	0.08	0.06

Figure 5. A screenshot from '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' ('Survey_results' sheet) showcasing where the data on the respondents' actual forest composition must be inserted

	A	B	C	D	E	F	G	H	I
34	3	8	Liquidity	7	9	3	6	7	0
35	3	9	Liquidity	8	6	2	2	3	1
36	3	10	Liquidity	7	8	3	4	7	0
37	3	11	Liquidity	10	10	8	8	9	
38	3	12	Liquidity	10	7	7	5	6	0
39	4	1	Carbon storage and sequestration	5	5	5	5	5	5
40	4	2	Carbon storage and sequestration	9	10	7	8	9	8
41	4	3	Carbon storage and sequestration	2	3	2	3	6	10
42	4	4	Carbon storage and sequestration	10	10	10	10	10	0
43	4	5	Carbon storage and sequestration	6	10	5	8	9	10
44	4	6	Carbon storage and sequestration	6	7	6	7	8	8
45	4	7	Carbon storage and sequestration	8	9	9	9	10	5
46	4	8	Carbon storage and sequestration	4	7	5	7	10	7
47	4	9	Carbon storage and sequestration	10					
48	4	10	Carbon storage and sequestration	4	5	5	5	10	0
49	4	11	Carbon storage and sequestration	7	7	9	9	10	
50	4	12	Carbon storage and sequestration	5	7	6	8	8	5
51	5	1	Natural hazards protection	1	3	5	7	7	5
52	5	2	Natural hazards protection	6	10	5	9	10	7
53	5	3	Natural hazards protection	1	2	3	4	7	8
54	5	4	Natural hazards protection	8	8	9	7	9	0
55	5	5	Natural hazards protection	7	9	5	6	8	10
56	5	6	Natural hazards protection	5	7	5	7	9	4
57	5	7	Natural hazards protection	3	2	3	2	2	7
58	5	8	Natural hazards protection	8	9	8	9	10	
59	5	9	Natural hazards protection	2	5	5	5	5	3
60	5	10	Natural hazards protection	6	6	6	7	8	2
61	5	11	Natural hazards protection	4	6	6	8	9	
62	5	12	Natural hazards protection	1	4	2	4	7	0
63	6	1	Ecological functions of the forest	3	6	5	7	8	5
64	6	2	Ecological functions of the forest	5	6	7	8	9	10
65	6	3	Ecological functions of the forest	3	4	3	4	7	10
66	6	4	Ecological functions of the forest	10	10	2	3	4	0
67	6	5	Ecological functions of the forest	6	10	4	5	8	10
68	6	6	Ecological functions of the forest	5	7	5	7	9	8
69	6	7	Ecological functions of the forest	8	8	8	8	9	8
70	6	8	Ecological functions of the forest	3	7	4	8	10	10
71	6	9	Ecological functions of the forest	4	4	4	4	6	6
72	6	10	Ecological functions of the forest	3	4	2	3	6	8

Instructions | Survey_results | Input_values | Opt all | Opt profit | Opt non-profit | Opt man | Sensitivity | BC-measure of dissim | Solver_input | Variables | +

Figure 6. A screenshot from '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' showcasing how to treat "not applicable" answers (empty cells highlighted)

The model input values will be automatically calculated in the 'lnput_values' sheet. This sheet should not be edited. The input values are then automatically transferred to the optimization models, constructed for all three objectives ('Optimization_all' sheet) and for single objectives – market ('Optimization_market' sheet), non-market ('Optimization_non-market' sheet) and management effort ('Optimization_management' sheet). The objectives and respective indicators are presented in Table 2.

Table 2. Description of the nine pre-defined indicators, *i*, against which forest owners will evaluate the six forest stand types.

Management objective	i	Indicator	Definition	Direction	Rational	References
Market value	I	Long-term income	Profit made by the forest owner over 20 years, including all possible revenue streams from the forest type (timber, fuelwood, non-wood forest products, commercial recreational activities, etc.)	More is better	Profitability is believed to be an important rationale for the forest management decisions	Chazdon et al. (20l6); Gosling et al. (2020); Plevnik & Japelj (2023); Spinelli et al. (20l7)
	2	Meeting household needs	The degree to which the forest type is able to provide materials and food needed in the household of the forest owner	More is better	Non-industrial forest owners may be constrained by the need to meet household needs	Gatto et al. (20l9); Gosling et al. (2020)
	3	Liquidity	The extent to which the forest type provides frequent and regular income, including how easily the forest type can be converted to cash if needed.	More is better	Cash flow can be an important concern or constraint for the forest owners	Chazdon et al. (20l6); Gosling et al. (2020); Reith et al. (2020)
Non-market value	4	Carbon storage and sequestration	The degree to which the forest type is able to sequester and store carbon	More is better	According to the preselection of FES relevant for the Forest EcoValue Living Lab areas	Chazdon et al. (20l6); Chreptun et al. (2023); Gatto et al. (20l9); Juutinen et al. (2022); Lombardo (2023); Riviere & Caurla (202l); Schaich & Plieninger (20l3)
	S	Natural hazards protection	The degree to which the forest type is able to prevent natural hazards like avalanches, landslides, rockfalls, and floods	More is better		Chreptun et al. (2023); Dupire et al. (20l6); Floris & Di Cosmo (2022); Lombardo (2023); Maroschek et al. (20lS); Scheidl et al. (2020)
	6	Ecological functions of the forest	The degree to which the forest type is able to maintain its ecological functions, such as provision of soil, water and air quality, and habitat for wild plants and animals	More is better		Chazdon et al. (20l6); Chreptun et al. (2023); Gatto et al. (20l9); Juutinen et al. (2022); Lombardo (2023); Plevnik & Japelj (2023); Schaich & Plieninger (20l3)

Management objective	i	Indicator	Definition	Direction	Rational	References
	7	General preference	Forest owners' preferences for each forest type as a proxy for cultural value of the forest	More is better	Proxy for additional cultural benefits of each forest type, to reflect less tangible, intrinsic values not captured by the other indicators	Ciesielski & Stereńczak (20l8); Feliciano et al., 20l7; Ficko et al. (20l9); Gatto et al. (20l9); Gosling et al. (2020); Lombardo (2023)
Management effort	8	Management complexity	The need for labor, special equipment, machinery, skills, and knowledge	Less is better	lncreased management complexity, labor availability, and the need for specialized knowledge may represent a barrier to adopting a new forest management regime	Gosling et al. (2020); Spinelli et al. (20l7)
	9	Management costs	The costs of establishing and maintaining the management regime for the forest type	Less is better	High costs of managing a forest type could pose a potential barrier to multifunctional and FES-oriented forest management	Gosling et al. (2020)

Direction refers the desirable state of an indicator.

ln principle, the contents of these sheets should not be edited, however, if the user wishes to optimize the forest composition by a different combination of objectives (e.g., market and non-market values) or indicators (e.g., natural hazards protection and ecological functions of the forest), a new optimization model can be created based on the 'Optimization_all' sheet – the user should copy the sheet, remove all irrelevant indicators and objectives and adjust all the respective model inputs (as described below).

Moreover, the user can adjust the uncertainty factor $\mathrm{m_u}${Figure 8, highlighted in light blue). An uncertainty factor in the optimization process allows for the consideration of uncertainties associated with FES provision and potential risk aversion among forest owners. This factor determines the size of deviations in the pessimistic estimate and thereby reflects the uncertainty level in the model, where $\mathrm{m_u} = 0$ excludes uncertainty, $\mathrm{m_u} = 1.5$ stands for a moderate uncertainty level, and $\mathrm{m} = 3$ represents a high level of uncertainty. We recommend computing values with different uncertainty levels as a sensitivity analysis and choose the model that produces the result closes to the actual average forest composition, when optimized by all objectives {i.e., the smallest Bray-Curtis measure of dissimilarity, see explanation below). {Knocke et al., 2016)

Then, the model must be created on each optimization sheet according to the guidelines indicated in the 'Solver_input' sheet and illustrated in Figure 7. More specifically, on the Data toolbar, the following inputs must be included in the model (press 'Model', as highlighted in blue in Figure 8):

- Objective cell **$AK$19** must be set to **minimize**; this cell is linked to Dl4; it represents the objective function;
- Variable cells are **$AK$19:$AK$601**; these are the cells where computations can be applied;

- The following constraints must be applied as in Table 3.

Table 3. Model constraints with explanation.

Left-side	Operator	Right-side	Description
$AK$20:AKS9S	<=	AKI9	Represent a constraint-wise formulation of the objective function (Eq 6)
$AJ$20:AJS9S	<=	$AK$20:AKS9S	
JS	=	I	Area budget constraint (Eq 7)
DS:IS	=>	0	Non-negativity (all land-use shares must be greater or equal to 0, Eq 8)

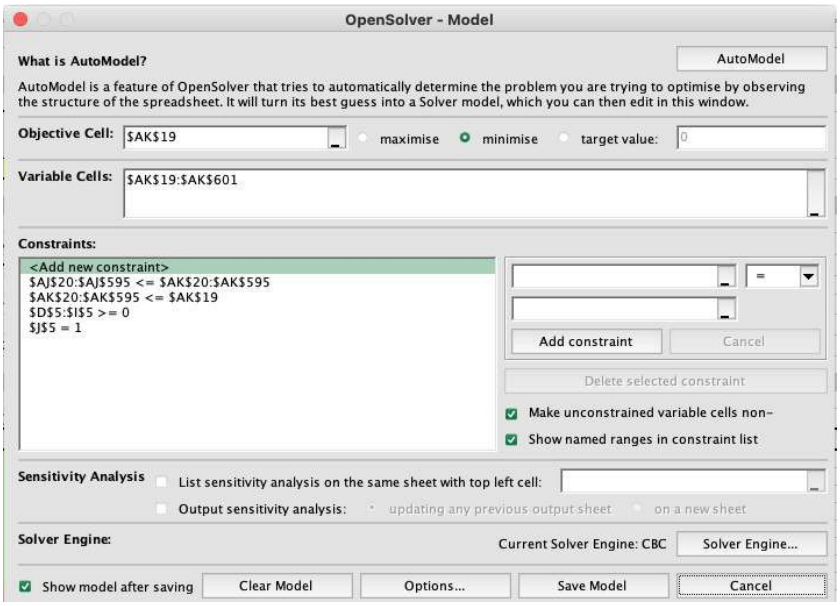
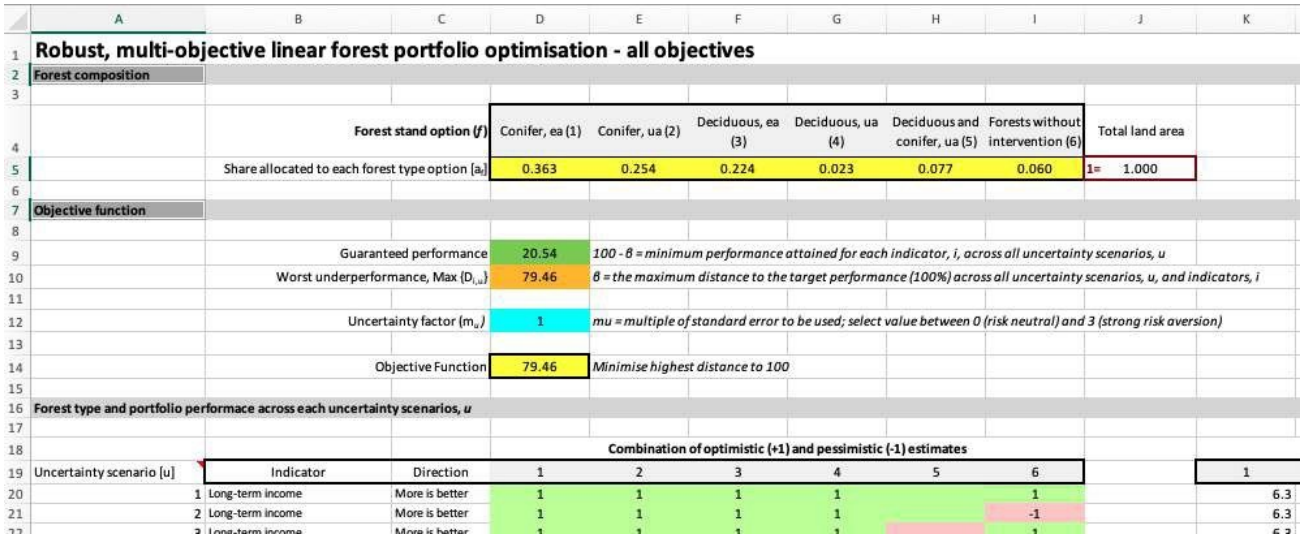


Figure 7. Model objective, variables and constraints.

Figure 8. Data toolbar and sections relevant for model construction and analysis.

After that, the model must be saved (press 'Save Model') and run (press 'Solve' on the Data toolbar, as highlighted in green in Figure 8). Results of the calculations will be presented in the 'Forest composition' and 'Objective function' blocks (Figure 9).



Robust, multi-objective linear forest portfolio optimisation - all objectives

Forest composition

Forest stand option (*f*)	Conifer, ea (1)	Conifer, ua (2)	Deciduous, ea (3)	Deciduous, ua (4)	Deciduous and conifer, ua (5)	Forests without intervention (6)	Total land area
Share allocated to each forest type option [a_f]	0.363	0.254	0.224	0.023	0.077	0.060	1= 1.000

Objective function

Guaranteed performance	20.54	*100 - $\bar{\delta}$ = minimum performance attained for each indicator, i, across all uncertainty scenarios, u*
Worst underperformance, Max {$D_{i,u}$}	79.46	*$\bar{\delta}$ = the maximum distance to the target performance (100%) across all uncertainty scenarios, u, and indicators, i*
Uncertainty factor (m_u)	1	*mu = multiple of standard error to be used; select value between 0 (risk neutral) and 3 (strong risk aversion)*
Objective Function	79.46	*Minimise highest distance to 100*

Forest type and portfolio performace across each uncertainty scenarios, *u*

			Combination of optimistic (+1) and pessimistic (-1) estimates						
Uncertainty scenario [u]	Indicator	Direction	1	2	3	4	5	6	1
1	Long-term income	More is better	1	1	1	1		1	6.3
2	Long-term income	More is better	1	1	1	1		-1	6.3
3	Long-term income	More is better	1	1	1	1		1	6.3

Figure 9. A screenshot from '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' showcasing the blocks with the results of the calculations.

An additional sensitivity analysis could be performed using the optimization model by all objectives but with the weights integrated into the input values ('Sensitivity' sheet). This sensitivity analysis could be performed to see if there are big deviations in the results when the input is adjusted to the indicator importance ranking and provide additional information on suitability and interpretation of the model results.

Finally, the Bray-Curtis measure of dissimilarity will be automatically calculated and presented in 'BC-measure of dissim' sheet (Figure l0). For the definition of this measure as well as its calculation the reader is referred to the **D.1.3.1 Working Group ECO – Report**, p. 29 (Step 3).

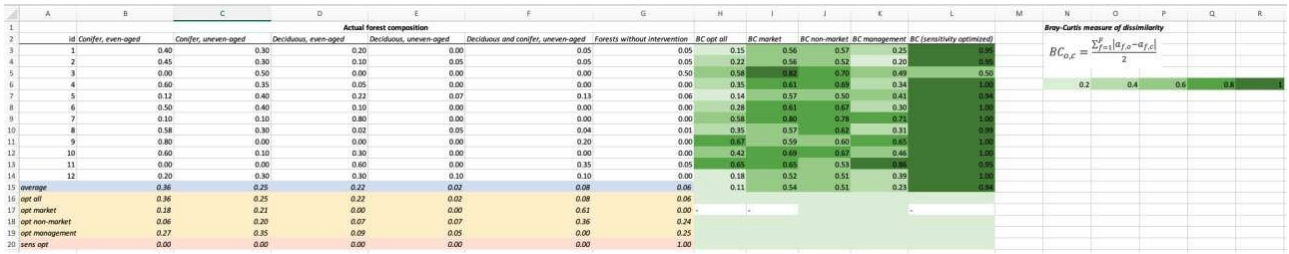


Figure 10. A screenshot from '**D.1.3.2_Multi-criteria-approach_ROM.xlsx**' showcasing Bray-Curtis measure of dissimilarity

In column A:

- 'average' stands for the average forest composition of respondents as indicated in the 'Survey_results' sheet;
- 'opt all' stands for the optimized (ideal) forest composition according to the results of the model run in 'Optimization_all' sheet (i.e., optimized using all objectives);
- 'opt market' stands for the optimized (ideal) forest composition according to the results of the model run in 'Optimization_market' sheet (i.e., optimized using only market objectives);
- 'opt non-market' stands for the optimized (ideal) forest composition according to the results of the model run in 'Optimization_non-market' sheet (i.e., optimized using only non-market objectives);

- ‘opt management’ stands for the optimized (ideal) forest composition according to the results of the model run in ‘Optimization_management’ sheet (i.e., optimized using only management effort objectives);
- ‘sens opt’ stands for the (optimized (ideal) forest composition according to the performed sensitivity analysis in 'Sensitivity' sheet; the number will appear only if the additional sensitivity analysis will be performed.

Bray-Curtis measures of dissimilarity for different models (i.e., ran with different combinations of objectives) are presented in columns H (all objectives), l (only market objective), J (non-market objective), K (management objective), and L (additional sensitivity analysis), both compared to the actual forest composition of each individual respondent and for the average. The lower the value is (and the lighter the colour is), the more similar the actual forest composition is to the optimized one. At this stage, average share of forest type derived from the national forest inventories could be used instead of the average forest composition of the respondents (just replace the values in respective cells Bl0:Gl0).

lf the analysis was also performed based on different indicator combinations, an additional column for the calculation of the Bray-Curtis measure of dissimilarity and the row with the optimized forest composition shares must be added to interpret the results of the analysis.

3. Regional market assessment in the Living Labs

This section reports on the logic and methodology followed to frame and assess local conditions in view either of the introduction of a brand-new FES market or the improvement and refinement of existing market mechanisms capitalizing on FES.

A market is a place where buyers and sellers come together to exchange goods and services. lt provides a platform for people to engage in voluntary transactions where they can exercise their property rights. Economics tends to assess markets based on their structure (based on features such as number of players, power concentration, openness, etc.) and efficiency (based on the ability of a market to achieve an effective allocation of scarce resources). The latter can be expressed as a measure of the welfare created by the allocation of goods or services realized through the market itself.

To check market feasibility, it is possible to assess the presence, quality, and intensity of a set of standard conditions (Perman et al., 20ll), a few of which are unlikely to be fully met in ecosystem services markets (Table 4).

Table 4. Conditions for market feasibility

Market condition	Markets for FES
There is a market for all goods and services	Usually, some goods and services depending on ecosystem services are not traded on any market
All markets are perfectly competitive	Market power and supply can be concentrated geographically or on few providers
Perfect information is available in all markets	Functions and services supplied by forests are not always clear and quantifiable according to standardised rules
Property rights on the traded goods or services are fully assigned in all markets	Property rights on specific services are not formally dealt by legislation, nor subject to specific regulations
All goods and services traded on markets are private ones (excludable, rival)	Several ecosystem services show the characteristics of public goods, common pool resources, or club goods

There are no externalities and all costs and impacts determined by production or trade are internalized	There are negative externalities affecting the production of ecosystem goods and services not fully recognised. There are positive externalities from ecosystem goods and services affecting the consumers' utility that are not quantified nor financed.
Utility derived from market transactions by the participants, and production possibilities and trends are predictable and regular over time	There is a share of uncertainty about the calculation of the impact of some ecosystem services on individual utility. Similarly, the biophysical processes at the basis of ecosystem services' supply are not fully studied. This situation reduces predictability of trends in utility and supply potential.
All market participants are rational and aim at profit (firms) or utility maximization (consumers)	As in all other markets, decisions are typically influenced by non-strictly rational behaviour.

3.1 Procedure

The objective of a market assessment is to determine which markets are feasible within the Living Labs areas. We assume that a regional market can contribute to enhancing the provision of FES and collect resources to cover at least a share of the costs of sustainable forest management. We expect that, since FES markets are unlikely to meet the ideal market conditions naturally, setting up effective local markets for ecosystem services may entail some active policy interventions.

Since very often markets for FES do not exist at all within Living Labs, we introduce the concept of market design assuming that special interventions by institutions (e.g., policies) and the private sector (e.g., self-regulation) can allow for creating new markets or strengthening existing ones.

Designing a market for ecosystem services requires: (l) gathering contextual information, and (2) identifying and addressing aspects that lead to market failures. We analyse the two phases of the assessment.

3.1.1 Gathering contextual information

Here follows the procedure set up to assess the conditions for FES markets' setup in Living Labs, *i.e.,* aimed to determine how likely a market for FES is to work in a specific site. The procedure resulted in an *evaluative tool for FES market assessment*.

The conditions considered link either to the forest ecosystems present in the site or to the type and dimensions of a running or potential market. All information closely links to the work on business models presented later.

The evaluative tool was developed based on a literature review that identified the sections and subsections to be included; then, the work underwent review by project partners, and was differentiated based on its target, *i.e.* (l) evaluating the conditions for existing FES markets, (2) evaluating the conditions for potential FES markets.

The tool is based on *eight macro-sections* to be filled in for each LL chosen based on a synthesis of the principal aspects typically analysed within any market structure[2]. They aim at collecting basic information for a qualitative assessment of the *adequacy of a regional FES market to be initiated or consolidated in a specific and clearly defined site* (see the details in Table l3 in Dl.3.l).

[2] They include the regional context, type of FES, the scale of FES and market, the actors in the market, the market dynamics and functioning, the societal benefits delivered by the FES, the governance and regulation on the FES or market, the monitoring of effectiveness or efficiency of the market scheme examined.

As a result, two *templates* including the information to be collected in the Living Labs were developed, as summarized in Table S.

Table 5. Template for market conditions in the Living Labs

Entry	Potential Market	Existing Markets
Title	The title should describe the main characteristics of the potential market: particularly FES type, location, ecosystem involved	
Country	Report the country where the scheme is applied.	
Region	Report the region, district, municipality, park, etc. where the scheme is applied.	
Ecosystem	Describe the ecosystem to which the market refers. Be as descriptive as possible and include any relevant information not found in other sources (e.g. WG BIO matrix)	
FES provided	Identify forest ecosystem service of interest e.g. provisioning, regulating, cultural, supporting	
Cost of the service	Indicate the cost to be borne for delivering the FES, if possible, using a standardised indicator/metrics. The cost of the service can sometimes coincide with the forest. If possible enter a quantity/number, otherwise enter qualitative information. management cost.	
FES scarcity scenario	Indicate the likely consequences of a significant variation of the FES investigated in case of extreme scarcity of the service itself. If possible describe the range for variation.	
Time scale	Indicate information on the duration of the FES in time (at least: long term, short term). Not always relevant.	
Space scale	Indicate information on spatial borders / geographical scope of the project (local, regional, national, international). Note: usually FES have local reach, except some. This information is relevant in case of congestion.	
Beneficiaries	Try to compile a list of organizations and individuals who may participate as buyers in the FES market.	Describe the type of organizations or subjects that join the market as beneficiaries (buyers). You can ideally also include a detailed list of organizations or people (possibly report on the number or scale of the demand side)
Providers	Try to compile a list of organizations and individuals who may participate as sellers in the FES market. Sellers are those who make possible the provision of FES. They might coincide with the forest owners, for example. Be as descriptive as possible.	Describe the type of organizations or subjects that join the market/PES scheme as providers (sellers). You can ideally also include a detailed list of organizations or people (possibly report on the number or scale of the supply side)
Intermediary	Who among the stakeholders could play this role?	Describe the role of the intermediary in the PES scheme (if any)
Aim of the market	Clarify the desired objective of the market: e.g., preserving biodiversity, making profits, increasing public participation in natural resource management, etc.	
Business model		Briefly describe the plan for the success of the market
Payment mechanism	Describe if there is already a direct or indirect payment to those providing FES: if yes, how do they work (e.g. contractual agreement), and which is the source that originates the payment?	Describe which is the medium through which the exchange takes place
Payment type		Describe how the payment is organized between the parties involved.
Source of payment		Clarify which is the source that originates the payment
Ecological benefits	List all the ecological benefits from FES (possibly DMBs)	
Social benefits	List all the benefits (impacts) from FES that contribute to societal variables and poverty reduction (or viceversa). (possibly DMBs)	
Regulatory framework	We are in a situation of market absence, however, in some way, is the ecosystem service recognized and/or regulated? Are there, for example, policies or direct and indirect support services for the service? (e.g. a protected area does not imply the presence of a market but gives an idea of a possible framework within	Briefly discuss the regulatory context where the PES scheme is being applied
Policy		Describe the main policies adopted for market development
Support services		Describe the services implemented to facilitate the success of the PES scheme

	which to situate the BM and its governance; volunteering and local associations should also be considered)	
Success indicators/methods	Has the FES ever been measured locally? If yes, how?	Describe which methods have been utilized to prove the success of the PES scheme

All the information is collected under a double conditionality:

1. it refers to a single FES out of the list identified for each Living Lab (see Matrix developed under WP l WG BIO),
2. it refers to a single Living Lab.

Data collection from the Living Labs is facilitated by special Guidelines and a list of good practices (GPs) displaying a comprehensive collection of case studies focusing on FES markets and PES. The list aims to gather consistent and relevant examples from various contexts within the EU.

Data collection and analysis allows the WG ECO coordinator to fill in a *checklist* where market conditions for each Living Lab are reported and identify the principal gaps.

3.1.2 Addressing market limitations and failures

Market-based instruments (MBIs) are tools that use market signals and economic incentives to encourage the conservation and sustainable use of ecosystem services. These instruments aim to address market failures, such as the public good nature of many ecosystem services, by creating financial incentives for their protection and sustainable management.

MBIs can be considered a type of incentive aimed to change stakeholder behaviour by offering something in exchange. The main categories considered here are *price based MB/s* and *quantity based MB/s.* We summarize them in Table 6 below, but a more detailed description of them can be found in Dl.3.l.

Table 6. Market based instruments

	Description	**FES market consequence**	**Examples**
Price based MBIs	Create a *price signal* for ecosystem services or *modify existing market prices* to reflect the impact on ecosystem services	Adjust costs and benefits associated to the delivery of ecosystem services in order to provide a signal on the value of their provision	Performance bonds, taxes, subsidies auctions, tenders, grants, payments for ecosystem services (PES) and markets for ES (MES)
Quantity based MBIs	Used to manage environmental resources by setting specific quantitative limits or targets	They focus on controlling the actual quantity of a resource and directly regulate its use, extraction, or preservation	Cap & trade schemes, permit auctions, offset schemes

The two categories of MBIs summarized in Table 6 are suitable in presence of specific conditions (Whitten et al. 2009) in the analysed contexts. Information on those conditions is gathered through the templates in the Living Labs. Quantity-based *MB/s* are preferred when there is a specific quantity target, low additional costs for providing ecosystem services, the presence of damage thresholds, environmental outcomes are seen more as a duty than a reward, or when there are considerable time lags in achieving the desired results. On the other hand, *price based MB/s* are preferred when there is a fixed budget,

additional actions come with excessive costs, payment is deemed acceptable, and outcomes can be achieved within the payment period[3].

3.1.3 Evaluation of preferred market-based instruments for the Living Labs

The second phase of evaluation is performed based on the applicability of specific MBIs to address the identified gaps in the Living Labs. lt is known that the effectiveness of MBIs in incentivizing landholders to provide ecosystem services is heavily dependent on the specific application context and design. MBIs' success is strongly influenced by these factors.

Particularly, we use three factors to assess the applicability of MBIs to each Living Lab, namely:

Gains from trade: assessed through *heterogeneity*, i.e., degree of variability and differences among stakeholders in terms of resources, preferences, and costs. Further divided into:

l. *biophysical heterogeneity* (physical characteristics of the area, how resources are distributed in the territory, availability of a service within a perimeter);
2. *management heterogeneity* (ability to undertake different actions to deliver the same ecosystem service, with costs and benefits that vary for each action);
3. *stakeholders' heterogeneity* (esp. applied to forest owners/landholders, it refers to the quantity and distribution of resources they own - such as time available, business size, human capital, technology, personal preferences - from which different cost structures derive).

Market failures: impediments to market formation that do not allow gains from trade to emerge. They can refer to any of the market conditions that fails to materialize in a specific situation and can be addressed by MBIs. For FES markets assessment in the Living Labs, four types of market failures are considered:

I. */ncomplete property rights:* lack of clear definition of ecosystem property rights can hinder the determination of benefits or costs resulting from land use impacts on ES.
2. */nformation failure or asymmetry*: one or both parties lack complete information about the ES benefits and their management.
3. *Market structure issues*: challenges to a proper functioning of the market linked to aspects such as market size, number of buyers/sellers, transaction costs.
4. *Constraints to market participation*: costs related to entering the market often create barriers that may need to be reduced for the purpose of creating or widening FES markets.

Supporting mechanisms: frameworks intended to support the proper functioning of a market such as regulatory frameworks, institutional capacity, or communication and engagement programmes. They may address issues concerning participation, transaction costs, transparency of information, etc. Supporting mechanism are often policy-driven and may require an involvement of policy makers for implementation.

The analysis of the answers provided by the Living Labs on a list of specific local FES market features allows to assess local market performance against the three factors recalled above. The local FES market features from the template developed for the Living Labs corresponding to the factors *Gains from trade, Market failures,* and *Supporting mechanisms* are reported in Table 7.

[3] For a more specific discussion on MBIs' suitability to address specific market limitations and on the conditions that suggest to use quantity vs. price-based MBIs, see Dl.3.l and Whitten et al. 2009.

Moreover, based on these three factors, indicators have been identified to assess the consistency of the local markets in the Living Labs with an ideal condition, identified as “archetype”. Once data from the Living Labs are collected, they are assessed against the indicators that are also reported in Table 7.

Table 7. Market assessment overview

Indicator	Description	How to assess	Archetype/model answer	Template for markets - entries
Issue or threat	Is there a specific problem, such as loss in biodiversity, or a service, like carbon sequestration, that is recognized by at least one set of stakeholders, who are willing to pay to rectify/address the situation?	*There must be a clear cause and effect*	Buyers know that the FES they are willing to pay for will provide the desired benefit	Ecosystem FES provided FES scarcity scenario Aim of the market
Rivalry and Excludabilty	What kind of FES is it? Private good, public good, club…	*Rival/Non rival* *Excludable/non excludable*	Private good are more suitable for establishing MBIs, but it is possible to address also other types of good.	FES provided
Number of FES	Is the ecosystem service provided individually or in bundles?	*Single* *Bundle*	It is often difficult — and possibly misleading — to isolate and pay for just one ecosystem service without simultaneously considering other services. The choice should consider the biophysical and management option heterogeneity at LL levels.	FES provided Social and ecological benefits
Clearly defined	Nature and extent of the property right is unambiguous: the nature and extent of property rights need to be defined by law and confirmed through registration	*Yes* *No*	Yes Nature and extent of property rights are clear and there is a registration system.	Regulatory framework Payment type Source of the payment
Verifiable	Use of the property right can be measured at reasonable cost.	*Yes* *No*	Yes There is a correlation between property right and ES. Transactions cost are low.	Actors (Buyers, sellers, intermediaries) Payment type Source of the payment
Enforceable	Ownership of the property right can be transferred to another party at reasonable cost.	*Yes* *No*	Yes Enforcement of property rights is mandatory. Compulsory realization requires supporting measures, such as fines, security deposits, etc	Regulatory framework Support services Payment type Payment mechanism Source of the payment
Valuable	There are parties who are willing to purchase the property right.	*Yes* *No*	Yes Property rights related to ecosystem services are valuable	Actors Regulatory framework Support services

Transferable	Ownership of the property right can be transferred to another party at reasonable cost	*Yes* *No*	Yes Transaction feasibility: There is a platform for review and supervision to reduce transaction costs.	Actors Regulatory framework Support services Cost of the service
Low scientific uncertainty	Use of the property right has a clear relationship with ecosystem services	*Law* *Moderate* *High*	High Use of the property right has a clear relationship with ecosystem services	Actors Aim of the market Regulatory framework
Low sovereign risks	Future government decisions are unlikely to significantly reduce the property right's value.	*Low* *Moderate* *High*	Low Future government decisions are unlikely to significantly reduce the property right's value.	Policy Regulatory framework
Typology and number of sellers	Who owns the ecosystem service? Who is legally entitled to sell the ecosystem service? forest owners local governments firms	*Low variety* *Moderate variety* *High variety*	Moderate to high variety. N.B. Sometimes high variety means higher transaction costs	Actors (sellers) Regulatory framework Payment type Source of the payment
Typology and number of buyers	Who is going to buy the ecosystem service? Is the buyer known to the seller? Citiziens governments NGO firms	*Low variety* *Moderate variety* *High variety*	Moderate to high variety. N.B. Sometimes high variety means higher transaction costs	Actors (buyers) Regulatory framework Payment type Source of the payment
Are there any intermediaries?		*yes* *No*		Actors (intermediaries)
Width	What scale is large enough to avoid thin markets, but small enough to ensure geographically relevant benefits for purchasers?	*small portion of the LL* *medium portion of the LL* *all/big portion of the LL*	Largest relevant geographic scale to avoid thin markets. It depends on the width of the LL area.	Region Ecosystem Space scale Actors
-	Would action have been taken without the intervention?	*Yes* *No/unlikely*	No/unlikely. We have a baseline scenario thanks to which we can evaluate and compare the MBI implementation.	FES Scarcity scenario Aim of the market Business model
Accessibility to the market	i.e., codifying property rights, seeking out buyers or sellers, negotiating a sale, measuring the quality and quantity of goods, specifications about the transfer of property rights	*Low* *Moderate* *High*	Low	Policy Regulatory framework Support services
Cost structure	Are fixed and variable costs mentioned? What are the characteristics of the forest (physical features, tree species, accessibility, threats,	*See the FEV_forest management cost document (in progress)*	Management costs are known.	Cost of the service

	risks, and management objectives) that might influence the cost strucure (cfr. excel FM costs)?			
Presence of market friction instruments	Are there any market friction instruments? Market friction instruments are designed to remove or reduce impediments to existing or potential markets for ecosystem services and thus improve the flow of signals and incentives there in;	*Yes* *No*	It's feasible to adopt market friction instruments to facilitate the flow of information.	Policy Regulatory framework Support services

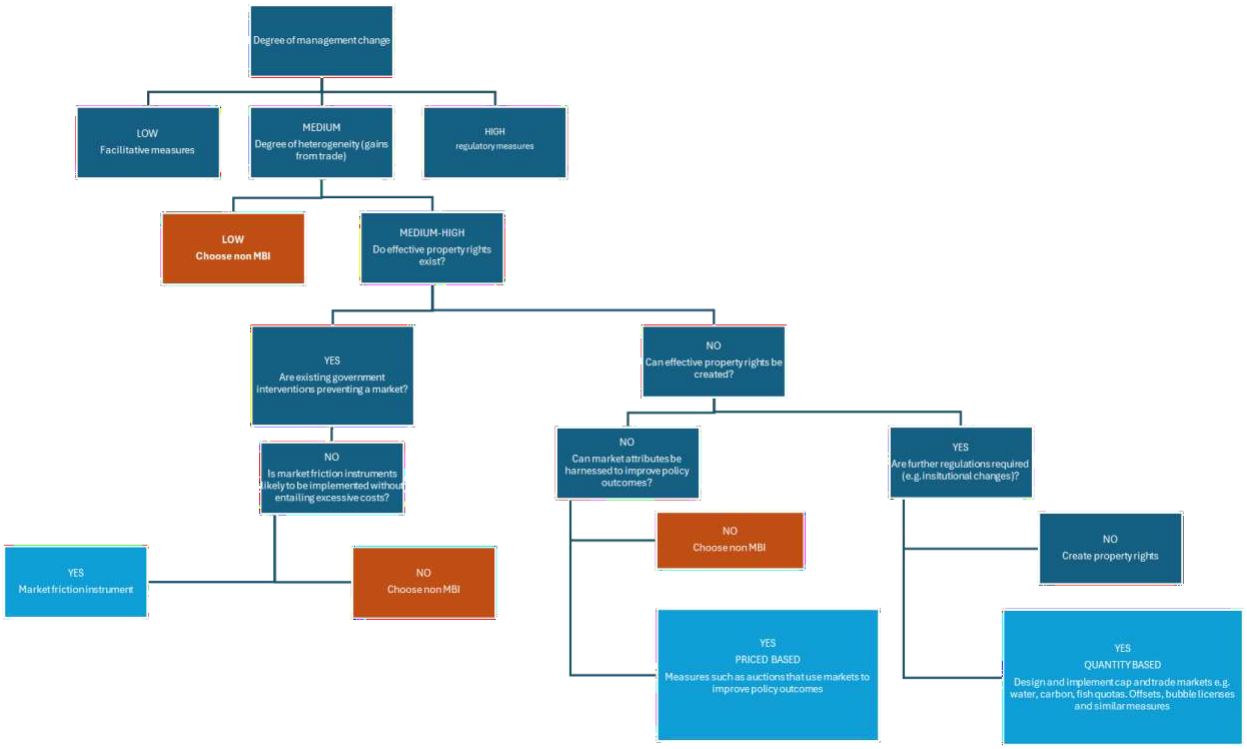
The choice of an appropriate MBI is the result of a process of identifying and overcoming factors that may hinder the conditions for market creation.

Available MBI are classified in a two-stage decision process according to the following rules:

- **Stage 1**: assessment of MBIs' ability to address problems in *heterogeneity,*
- **Stage 2**: assessment of MBIs' ability to manage a special type of *property rights* for implementing a market system, requiring well-defined rights to establish a payment and exchange scheme for all the stakeholders involved.

The resulting decision-tree is represented in Figure ll below.

Figure 11. Decision tree for MBIs



Once the type of MBIs (price or quantity-based instruments) deemed more suitable to be introduced at the local level in the Living Labs has been identified, examples can be retrieved from the good practice collection and further refined at the local level, also based on additional sources.

3.1.4 Transfer and use of results in other WPs

Commentaries based on the existing gaps, and on the identification of suitable MBIs are shared with Living Lab coordinators and WG BIO coordinator.

The major gaps are shared with WP3 coordinator to allow WP3 to include them in the policy analysis, and indicate possible policy interventions to address them in each Living Lab. The information available from the GPs is also used to support the identification of possible solutions to the gaps identified.

4. Business Model and Business Model Canvas

This section is a guidance tool for working on the Business Model Canvas (BMC), an operational tool for analyzing, assessing, and planning business activities within Living Labs (LLS). The document intends to be a guide to help the LLs coordinators use the BMC as support to frame suitable and financially sustainable business models based on local forest ecosystem services. In the following pages, some preliminary concepts will be presented. Later we will discuss more in detail the categories making up the BMC tool as a whole.

Many studies include a definition of business model (BM). In general terms, it can be defined as a structured description of how an organization creates, delivers and captures value. In other words, it is how a company operates to generate revenue, and (usually) make profit (Osterwalder & Pigneur, 20l0).

By describing a business model and its components, we want to find answers to questions such as:

- *Who is the customer* (*i.e.,* the individual or organization willing to pay for a product or service)?
- *How does the company generate profits?*
- *What resources does it have?*
- *What are the main costs involved in supplying a good or service?*

BMs are deeply linked to the markets where companies operate. They describe how a company behaves within a market context (i.e., its choices, revenue streams, competitive behaviour, etc.). Although they are not strategies *per se*, BMs can be used to implement strategies, *i.e.,* to make a company perform better than its rivals in the market, creating a competitive advantage for those who adopt them. BMs can induce disruptive innovations in static and path-dependent markets. When successful, they can be analyzed for their value proposition, profit formula, processes and resources. Basically, a *business model theory* helps to explain why a competitor is successful in the market (Christensen & Johnson, 2009).

4.1 Business models for managing public goods

Forest ecosystem services can be classified as both private (rival and excludable) and public goods; in the latter case, they have characteristics of non-rivalry and non-exclusion, which often leads to difficulties in the provision of these goods and services for the community. For a public good to be provided within an efficient market system the revenue must at least be equal to the cost of production – when this is not the case, there will be no incentive for anybody to perform even the basic activities needed for its supply. As a result, the potential benefits deriving from those goods to individuals and society are at risk of being lost (net loss)[4]. In particular, to maximize the value of public goods, it is important to minimize both 'free-riding' and 'forced riding' by their beneficiaries. Free riding occurs when individuals or entities benefit from a public good without contributing to cover its cost, whereas forced riding refers to situations where individuals or entities are forced to pay for a public good that they do not directly benefit from, or do not wish to benefit from.

One approach to address these issues can be to harness entrepreneurship in the market to provide these goods at a lower cost. In this context, private sector innovation and efficiency can help improve access to and quality of public goods, while reducing overall costs.

On the other hand, the public sector has a more complex view of who the entrepreneur is and how a public good is produced. The dynamics and responsibilities in the delivery of public goods may require more complex considerations, including social, ethical, and equity aspects that go beyond mere economic efficiency.

Business models can be used both by private entrepreneurs and the public sector committed to provide public goods.

4.2 What is a BMC useful for?

The information required to compose a business model can be categorized and made easily accessible in the form of a working tool such as the **Business Model Canvas** (Figure l2). This is not the only one, but it

[4] A loss is typically experienced also when public goods are supplied by using public expenditure to finance their provision since the lack of finance and its alternative uses for other public policies tends to cause underprovision of public goods against an equilibrium situation.

is certainly among the best-known tools for systematizing and organizing ideas and for clearly visualizing a company's logic of action.

A BMC is a strategic management tool that helps businesses analyse, assess, frame and plan their business models. The canvas is a visual representation of the nine key elements that make up a business model, including customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. This tool is used by entrepreneurs, start-ups, and established companies alike, as it provides a structured framework for understanding and communicating a business model effectively (Osterwalder & Pigneur, 20l0).

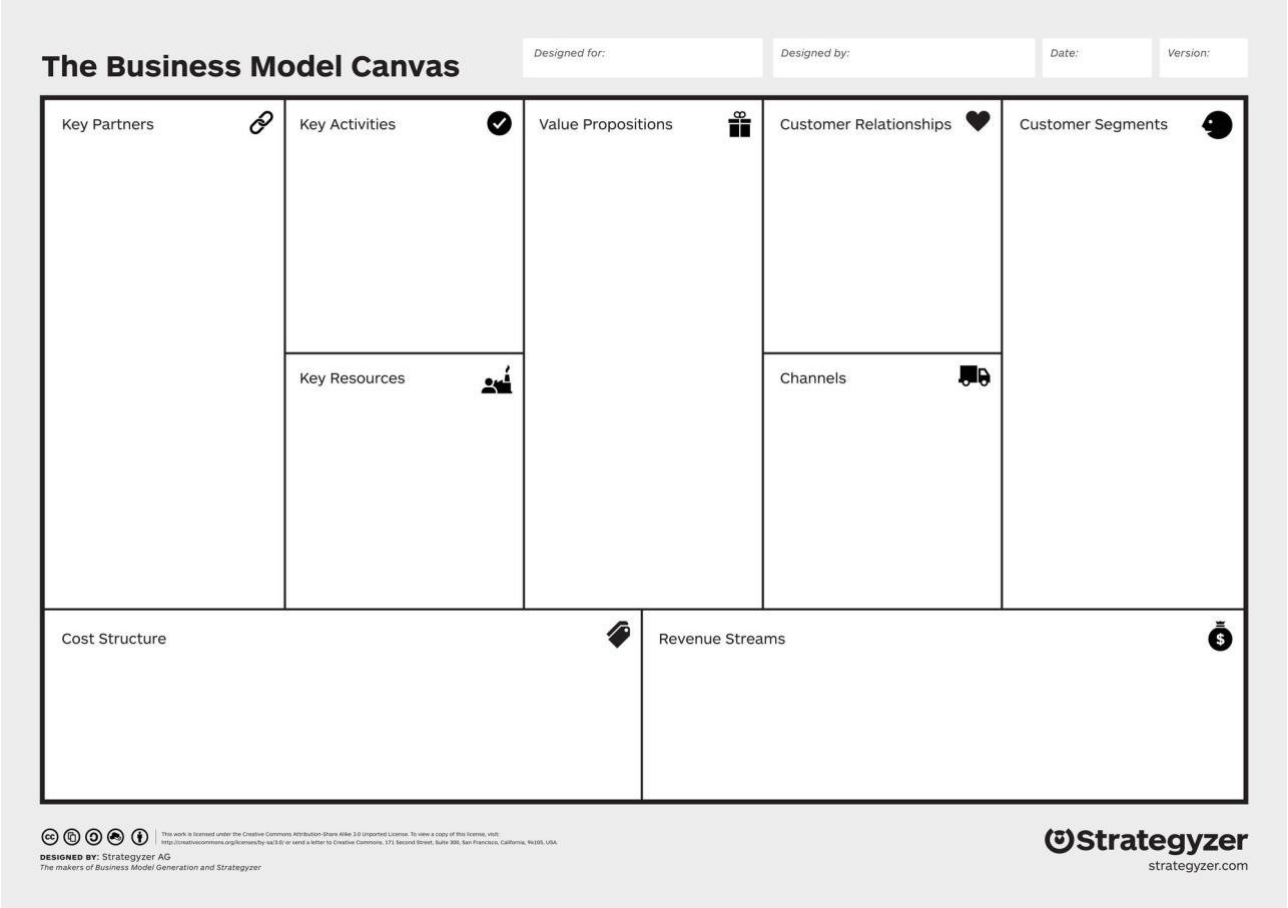


Figure 12. Traditional business model canvas*. Source: strategyzer.com.org*

The decision to utilize this tool is driven by the fact that the BMC is particularly useful for:

- **Planning**: it helps to organize thoughts, test assumptions, and provide a strong foundation for new businesses.
- **Existing business analysis**: it aids established businesses in evaluating the success of their current business model, identifying improvement areas, and exploring potential new markets. Moreover, it is useful to compare BMs with the ones adopted by other companies (it is possible to proceed by analogy to identify suitable examples. (See Figure l3)
- **Building Partnerships:** it enables organizations to evaluate the suitability of their various business models when considering collaborations or partnerships.

- **Product development**: it helps business owners determine their target market, understand client requirements, and create a value proposition that fits client taste.
- **Innovation**: it encourages business owners to think creatively and explore new business strategies by questioning preconceived notions and experimenting with different arrangements of the building blocks. This opportunity will be used to adapt this tool to forest ecosystem services, as shown in the next section.

CAN'T THINK OF A NEW BUSINESS MODEL?
Try adapting one of these basic forms.

ANALOGY	HOW IT WORKS	EXAMPLE
Affinity club	Pay royalties to some large organization for the right to sell your product exclusively to their customers.	• MBNA
Brokerage	Bring together buyers and sellers, charging a fee per transaction to one or another party.	• Century 21 • Orbitz
Bundling	Package related goods and services together.	• Fast-food value meals • iPod/iTunes
Cell phone	Charge different rates for discrete levels of a service.	• Sprint • Better Place
Crowdsourcing	Get a large group of people to contribute content for free in exchange for access to other people's content.	• Wikipedia • YouTube
Disintermediation	Sell direct, sidestepping traditional middlemen.	• Dell • WebMD
Fractionalization	Sell partial use of something.	• NetJets • Time-shares
Freemium	Offer basic services for free, charge for premium service.	• LinkedIn
Leasing	Rent, rather than sell, high-margin, high-priced products.	• Cars • MachineryLink

Figure 13. *Examples of BM mechanisms*.
Source: Ovans, 20lS

4.3 Why a Business Model Canvas for FES

After presenting the BMC as a useful tool to spur innovation and organize the components of a significant and sometimes radical change in the design, functioning and aims of an organization, we show how this successful model has been modified for the purpose of the FEV project aiming to allow its users to build innovative business ideas based on the special products and services delivered by forest ecosystems.

A BMC for ecosystem services, namely, Forest Ecosystem Services, can be interesting for several reasons, including:

- **Communicating** a relatively *new concept* can be a challenge, as it is often difficult to explain to people what you want to do and why, who should be involved and how you intend to achieve it. In this context, the FES Business Model Canvas (BMC) is a useful first step for individuals or groups in

planning the implementation of a FES project. This tool helps to structure and organise ideas, facilitating the creation of a clear and coherent plan.

- **Identifying new partners** is another crucial aspect. Considering the value that the FES can offer to different groups of people, the FES BMC helps to identify potential new partners or beneficiaries who might be interested in participating. Working with new partners can lead to a synergy that benefits all parties involved.
- Exploring **new sources of funding** is essential for project sustainability. By combining reflections on the value of the FES with the identification of new partners, new ways can be found to finance operating costs or contribute to cost reduction. This integrated approach makes it easier to raise the financial resources needed to carry the project forward successfully.

The tool's versatility allows it to be adapted to multiple case studies. We therefore drew inspiration from the basic model and compared it with other models applied to the circular economy and nature-based solutions to find the most suitable model for forest ecosystem services (Figure l4)

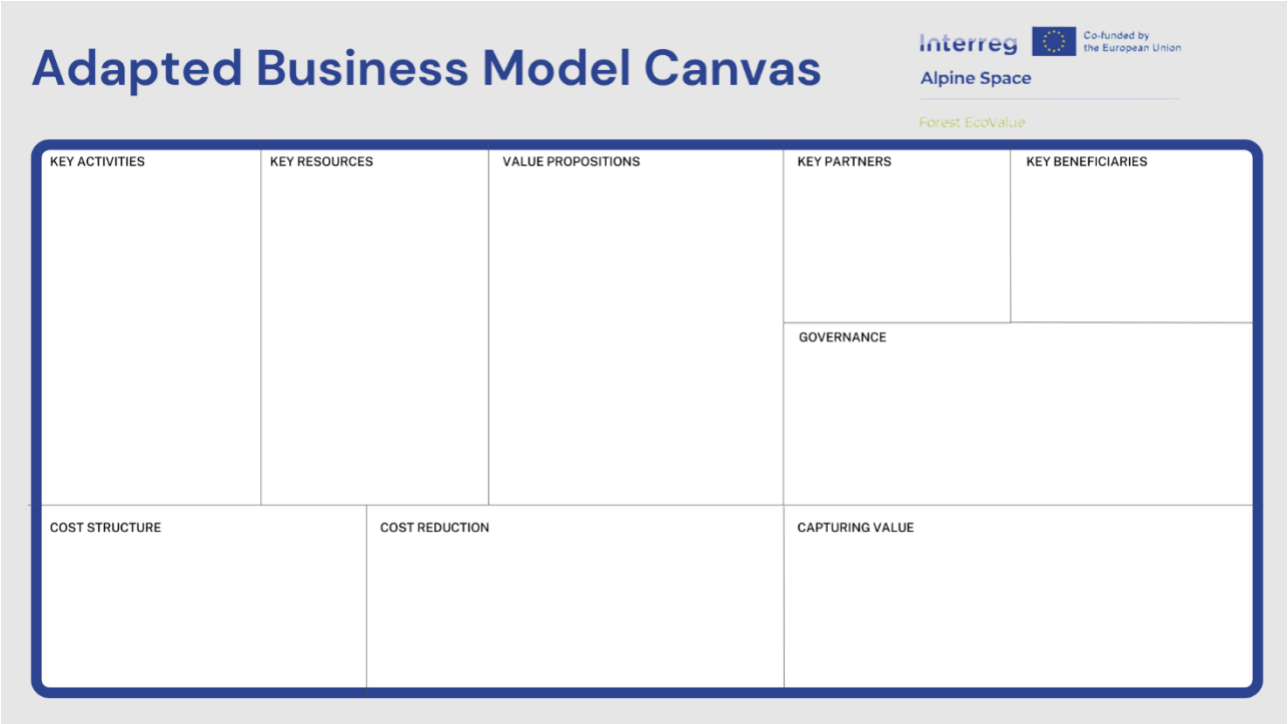


Figure 14. Business Model Canvas for Forest Ecosystem Services*. Source: own elaboration from Connecting nature*

The adaptation of BMC to the case of FES relies on a few minor modifications to the original structure described by Osterwalder & Pigneur (20l0) aimed at aligning the approach to the specific characteristics of value, product, services, users/customers/beneficiaries, and governance issues that we typically find when ecosystem services are at the basis of a set of market transactions.

To better illustrate the differences between the original model and the adjusted ones presented here, we start from the definition of the relevant categories used in a BMC and highlight the most telling differences and specifications applicable to the case of FES. To start, Table 8 provides a list of short definitions for each of the categories typically used in a business model canvas and a summary of the specificities found in the case of FES.

Table 8. Categories of Business Model Canvas for FES

Category	Definition	Specificities with FES
Value Proposition	The proposition that an organization makes to its beneficiaries. It describes the set of needs, problems, desires, and interests that the organization undertakes to achieve through its project.	Having regard for the most common types of values associated with FES, it is suggested to focus on the categories of environmental value proposition (EnVP), social value proposition (SVP), and economic value proposition (EcVP). Ecosystem services are likely to deliver ecological improvements (e.g. biodiversity), socially relevant impacts (e.g. health), and economic revenues (e.g. timber provision).
Key Activities	They include only the most important activities needed to make the project work (e.g., production, research, maintenance and development). Participants should attempt to go deeper into the area identified as value propositions.	Even though the structure does not need any significant change, some of the key activities often refer to ecosystem management and maintenance. Additionally, since some FES are invisible and require specific measurements, special activities may be needed to make them visible to potential users (also through *ad hoc* marketing approaches).
Key Resources	The most important internal resources necessary for the business model to run properly	No significant change required. Resources are very context-dependent and may change depending on the business idea considered. However, it is likely that specialists in the field of ecology, ecosystem services, and forest management are required for almost every possible business development based on FES.
Key Partners	Different types of stakeholders exist who can play a partner role within a BM project	In the case of ecosystem services very often intermediaries (not strictly necessary for other more classic business domains) are essential for certifying or ensuring the quality of the traded services (e.g. the quantity of CO2 absorbed by a forest).
Key Beneficiaries	All those individuals and organisations that receive benefits from the provision of FES independently from them being customers (i.e. paying for the benefits received)	It is a broader concept that expresses those who are affected by the positive externalities that an enhancement of the FESs entails
Governance	The framework and processes that guide the decision-making, accountability, and overall management of a business model within an organization	It is one of the biggest challenges in addressing markets and BMs for FES
Cost Structure	It outlines all the costs and expenses that a business will incur while operating its business model, such as the costs associated with creating and delivering value, maintaining customer relationships, and generating revenue.	No significant change required. Costs are very context-dependent and may change depending on the business idea considered.
Cost reduction	The process of decreasing a company's expenses to maximize profits. It involves identifying and eliminating expenditures that do not add value to customers while optimizing processes to improve efficiency.	The activities necessary to enhance the FESs may have lower costs than a "traditional" economic activity because they may involve reduced cost items such as labour costs (e.g. volunteering) or they may provide for interventions that have lower costs in the long term (e.g. Sustainable Forest management and

		risk reduction reduces the cost of managing an emergency and reconstruction)
Value capture / Capturing value	The strategies and mechanisms a business uses to retain a portion of the value it creates through its products, services, or activities	In FES related activities, Value capture does not only refer to profits, but also to the measurement of the added value that is generated by the valorization of EDFs (e.g. Increased attractiveness, increased value of the land...)

As with the traditional model, a few groups of the classical nine categories used for a business model[S] can be identified:

1. **Value proposition**
2. **Value creation and delivery (including key activities, key resources, key partners, key beneficiaries, and governance)**
3. **Value capture (including cost structure, cost reduction, capturing value)**

The adaptation of the BMC to the case of the FES involves the following specifications regarding some of its classic categories.

Value Proposition (VP): as we explain later, VP refers to a clear statement that explains how a product or service solves a problem, delivers specific benefits, and why it is better than the alternatives. Since FES are different and multiple, and refer to several thematic areas, it is useful to indicate a value proposition for the main three areas of:

- **Environmental VP**: refers to the ecological benefits provided by forest ecosystems, such as carbon sequestration, biodiversity conservation, water purification, and soil stabilization
  A forest management company might highlight its role in reducing carbon footprints by maintaining and expanding forest areas, thus contributing to climate change mitigation (Tundys, 2022).
- **Social VP**: refers to the social benefits provided by forests, such as recreational opportunities, cultural values, and contributions to local communities' well-being.
  A company might focus on how its forest conservation efforts support local communities by providing jobs, preserving cultural heritage, and offering recreational spaces for public use. (Kwak et al. 2020)
- **Economic VP**: refers to the financial benefits derived from forest ecosystems, including timber production, non-timber forest products (like nuts and berries), and eco-tourism.
  A business could emphasize its sustainable timber harvesting practices that ensure long-term profitability while maintaining forest health, or its development of eco-tourism activities that generate revenue and create jobs (Cardeal et al., 2020).

Furthermore, for ecosystem services it is crucial to broaden the group of potential '*customers*' by replacing the standard category of "customer segments" with **key beneficiaries**, taking note of the wide range of stakeholders who benefit from public goods and not only those who pay for them (Taipale-Eravala et al.

[S] The classical categories used in a BMC are the ones represented in Fig.S, namely: key activities, key resources, value propositions, key partners, key beneficiaries, governance, cost structure, cost reduction, capturing value.

2020), including local communities, governments, businesses, and even future generations. This approach allows to consider a broader range of stakeholders, thereby increasing opportunities for involvement and support. In the case of FES, key beneficiaries may include local communities, farmers, citizens, tourists, wildlife & biodiversity, the global community, education and research institutions.

Key partners and key beneficiaries can often overlap in the FES, including business communities, citizens, and other stakeholders who can both benefit from and contribute to the project. To correctly identify these groups, it is useful to construct a *stakeholder map* (see the specific section below).

FES governance emphasizes the importance of identifying from the outset how the system will be managed at the operational level. Managing many different partners and beneficiaries that may be involved can be complex. A clear governance structure is thus essential to ensure effective collaboration and transparent, accountable project management. In the case of ecosystem markets, governance can be of the utmost importance, since some of the actors participating in the market are not typically operating in other more classical markets for private goods and services (e.g., certification services for sustainable forest management, or FES quantification and accounting).

Finally, **cost reduction** refers to the methods available to reduce direct costs in the delivery of the FES and the related operations. This may include optimizing resource use and quantity, adopting new technologies, and making operational processes more efficient. Direct costs can be reduced e.g. by using volunteers, or specific forest management approaches that cut costs, or by reducing waste, energy use, etc.

5. Business Model Archetypes for FES

5.1 Introduction and definition

Business Model Archetypes (BMAs) are predefined frameworks or templates that classify businesses based on their sources of revenue, customer segments, and relationships with customers and suppliers. These archetypes help organizations understand different ways that they can use to generate revenues.

BMAs can be used as a basis for elaborating real-life business models, referring to specific markets, stakeholders, customers, decision and policymakers, etc. Archetypes have a general value and are inspired by successful cases; however, they always need to be adapted to the specific contexts where they need to be tested: product, customer segments, prices, legal conditions, and other fundamental aspects of the market addressed can show even significant differences for different geographies, legal systems, cultures, etc.

Due to their general and flexible nature, BMAs do not provide a detailed description of a specific case but highlight the reasons for the success of that model: first of all, by indicating the most important BMC categories, which distinguish the model from the others (e.g. Value Proposition), then better specifying the more specific success factors within the standard categories (e.g. the social value of involving local producers, etc.).

5.2 Linking local FES markets and BMAs in the Living Labs

From a purely economic point of view, most FES are categorized as public goods[6]. The issue that the FEV project mainly address is about making the beneficiaries of FES (or anybody else) pay for their provision and transfer the payments to the providers to incentivise the continuation of the delivery of the public goods, that typically benefit the society at large.

We consider a BMA as a tool that can support the creation of markets for FES, by suggesting how an entity willing to capitalize on some existing ecosystem product or service supplied by a forest (e.g. timber, biodiversity, tourist attractiveness, natural hazard protection, etc.) may organize trade, generate revenue streams, solve commercialization problems, deal with customers and other stakeholders, etc.

lt is essential to highlight how BMs and markets are strictly interlinked: some of the classic categories used to qualify a BM refer to market structure, participants, and dynamics (e.g. key beneficiaries, key partners, are all categories used in the BMC). Therefore, for testing the applicability of business models in each territorial context, a market assessment is required since the lack of some conditions or information on how a local market is framed (or should be framed) does not allow to assess the economic potential of a business model in that territory.

The non-economic aim of FES markets and business models is to ensure the provision and conservation of forest ecosystems and the related FES.

Since the quantity of examples of innovative business models applied to forest ecosystem services is limited, the selection of BMAs presented for the FEV project includes cases applied in fields other than forest management and FES. To a significant extent, however, the proposed archetypes have been collected from research and policy papers addressing Nature-based Solutions and other ecosystem services markets.

5.3 Business models archetypes for FES identified

A typical approach to present a BMA is about describing how it addresses a selection of the relevant categories that typically frame a business model. Thus, based on the categories used in the business model canvas (BMC), and in most typical models for business plans, BMAs can be defined by identifying the distinctive BMC categories where they introduce significant innovation or additional aspects. Different BMAs are expected to primarily address some vs. others of these nine categories, as characterized and numbered in Table 9 below.

Table 9. References to suitable BMC categories

1	Value proposition
2	Key activities
3	Key Resources
4	Key partners
5	Key beneficiaries
6	Governance
7	Cost structure

[6] Public goods typically present two characteristics: non-excludability (it is relatively complex to limit the accessibility to the good or service to groups of beneficiaries) and non-rivalry (the consumption or use of the good/service by one user does not harm the possibility to consume it by other users).

8	Cost reduction
9	Capturing value

In each Living Lab, a selection of FES has been proposed, based on their biophysical consistency (assessed under WG BIO), and the consideration of local preferences and political priorities. Therefore, each Living Lab showed an interest in utilizing and enhancing one typology of FES classified according to the CICES classification codes. To select a BMA, based on the BMAs' collection performed, however, only the three FES categories shown in Table IO are considered.

Table 10. Categories of FES

Service category	Examples
Regulating, supporting and maintenance	biodiversity, pollination, air purification, water regulation, carbon capture and climate change mitigation
Cultural services	recreation, sports and wellbeing activities, aesthetic value, ecotourism, science, education
Provisioning	Biofuel, timber and non-timber goods, harvesting, hunting

The analysis performed in the Living Labs to assess the local market features allowed identifying different categories of regional performance that may ease the introduction of alternative BMAs and refer to the following four macro-dimensions: *physical, economic, social/community, and governance/organizational.*

Here we describe the steps made to align a selection of l4 BMAs collected from various sources and applied in the domains of ecosystem services and Nature-based Solutions with some distinctive features of the sites identified for each Living Lab in the FEV project.

I. The first step is to identify the FES on which there is the intention to apply a BMA;
2. The second step to qualify a BMA requires identifying the BMC categories that it primarily addresses out of the nine reported in table 8;
3. The third step to qualify a BMA requires identifying the forest features (*macro-dimensions*) required for the proper functioning of the model itself;
4. The fourth step is to detail the specific aspects of the macro-dimensions that allow for an application of the BMA in the selected site.

As a result, l4 BMAs have been selected and described in detail using the BMC categories to support their application in the project Living Lab, as shown in Table ll below. A more detailed description of the BMAs can be found on the website.

Table 11. Business models archetypes

Business Models Archetypes	Description	Examples related to FES
Donation-based I Crowdfunding	Outsourcing financial support for a project from public (individuals, business, philantropic organizations), typically via the internet.	Conservation activities, non-profit organization that rely on crowdfunding for forest management: Size of Wales project - http://www.jamesborrell.com/crowdfunding-conservation-l0-inspiring-projects/

Subscription-based I Membership	Users pay a recurring fee to access goods or services offered by the organization that have public good characteristics. Revenue from subscriptions (*fees*) covers the costs of production and maintenance of the PGs.	Access fee to forests with daily, monthly or yearly passes. https://www.fs.usda.gov/passespermits/about-rec-fees.shtml
Freemium	The organization offers a basic version of a product or service for free, while charging a premium (price) for enhanced features or additional services.	Carbon footprint calculators (free) with personalized carbon offsetting plans (premium) with the possibility to adopt a tree within the forest itself
Public-Private Partnership	Forms of collaboration between public and private sector organizations to finance, develop, and manage projects aimed at providing public goods by sharing some risks and rewards.	The LIFE program: https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/programme-environment-and-climate-action-life_en
		Andean Biotrade Program - https://www.thegef.org/sites/default/files/documents/promoting_finance_instruments_for_biodiversity_conservation_though_biotrade_in_the_andean_region.pdf%SB%7Bc.pdf
Pay What You Want	A pricing mechanism where customers are allowed to choose how much, if anything, to pay for a given service or commodity.	Individuals, local governments, communities and businesses benefiting from improved ecosystem quality from forests can contribute to funds based on the value they perceive from these services (Payments for Ecosystem Services)
Revenue Sharing I partnerships	A symbiotic agreement between individuals, groups, or companies to share resulting revenues. Profit are re-distributed among stakeholders.	Local communities can be involved both in forest management and in related activities (e.g. educational, cultural), so they can benefit from FES preserved, obtaining some economic revenues (shared with public administration, firms and other actors)
Experience selling	Offer customers emotional (personalised) experiences instead of a transactions	Eco-tourism, workshops, hiking/trekking and other sports
Trash to cash	Based on the concept of circular economy, used products, production scratches, waste, are colleted and transformed (upcycled) in new products	Recycling/Upcycling timber production scratches (e.g. Vaia Wood)
Green Health Model	A project with both social and environmental positive effects is created thanks to the voluntary work of people in the community, as well as expert operators, and financed by public funding, philanthropy and NGOs	The community garden 'Food For Good' is a project that connects and supports vulnerable people from diverse backgrounds (such as refugees, elderly, disabled people) by growing and harvesting fruits, mushrooms, and local plants.
Educational activities	Guided tours, workshops, and research activities for groups of students or researchers, organized in cooperation with organizations such as schools, universities,	Integration of educational activities related to forestry into school programmes, cooperation with research centres and university institutions

	educational and research groups of various kinds.	

5.4 Matching local markets conditions in the Living Labs with BMAs for FES

Step one: Socio-economic variables and BMA

Based on the analysis of the local market conditions identified in the market assessment phase, a matching tool has been set up aiming at combining the actual local conditions identified in each Living Lab, and the ones aligned to a specific archetype out of the l4 BMAs reported in the list discussed above and presented in Table l2.

Table 12. Contextual socio-economic variables for the matching tool: IS variables identified to represent the requirements that the forest area needs to present to apply the BMA

Contextual (socio-economic) variables	Question for LL coordinators
1. Cooperative stakeholder networks	Are there, or can be created, stable networks of cooperation and communication between local stakeholders (LL partners, institutional actors, private companies, associations, local community)?
2. Proximity to local communities	Are there towns, villages or settlements within or in the proximity (within S0km) from the LL?
3. Community engagement platforms	Are there, or is it possible to create, specific cooperation networks with the local community, or is it possible to create such networks?
4. Access to public funding	Is it possible to ensure access to public funds and external financial support for activities and projects within the LL?
5. Locally active entities	are there local entities (public or private) permanently and actively operating in the LL area, responsible for forest managing and maintenance? E.g., private forest owners, private companies, public institutions, associations and more.
6. Presence of local forestry enterprises	Are there forestry or timber manufacturing enterprises established in the area or nearby?
7. Touristic attractiveness and receptivity	Does the LL regularly receive touristic flows, or would it be suitable for it (e.g. existing accommodation facilities, information offices, accessible routes?)
8. Spatial accessibility	Is the forest area accessible through routes or trekking paths and routes?
9. Partnerships with educational institutions	Are there, or is it possible to establish, active partnerships with educational institutions (schools, universities, research centers) or other
10. Partnerships with research institutions	Are there, or is it possible to establish, active partnerships with educational institutions, private entities investing in r&d (e.g. pharmaceutical companies)?
11. Permanent stewardship	Is it possible to establish long-term, permanent forest management and restoration activities?
12. Legal limitations to access	Are there or is it possible to establish legal limitations for accessing the forest, e.g. through a fee or ticket?
13. Legal limitations to provisioning	Are there or is it possible to establish legal limitations for provisioning (mushroom picking, hunting or harvesting), e.g. through a license?
14. Eligibility for carbon credits market	Does the forest area comply with established regulatory standards for carbon sequestration and storage to sell carbon credits (i.e. eligibility,

	additionality, measurement and monitoring, verification and validation, registration and issuance)?
15. Eligibility for biodiversity credits market	Does the forest area comply with established regulatory standards for selling biodiversity credits (i.e. eligibility, additionality, measurement and monitoring, verification and validation, registration and issuance)?

To investigate the presence of these conditions within FEV's Living Labs, a questionnaire for LL coordinators was created through the application of Google Forms (https://forms.gle/9PzlHt9nBKPq3o8i7). A simple algorithm has been set up: every variable is connected to a question and respondents can choose between three answer options: yes, no, I don't know. Answering "no" means that that specific variable isn't present (and can't be introduced in the LL area); therefore, the BMA that strictly require that condition to be implemented, will be excluded from a list of possible, viable, BMA. Answering all the questions from l to lS, only the suitable BMA will remain from the selection (see Table l3)

Table 13. Connection between the shortlisted BMA and variables presented in Table l2, reported by their numbers.

BMA	Required condition for its application
Donation-based / Crowdfunding for the promotion or conservation or forest management activities	S, **II**
Subscription-based / Membership	S,7,8,l2,l3
Freemium for forest access and other activities	8,l2,l3
Public-Private Partnership for conservation or forest management projects	4,S,6
Revenue Sharing / partnerships	l,2,3,S,6
Ecotourism: sustainable accommodations and eco-friendly activities	7,8
Experience Selling - sport, spiritual and cultural activities	S,7,8
Trash to cash to produce wooden materials with recycled timber or production scraps	I, 6
Green Health Model /Community Gardens for provisioning goods	2,3
Green chemistry	7,9,l0,l3
Educational activities	8,9
Carbon credits and offsetting/plans	S,II,l4
Voluntary PES schemes	2,3,S,II
Biodiversity credits	S,II,IS

The results will be then analyzed by the Working Group ECO and used as a basis to recommend one or more BMAs that align with the conditions of the forest area. Each response will be accompanied by a detailed description of the BMAs resulted, including an outline of the types of ecosystem services they could preserve (*step 2*) and an indication of relevant biophysical variables to assess within the forest area (*step 3*), that will indicate whether the BMA is practically applicable to the forest context. The result obtained through this method should be taken only as suggestions, not as definitive solutions: the practical application of actual BMAs needs a further and more complex investigation to be developed.

Step Two: FES and BMA

The second step of the process of finding the most suitable BMA to apply in a forest area regards the connection between each BMA and one or more FES it could effectively address. To validate this connection, the Working Group ECO relied on partner's opinions as well as some external experts. The results are reported in Table I4 below:

Table 14. Hypothesis of connection between BMA and FES that may be subject to

BMA	FES potentially addressed
Donation-based / Crowdfunding for the promotion or conservation or forest management activities	**Different regulating** or **supporting FES** according to the kind of forestry/conservation project proposed
Subscription-based / Membership	**Provisioning** and **cultural** services
Freemium for forest access and other activities	**Recreational** and **cultural** services
Public-Private Partnership for conservation or forest management projects	Forest conservation, management and reforestation activities aimed at supporting **regulating** services and generating value from their conservation
Revenue Sharing / partnerships	**Provisioning** services and **recreational**, such as ecotourism, sport activities. NB: revenue sharing can be used in combination with other BMA.
Ecotourism: sustainable accommodations and eco-friendly activities	**Recreational and cultural services**
Experience Selling - sport, spiritual and cultural activities	**Recreational** and **cultural** services
Trash to cash to produce wooden materials with recycled timber or production scraps	**Timber** extraction (provisioning services)
Green Health Model /Community Gardens for provisioning goods	Provisioning services (**harvesting**), and social benefits.
Green chemistry	Provisioning services, while supporting **biodiversity** and the maintenance of natural habitats (regulating services)
Educational activities	**Educational and cultural** services

Carbon credits and offsetting/plans	**CO_2 sequestration and climate change** mitigation
Voluntary PES schemes	PES schemes, under different conditions, can be potentially applied for the conservation of many regulatory services; in the case of FES, especially **clean water provision.**
Biodiversity credits	Biodiversity conservation

Step Three: FES and Bio-Physical Variables

A suitable BM for the conservation of FES cannot be implemented without previously inspecting the forests' bio-physical characteristics, which can strongly influence FES supply capacity as well as the possibility of implementing certain specific models. For instance, in order to initiate eco-touristic activities in a certain forest area, not only it must be suitable for welcoming touristic flows in terms of presence of touristic facilities, but it must also be accessible with trekking paths or routes, its slope shouldn't be too high, and the forest should be characterized by a high recreation potential.

Moreover, the evaluation of which FES should be subject to a new market shouldn't consider only the presence of the FES in an area and its supply conditions, but also its flow, the part of the supplied FES that is actually utilized, and its demand: demand for fuelwood, demand for carbon compensation, demand for recreational activities, can differ from how much fuelwood is used, how much carbon credits are purchased and how many tourists are actually visiting a forest. Every forest owner – in FEV's case, every Living Lab coordinator – should be aware of the magnitude of the supply, demand and flow of FES in their location, before implementing measurements for enhancing some FES through specific BMs.

In the following Table lS, indicators for supply, flow and demand for each FES are reported.

Table 15. Bio-physical indicators for every FES (Source: AlpES, 20l8, internal sources from Forest EcoValue)

	Bio-physical indicator		
FES	**Supply**	**Demand**	**Flow**
Provision of timber for energy and material	Forest Biomass Increment (m^3/ha^{-l} / y^{-l})	Potential municipal timber demand (m^3/y^{-l}), based on average timber consumption, energy efficiency class, calorific value of wood	Wood removals (m^3/ha^{-l} / y^{-l}), depending on accessibility technical feasibility of harvesting due to topographical site conditions.
Provision of other material (e.g. biochemical products)	Non-timber forest products yield	Demand for non-timber forest products	Forest products removal
Provision of fruit, vegetable, mushrooms	Non-timber forest products yield (forest exploitability index)	Market demand for edible forest products	Forest products removal
Aesthetic value, beauty of nature	Presence of protected areas, landscape attractiveness,	Potential beneficiaries (residents and tourists) within a catchment area (S0km radius)	Visitation rates (+ metadata, i.e., number of photos posted on social media)

Recreational value (outdoor sports, spiritual values…)	Recreation potential, based on index of naturalness, presence of protected areas, distance to water bodies, landscape diversity, rettain ruggedness index, density of mountain summit, accessibility (roads, slope angle, density of tracks and paths)	Potential beneficiaries (residents and tourists) within a catchment area (e.g., S0km radius)	Visitation rates in municipalities, touristic overnight stays
CO_2 storage and sequestration, climate change mitigation	Annual rate of CO_2 sequestration (increase in carbon stock due to biomass increment, acordin to forest type, altitude and climatic region) (t CO_2 / ha^{-1} / y^{-1})	CO_2 emissions per municipality (t CO_2 / ha^{-1} / y^{-1})	Annual rate of CO_2 sequestration
Regulation of areas against avalanches and landslides	% of site protecting forests	Infrastructure in hazard zones (index)	% of object-protecting forests
Preservation of biodiversity and natural habitats	Presence of protected areas, specie richness and abundance, ecosystem health metrics	WTP for biodiversity conservation and biodiversity conservation targets (policies)	Changes in species population
Provision of fresh water	Drinking water availability (annual water yield, m^3/ha^{-1} / y^{-1})	Drinking water abstraction (demographic data + touristic overnight stay)	Water use
Filtration of surface water	Nitrogent removed, (kg / ha^{-1} / y^{-1})	Nitrogen loads introduced (kg / ha^{-1} / y^{-1}) via fertilization, wet and dry nitrogen deposition, biological nitrogen fixation	Nitrogen removed (kg / ha^{-1} / y^{-1})

5.5 Results and their use

The matching identifies one or more BMAs that are aligned to the local market conditions. It can be used mainly as an exclusionary instrument whose aim should be to disincentivize, at least in the short run, local stakeholders to try the application of a BMA that demands specific local conditions not currently met in the Living Lab.

At the same time, the list of preferred BMAs for each Living Lab can be compared to the market assessment performed on the same region, where gaps and areas of need for policy intervention have been identified.

Especially in case of concomitant local market gaps identified through market assessment, and local requirements for the application of some BMAs, the matching will help prioritize the policy interventions needed to allow for the introduction and test of a BMA seemingly suitable for the regional context of a Living Lab.

Once the obstacles and difficulties to develop a new business model, inspired to one of the archetypes identified, are smoothed or removed, local and external stakeholders might test a new business idea more safely and within a supportive economic and policy environment.

6. Step-by-step guide to filling in the BMC for FES

6.1 Premise

The Business Model Canvas is used primarily in corporate/start-up contexts and related to private business initiatives. For this reason, its use applied to all FESs selected by the Living Labs may not be immediate.

However, one of the most appreciated advantages of this tool is that it can be used in an adaptable way by a facilitator. The facilitators for this case will likely be the Living Lab coordinators. Here we will present preliminary and supporting tools for using the BMC in the Living Labs.

A BMC can be filled in by a group of stakeholders during a specific workshop, or a set of successive workshops to be organised over a reasonable time in each Living Lab. Even though the BMC workshops are not run as described below, all Living Labs are expected to use a template framed around the categories of the BMC to describe the business models that they wish to test within their territory.

Below, we describe how a BMC can be filled in aiming at introducing a new business model within a workshop. The suggested steps and phases are applicable also in the case another approach is followed in the Living Labs.

6.2 Applying the BMC

Once the problem and stakeholders have been identified, and the ultimate goal is to improve forest ecosystem services in the LL, you can start to compile the BMC.

The following paragraphs describe how to use the BMC and fill in the categories that make up the canvas. We provide general information and try to refer to forests and FES in the examples and discussion. Each category of the FES BMC is addressed in a separate section. This section focuses on the last two stages of the double diamond framework as in Figure 6.

6.2.1 Value proposition

The first category that can be addressed in the BMC is the *value proposition* (VP). The value proposition statement is a sentence that summarizes these concepts and guides the whole process of using the BMC.

To write this statement, the following questions can be answered within the working group:

- What kind of intervention do you intend to put in place? (e.g., selling a new service)
- Whom does it help/who is the beneficiary? (e.g., visitors, young people, residents)
- To do what/what need does it address? (e.g., leisure activities, healthcare)
- How/through what activities? (e.g., by providing special tourist products, by selling CO_2 credits)
- In order to generate what? (e.g., revenues, sustainable forest management, green jobs)

When discussing ecosystem services, it is important to remember that they often come in bundles.

This typically means that more values are proposed together by the same ecosystem (e.g. a forest). They can be treated as independent ones when addressing value proposition, but all values deserve to be assessed when associated to a single ecosystem since each of them could be a source of revenue and be relevant for some groups of beneficiaries (e.g. forest companies can be interested in timber sales deriving from a provisioning ecosystem service, while tourist operators can be interested in natural beauty or forest tracks as potential sources of income for them, etc.).

Concerning the multifunctionality of forest ecosystems, we can notice that when more FES are produced jointly, two typical situations may materialize:

a) more VPs exist for the ecosystem and a wise management of FES can use all of them;
b) some FES imply a trade-off to each other, i.e. when one is supplied the other one cannot be ensured (or can be provided e.g. only in a limited quantity or with lower quality).

In case of conflicts between FES a decision on the ones to be preferred is necessary. Thus, a local characterization of an ecosystem and the FES it provides helps identify risks and opportunities associated with the specific case-study.

Assuming that a principal goal of collecting payments for FES is to cover the cost of sustainable forest management (SFM), all values implying some monetary transactions can generate revenues that can be partially used to pay for SFM in a specific forest site[7]. To identify different value propositions such as economic, social and environmental ones, a diversified group of stakeholders can bring the necessary competences and knowledge to identify multiple possible value propositions.

To facilitate this work, the template shown in Figure IS can help to address value proposition and deliver a satisfying statement. It is advisable to find a value proposition for each of the relevant scopes (e.g. social, economic, environmental), and work in groups using post-it notes, or similar items.

Figure 15. Value proposition canvas
Source: own elaboration

To identify a suitable value proposition for each of the three mentioned scopes, the guiding questions reported in Box 2 below can be helpful.

[7] At any rate, possible conflicts and mutual reinforcements between different FES should be identified on a biophysical basis before combinations are considered as a potential source of revenue from an ecosystem.

Box 2 – Guiding questions on value proposition

- *What is the Environmental Value Proposition?* How will the FES help address key environmental challenges at the community, city or regional level? (e.g., increased tree cover will lead to decreased air pollution, reduced flooding, reduced heat island effect, and increased biodiversity). It can be linked to the results of the biophysical assessment run on each Living Lab, if available. If this is not available, expert assessment can be helpful to identify it. For instance, consider how an increase in tree cover may help the local community to benefit from clean air and increased hydrogeological security through sustainable forest management activities (such as tree planting and maintenance), to get a more resilient and adaptive ecosystem.

- *What is the Social Value Proposition?* How will the FES help address important social challenges at the community, city or regional level? (e.g., increased tree cover will increase the health of citizens by reducing air pollution leading to reductions in health conditions such as asthma). It can be linked to the results of the economic assessment run on each Living Lab according to the methodology presented at the beginning of this paper, if available. If this is not available, expert assessment can be helpful to identify it.
- *What is the Economic Value Proposition?* How will the FES help address priority economic challenges at the community, city or regional level? (e.g., more tree cover will improve the attractiveness of the area for businesses and lead to an increase in property prices and related taxes. Opportunities may arise for new jobs/enterprises related to the delivery and maintenance of trees; carbon storage capacity of the newly planted trees can be allocated to emitters for offsetting purposes). A full answer to this question can be provided only by the application of the whole BMC and even by the development of a business plan, however in this phase expert opinion and expectations are sufficient to frame potential directions for developing the ecosystem-based business model referred to here.

A mixed example involving more value propositions at the same time could be the case with a consortium of forest owners united to supply non-timber forest products (mushrooms, fruits, medicinal herbs, honey) feeding the supply chain of some local businesses (farmhouses, SMEs). The consortium would help meet the growing demand for sustainable and zero food miles products by partnering with networks of local entrepreneurs with the side effect of promoting sustainable forest management and local development.

The value proposition is the heart of the BMC. This section must clearly explain how a BM creates value for certain target audiences that may show different needs and demands. This is not yet a strict quantification of value created, and the value is more linked to its capacity to meet the needs, expectations and wants of beneficiaries than to their willingness to pay for the value delivered. Using a BMC is mainly a creative process that is rigorously assessed under a financial point of view only after the whole exercise has been run and the BMC has been completed.

It is a fact that business models help create values formerly not visible for potential beneficiaries, that is even truer in the case of relatively invisible/intangible goods and services such as the ones delivered by ecosystems. For instance, tickets allowing to skip a line were unthinkable before they were introduced: by making visible the value of skipping a line when people are in a hurry, it was possible to levy an additional fee through special tickets. In this case, identifying the value of time when in a line, it was possible to identify a special business model based on making people pay to save time when in a special situation (i.e. in a line).

The value creation potential achievable by innovation in business models' structure, in the case of FES, can be related, for instance, to the following features of value proposition:

- *Originality*: the value proposition may meet needs that beneficiaries did not know they had (e.g. need for better and cheaper tap water when filtered by a forest; need for protection of buildings from natural hazards when a forest nearby is properly managed);
- *Problem solving*: the value proposition can help the beneficiaries address and solve a particular problem (e.g. lack of visitors in local hotels can be addressed after outstanding levels of biodiversity are identified in the local forest; lack of funds for running sustainable forest management can be solved by selling carbon credits in a voluntary local carbon market)
- *Design*: a new value proposition can bring to identify opportunities not formerly considered, based on some physical or visual properties of the forest or its timber (e.g. a new use of local timber for hi-end furniture or wood home accessories where local sourcing is a distinctive value).
- *Price*: a new value proposition can allow to supply a service or good at a lower price to price-sensitive beneficiaries who may add to the original market base (e.g. use of cheap timber to build design furniture can allow new customers to buy design furniture at a lower price; if the price of an excursion in the woods with local volunteers is cheaper than it used to be with professional guides, more tourists may decide to buy such services)
- *Natural risk reduction:* specific FES can directly address some natural risks depending on locally relevant and frequent hazards that had not been considered a target for FES before forest protective capacity was disclosed and identified as a value proposition (e.g., landslides and rockfalls in the case of protective forests against natural risks).
- *Accessibility to products or services:* the identification of a value proposition can make some products or services accessible to specific beneficiaries or customer groups, depending on the type of product or services the accessibility can have more or less physical relevance (e.g. the identification of outstanding levels of biodiversity in a forest spot allows to grant access to the new species for potential beneficiaries, depending on the species, that may range from scientists to pharmaceutical companies interested in the medicinal use of some plant species).

6.2.2 Value creation and delivery – key activities

Value creation is a category that needs to be tailored on a target audience and for delivering a desired impact. So, the guiding question for framing the value creation approach within a BM is: how does the product/service/project being envisioned create value? Does it serve to solve a problem? Does it satisfy a desire? The analysis performed on the problem/issue identified in the previous paragraphs is useful to frame a focused discussion steady.

The **activities**, as the name suggests, include only the most important activities needed to make the project work (e.g., production, research, maintenance and development). Participants should attempt to

go deeper into the area identified in the *Value proposition canvas* without becoming overly focused on micro-design.

In the example on tree cover, the main activities involve tree planting, running a maintenance program, and monitoring activities against specific targets.

6.2.3 Value creation and delivery – key resources

Key resources are the most important internal resources necessary for the business model to run properly. Depending on the stage of the project, resources may have already been found or collected, or have to be acquired/developed in the future. It is necessary to refer to the internal resources of the working group where the discussion on problem solving, value creation and delivery, and key resources is held. Working on internal resources helps to understand what is already available and what is needed from external partners to implement the project (e.g., special skills or expertise, technology). Key resources can include physical, intellectual (expertise), human, technological and financial capacity.

6.2.4 Value creation and delivery – key partners

In this section and the next one, the stakeholders already mapped through the interest-influence matrix need to be further studied and addressed. Different types of stakeholders exist who can play a partner role within a BM project. However, sometimes the partner and beneficiaries' roles may overlap.

As a general guideline, looking back at the activities and resources section of the VP canvas, participants should consider who the main partners are required to deliver activities and provide resources. This involves identifying the people, groups, or entities that necessarily need to be involved in order to deliver the project. It is important to check if special permissions or access are needed or granted by specific institutions since the entities that issue these permissions or grant access to resources must be included in the project.

For example, in the case of tree coverage, key partners may include local forestry agencies, environmental departments of regional and local public administrations, local government bodies that may need to authorize the planting of trees or approve the choice of some specific species.

6.2.5 Value creation and delivery – key beneficiaries

As with partners, beneficiaries should have already been identified in the stakeholder matrix. A further distinction can be drawn here between direct and indirect beneficiaries, i.e., those directly impacted by the project activity (e.g., the local community) and those who benefit indirectly from it (e.g., local authorities and policy makers who see some of their land management and nature protection objectives realized).

6.2.6 Value creation and delivery – governance

The governance aspect of value creation and delivery is crucial, as it refers to the operational management of FES projects. Several possible governance models can be considered to guide the discussion: here we recall the ones developed within the EU Naturvation[8] project for NBS, run between 20l7 and 2022:

[8] https://naturvation.eu/home.html

Traditional Public Administration: the public sector is primarily responsible for planning, implementation and ongoing management activities. Public authorities may engage citizens through activities such as participatory planning processes and participatory budgeting.

New Public Management: the public and the private sector partner with each other in the implementation of a project revolving around FES. Appropriate legal structures facilitate this type of governance model regionally.

Private-Private Partnership: in this case, the public sector would step back and facilitate sole governance of the FES project by the private sector or some community organisations. Appropriate legal structures facilitate this type of model regionally.

Societal Resilience: the lead actors are community organisations, and the public sector plays a responsive, supporting, low-level role. Appropriate legal structures facilitate this type of model regionally.

Network Governance: in this case many different types of actors may be involved in many different ways in the implementation of the FES project. Appropriate legal structures facilitate this type of model regionally.

In addition to the legal and regulatory environment, which varies from country to country, the FES (or bundle of FES) addressed by the project/business idea requires special attention. When working on a public good, local governments are more likely to be involved since they are often in charge of managing these goods and services.

6.2.7 Value capture – cost structure

To fill in this section you do not have to create a detailed business plan. It is used to identify the macro-cost items for the project. The topic of costs is certainly among the most important in a BMC, because a cost estimate can be crucial in determining the decision to start a project. Generally, it is advisable to divide fixed costs from variable costs. In the case of tree coverage, fixed costs may include personnel costs, while variable costs may include the cost for trees, which varies according to the chosen species and number of plants.

6.2.8 Value capture – cost reduction

Cost reduction refers to the possibility for BMs involving actions on forests to reduce some cost items, typically related to labour or staff costs, through special strategies, such as the use of volunteers, but also through better or novel forest management techniques that in the long run can reduce maintenance or fixed costs.

In addition, some FES (e.g., regulating services, such as protection from hydrogeological risk) improving soil stability, and preventing future disasters can reduce costs for losses, damages, and reconstruction. Though difficult to calculate, even a rough estimate of these costs is helpful in demonstrating the side-benefits from investing on better FESs.

6.2.9 Value capture – capturing value

This last section is challenging to define because often a business model for ecosystem services does not involve the same dynamics as traditional models, where a private good or service is sold in a well-

established market. In a traditional BMC, this section would describe how a business creates profits from its value proposition.

Capturing value often is achieved by addressing market competition and controlling production costs. Capturing value involves mechanisms to monetize, commercialize, and benefit from the innovative solutions of the value creation phase. The value created for customers or beneficiaries is converted into tangible and intangible results (e.g. profits, market share, profitability, competitive advantage, brand value).

Some types of FESs, namely private goods such as timber, fall within this logic, however for other types of goods, such as public goods, the situation is more challenging. Often the funds captured derive from public sources (regional, national or EU) or can be obtained through philanthropy or crowdfunding, rather than from customers and competitors – which sometimes do not exist especially during the first stages of FES provision.

In the case of this type of funding, the ability of a FES in capturing value needs to be visualized by indicators that demonstrate the value created and provide evidence of the goodness of the project implemented. Some examples of indicators are listed in Table 16 below:

Table 16. Indicators for assessing the value capture

Economic indicators	**Contribution to the local economy**	**Market prices**
Increase in value of land (commercial/residential) close to forests	On-site businesses benefit most from increased FESs	Use of forest as CO_2 sink
Increase in house prices (property related tax)	Technology transfer, upskilling of existing firms	
	New jobs and enterprises creation (eco-tourism), emerging clusters, new market creation (incentives & subsidies)	
	Increase in attractiveness of area for new business (inward investment & start-up environment)	

Source: WGECO own elaboration

Another possible approach to assessing the value captured by investing on FES is to aggregate FESs to deliver multiple benefits with the same activity. An example may be ecotourism and the creative value of forests. Forests can be the subject of guided tourist itineraries, host activities for children and young people (such as tree adventure parks) and be included in employee welfare packages offered by companies for "forest bathing" sessions or team building activities in natural spaces. These activities, for a fee, also help fund the maintenance of the forest by using a sustainable forest management scheme, and thus conserving biodiversity but also providing other services such as temperature regulation, and water filtration.

To summarize, the guiding questions that can be used with working group participants in this session are:

- how do enterprises make money from their value proposition?

- Is it possible to generate any money from the FES under investigation?
- Is the FES producing a public good? Can it be financed by public funding (e.g., EU, national, international, etc.)?
- What are the direct revenue generation possibilities from the activities planned?
- Can the public good be measured by indicators of any kind? What indicators can be used to capture 'non-monetary' value (e.g., environmental indicators, social & health/well-being indicators, economic indicators)? See also the biophysical assessment to address this issue.
- Which are the partners whose interests are aligned with achieving targets related to these 'non-monetary' indicators? Are there any opportunities to co-create joint programmes with these partners to reduce or share the cost of FES delivery? Are there any funding opportunities?

Conclusion

To wrap up, this guide on the Business Model Canvas helps reflect on the results and offers a template to use during working group sessions within LLs. This template can be used to evaluate the overall business model or focus on its most important categories. We can identify:

- *Strengths*: determine what the project does well, including unique resources, skills, and competencies that make it unique and valued.
- *Weaknesses*: assess areas where the project could improve, such as insufficient resources, inadequate skills, or inefficient processes.
- *Opportunities*: analyse the opportunities for growth and development that may emerge from the market, emerging technologies, or industry trends.
- *Threats*: assess the challenges and threats that could affect a business, such as competition, technological changes, or external events such as natural hazards.

As food for thought, it is suggested that the input data be evaluated according to these points before they are included in a BMC:

VALUE PROPOSITION

- Clarity and attractiveness of the value proposition to the target customer/target.
- Innovation and differentiation from competitors.
- Ability to solve specific customer problems or meet needs not yet covered

COSTS

- Clarity in operating cost structure.
- Efficiency in processes and allocated resources.
- Long-term financial sustainability

CAPTURING VALUE.

- Diversification of revenue sources.
- Competitive and appropriate pricing model for the market.
- Scalability of the revenue model.

RESOURCES

- Effective identification and management of key resources (human, financial, physical).
- Ability to access and use resources critical to the success of the business model.
- Sustainability of resources over the long term

ACTIVITIES

- Clarity and importance of activities performed for value creation.
- Operational efficiency and management of key activities.
- Ability to innovate and adapt activities to market needs.

Annex - BMC Workshop

The tools we are going to show can be used during stakeholder workshops held in each Living Lab. They can be presented in workshop mode. In such a workshop, all participants collaborate for a satisfactory elaboration of a business model idea applicable to local FESs.

It is advisable to fill in the available templates during a workshop to graphically visualize an idea that has only been sketched out up to that point, focus on aspects that have been ignored up to that point but which are important for the activation of a service/activity and also, if in a group, to encourage discussion and the exchange of opinions within the LLs and with different typologies of stakeholders.

Local meetings can be organized in different stages and may involve different participants. Initially, they will facilitate a group discussion about the Living Lab context at large, and then provide an opportunity for stakeholders who have more potential and interest to design and activate a new business model (es. SME, private forest owners…)

It is important to note that working with the BMC is beneficial - in addition to the individual purposes of some firms for their own activities - to involve different kinds of participants, incentivize them to think in a network about a possible common idea or project, in which everyone can identify a contribution to offer, and strengthen the local community.

The work on BMs carried out by Forest Eco Value in the LLs should be understood as supportive to local entrepreneurs, sharing best practices, and defining potential markets and opportunities for innovation. Of course, the whole process is voluntary. Therefore, the methodology proposed here allows to involve stakeholders around one or more shared topics to discuss and refine possible approaches, solutions and projects that can be implemented in the LL, based on their own resources and those offered by Forest Eco Value (e.g., list of BM archetypes[9]). The outcome hopefully could trigger collaborations and understandings among the subjects in order to concretely implement a project based on a sustainable business model for forest ecosystem services. The FEV BMC is thus set up as a support tool to facilitate the exchange of ideas, comparison, and grounding of project ideas.

When organizing local meetings with stakeholders, it is beneficial to consider some facilitation aspects. In the paragraphs that follow we assume that the workshop format will be preferred.

[9] A business model archetype is a predefined framework or template that represents a standard, recurring way of organizing and operating a business that can help companies find different ways to create, deliver, and capture value. Business model archetypes are better discussed below and in the WG ECO report.

Workshop goals

Clearly define the objective of the workshop: informative, project-related or other.

An **informative workshop** provides participants with information on a new project, policy or procedure. Typical activities include presentations, question and answer sessions, and distribution of information material. The main output is a clear understanding of the subject matter.

A **project-related workshop** involves participants in the planning and development of a project or initiative. In this case, activities may include brainstorming, mind mapping, group discussions and prototyping. Main outputs can be action plans, project outlines and collection of innovative ideas.

Participants

The type of participants to be involved needs to be decided by the coordinator based on the information collected in each Living Lab concerning the FES that will be addressed and a local analysis of the stakeholders. They can be institutional subjects (e.g., local public administrations, public managers), operational people (e.g. forest owners and workers, industry representatives), or a mix of both, depending on the workshop goal and the desired internal dynamics. Involving institutions can provide strategic insight and decision-making capacity, while operational staff can contribute practical and detailed knowledge and information on day-to-day operations. A mix of both roles allows the integration of strategic vision, policy perspectives with operational knowledge, ideal for cross-functional projects and continuous improvement.

Expected output

The expected output may vary: it may be networking without necessarily a written document, an insightful presentation, or other specific outcomes. Clearly defining the expected output in advance helps guide the workshop activities and ensure that the stated objectives are achieved.

Time and resources available

It is crucial to clearly establish the duration of the workshop (typically from 2 to 6 hours), and the number of facilitators needed to handle the participants (usually **1** to 3 for 20 people). A 2-hour workshop is ideal for focused and concise sessions; while a 4-hour duration is suitable for a combination of presentations and practical activities; a 6-hour workshop is useful for intensive sessions with detailed insights and group work (e.g., finalizing a business model).

Activities

Workshop activities may include *ideation, analysis, discussion, and synthesis*. Each activity must be planned to take into account the timing and mental energy level required.

1. Ideation involves generating new ideas and solutions through brainstorming and mind maps (e.g. a possible new business model).
2. Analysis evaluates the ideas already generated using tools such as *SWOT* analysis and *cause-effect* diagrams aiming at assessing the competitive advantage associated to alternative business models (e.g., the local applicability of a business model that has been theoretically framed in a previous session can be assessed through the mentioned tools).
3. Discussion involves the exchange of opinions and evaluations among participants through debates and round tables (e.g., the concrete implications of setting up a FES-based service offer for several stakeholders involved).

4. Synthesis gathers and organizes the ideas that emerged through flowcharts and concept maps (e.g., a document describing the feasibility of a new business model for institutions or organizations not directly involved in the workshop can be framed and written during a synthesis session) (see Figure l6)

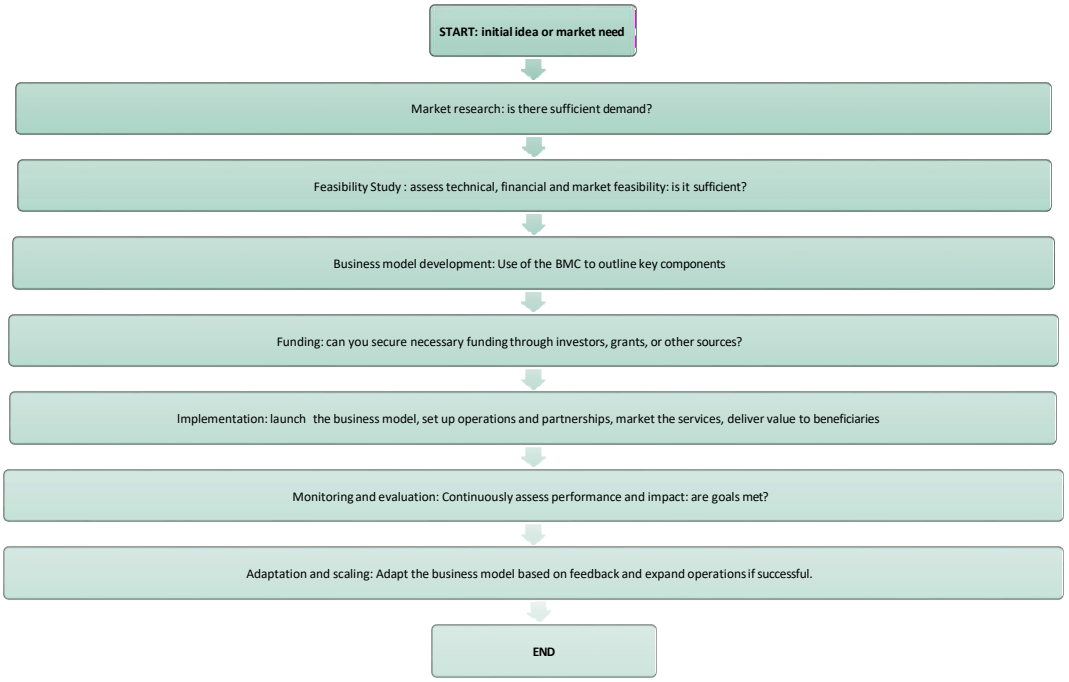


Figure 16. Example of a simple flowchart map applied to a business model

Class composition, groups, and roles

The composition of groups in a workshop needs careful planning. Groups may be equal or may include intermediate moderators. lt is important to decide whether groups will be random or representative of various stakeholders, such as institutional bodies, entrepreneurs and citizens. The groups may be thematic and may be fixed or they can rotate in the middle of the session. lt is recommended to form groups of 3 to S people to ensure active participation, avoiding too large groups that may be dispersive.

Media and tools

Media used in the group sessions can be paper, digital, or hybrid.

- *Paper media* include printed documents, post-it notes, and whiteboards, ideal for brainstorming and ideation (printable templates are available in the FEV repository).
- *Digital media* include collaborative software and online tools, facilitating information sharing and storage (e.g., mentimeter. etc.)
- *A hybrid approach* combines the benefits of both approaches. lt can be ideal for complex workshops and interactive sessions.

Arrangement of tables in space

The arrangement of tables must allow for alternating moments when participants sit, and others when they stand up, to keep them active. lt is essential to check that everyone has equal visibility of the tools and access to writing texts, to avoid only one or two people writing, and determining what is reported.

Before the BMC: Addressing the Living Lab Context and Challenges

The spatial and social context of the LL is the first place to start when working in the field. LL coordinators have some knowledge of the local context, but they may not be familiar with all the relationships and dynamics in the area of interest, as well as the stakeholders' perceptions of an objective fact or event.

When meeting with stakeholders selected for a specific LL, it is helpful to initially analyze the context and involve those present in identifying environmental and/or social challenges related to FESs within the LL. For FEV, challenges include the issues that the project aims to address with its solutions (e.g., unmanaged forests, application of sustainable forest management techniques, etc.).

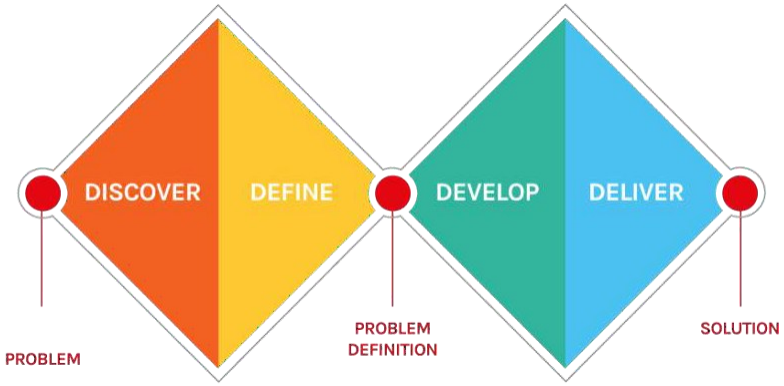
This step is preliminary to filling in the business model canvas. Each LL identified ecosystem services to work on aiming at enhancing and innovating forest management through new business models, and the choice of local FESs was also motivated by locally perceived needs and conditions to be shared with stakeholders.

Double diamond method

A general way to proceed for context analysis is by using the "double diamond" method (Figure l7), i.e., an approach derived from *design thinking* that alternates between divergent (*discover* and *develop*) and convergent (*define* and *deliver*) stages (Design Council, 20l8).

- The *discover* stage starts from the problem/need identified at the Living Lab level and collects as much objective information as possible for understanding the problem.
- In the *define* stage the data are processed according to priority, and the problem to be solved is precisely identified.
- The *develop* stage is characterized by being the most creative one, in which as many solutions as possible are identified, leaving room for imagination and without paying attention to the feasibility of the solutions: this phase gives space to the innovative part of Forest Eco Value, and its purpose of developing innovative, sustainable and *win-win* business models. Reasoning by analogy – as suggested in the previous paragraphs – can be a stimulus to find new ideas for FESs management.
- Finally, the *deliver* stage refers to the selection and adaptation of the most suitable ideas for the identified problem.

Figure 17. *Double diamond*



Source: Aton

At the beginning of a process, a diverse audience of participants is involved (e.g., small business owners, local authorities, voluntary associations, forest owners), the first two stages can be addressed, while the last two are more focused on identifying ideas to prototype, and thus might be more interesting for the design of a real business idea. In the next section, we will look at the first two stages.

Identify the problem

As mentioned in the introduction paragraph, in order to activate participants when meeting in groups, it is useful to divide people into subgroups and work in workshop mode by applying the "Double Diamond" method.

Discover

In the *discover* stage, participants should explore the environmental/social challenge by defining the issues involved, based on one's prior knowledge and comparison with the working team. When seeking information and data, you can refer to two types of sources: primary and secondary. Primary sources involve collecting data directly from the work team (direct knowledge), while secondary sources entail investigations carried out by others and are therefore indirect sources (e.g., industry or government reports). As a first step, secondary sources need to be consulted. They typically include reports and research, databases referring to the LL, and search for similar examples outside the LL.

Then, once some additional information has been collected, it is possible to collaborate in groups to explore the environmental and/or social issues emerged from secondary sources. An example might be organizing focus groups, a method used to understand a group's perceptions, ideas, and attitudes toward specific issues, i.e., using a primary source of information. The goal of such groups is to freely engage in discussion and bring in one's own point of view, but the whole exercise must be controlled by an outside moderator who can "guide" the group, by asking questions, making points, and summarizing key findings.

Define

To better focus the problem and lead to more comprehensive results (*define*), a supporting tool to be used is the "problem definition canvas", i.e., a tool that facilitates visualization of the problem by breaking it down into causes and effects. This analysis can help in directing the next step, which is the identification of solutions with their associated BMs. Figure 18 shows an example of a problem definition canvas to be used with post-it notes for visualizing its complex context. Understanding *whom* will be affected by the consequences and effects of a problem is important. This step helps to identify the stakeholders impacted by the problem and to be involved in the definition of specific BMC categories.

Particularly, the problem definition canvas allows to clearly state the problem to be addressed by the group, and answer questions on its primary and secondary causes and effects. Usually, primary causes of a problem are the direct ones, while the secondary ones are more general and context-dependent. For instance, low salaries and limited availability of infrastructure are primary causes of lack of forest management in the LL, while timber market prices and dynamics are secondary causes of the observed situation. Similarly, primary effects are the ones directly related to the problem and refer to the specific sector or industry under investigation, while secondary ones include the cascading effects on other sectors or dimensions of society. For instance, as a primary effect, a lack of forest management can cause increase

of forest cover in a region, as a secondary (cascading) effect it can increase the regional economic damages from forest fires.

Figure 18. *Problem definition canvas*

Source: WGECO own elaboration adapted from several templates

Stakeholders

By definition, stakeholders are those who are in some way affected by, or can affect the activities of an organization (e.g., an enterprise), or a project. Stakeholder analysis is used to identify influenced and influential subjects for an organization or a project, and understand the networks involving those subjects in the area, the ties and relationships that bind them.

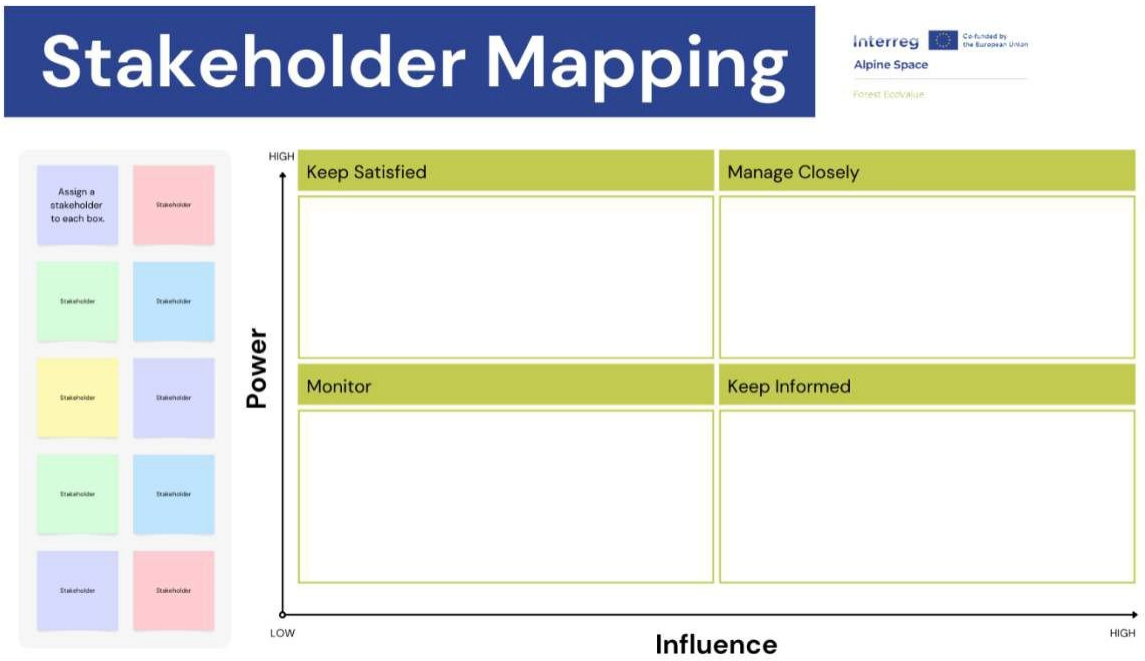
In general terms, stakeholders can be:

- *Direct beneficiaries:* subjects specifically involved in program or project activities, and benefit from the project and are touched by the problem.
- */ndirect beneficiaries:* subjects close to the direct target group and contribute to the operation/success of the project
- *Other stakeholders*: subjects being affected or influential in various ways to the activity of the organization or project. Depending on the nature of the entity performing the activity they may vary. For example, for a local association engaged in regional business development, they can be policy makers, funders, or citizen groups.
- *Customers*: those people or organizations who are willing to pay in exchange for a good, service or benefits delivered to them.

When in the phase of identifying the problem to be addressed, the group or groups (depending on the number of workshop participants) are invited to think about significant stakeholders as a basis for developing the BMC categories related to *partners* and *beneficiaries*.

A useful tool that can be adopted at this stage to draw a stakeholder map and assess the stakeholders revolving around a project to be implemented in a LL as a response to a problem/issue is the "influence-interest matrix". This method helps to map stakeholders and divide them according to the degree of influence and interest they have towards the problem/issue identified in the previous stage (Figure l9).

Figure 19. *Power/influence matrix for stakeholder mapping*



Source: own elaboration adapted from www.servicedesigntools.org

The group, based on the issue identified earlier, is required to fill out the matrix taking into account alternative combinations of the variables of power and interest reported below:

- *High power/high influence*: stakeholders holding significant decision-making power concerning the identified theme are part of this group. They need to be involved during the construction of the idea/service, roadmap, and in possible trade-offs. It is important to keep them aligned on their goals and achievements, seeking points of contact and preventing them from losing interest.
- *High power/low influence*: this group possesses great authority and decision-making power, but has little time. They need quick and fast information.
- *Low power/high influence*: people involved with little decision-making power, but can be useful for some details, so they need to be informed of project progress and listened to.
- *Low power/low influence*: they are not to be excluded, but should be monitored in case their status changes.

Attachments

l. Database of FES values Europe
2. Multi-criteria approach_ROM
3. Multi-criteria approach_Survey
4. Adapted Business Model Canvas
S. Problem definition canvas
6. Stakeholder mapping matrix
7. Value Proposition Canvas

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