Firelogue

Fire Up the Dialogue

D3.4 IMPACT ASSESSMENT METHODOLOGY HARMONIZATION II

Project: Cross-sector dialogue for Wildfire Risk Management

Acronym: Firelogue

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Lead Beneficiary	NOA			
Responsible Authors	Mariza Kaskara, Stella Girtsou, Nikolaos Bartsotas			
Contributions from	PCF, EDGE, INESTEC, TIEMS, VOST, CTFC, ADAI, UAH, KEMEA, HFS, TRI			

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List of Abbreviations

Abbreviation	Meaning
CBA	Cost Benefit Analysis
CSA	Coordination and Support Action
D	Deliverable
EC	European Commission
EI	Expected Impact
EU	European Union
IA(s)	Innovation Action(s)
KPI	Key Performance Indicator
LiDAR	Light Detection And Ranging
ML	Machine Learning
MVP	Minimum Viable Product
S-ROI	Social - Return on Investment
UAVs	Unmanned Aerial Vehicles
UP	User Product
WFRM	Wildfire Risk Management
WG	Working Group
WUI	Wildland Urban Interface

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Executive Summary

This document (D3.4) builds up on previous work (D3.1) and discusses issues related to the expected impacts mentioned in the call, as well as D3.4 acts as a second iteration of impact assessment methodologies developed by the Innovation Actions (IAs), with the ultimate goal to find common grounds.

The document is organized into five key sections:

- **Section 1** introduces the scope of the deliverable.
- **Section 2** offers an analysis of Expected Impacts (EI) in relation to the challenges that hinder their achievement.
- **Section 3** presents insights into the methodologies that each Innovation Action (IA) intends to employ.
- **Section 4** outlines the comprehensive efforts undertaken and unveils a collective approach to impact assessment methodologies.
- **Section 5** summarises the content of the deliverable.

Special thanks for the successful completion of this deliverable are extended to the teams associated with the three IAs.

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1. Introduction

Firelogue, as a Coordination and Support Action (CSA), aims to fulfil the CSA's remit by integrating the Innovation Actions' (IAs) findings across stakeholder groups and fire management phases. One of Firelogue's key objectives is to facilitate the impact assessment of WFRM measures and proposed solutions towards the impact expected by the call, while at the same time critically reflecting about those goals.

This document, Deliverable 3.4: Impact Assessment Methodology Harmonization II, is the second version of the Deliverable 3.1: Impact Assessment Methodology Harmonization, delivered in Month 6. Furthermore, the Deliverable 3.2: Baseline Assessment Report, submitted in Month 18 under "WP3 Common impact assessment methodology of WFRM IAs", presenting a summary of the variables available at European Level to assess the status of the expected impacts.

The D3.1 set the groundwork for a common impact assessment methodology of the three WFRM IAs, facilitating the harmonization of the different impact assessment methodologies (towards the impact defined by the call) that the specific IAs (FIRE-RES, SILVANUS, TREEADS) have started to develop. D3.1 described the detailed methodology to be followed for a coordinated evaluation of the impacts of technologies with respect to their contribution towards the expected impacts defined by the EC, as well as highlighted the available data to develop effective strategies to assess the impact. Through this task, Firelogue partners, supported by the partners from each of the IA projects extract valuable and easily measurable information regarding the contribution of each IA to the expected impacts. Deliverable's suggestion for a specification of all targets building on initial discussions with the Innovation Actions can be found in Annex I.

The D3.2 presented a summary of the variables available at European Level to assess the status of the targets proposed by the European Commission (EC) to the IAs as part of the H2020_LC-GD-1-1-2020 call, corresponding to a baseline for the year 2019 (and extended to the period 2010-2019 whenever possible).

This report here aims to highlight crucial elements associated with realizing the expected targets set forth for wildfire risk management, as outlined in the European Green Deal. Additionally, it seeks to arrive at a determination regarding the cumulative measurement of the impact generated by the three projects.

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2. Challenges of the Expected Impacts of the 2030 Green Deal Targets

Deliverable 3.1 listed the expected impacts, as defined in the respective Horizon 2020 calls and for each one provided a short definition (Table 5), the related Phase of wildfire management and some indicative KPIs to measure it. D3.1 also started the discussion about each expected impact and some views regarding achievability.

The H2020_LC-GD-1-1-2020 call proposes in its Statement of Work (SoW)[1] that: "*The actions funded under this call topic should jointly contribute substantially to achieving by 2030 the following targets in Europe (with respect to 2019)":*

- *0 fatalities from wildfires*
- *50% reduction in accidental fire ignitions*
- *55% reduction in emissions from wildfires*
- *Control of any extreme and potentially harmful wildfire in less than 24 hours*
- *50% of Natura 2000 protected areas to be fire-resilient*
- *50% reduction in building losses*
- *90% of losses from wildfires insured*
- *25% increase in surface area of prescribed fire treatments at EU level*

Given the absence of any supporting background documents or additional guidance, it becomes necessary to interpret the targets for the purpose of monitoring the actions taken by the IAs and their impact in contributing to these targets. The challenge also lies in quantifying the contribution of the projects to the various targets, as well as in the estimation of the potential scaling of the solutions at EU level and with an outlook towards 2030. Apart from that, this interpretation presents several challenges:

- **Complexity of Wildfire Risk Management** (WFRM): WFRM is a multifaceted challenge that involves various stakeholders with differing perspectives and, at times, conflicting objectives converging towards a single target. Developing integrated multi-stakeholder strategies for managing wildfire risk is a formidable task due to the diverse mandates and objectives of stakeholders, leading to potential conflicts over responsibilities and costs. Procedural justice and governance aspects, such as who participates in strategy development, defining priorities, and addressing issues like land-use restrictions, further complicate the process. It is crucial to specify the scales involved in wildfire risk management discussions, as distinct strategies and features are linked to local, regional, national, and EU levels, ensuring that tailored approaches effectively address varying degrees of wildfire risk and response. These challenges underscore the complexity of specifying WFRM targets and strategies, highlighting the need for multi-stakeholder discussions and considering contextual factors like culture,

[1] https://cordis.europa.eu/programme/id/H2020_LC-GD-1-1-2020 accessed in September 2023.

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legal systems, and governance in the decision-making process. The complexity inherent in wildfire risk management makes it challenging to isolate the contribution of single actions, activities, or measures to specific targets.

- **Desirability and Feasibility**: The desirability and feasibility of these targets vary depending on the analytical perspective, contextual factors, and the goals, political interests, and views of the stakeholders involved. Expected impacts for WFRM represent important aspirations, but closer examination reveals complexities in their achievability and desirability. For instance, the target of zero fatalities from wildfires, while desirable, may require challenging trade-offs, such as allowing certain fires to burn, potentially leading to property losses and emissions. Focusing solely on final targets can obscure critical underlying factors and normative questions. To navigate within the complexities of these targets and the trade-offs they entail, it's essential to explicitly address the prerequisites, potential approaches, and tensions between actions. Given the normative nature of these targets and their varying impacts on stakeholders, addressing justice issues and involving multiple perspectives requires a broader societal debate on the targets and how to attain them.

- **Controversial Target Specifications**: To effectively address societal wildfire risks, it's crucial to specify the targets in a way that considers their complexity and justice dimensions. Defining these targets involves not only quantifying them but also understanding their various interpretations across different contexts. For instance, defining "fire-resilience" or "reduction of emissions from wildfires" requires consensus on measurement methods, impacted areas, and the social and environmental effects. This involves engaging with stakeholders and considering questions about what should be measured, the geographic scope, impacts on affected communities, measurement techniques, supporting activities, and variations across different regions and environments. These considerations are essential for developing meaningful indicators and proxies for each target.

- **Inconsistent Data Quality and Availability**: To effectively monitor and assess progress toward wildfire risk targets, it's essential to address various challenges related to data. Data availability, quality, and consistency across countries pose significant hurdles. While programs like Copernicus and EUMETSAT provide valuable Earth observation data for monitoring wildfires, ground-based air quality monitoring is often limited, and the use of models introduces uncertainty in estimating emissions. Additionally, data ownership and the varying standards and formats used for data collection make cross-country comparisons difficult. To build evidence toward achieving these targets, resources are needed for activities, data collection and processing, and data storage and archiving.

- **Establishing Baseline Data**: The need to establish clear and agreed-upon baseline data is essential. This provides a solid foundation and serves as a benchmark against which to assess the impact. The Green Deal call aims to achieve impacts compared to 2019 values, but defining a baseline for these targets presents challenges because no historical data exist for these specific target dimensions. Building a baseline relies on existing data, which may not fully represent the new target specifications and actions. Furthermore, the lack of legal frameworks for mandatory documentation and data storage in various areas, such as

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fatalities, building losses, and prescribed fires, complicates the baseline assessment. To address this, a 10-year period ending in 2019 (2010-2019) was considered more representative of fire occurrence in Europe than just the year 2019 (D3.2). Firelogue proposed a European-level baseline assessment based on data from European institutions, striving for data consistency. However, data gaps and inconsistencies still exist in various areas, making the establishment of baselines challenging. For targets related to the resilience of Natura 2000 protected areas, assessing the "level" of resilience and defining thresholds remains complex, leading to evaluations focusing on changes in resilience, particularly aspects influenced by human intervention, in selected pilot sites proposed by the IAs.

- **Defining Target Scale**: The Green Deal's WFRM targets lack specification regarding the geographic scale, making it unclear whether they should be addressed at the country or EU level. This choice impacts data collection and responsibility attribution. Scaling data for comparison can be challenging, as some information is only available locally, while other targets require regional or national data. The scale decision also raises questions about how to balance efforts among Member States and whether over-achievement in one country can offset under-achievement in another, as well as considering local nuances and lessons for broader regions.
- **Consideration of Multiple Parameters**: Given the multifaceted nature of WFRM, it is essential to consider social, environmental, and economic parameters to compare different solutions based on their socio-economic impact. The Social Return on Investment (S-ROI) methodology, developed by TREEADS, can be used to assess the societal, economic, and environmental impacts of a wildfire management system, facilitating the comparative evaluation of different wildfire management systems. This methodology considers 22 socio-economic impact parameters, such as forest preservation, life protection, economic impact, and community resilience, specific to wildfires. Additionally, it incorporates various socio-economic indices like the Environmental Sustainability Index and Quality of Life Index to comprehensively evaluate the system's benefits.

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3. Impact assessment methodology and criteria per IA

This section aims to present the methodology that each IA intends to develop and apply in order to assess the projects' achievements against the expected impacts. This collection of IAs' impact assessment methodologies will form the basis for creating a common methodology for all the three IAs within Firelogue. This joint impact assessment will then be applied to present streamlined results to the EC.
It should be mentioned that currently the impact assessment methodologies have not been finalised by the IAs.

3.1 TREEADS

TREEADS is in the process of formulating an extensive array of systems and technological solutions that actively contribute to the diverse set of the expected impact. Table 1 provides illustrative examples of how the advancements within the TREEADS project align with and contribute to the various anticipated impacts.

Table 1: Exemplifications of the Contribution of TREEADS Developments to various impacts

Expected impacts	TREEADS Systems contributing to each impact
0 fatalities from wildfires	The TREEADS platform provides advanced capabilities that support the entire wildfires management lifecycle, including capabilities for before (prevention and preparedness), during (monitoring and real-time management), and after (impact mitigation) the extreme event. These capabilities will contribute to the minimization of fatalities.
50% reduction in accidental fire ignitions	TREEADS develops advanced technological tools (i.e., a real-time risk calculator, a neural network-powered risk factor indicator, and a model of Fire adapted communities) and creates initiatives for citizens' engagement. In this way it enables prevention and preparedness strategies that minimize accidental incidents.
55% reduction in emissions from wildfires	TREEADS' overall solution mitigates wildfires and impact this KPI in accordance with fire ignition reduction and by the better management of the incidents when they occur.
Control of any extreme and potentially harmful wildfire in less than 24 hours	TREEADS combines several tools and services for early detection and response. Accurate fire danger forecast of surveyed areas and the real-time data collected from the Unmanned Aerial Vehicles (UAVs) provide the ability to immediately intervene in the scene and thus to manage and control a possible wildfire effectively and in more timely fashion.
50% of Natura 2000 protected areas to be fire-resilient	Based on the implementation of tools like accurate fire danger forecast of surveyed areas, image spectrometry, LiDAR Forest Scanning, and others, TREEADS will help minimizing the overall percentage of wildfires as a result of Natura 2000 protected areas also. One of the TREEADS pilots also includes a specific Natura 2000 area were Fire detection and Response simulation in real environment are tested.
50% reduction in building losses	TREEADS uses advanced nanomaterial for fire-resilient buildings and infrastructure. The new materials and passive fire protection systems

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	developed during the project are implemented in the Wildland Urban Interface (WUI) to protect essential infrastructures including buildings.
90% of losses from wildfires insured	TREEADS develops and promotes specific Insurance Models and Risk Transfer Solutions, which will lower the barriers for insuring wildfires related losses. In this direction the project is also offering a wide range of technological solutions and tools that can provide insurers with large volumes of accurate data that enable the calculation of insurance premiums for wildfires and the offering of related products and services.
25% increase in surface area of prescribed fire treatments at EU level	The TREEADS forest and fuel mapping algorithm, wind model, and decision support system is used in the planning and application of the prescribed fire treatments at EU level.

To evaluate the benefits of the various systems developed in each Innovation Actions (including the benefits of their technological components), it is important to consider both **socioeconomic and environmental parameters**. In this direction, the TREEADS project is developing a **Social Return on Investment (S-ROI)** methodology for wildfires management applications. The TREEADS S-ROI methodology will be used to analyse the socio-economic impact of TREEADS and to derive "Cost-Benefit-Analysis (CBA)" and "Social-ROI" indicators that will enable the comparative evaluation of different systems and technologies. The development of this S-ROI methodology considers:

- Parameters that cover a range of environmental, social, and economic aspects that could be included in CBA and Social-ROI estimations. These parameters are commonly used in social value calculations.
- Indices from world-renowned methodologies, in order to attempt to quantify the above with metrics and "quantification" of qualitative data. Indices differ from individual parameters as they are typically calculated considering multiple socioeconomic and environmental parameters as input.

Both parameters and indices are selected and tilted towards ideas, specifically relevant to forest preservation and wildfire prevention actions, rather than "generic" (i.e., general purpose) social impact indicators that are broadly applicable to sustainability and European Green Deal projects.

Specifically, the TREEADS S-ROI methodology considers the following known twenty-two (22) socio-economic and ecological impact parameters that are relevant to wildfires covering the aspects outlined in the following list (Figure 1 in Annex II):

1. Forest Coverage and Protection: The extent of forested land protected or preserved.
2. Biodiversity Preservation: Protection of diverse plant and animal species in the forest ecosystem.
3. Life protection: Avoid loss of life and/or injuries for humans (and animals) due to wildfires.
4. Water Resource Protection: Preservation of water bodies, watersheds, and water quality. Improved Water Availability in the region.
5. Air Quality Improvement: Reduction in air pollution and particulate matter.
6. Wildlife Habitat Conservation: Preservation and restoration of habitats for wildlife species.

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7. Carbon Sequestration: Amount of carbon dioxide absorbed and stored by the forest.
8. Soil Erosion Prevention: Measures taken to prevent soil erosion and maintain soil fertility.
9. Climate Change Mitigation: Actions that help reduce the impacts of climate change.
10. Community Health: Improvement in the physical and mental health of local communities.
11. Economic Impact: Avoid disruption of infrastructure, blocked transportation, loss of communications, power and gas service, etc.
12. Economic Impact: Avoid destruction of property, buildings, industries, crops, etc.
13. Avoid property evacuation, loss of property value post-fire, loss of jobs and economic impact of destroyed business.
14. Economic Impact: Contribution to the local economy through employment and tourism.
15. Consequent natural disaster mitigation: post-Fire water floods and debris flows, or droughts due to wildfires dramatically changing landscape and ground condition.
16. Optimized public expenditure and resource allocation on firefighting and emergency response: Reduced Firefighting Costs, Efficient operations for preparedness and response.
17. Community Resilience: Strengthening the ability of communities to withstand and recover from disasters and have feeling of safety and security.
18. Renewable Resource Management: Sustainable management of forest resources for long-term benefits.
19. Improved Volunteerism and Community Engagement: Involvement of local communities and stakeholders in decision-making and in action processes.
20. Green Jobs Creation: Creation of employment opportunities in sustainable forestry and related industries.
21. Recreational Opportunities: Enhancement of opportunities for outdoor activities and recreation.
22. Ecotourism Potential: Enhancement of tourism potential based on the forest's ecological value.

Likewise, the following socio-economic indices have been also considered (Figure 2 in Annex II):

1. Environmental Sustainability Index: Measures the environmental impact and sustainability of a region.
2. Quality of Life Index: A measure that includes many factors like education, healthcare, income, and social well-being.
3. Human Development Index: A composite index that includes factors like life expectancy, education, and income.
4. Carbon Footprint Index: Measures the amount of greenhouse gas emissions produced by a region.
5. Air Quality Index: Measures the level of pollutants in the air.
6. Water Quality Index: Includes Water Resource Protection, infrastructures on clean water, sanitation, irrigation and other water usage.
7. Natural area and biodiversity preservation indices.
8. Happiness Index: Measures subjective well-being and life satisfaction.
9. Mortality and Injury Indices.
10. Perceived Sentiment of Safety and Security Index within society.
11. Morbidity Indices. Mental and Physical Health Indices.
12. Social Capital: The strength and extent of social networks, trust, and cooperation in a community.

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The TREEADS ambition is to develop an analytical methodology for wildfires impact assessment that **consider the relevant importance of the above-listed parameters**. To this end, TREEADS experts have been invited to rank the various parameters in terms of their relevant importance for wildfires management and for the TREEADS pilot. The relevant feedback has been solicited via a proper survey/questionnaire. Annex II presents the outcomes of the ranking process, which has led to the specification of a weighted score of each socio-economic impact assessment parameter and of each index. These weights serve as a basis for developing weighted formulas to be used in the S-ROI calculations.

3.2 FIRE-RES

FIRE-RES concept and methodology is meticulously devised with the primary objective of enhancing the resilience of landscapes to wildfires and implementing a holistic and integrated fire management strategy to efficiently and effectively address Extreme Wild Events. This endeavour is intended to make a substantive contribution towards the realization of the 2030 objectives set for Europe.

FIRE-RES has diligently undertaken the task of **conducting an extensive analysis** for each anticipated impact. Within this comprehensive analysis, a set of indicators were stablished to assess the impact of project tasks. Moreover, the project has developed systematic methodologies for the monitoring of each of these indicators.

The FIRE-RES project will use a **dual-method approach** considering both short- and medium-term impact assessments.

The **short-term impact assessment** methodology that the FIRE-RES project will use involves a set of Key Performance Indicators (KPIs) to monitor the project's activities. These KPIs will be selected to evaluate the performance of work of the project and will be used in both a preliminary impact assessment at Month 24 and an ex-post impact assessment at Month 46. The selection of the KPIs was done involving input from the different partners involved in FIRE-RES's innovations in collaboration with Firelogue. The KPIs will be used to measure the immediate effects of the project's work.

The **medium-term impact assessment** approach includes dissemination and upscaling activities, as well as a multi-actor approach project partnership with regional and national governments and the private sector. The project aims to achieve the medium-term impact by implementing the innovations throughout Europe jointly with the other projects belonging to the WFRM cluster, assuming a public-private upscaling framework. The effects on different dimensions, such as technological, economic, social, and land-use, will be assessed as complementary and synergetic. The project will also consider the contributions of other related projects under the WFRM Green Deal to achieve the expected impacts.

3.3 SILVANUS

SILVANUS aims to deliver an environmentally sustainable and climate resilient forest management platform, focusing on supporting wildfire management. The project will develop several innovative components, that have been named **User Product (UP)** that can support the management and the operations of different phases of wildfire management. The project will integrate all the UPs in the SILVANUS platform ensuring they are able to communicate between them and interchange data.

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At the moment, the project has focused on the development of a minimum set of functionalities that can be interpreted as a Minimum Viable Product (MVP). In particular, the MVP contains a total of 8 UPs:

- UP1: AR/VR training toolkit for trainers;
- UP2: Fire danger risk assessment;
- UP3: Fire detection based on social sensing;
- UP4: Fire detection from IoT devices;
- UP5: Fire detection from UAV/UGV;
- UP6: Fire spread forecast;
- UP7: Biodiversity profile mobile application;
- UP8: Citizen's engagement programme and mobile app.

Among the activities of the project there is the creation of an impact assessment framework to measure the contribution of the project in relation to the Expected Impacts (EIs) mentioned in the call for proposal (H2020-LC-GD-1-1-2020). Considering the characteristics of the project, e.g., the development of a platform composed of several components, and the expected impacts, the impact assessment framework of the project has been built by adopting an indirect approach.

Preliminary activity to the development of SILVANUS' impact assessment framework was the collection of information about the UPs from the partners in charge of their development. This collection allowed to identify and describe the contribution that the UPs developed in the project can bring to each of the EIs, if any. Different UPs will contribute differently to the same EI, some links will be more direct, while other will be more indirect, for this reason an explanation about all the links that have been identified between UPs and EI have been written for every UP, an example for a User Product that will perform fire detection from IoT devices is presented in Table 2. This activity has been carried out for all the UPs included in the MVP, leading to the realisation of summary table that provides a general overview between SILVANUS UPs and the EIs (Table 3). This activity will be carried out again as soon as new UPs are identified and approved for the inclusion in the SILVANUS platform.

Table 2: SILVANUS links of UP4 - Fire detection from IoT devices with the EIs

EI#	Y/N	Explanation
EI1	Y	The use of fire detection with IoT devices will allow to detect fires earlier, that will allow the firefighters to act sooner, thus reducing the spread of the wildfire and eventually the number of fatalities.
EI2	N	-
EI3	Y	The early detection of wildfires will allow to control the wildfire earlier and consequently emissions caused by wildfires will decrease.
EI4	Y	The early detection of wildfires will allow a faster response of the firefighters, reducing the time needed to control the wildfire, achieving response record bellow 24 hours.
EI5	Y	The early detection of wildfires will allow a faster response of the firefighters, reducing the time needed to control the wildfire and potential impacts, enabling on-going natural regeneration processes towards mature and more resilient habitats and reducing the risk of "locking" the system in a stage dominated by fire-prone communities (e.g., fire-prone shrublands).

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EI6	Y	The early detection of wildfires will allow to control the wildfire earlier, consequently there will be reduction of damage caused by the wildfire, including building losses.
EI7	Y	Proving the effectiveness of this tool to early detect wildfires could encourage insurance companies to redefine fire insurance rates, encouraging people to insure their goods.
EI8	N	-

Table 3: SILVANUS links between UPs and EIs

	EI1	EI2	EI3	EI4	EI5	EI6	EI7	EI8
UP1	X		X	X		X	X	
UP2	X	X	X	X	X	X	X	X
UP3	X		X	X	X	X	X	
UP4	X		X	X	X	X	X	
UP5	X		X	X	X	X	X	
UP6	X		X	X	X	X	X	X
UP7		X	X	X	X			X
UP8	X	X	X	X		X	X	

Having defined the potential contribution that the UPs can have on the EIs, a set of KPIs has been identified and described for each UP, collaboratively with technical providers and pilot leaders. The KPIs will be used to assess the performance of the UPs during the evaluation of the pilot trials. The set of KPIs are a made of a mix of elements to ensure that enough data is gathered, assuring that the evaluation has sufficient data to be reliable. For the UPs that will deliver training programs, specifically UP1 and UP8, a **learning evaluation survey** is planned to be created as soon as the training programs are finalised. The survey will allow to evaluate the efficiency that the training program had on its participants.

The last component that is planned to be included in SILVANUS' impact assessment framework is a **user satisfaction survey**. The user satisfaction survey will be included in the framework once the UPs' interfaces are finalised. This last element will serve to evaluate the design aspects of the UPs and the feelings of the users while using it, gathering suggestions on how to improve its usability and on additional features that could be included.

Table 4: Summary of the elements of SILVANUS' impact assessment framework

Component	Scope
KPI	Evaluate the performance of the UP during the pilot trials, allowing to verify if it is in line with the expectations.
Learning evaluation survey	Evaluate the efficiency of the training programs, allowing to understand if the training programs are effective in reaching the objectives of their programs as they are or if they need to be updated.
User satisfaction survey	Allow to evaluate the satisfaction of the user while testing the UPs, allowing to understand if the UI/UX design of the UP is appropriate for the stakeholders that will be using it.

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4. Joint Impact Assessment

FIRELOGUE envisages acting as a catalyst towards a more efficient and coordinated mitigation of extreme wildfire impacts as well as empower the WFRM community to face the current and future wildfire challenges. This section aims to establish an effective, well-coordinated methodology for harmonising WFRM impact assessments towards 2030 across the IAs.

4.1 Joint Impact Assessment Workshops

As soon as all IAs started, Firelogue diligently organized **bilateral** meetings with each IA. These meetings served as a foundational platform for initial discussions, ensuring that all stakeholders were unequivocally aligned with the overarching objectives of the collaborative endeavour.

In April 2022, during the first **clustering** event, Firelogue undertook the role of moderator for a session dedicated to Impact Assessment. This session brought together all relevant stakeholders from the IAs, fostering a comprehensive discussion on issues of paramount importance pertaining to impact assessment within the context of wildfire risk management.

After the **clustering event**, Firelogue proactively initiated a structured series of joint impact assessment workshops, convened at regular intervals of three months. These workshops represented a pivotal forum for the exchange of ideas, project progress updates, and collaborative problem-solving. Throughout these workshops, the teams of the three IAs engaged in substantive dialogues addressing various challenges associated with the Green Deal targets for wildfire risk reduction (Section 2). The discussions spanned a spectrum of critical considerations, including but not limited to feasibility and achievability, strategies for achievement, cumulative assessment as well as the scalability of solutions. Additionally, these workshops are a great opportunity for the 3 IAs to exchange knowledge on how to approach issues such as baseline assessment.

Firelogue actively took part in a panel discussion during the "**19th International Conference on Forest Fire Research**", convened in Coimbra in November 2023. This notable event convened a diverse assembly of stakeholders, encompassing policymakers and distinguished researchers. One of the primary objectives of Firelogue's engagement were to disseminate awareness regarding the critical topic of impact assessment to the discerning audience, stimulate constructive discourse regarding the current status of the assessment, and foster meaningful connections within the wildfire research community. The discussion served as a fertile ground for participants to interchange insights, experiences, and research discoveries pertinent to impact assessment.

In conclusion, Firelogue's commitment to facilitating **collaboration among the IAs** has yielded notable results. Through bilateral meetings, moderation of critical sessions, and the organization of regular impact assessment workshops, Firelogue has championed a culture of alignment, open discourse, and collective problem-solving. These initiatives have not only enhanced the progress of the IAs but have also enriched the collective knowledge base surrounding wildfire risk management and impact assessment. Such collaborative endeavours are pivotal in advancing the objectives of the Green Deal and in effecting meaningful change within the domain of wildfire risk reduction.

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4.2 Joint Impact Assessment Methodology

This section plans to describe the framework that will be built based on common aspects of the impact assessment methodologies defined by the IA against common criteria.

4.2.1 Extrapolating Future Impact across Different Times and Regions

The three IAs have undertaken a collective effort to collaboratively devise an extrapolation and prediction methodology. This methodology aims to quantitatively assess the impact of individual solutions on specific regions and scale up the impact, contingent upon the anticipated adoption and penetration of these solutions across different European regions.

The foundational premise of this methodology initially rested on a relatively simplistic assumption: the impact of a solution on one region is similar to its expected impact on another region as well. In essence, this approach serves the fundamental purpose of aggregating the contributions of multiple projects, enabling the estimation of the cumulative effects of these projects on target impact indicators.

The extrapolation process starts by estimating and validating the impact of a specific pilot project (hereafter referred to as "Pilot Xn," where X denotes the project and n denotes the specific pilot within that project) on each KPI, exemplified by "EI3 - Reduction in emissions from wildfires."

The process unfolds in the following sequential steps:

- Step 1: Estimation of the impact of Pilot Xn in 1 Region e.g., 30% Reduction over Baseline Values (B) (0,3 * B).
- Step 2: Estimation of the Penetration of the Solution across European Regions by the year 2023. This estimation may indicate, for example, that the solution is expected to be adopted in 5% of the total 735 regions.
- Step 3: Estimation of the Total Impact of the Single Solution (Pilot Xn) when deployed in the specific target percentage (e.g., 5%) of the European Regions. The outcome would be calculated as e.g., (0,05*0,3 * B) = (0,015 * B) (Reduction-Xn * B).
- Step 4: Repetition and Aggregation of these estimations for all relevant solutions that contribute to accidental fire ignitions i.e., Total Impact = Σij (Reduction-Xn)), where ij is the jth solution of the ith project.

It is imperative to acknowledge that more sophisticated methodologies are currently under development. These advanced approaches are specifically tailored to address scenarios where multiple solutions are concurrently deployed within the same European region. In such instances, statistical formulas are employed to quantify the potential impact and individual contributions of these diverse solutions to the overarching impact indicator.

4.2.2 Joint Impact Assessment Actions

During our joint impact assessment workshops (Section 4.1), several collaborative actions have been proposed to enhance our collective efforts. One crucial aspect of effective collaboration is the ability to

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demonstrate our progress through **tangible examples**. For instance, once TREEADS conducts its initial S-ROI (Social Return on Investment) evaluation, they can share this as an illustrative example for all other projects. This will enable other projects with similar goals and characteristics to consider and potentially adopt a similar approach.

Another valuable initiative that we can explore further is the **comparison of methodologies**. In cases where the different projects aim to do similar actions, we can conduct experiments using the various methodologies employed within the three projects. For example, we can apply our three different assessment methodologies to a common technology or process used across the projects. By doing so, we can compare the results and identify the strengths and weaknesses of each methodology. However, it's essential to delve deeper into this matter since it can be challenging to locate common technologies suitable for application in similar case studies.

To facilitate this collaborative effort, we emphasize the importance of **sharing baseline data**. Firelogue has committed to provide a deliverable related to baseline assessment through the Deliverable 3.2, fostering a cooperative environment where valuable information can be exchanged and utilized collectively to achieve our common goals.

Our **ultimate objective** is to converge towards a homogeneous methodology that capitalizes on the best practices and insights from all the impact Assessment that will be conducted within the IAs. This harmonized approach will not only streamline our efforts but also ensure consistency and reliability in our assessments. Ultimately, our goal is to present to the Commission with a well-reasoned recommendation on the most effective path forward.

Until today, discussions have been ongoing regarding the joint impact assessment that could be conducted.

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5. Conclusions

In the pursuit of achieving the ambitious wildfire risk management targets set forth in the 2030 Green Deal, this report has undertaken a comprehensive **analysis** of the challenges and methodologies associated with assessing the impacts of the IAs in the Firelogue project.

A **harmonized approach** to impact assessment is essential when multiple projects share a common goal. Firstly, it enables a consistent evaluation of the combined impact of these projects, providing stakeholders with a clear and comprehensive understanding of their collective contributions. Secondly, it helps identify potential synergies and overlaps, allowing for more efficient resource allocation and coordination among projects. Additionally, a harmonized approach promotes transparency and accountability, as it ensures that the assessment criteria and metrics used are standardized and comparable across projects, facilitating accurate reporting and decision-making. Finally, it enhances the ability to communicate the broader societal benefits of these initiatives by presenting a unified, coherent narrative of their impact on the shared objective.

In conclusion, the journey towards achieving the wildfire risk management targets of the 2030 Green Deal is fraught with **complexities**, from defining targets to assessing their impact. The collaborative efforts of the IAs within the Firelogue project, under the guidance of Firelogue itself, are crucial in addressing these challenges and facilitating progress towards a safer and more sustainable wildfire management future in Europe. This report marks a significant milestone in that journey, providing valuable insights and methodologies to guide future actions.

During the **next 2 years**, Firelogue plans to continue with the Impact assessment Workshops and to foster the discussion on impact assessment among the IAs. Continuous adaptations to the suggested methodology will be made in close collaboration with the IAs and an “Action Plan” towards 2030 will be developed. Next deliverable of the “WP3 Common impact assessment methodology of WFRM innovation actions” will be the “D3.3: Impact Assessment Action Plan towards 2030” in M48, which will provide a set of recommendations for actions towards meeting the 2030 desired impact. Additionally, an interim version of these recommendations will be accessible in M36, allowing ample time for in-depth discussions among the Innovation Actions (IAs).

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6. Annex I

Table 5: Suggested expected impacts definitions

#	Expected Impact (EI)	Definition
EI1	0 fatalities from wildfires	Fatalities are defined as those that would not have otherwise occurred, if there had not been a wildfire. This includes direct fatal casualties (in the fire), as well as any indirect fatalities as a result of injuries caused by a wildfire incident. Even if the casualty dies at a later date, any fatality whose cause is attributed to a wildfire is included.
EI2	50% reduction in accidental fire ignitions	Human-caused wildfires as result of accidental (not intentional) ignition sources are ignitions that were not intentional and can be altered through prevention efforts. In these fire ignitions, all human causes (electrical network, railroad, campfire, smoking, fire use, candles, cooking/electrical appliances, equipment, railroad, juveniles, farm machinery etc.) are included.
EI3	55% reduction in emissions from wildfires	There is a wide range of contaminants that could be in theory assessed. Some of them are: 1. Carbon dioxide (CO2) emissions 2. Carbon monoxide (CO) 3. Nitrogen oxides (NOx) emissions 4. Methane (CH4), etc.
EI4	Control of any extreme and potentially harmful wildfire in less than 24 hours	Control is the process of completely suppressing the combustion in the perimeter of the wildfire. Control occurs by removing one of the three ingredients fire needs to burn: heat, oxygen, or fuel, within 24 hours since the recording of the initial ignition time. Harmful wildfires are those that can potentially become social, economic, and environmental disasters.
EI5	50% of Natura 2000 protected areas to be fire-resilient	• Officially declared Natura 2000 areas. • Fire resilience based on the geographical coverage area. • Fire-resistant ecosystems by promoting the resilience of old-growth forests or by adapting young forest under natural evolution to expected climate change impacts, optimizing protection and provision functions in managed areas. • Two forms of resilience: (i) Adaptive resilience to wildfire centres on managing both the human and non-human environment in response to changing climate and fire regimes and increasing wildfire risks and exposure of human communities; (ii) Transformative-resilience requiring a profound shift in the human relationship with the environment and the wildfires, that embraces the dynamic and rapidly changing role of fire in social ecological systems (McWethy, D. Et al, 2019)
EI6	50% reduction in building losses	A building is a structure with a roof and walls, such as a house or factory. Structural loss means any loss as a result of wildfire ignitions.

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EI7	90% of losses from wildfires insured	Types of insured losses include home property, garage, tool shed, belongings, vehicles, businesses, etc. and anything else that can be insured.
EI8	25% increase in surface area of prescribed fire treatments at European (EU) level	1. Prescribed fire treatments include the planned use of fire to achieve precise and clearly defined objectives. 2. Introduced in south Europe to control fire regimes by managing fuels, counteracting the disappearance of biomass-consuming practices, and reducing the fire risks inherent in highly flammable forests and shrublands. 3. The primary objective prescribed burning is to reduce risks to human and natural assets via modifications to fire behaviour, although prescribed burning can be undertaken to promote ecological assets or for cultural purposes (Penman et al., 2011).

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7. Annex II

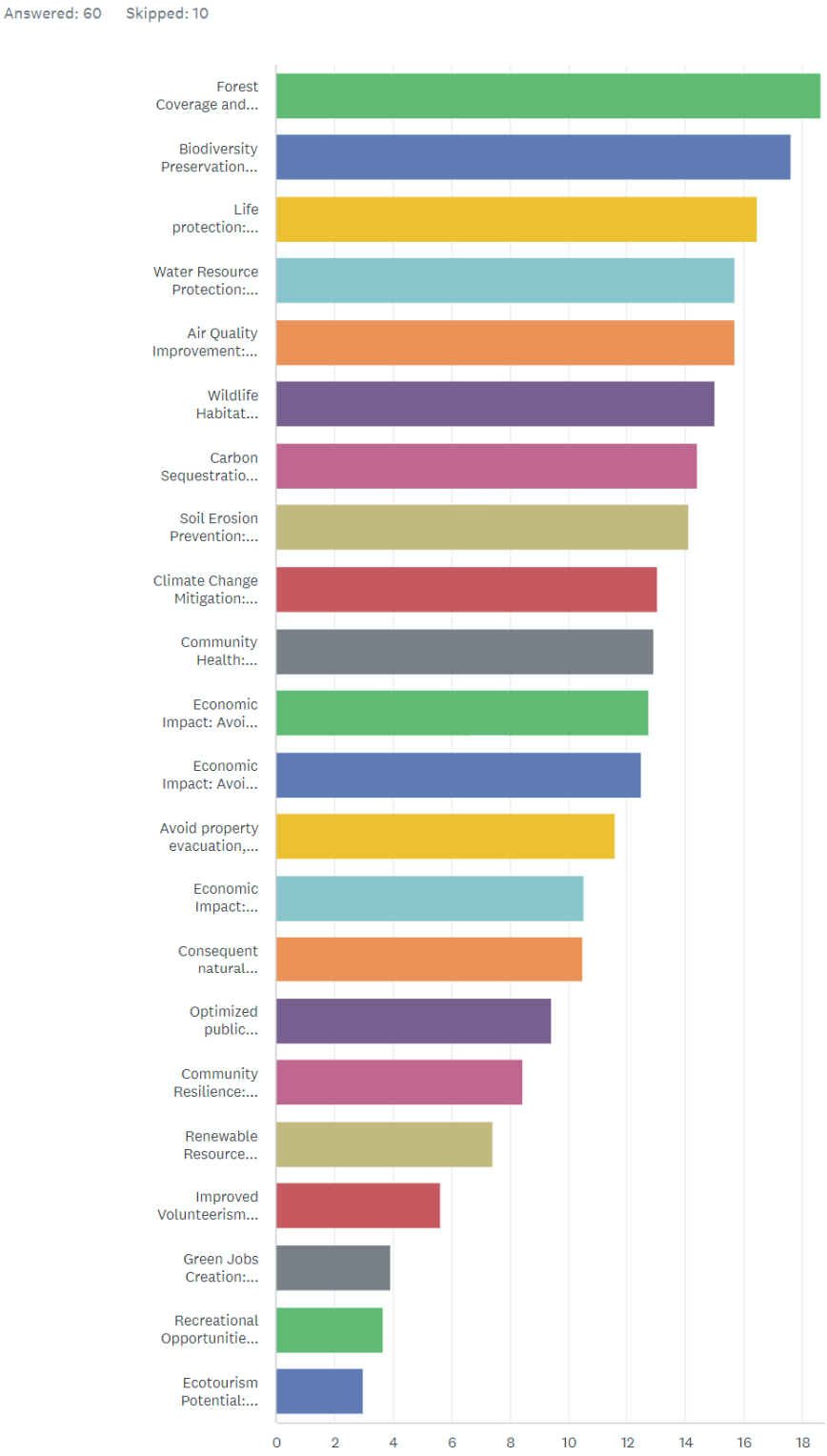

Figure 1: Experts' Ranking of the various Socio-Economic Impact Parameters

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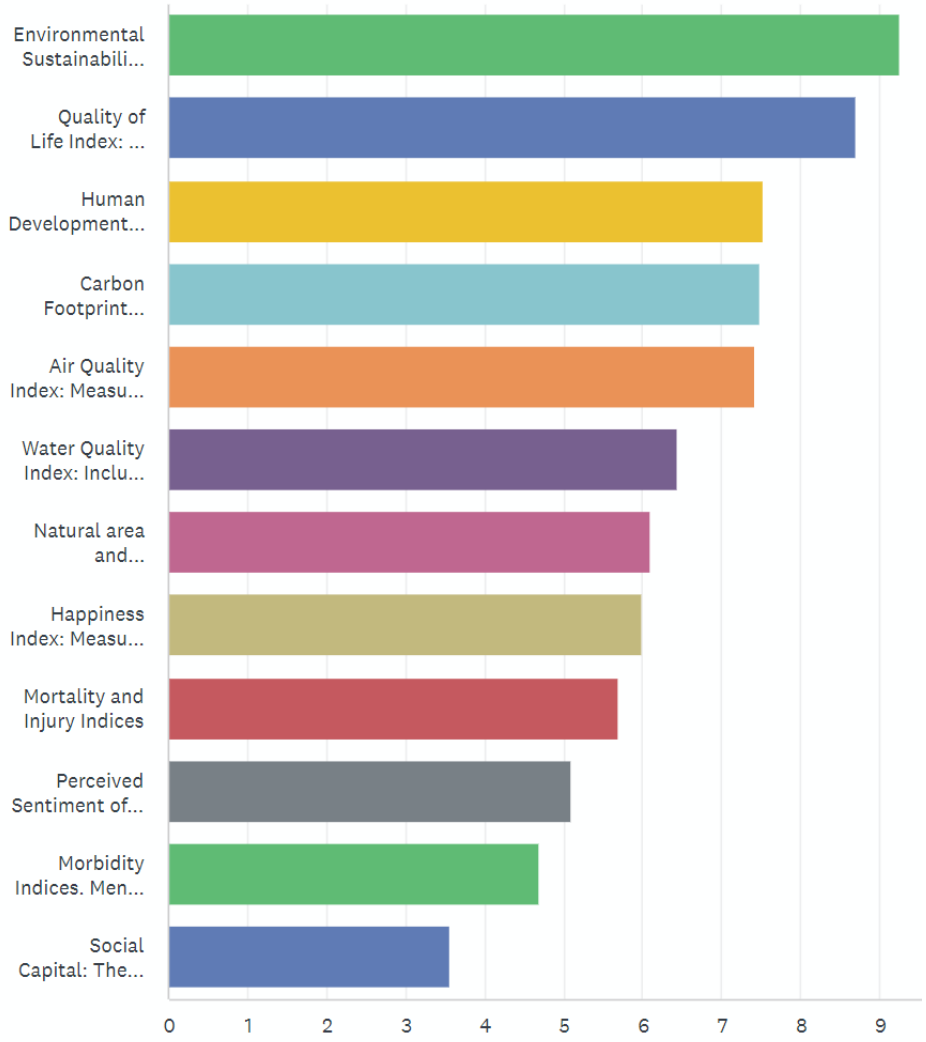

Figure 2: Experts' Ranking of the various Socio-Economic Impact Indices

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8. References

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