



Brussels, 12 February 2016

COST 027/16

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action “Climate-Smart Forestry in Mountain Regions” (CLIMO) CA15226**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Climate-Smart Forestry in Mountain Regions approved by the Committee of Senior Officials through written procedure on 12 February 2016.



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MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA15226 CLIMATE-SMART FORESTRY IN MOUNTAIN REGIONS (CLIMO)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

- a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14);
- b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14);
- c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14);
- d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14).

The main aim and objective of the Action is to enable forestry, like agriculture, to challenge the adverse impacts of climate change taking into account the costs for mitigation and adaptation strategies. This will involve translating to mountain forestry the FAO-defined concept of Climate-Smart Agriculture (CSA), which integrates the three dimensions of sustainable development (economic, social, environmental). This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 56 million in 2015.

The MoU will enter into force once at least five (5) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14.

OVERVIEW
Summary

Climate-Smart Agriculture (CSA) integrates the three-dimensions of sustainable development (economic, social and environmental), and aims at sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change (CC), and reducing greenhouse gas emissions. CLIMO wants to translate the CSA concept for a Climate-Smart Forestry (CSF). Three main pillars will be considered: improve livelihood of mountain inhabitants by sustainably increasing forest ecosystem services (ES); enhance the adaptation and resilience to CC of mountain forests; optimise the CC mitigation potential of mountain forests, focusing on the most efficient and cost-effective mitigation options and capitalising on adaptation-mitigation synergies. The main objective is to define CSF in the European context, which will require the identification of key silvicultural characteristics and the harmonisation of CSF in mountain areas to create a common knowledge at European level. The “smartness” of the European forests will be defined according to the sustainability of forest management and mitigation potential. The “smartness” will be defined on the basis of measurable criteria and a checklist of parameters of “smartness” for mountain forests will be proposed. Experimental forest sites with available data to quantify the “smartness” of mountain forests will be identified to build a European Smart Forest Network (ESFONET). A feasibility study for the development of a cyber-technology able to quickly transfer data from monitoring sites to stakeholders will be developed. Innovative schemes of payment for ES (PES) will be developed to shift the objective of mountain forest management from the production of timber to the production of ES.

Areas of Expertise Relevant for the Action <ul style="list-style-type: none"> ● Agriculture, Forestry, and Fisheries: Sustainable forest management 	Keywords <ul style="list-style-type: none"> ● Forest management ● Ecological resilience ● Stand complexity ● Mitigation options ● Ecosystem services
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Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

- DEFINITION OF CLIMATE-SMART FORESTRY AND IDENTIFICATION OF “SMARTNESS” CRITERIA FOR THE EUROPEAN MOUNTAIN FORESTS

This will require the identification of key silvicultural characteristics and approaches, considered “smart” from all members of the CLIMO Action. Understanding, “translation”, and harmonisation of CSF in mountain areas are necessary to create a common knowledge.

- CREATION OF AN EUROPEAN SMART FOREST NETWORK (ESFONET)

This will be achieved through the identification of experimental forest sites with available data to quantify the “smartness” of mountain forests. CLIMO will build ESFONET, composed of experimental sites, strategically distributed across major geographic, climatic and vegetation gradients, with long-term dataset.

- ANALYSIS OF THE REQUIREMENTS FOR THE DEVELOPMENT OF A CYBERNETIC WEB OF EXPERIMENTAL STRUCTURES

A feasibility study for the development of cyber-technology to transfer data from monitoring sites to stakeholders will be developed to integrate new generation, real-time measurements and wireless sensor

communication into the traditional ecological and silvicultural studies.

- DEVELOPMENT OF INNOVATIVE SCHEMES OF PAYMENT FOR ENVIRONMENTAL SERVICES (PES).

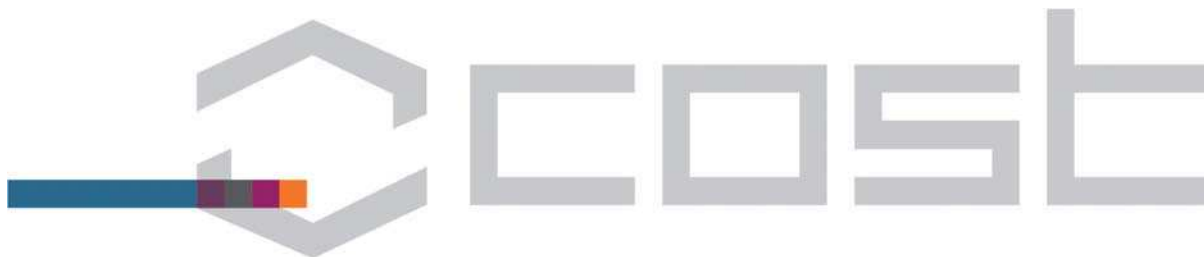
Since the use of PES could increase and maintain the multifunctional role of forests, innovative schemes of PES will be developed to provide additional income opportunities from the provision of ES besides the traditional production of timber in mountain forests.

- DISSEMINATION OF RESEARCH RESULTS TO THE GENERAL PUBLIC AND TO STAKEHOLDERS.

To increase the awareness of the general public, specific reports and other communication tools will be elaborated. To join the stakeholders, a specific road map around European countries will be designed to disseminate the knowledge about tax reduction possibilities.

Capacity Building

- Through an activity of synthesis and merging of the available knowledge on sustainable forestry, climate change adaptation and mitigation strategies, the Action will define the characteristics of CSF in mountain areas and will identify the criteria to define the “smartness” level of European mountain forests.
- A network of experimental forest sites will be designed having the potential to serve as a regionally distributed, multi-site, multi-sensor platform for detection and monitoring of long-term environmental changes for mountain forests and rangelands of the European countries and associated members.
- The establishment of an integrated technological platform to monitor environmental changes and test mitigating strategies, from local to continental scales, will complete the set of tools aimed to promote CSF in mountain areas.
- The action will also propose innovative schemes of PES useful to the development of policies supporting the delivery of ecosystem services crucial for the economic growth of mountain areas as challenged by climate change.
- CLIMO will create the first European network for the application of CSF in mountain regions with the aim of promoting the adoption of CSF criteria in the policy process at national level, fostering knowledge exchange between scientists, with an interdisciplinary approach connecting different scientific disciplines and involving early career investigators.
- Involve PhD students, particularly those from less research-intensive countries, in international joint research programs, conferences, workshops and training schools.



DESCRIPTION OF THE COST ACTION

1. S&T EXCELLENCE

1.1. Challenge

1.1.1. Description of the Challenge (Main Aim)

Mountain regions occupy around one third of Europe and hold 118 million of people, including 10 countries with half of their populations living in mountains. Forests cover 41% of the total mountain area – with over half in the Alps, Balkans, Carpathians, and Pyrenees – and are the dominant land cover except in the Nordic mountains. Most mountain forests are semi-natural or naturally regenerating forests that, through forest management activities, provide diverse ecosystem services (ES) and livelihood opportunities. According to the conceptual framework proposed by the Millennium Ecosystem Assessment (MA, 2005) forest ecosystem services (FES) include supporting services (e.g. soil formation, photosynthesis, habitat for flora and fauna, watershed protection), provisioning services (e.g. production of timber, fuel, non-timber forest products), regulating services (e.g., regulation of water flow and quality, erosion prevention, climate change (CC) mitigation, air purification, carbon sequestration), and cultural services (e.g. aesthetic, spiritual, recreational). The majority of FES is non-marketed public goods or common resources; therefore, an adequate provision of those services is needed to support both beneficiaries and suppliers (i.e., people living in mountain areas) (EFI 2014a). The recent report on impacts and vulnerability to CC in Europe highlights the fragility of mountain areas and forest ecosystems faced with environmental change (EEA 2012; IPCC 2014). Rising atmospheric carbon dioxide concentrations, higher temperatures and changes in precipitation are likely to have significant effects on the vegetation period, growth, health and distribution of trees as well as on forest ecosystems, and thus on the goods and services provided by forests. The increase in temperature is particularly large in many mountain regions, where loss of glacier mass, reduced snow cover, thawing of permafrost and changing precipitation patterns, including less precipitation falling as snow, have been observed and are expected to increase further. This could lead to an increase in the risk of floods and soil erosion, forest fires and a decrease in winter tourism (EEA 2012). The concept of Climate-Smart Agriculture (CSA) was defined and presented by the FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, as an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under CC. CSA integrates the three-dimensions of sustainable development (economic, social and environmental) and aims at sustainably increasing agricultural productivity and incomes, adapting and building resilience to CC, and reducing and/or removing greenhouse gas emissions, where possible. Forestry, as for agriculture, needs to challenge the adverse impacts of CC taking into account the costs for mitigation and adaptation strategies (FAO 2013).

CLIMO wants to translate the CSA concept to mountain forestry. Taking into account FAO key messages for a Climate-Smart Forestry (CSF) in mountain areas, a similar three-dimensional approach of sustainable development is proposed, by identifying three main pillars that will:

- improve livelihood of inhabitants in mountain regions by sustainably increasing ES provided by forests and their payment;
- enhance the adaptation and resilience to CC of mountain forests;
- optimise the CC mitigation potential of mountain forests, focusing on the most efficient and cost-effective mitigation options and capitalising on adaptation-mitigation synergies.

1.1.2. Relevance and timeliness



The beginning of the millennium is emerging as a time of great environmental and societal changes, which includes a rapidly changing climate, a continuous input of atmospheric pollutants, and current and projected shifts in the current and projected trends in demographics and land use. Together, these challenges threaten the health and sustainability of natural systems. The demand for a better understanding and monitoring of these environmental changes and a need to expeditiously communicate this information among scientists, policy makers, land managers, and the concerned public has never been greater. Mountain forests yield multiple benefits, they support biodiversity, mitigate natural disasters, sequester carbon, but they also provide an environment for sustainable commercial activity.

The new European Forest Strategy (EC 2013) gives a new framework in response to the increasing demands put on forests and to significant societal and political changes that have affected forests over the last decades. Its guiding principles are: (i) sustainable forest management and the multifunctional role of forests, delivering multiple goods and services in a balanced way and ensuring forest protection; (ii) resource efficiency, optimising the contribution of forests and the forest sector to rural development, growth and job creation; (iii) global forest responsibility, promoting sustainable production and consumption of forest products. The CSA Sourcebook (FAO 2013) outlines key messages for the development of a CSF, aimed at facing the threats posed by CC and climate variability to the delivery of goods and services from forests and trees that are essential to livelihoods and food security, to environmental sustainability, and to national development. According to the FAO document, CSF in mountain areas should:

- introduce CC into forest policy and practice by capturing synergies and managing trade-offs with other forest management objectives, i.e., to foster a widespread application of sustainable forest management (SFM) principles;
- develop strategies to strengthen local institutions and governance processes to improve capacities for sound forest-related decision-making under uncertainty and supporting adaptation actions;
- drive the transition to CSF at all levels (individual/enterprise, community, national and regional) and time scales;
- design adaptation actions targeted at the most vulnerable communities and sectors of the population and forest systems, focusing on the most efficient and cost-effective mitigation options and capitalizing on adaptation-mitigation synergies;
- increase the understanding of FES in order to maintain and enhance them will be of heightened priority together with the development of policies to support their delivery;
- foster a sensitive approach to forest planning and management better able to adjust to changes in markets for forest products caused by CC responses, particularly mitigation policies.

At the end of July 2015 the new strategy for the Alpine Region was launched as well (CE 2015a) that includes, among the objectives of its action plan, a more inclusive environmental framework and renewable and reliable energy solutions for the future, aimed at preserving the environmental heritage of the Alps, helping the Region benefit from its resources and to cope with the changes predicted as a result of CC, including preventing major natural risks. The action plan (CE 2015b) among others, encourages action and projects aimed at the valorisation of the services of the Alpine Region's ecosystems, to the setting up of a Virtual Alps Observatory that brings together Alpine research centres and helps to improve prognosis and common efforts into the research on CC adaptation, to conduct research on regional and transboundary adaptation, fostering the use of more standard data and protocols for risk assessment in the Alpine Region.

A comprehensive approach to sustainable management of mountain forests requires a cross-sectorial collaboration among scientists from different backgrounds and with different skills able to propose practical solutions for the challenges posed by CC to policymakers and stakeholders. The CLIMO initiative proposes a strategy to modernise the appeal and vision of mountain forests and build a "whole" green infrastructure at the continental scale. The Action will directly contribute to the Rovaniemi Action Plan's vision (UNECE/FAO 2014b), which suggests that forest sector governance

systems should take into full account all of the FES, thus compensating suppliers for providing them whenever feasible. Since forest provision of ES and resilience become critical, schemes of Payment for Ecosystem Services (PES) could be a valid tool to maintain these services (UNECE/FAO 2014a). By creating a well-distributed and competent network of scientists and stakeholders, CLIMO will build the foundations for both CSF and contribute to the forest sector to a greener economy.

1.2. Specific Objectives

1.2.1. Research Coordination Objectives

The objective of this proposal is to define the criteria of CSF and promote their application to European mountain regions. This will be carried out through five main objectives that are described below:

1. DEFINITION OF CLIMATE-SMART FORESTRY AND IDENTIFICATION OF “SMARTNESS” CRITERIA FOR THE EUROPEAN MOUNTAIN FORESTS

The first objective is to define CSF in the European context; this will require the identification of key silvicultural characteristics and approaches, which are considered “smart” from all members of the CLIMO Action. An understanding, “translation”, and the harmonisation of CSF in mountain areas are necessary to create a common knowledge at European level.

Consequently, the “smartness” of the European forests will be defined according to the sustainability of forest management, and the adaptive and mitigation potential to CC. For each of these three principal groups, the “smartness” will be defined on the basis of measurable criteria and, consequently, a checklist of parameters of “smartness” for mountain forests will be proposed. This main objective will be achieved by sub-objectives:

- development of a common definition of CSF in multidisciplinary and participatory manner on what the characterizing criteria of CSF are;
- definition of measurable criteria of “smartness” for mountain forests;
- creation of a document which will define CFS and the characteristics of smart forests;
- classification of the European mountain forests in smart classes, first at national level then at European or regional level;
- provision of a cartographic representation of European Forests in smart classes.

2. CREATION OF AN EUROPEAN SMART FOREST NETWORK (ESFONET)

This will be achieved through the identification of experimental forest sites with available data to be used to quantify the “smartness” of mountain forests. Taking advantage of the current research infrastructures CLIMO will build the European Smart Forest Network (ESFONET). The ESFONET will be composed of experimental sites, well established, strategically distributed across major geographic, climatic and vegetation gradients, where long-term dataset, providing state-of-the-art scientific information on European forests, water, and air resources exist. European LTER (Long Term Ecosystem research) Network sites located on mountain areas will be invited to join ESFONET. The ESFONET data will be used to quantify the parameters of “smartness” identified in the previous objective and consequently to classify the European mountain forests in different “smartness” classes. This objective will require a discussion on the harmonization and standardization of the data already available and future data.

This main objective could be organized in the following sub-objectives:

- drawing up of an inventory of experimental sites in mountain forests located in the participating countries suitable for being part of ESFONET;
- identification of the evaluation criteria that allows the assessment of a research infrastructure to be part of ESFONET;
- production of a document providing indication about how to harmonize and standardize data to be used to monitor the “smartness” of mountain forests.

3. ANALYSIS OF THE REQUIREMENTS FOR THE DEVELOPMENT OF A CYBERNETIC WEB OF EXPERIMENTAL STRUCTURES

A feasibility study for the development of cyber-technology able to quickly transfer data from monitoring sites (e.g., micro-meteorological and hydrologic data from long-term monitoring sites or national experimental forests) to stakeholders will be developed in order to evaluate the possibility of integrating new generation high frequency, real-time sensor-based measurements and wireless sensor communication into the traditional ecological and silvicultural field-scale studies. Stakeholders will be provided with short reports or alerts based on the gathered data and their interpretation. Sites without sensor networks in place can be interested in developing cyber technology, willing to participate in further informational and developmental meetings surrounding the topic of sensor installation and data management. The objective is to analyse the prospect of building a cybernetic web site as a single point of entry from experimental forest sites equipped with a synergistic technological platform, designed to monitor and respond rapidly to environmental change from the local to regional - and continental scales.

This main objective will be achieved by these sub-objectives:

- discussion of the state-of-the-art technologies for the measurements of forest parameters linked to "smartness" and fostering of its deployment in the ESFONET network;
- identification of standardized cyber technology for collection, and wireless transmittal to the internet of, a foundational set of environmental measurements at ESFONET sites;
- analysis of the ESFONET dataset with the double aim of selecting CSF proxy data to be monitored and discussing the way of harmonization of the already available and future data;
- analysis of the near real-time access to high quality forest environmental sensor data from ESFONET sites to a single point of entry web site;
- discussion about the visualization, interpretation and outreach tools to engage researchers, resource managers, educators and the public with smart forests.

4. DEVELOPMENT OF INNOVATIVE SCHEMES OF PAYMENT FOR ENVIRONMENTAL SERVICES (PES).

Since the use of PES could increase and maintain the multifunctional role of forests (UNITED NATION 2014), innovative schemes of PES will be developed to provide additional income opportunities from the provision of ES besides the traditional production of timber in mountain forests. This will be achieved by the following sub-objectives:

- general evaluation of the ES provided by forests of the main European mountain ranges, and their trade offs and vulnerability to CC;
- exploration and brief analysis of the existing PES schemes and approaches applied in different studied regions and countries. All relevant existing PES mechanisms will be considered to allow cross-regional learning based on the results of the analysis;
- definition of input for future market applications and/or tax reductions as a compensation for the ES provided by the forest.

5. DISSEMINATION OF RESEARCH RESULTS TO THE GENERAL PUBLIC AND TO STAKEHOLDERS.

In order to increase the knowledge and awareness of the general public on the ES, specific reports will be elaborated, together with website and workshop media, press conference, seminars, or email-based list. To join the stakeholders, a specific road map around the European countries will be designed to disseminate the knowledge about the possibility of tax reductions and other products/findings.

Specific sub-objectives are:

- the formulation of a document with guidelines and recommendations about the road to follow to reach a reasonable level of CSF in European mountain regions;
- the creation of a report on the characteristics of CSF in European mountains and on the mapping of different "smartness" classes of the European forests;

- the dissemination of research results to the general public in order to increase their knowledge and awareness on the ES.

1.2.2. Capacity-building Objectives

Being the springboard for new research ideas, CLIMO will use the combined experiences of COST members to initiate new directions and projects in CSF research, responding to research needs in European mountain areas. Opportunities and events from CLIMO, such as short-term scientific missions and other networking activities, will be organised to strengthen the interdisciplinary and transnational activities. In particular, CLIMO seeks to:

- create an international network of scientists, stakeholders, forest technicians responsible of the ESFONET datasets, with the double task to work on the selection of CSF proxy data to be monitored and to discuss a possible way for the harmonization of the data available and future data;
- develop a forum for knowledge exchange with different scientific backgrounds to enable the interdisciplinary approach required (due to the multi-functionality of mountain forests), defining the criteria for a CFS, this will create bridges between different science disciplines,
- promote the adoption of CSF criteria in the policy process at national level in the Action member's countries by facilitating knowledge exchange between scientists from different European countries,
- enhance the growth of a new generation of environmental scientists (currently Early Career Investigators) able to collaborate with scientists from different disciplines in complex fields such as Sustainable Forestry, Environmental Economy, and Forest Management,
- entrust under-represented gender and experts from countries with less capacity in the field of CSF in mountain areas with leadership roles,
- involve PhD students, particularly those from less research-intensive countries, in international joint research programs, conferences, workshops and training schools.

1.3. Progress beyond the state-of-the-art and Innovation Potential

1.3.1. Description of the state-of-the-art

Climate-Smart Forestry is a new concept, which still needs to be put in practice in the majority of European forests. The CSA Sourcebook (FAO 2013) only gives indications about the issues that need to be tackled in order to achieve forest management merging both CC mitigation and adaptation solutions fostering at the same time a sustainable development of most vulnerable communities and sectors of the population and forest systems such as those located in mountain areas. A big effort has been carried out so far in the study of the CC effect on mountain regions and their forest ecosystems at global and continental scales resulting in documents aimed to raise awareness of the importance and the need for sustainable management of these unique ecosystems (Kohler and Maselli 2009; Price et al. 2011; EEA 2012). The report on the status of SFM in Europe identifies the challenges for forest policy and management in Europe, and highlights differences between countries in the achieved level of SFM (FOREST EUROPE, UNECE and FAO 2011). The main concerns that emerged from that survey include a decline of forest area (in a very small number of countries); nitrogen deposition exceeding critical limits; soil condition; fragmentation and low forest connectivity; low value of marketed wood and non-wood goods and services; low levels of occupational safety and health for the forest workforce; and declining employment in the sector. Recently, a strong effort was made to quantify the forest ES using relevant measures (EFI 2014a). Moreover, based on the EU project NEWFOREX (243950) on FES, new examples and insights were provided for the quantification and valuation of non-marketed FES, the estimation of the cost of provision for ES and the definition of the economic instruments for ES payment (EFI 2014b). UNEP together with UNECE and FAO recently produced a document (United Nations 2014), which

discusses the concept of PES, as well as the various approaches, applications and resulting benefits in the UNECE region. The report highlights how PES schemes are not a universal solution. As forest use and tenure is usually deeply rooted in a specific region's culture and suggests that PES would need a proliferation of different and larger projects rather than universal adopting of a single model (UNECE/FAO 2014a). It is suggested to establish a virtual expert network supported by a virtual library of documents, valuation methods, case studies and projects on PES and forests.

1.3.2. Progress beyond the state-of-the-art

No attempts to develop CSF concept for mountains areas of Europe in an integrated way have been carried out so far, likely due to both the novelty of the issue and the lack of networking in this multidisciplinary field. CLIMO aims to the development of a holistic approach, able to jointly face issues related to CSF (SFM, evaluation ES, enhancement of resilience capacity and CC mitigation potential). This will require a highly multidisciplinary approach, involving both the scientific community and all relevant stakeholders. At this purpose, a COST action can be a preferential tool to gather scientists from different fields of research and stakeholders directly involved with issues related to the presence of forests in mountain areas. CLIMO will establish the first European network on CSF proposing an integrated approach to its diffusion and application in European mountain regions. In the proponent network there are representatives from countries comprising the main European mountain ranges covered by forests.

Forests provide several benefits to the community and to quantify FES is necessary to shift from the product-based estimation to a service based estimation of forest value. The criteria used for this evaluation should be accepted across different mountain regions to support the creation of new common market and the exchange of expertise. An increase in awareness and knowledge of ES in the general public would help to start new policies to support local people living in mountain regions. The creation of a network of monitoring sites/areas and the proposition of technologies for the collection and transmission of proxy data to stakeholders, together with the creation of documents proposing different forest-based PES schemes to be adopted in the different situations of the COST countries, will constitute a first attempt to give practical tools to stakeholders and policymakers for a climate-smart oriented management of mountain forest systems. The introduction of CSF principles in European mountain areas will give an important contribution to the target of the new European strategy for the forest sector (EC 2013) and the transition towards a green economy as proposed by both the Rovaniemi action plan (UNECE/FAO 2014b) and the European Union Strategy for the Alpine Region (EUSALP) (EC 2015a and b).

1.3.3. Innovation in tackling the challenge

The CLIMO action proposes an innovative approach to tackle CC related issues that SFM is facing in Europe. The novelty of the approach is the result of the combination of the different levels of the Action, each one carrying some characteristics of novelty too.

The development of a common concept of CSF, tailored to the mountain regions of Europe and aimed to the production of tools available for local stakeholders and policy makers, is something completely new both at continental and global scales. The coordination of a network of scientists coming from different fields of expertise (i.e., from forest ecology to geography, from forest management to plant genetics, microbiology and soil science, etc.) is also innovative for a COST action, where usually research from the same background is networked to raise the level of understanding in a specific field. This CLIMO's specificity mirrors the multifunctional role of mountain forests and could be the key for a successful output of the Action.

Another element of novelty is the creation of the European Smart Forest Network (ESFONET) based on the available sites, which can provide long-term data sets critical for detecting patterns and trends in climate, forest health and productivity, and response to natural and human induced environmental

changes. These sites serve as benchmarks against which further change can be gauged, putting mitigating strategies into practice.

The analysis of the potentialities for the creation of a cybernetic web of experimental structures in smart forests will allow the development of future projects for the equipment and installation of the cyber web, as well as for testing proactive forest management practices.

The development of innovative schemes of PES built by researchers in collaboration with stakeholders in a common European framework, which will be available to governments and to the society, will be also an element of novelty.

1.4. Added value of networking

1.4.1. In relation to the Challenge

The added value of networking when facing issues that can take different forms along a wide geographical gradient is almost obvious. Within CLIMO we will create a network of scientists well distributed over the different mountain ranges in Europe, and comprising countries with different level of sustainability of forest management according to the State of Europe's Forests 2011 (FOREST EUROPE, UNECE and FAO 2011). This will gather different points of view in the same discussion facilitating both capacity building and comprehensiveness of the results. CLIMO will gather also scientists from different disciplinary fields creating a cross-sectorial network, which will permit to discuss different functions and services provided by mountain forests and their interaction with CC in an integrated and transdisciplinary way. The CLIMO Action supports the exchange of ideas across different mountain regions belonging to different countries and cultures in order to develop a common definition of CSF and a network of sites where the forest "smartness" will be quantify. Moreover, the CLIMO Action will promote the dissemination of this new concept to local people and stakeholders.

1.4.2. In relation to existing efforts at European and/or international level

In the past and current years, several COST actions have been funded to tackle some of the issues related to the provision of ES from forest ecosystem as challenged by CC, or their adaptation potential: FP0601 Forest Management and the Water Cycle (FORMAN); FP0603, Forest models for research and decision support in sustainable forest management; FP0703, Expected and Options for European Silviculture (ECHOES); FP1206, European mixed forests - Integrating Scientific Knowledge in Sustainable Forest Management (EuMIXFOR); ES1203, Enhancing the resilience capacity of sensitive mountain forest ecosystems under environmental change (SENSFOR); FP1304, Towards robust projections of European forests under climate change (PROFOUND); FP1106, Studying Tree Responses to extreme Events: a SynthesiS (STReSS); FP0903, Climate Change and Forest Mitigation and Adaptation in a Polluted Environment; FP1202, Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest trees to climate change in Europe (MaP-FGR).

However those Actions have been working only on single pieces of the complex puzzle that CLIMO will compose. Some of CLIMO's proponents have been involved in those Actions as well, and from that experience and from the already available outputs will start the activity of the present Action. Especially important will be the output of FP0703 ECHOES, which generated National reports on Impact, Mitigation and Adaptation to CC of Forests Ecosystems, and the activity of FP0903 on the creation of network of monitoring sites. For the definition of the more suitable PES schemes for the mountain forests regions, CLIMO will also build upon the results of the FP7 EU project NEWFOREX (243950), which has been focusing on three main aspects: (i) providing methodologies for the evaluation of forest externalities; (ii) the development of a methodology for assessing the cost of provision for externalities taking into account trans-boundary effects of forest management, and transactions and opportunity costs; (iii) the assessment of several market-based methods for enhancing the provision of forest externalities, including PES.

CLIMO will extend the knowledge based on monitoring, modelling, and inventorying of forest systems, contributing to integrate existing activities in mountain areas and to coordinate joint conferences and training schools.

2. IMPACT

2.1. Expected Impact

2.1.1. Short-term and long-term scientific, technological, and/or socio-economic impacts

As the lack of appropriate data inventory on CSF and the heterogeneity and uncertainty in the interrelationships between physical properties of the landscape and ES of mountain forests increase with increasing scale, the supply and demand of provisioning, regulating, cultural and supporting services require harmonized monitoring and reporting systems of their assets. CLIMO will address issues of thematic importance through a bottom-up approach, which will be developed towards top-down requests for network partners to offer expertise for climate-smart mountain forestry topics considered strategically relevant by stakeholders. CLIMO wants to influence policy and practices to meet the scientific, technological and socio-economic short-term challenges emerging in mountain environments, promoting contacts and collaboration with other organizations and providing long-term solutions.

In the short term, the Action will provide (i) measures to assign value to ES and to analyse trade-offs among ES, (ii) help managing mountain forests based on enhanced coordination at international, national and regional levels, considering local specificities of smart mountain forests, and (iii) integrating forest issues into broader mountain-specific policy and management programmes. The CLIMO technological platform will contain overview and site descriptions, data and knowledge repository, program activities and schedule, project personnel and products, technical transfer and interpretive section, including summaries of major findings. The database aims at creating a reference point for information about the progress of CLIMO and events on smart mountain forestry initiatives, and scientific, technological and socio-economic aspects of the network of CSF sites in mountain areas. It is a channel for diffusion of the Action objectives and results open to the potentially interested audience. An open discussion list will be also set-up. A website will be developed to ensure a transparent network of information and its worldwide visibility. CLIMO will support the building of a public visibility network and plan the interactions with the research community, resource managers, media, and the general public, to solicit funding for the operational phases of CSF in mountain areas. Impacts on the definition of terms across research groups and disciplines in the field of CSF, on the available knowledge about mountain areas in Europe, and on the development and integration of methods and data to investigate the response of mountain forests to global change will be shaped.

In the long term, the Action will help forest managers to implement proactive management practices, promoting measures towards CSF. CLIMO will assess application of procedures to the mountain context, considering possible market niches for specific products, economic drawbacks and the valorisation of non-market benefits from ES. The elaboration and discussion of an operative framework including indicators of good governance, adapted to mountain forests (participatory process of defining objectives of management, ToSIA - Tool for Sustainability Impact Assessment - analysis for policy guidance) will be tailed. The compensation of local communities for their stewardship will be reviewed, also considering long-term trends, such as CC and human wellbeing. The possible strategies or alternatives for developing policy instruments and governance mechanisms adapted to mountain forests will be tracked, through stakeholders analysis, negotiation of priority options and inventory of forest related PES (including their impact on forest management practices, and negotiation and monitoring costs). The implementation of CSF measures in rural development programs will be studied (public spending, beneficiaries, and impact on forest resources), as well as the link to institutions for active management (e.g., associations, contractual agreements, cutting concessions, community forests), for incorporating mountain-specific policies

into national sustainable development strategies. Impacts on standards for the reporting of “smartness” inventories regarding mountain forests in a European wide perspective, on international and national research programs due to the coordination of current research activities and outlooks on future research needs, and on policy issues will be produced.

2.2. Measures to Maximise Impact

2.2.1. Plan for involving the most relevant stakeholders

The initial review topic will be developed and scrutinised under a competitive process. Network experts in the field will assist in determining the validity and relevance of the question as well as the scope of the proposed review during its initial stages of the Action. The main topic will be shaped with stakeholders with a participatory approach, through a sustained dialogue between researchers (CLIMO networks), the European Forest Institute (EFI), the Food and Agriculture Organization (FAO), the European Forestry Commission Working Party on the Management of Mountain Watersheds (EFC WP MMW), the United Nations Economic Commission for Europe (UNECE), the International Centre for Integrated Mountain Development (ICIMOD), the Mountain Partnership Secretariat, the Alpine Convention, the Carpathian Convention, the Mountain Research Initiative (MRI), Euromontana, the European Confederation of Woodworking Industries (CEI-Bois), the Mountain Invasion Research Network (MIREN), the Confederation of European Forest Owners (CEPF), the European State Forest Association (EUSTAFOR), the European Forest Institute (EFI), the European Environment Agency (EEA), the World Wildlife Fund (WWF), The International Commission for the Protection of the Alps (CIPRA). CLIMO will strengthen and mobilize European forest research and expertise to address policy-relevant needs (contributing to the ThinkForest forum and the Forest Europe initiative). CLIMO will invite ad hoc participants to contribute to the COST Action’s activities, taking advantage of their expert knowledge for achieving the COST Action’s objective. Joint conferences, technical workshops and training schools will be organized with the mentioned organizations.

Generating, disseminating and translating information into a useful form is the key response to uncertainty generated by CC. Much effort will be invested in helping local forest managers to make more effective climate-sensitive decisions via improved access to timely, meaningful and trustworthy climate information and knowledge. Regional authorities will be involved to draft the framework of technical component, developing CSF tools - with institutions improving channels both for uptake of information and for demand for that information - supported by new information technology (e.g., ICT applications). Local communities will be engaged in decision making to develop stakeholder partnerships and to match long-term objectives for climate-smart mountain forestry. Technical workshops will be organized to discuss and refine the central question, define key terms, determine the breadth of analysis, identify sources of literature and propose a dissemination strategy in a participatory manner, with the aim of connecting the review to national and regional policy concerns. Beyond the researchers, CLIMO will involve the most relevant stakeholders such as professional associations, public authorities, expert panels and consulting agencies in technical workshops organized in target mountain areas of participating countries.

2.2.2. Dissemination and/or Exploitation Plan

CLIMO will contribute materials to the web platform based on the results of research infrastructures, permanent sites, and data modelling. The CLIMO website will be a focus for all activities and products, and will contain overview and site descriptions, data and knowledge repository, program activities and schedule, Action personnel and products, technical transfer and interpretive section, including summaries of major findings. The Action website aims at creating a reference point for information about the progress of CLIMO and its events and scientific aspects. It is a channel for diffusion of the Action objectives and results open to the potentially interested audience. An open discussion list will be also set-up moderated by the Steering Committee. Advanced courses and

scientific/technical seminars on climate-smart mountain forestry will be organized in order to train young researchers and forestry professionals. Short-term missions will contribute to the capacity building of partners.

The keys to its success will be modularity and flexibility. By modular, we mean developing a basic unit and its communications that can be deployed at multiple locations across CSF sites. By flexible, we recognize that the basic unit will need to be adapted to individual sites, reflecting potential implementation barriers, as well as different resource and management needs. The building of a public visibility network and plant the interactions with the research community, resource managers, media, and the general public will be supported by short communication releases on the events, achievements and progress of CLIMO. A procedure for inclusion of expert partners will be developed. Contributions to the scientific literature and science-based informative and outreach publications will be organized, in order to build consistent bridges between the academic and non-academic sectors and to show to key stakeholders and the society how CSF can improve their current and future lives.

A corporate design (logo, templates and newsletter) will be developed to ensure that dissemination and outreach materials have a uniform and recognizable image. Whenever possible, in order to make the research results more accessible, the scientific publications and other results of CLIMO will be made open access, either by publishing in an open access journal or by self-archiving in the institutional repository of the different partners. A twitter account will complement the website and will be used by all CLIMO partners to communicate actions and main results of the project.

2.3. Potential for Innovation versus Risk Level

2.3.1. Potential for scientific, technological and/or socio-economic innovation breakthroughs

Reviewing the state-of-the-art in research on mountain forests in Europe conducted in different research fields is essential for in-depth understanding of the effect of global change on future mountain forestry. The exchange of information on climate-smart mountain forestry will lead to the harmonisation in research approaches and the assessment and comparison of CSF across European mountains. European experimental mountain forest sites are located along broad gradients of climate, vegetation, soils, and land-use that are representative of most national mountain forest system lands. They have a long history of research and environmental monitoring. These long-term data sets are critical for detecting patterns and trends in climate, forest and range health and productivity, as well as the response to natural and human-induced environmental change. Individually, these sites serve as benchmarks against which further change can be gauged. Together, they have the potential to serve as a regionally distributed, long-term multi-site, multi-sensor platform for detection of short- and long-term environmental change for mountain forests of EU. To standardize future research, joint guidelines will be provided.

The outcome of the Action will contribute to strategic objectives as formulated in the Strategic Research Agenda of the Forest-based sector Technology Platform as it is related to the objectives of Advancing knowledge on forest ecosystems and especially to Adapting forestry to CC. CLIMO will provide an integrated technological platform to monitor and respond to environmental change at the local to continental scales. CLIMO will implement applied research and governance analysis to disseminate the benefits of climate-smart mountain FES to stakeholders, finding equilibrium between economic development (e.g., innovative wood technology and renewable energy sector) and environmental conservation (e.g., reduction of soil erosion and control of invasive species) and governance dimension (e.g., land tenure regimes and decentralization). CLIMO will be committed to develop the technological platform from the beginning of the Action and reach shortly its full potential, and to maintain the system in the long term, also through additional funding, for continuous updating of information.

The research platform will provide policy makers and forest managers with the vision of CLIMO (climate-smart mountain forestry) to make the most appropriate choices when managing and further

developing mountain forests, while achieving all socio-economic and environmental functions, as proposed by the current international processes and initiatives on mountains. International conventions specifically recognize that mountain forests are highly vulnerable to global changes and that mechanisms should be devised to compensate and reward worldwide mountain communities for the services they provide through ecosystem protection.

3. IMPLEMENTATION

3.1. Description of the Work Plan

3.1.1. Description of Working Groups

According to the goals of CLIMO, the Action will be implemented in four working groups (WG) as following described.

WG1: APPROACHES AND DEFINITIONS OF CSF

WG1 will aim at finding a common definition about the concepts of CSF and “smartness” of European mountain forests according to the sustainability of forest management, the forest adaptive potential to CC and its mitigation potential to CC based on literature review, historical data and contact with stakeholders experienced in smart forests. The discussion will consider the “smartness” for example with respect to the managed and not managed forests, with respect to the montane and subalpine forests and will consider also the system boundary in the definition to join a common understanding on the European level.

The tasks of the WG1 will be:

- development of a common definition of CSF by way of a multidisciplinary confrontation on what the characterizing criteria of CSF are;
- identification of measurable parameters between the sustainability of forest management, forest adaptive potential to CC and mitigation potential to CC which allow to define the “smartness” of mountain forests;
- production of a checklist of parameters of “smartness” for mountain forests for a common language between all the member of the groups;
- classification of European mountain forests according to different “smartness” classes.

The milestones

M1.1. Definition of CSF and climate smart forests characteristics.

M1.2. Elaboration of the report for WG1 including the document with the definition of CFS and its characterizing criteria.

M1.3 Final report with the definition of CSF, and its characteristics and a map of Climate Smarts Forests in European Mountains.

M1.4. Yearly WG meeting.

The deliverables

D1.1. CLIMO Action web page with all information about the action will be freely available (Month 6).

D1.2. Publication of a document with the definition of CFS and its characterizing criteria.

D1.3 Map and classification of European Climate Smart Forests in European Mountains.

WG2: EUROPEAN SMART FOREST NETWORK (ESFONET)

WG2 will aim at identifying forest sites with available data to be used to quantify the “smartness” of mountain forests building the ESFONET. Once the sites have been selected, data will be used to classify the forests within different classes of “smartness”.

The tasks of the WG2 will be:

- collection of information about experimental sites (i.e., inventory) with set of forest and environmental measurements strategically distributed across major geographic, climatic and

vegetation gradients in Europe, where existing long-term data can characterise smart forests in Europe;

- selection of the research sites which will be part of the ESFONET;
- classification of ESFONET sites according to different classes of “smartness”.

The milestones

M2.1. Creation of the ESFONET online database.

M2.2. Organization of a ESFONET workshop involving the responsible of each experimental site and open to the scientific community for the dissemination of the protocols.

M2.3. Yearly WG meeting.

The deliverables

D2.1. Creation of an online database of available environmental data from experimental sites of smart forest in Europe with the map of active sites.

D2.2. Publication of a document explaining the ESFONET purposes and requirements.

D2.3 Proposal of protocols for a standardized data collection (standard recording methods, data handling and management).

D2.4 Report on the needs/requirements to integrate the gaps of the ESFONET in terminal space and kind of data surveyed.

WG3: REQUIREMENTS FOR THE DEVELOPMENT OF A FUTURE CYBERNETIC WEB OF EXPERIMENTAL STRUCTURES

WG3 will aim at developing and implementing cyber infrastructure to collect and wirelessly transmit to the Internet a fundamental set of forest and environmental measurements from the ESFONET sites. The cybernetic web will provide real-time access to environmental sensor data from established research sites to a single point of entry web site which allow apply visualization and outreach tools to engage researchers, resource managers, educators and the public with smart forest data.

The tasks of WG3 will be:

- discussion of the state-of-the-art technologies for the measurements of forest parameters linked to “smartness” and fostering of its deployment in the ESFONET network;
- identification of standardized cyber technology for collection, and wireless transmittal to the internet of, a foundational set of environmental measurements at ESFONET sites;
- analysis of the near real-time access to high quality forest environmental sensor data from ESFONET sites to a single point of entry web site;
- discussion about the visualization and outreach tools to engage researchers, resource managers, educators and the public with smart forests.

The milestones

M3.1. Organization of workshop scientists, private companies, public stakeholders.

M3.2. Yearly WG meeting.

The deliverables

D3.1. Definition of a catalogue of technologies for the measurements of forest parameters linked to “smartness” based on the experiences of ESFONET members.

D3.2 Publication of guidelines about the wireless technology and standard for data transmission in ESFONET.

D3.3 Publication of a manual about standard approaches for new sites in ESFONET.

WG4: CLIMATE-SMART INNOVATIVE SCHEMES OF PAYMENT FOR ENVIRONMENTAL SERVICES (PES)

WG4 will aim at defining a system of PES suitable for mountain forest regions considering the recent literature and the different methodological approaches applied in different European regions and countries. This WG will also provide inputs for the individuation of the criteria for the definition of the economic instrument for the payment of the ES provided by the smart forests. The activity of WG4 will be

The tasks of WG4 will be:

- definition of the more appropriate methodologies for the valuation of FES in mountain regions through a review of the recent literature for the European Mountain Regions;
- review of the PES schemes already active in mountain regions in order to define the more suitable and climate-smart for European forest
- the estimation of the cost of provision for FES in European mountain regions and the definition of the economic instruments for ES payment, such as property tax reductions as a compensation for the ES provided by the smart forests.

The milestones

M4.1 Organization of workshops involving private and public institutions already involved in successful PES schemes in the mountain region.

M4.2 Yearly WG meeting.

M4.3 Final meeting for the dissemination of D4.3 to local stakeholders, forest owners and policy makers.

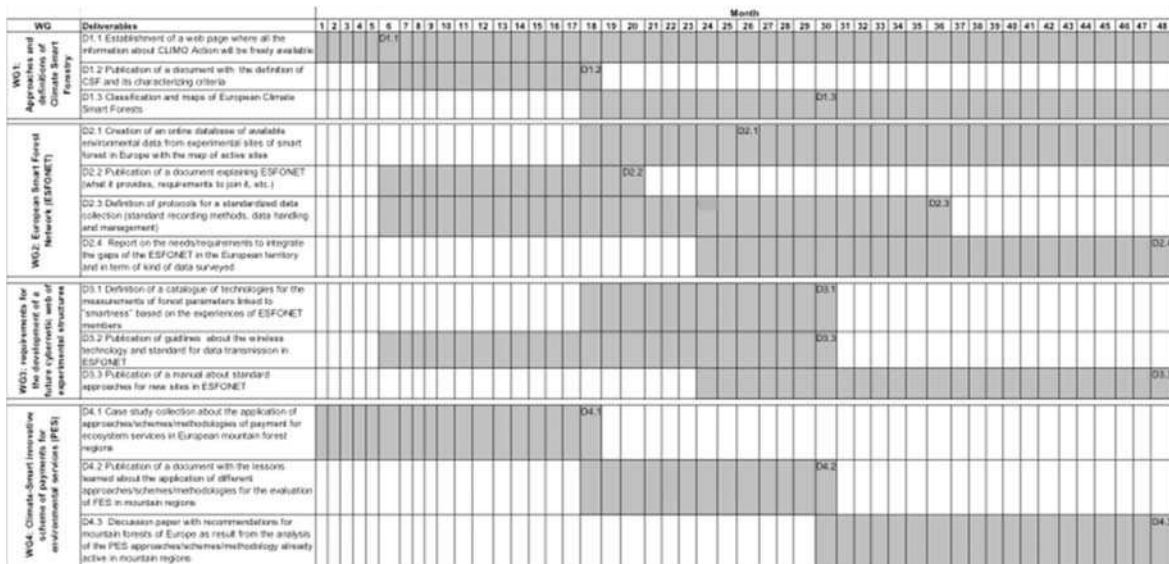
The deliverables

D4.1 Case study collection about the application of approaches/schemes/methodologies of PES in European mountain forest regions.

D4.2 Publication of a document with the lessons learned about the application of different approaches/schemes/methodologies for the evaluation of FES in mountain regions.

D4.3 Discussion paper with recommendations for mountain forests of Europe as result from the analysis of the PES approaches/schemes/methodology already active in mountain.

3.1.2. GANTT Diagram



3.1.3. PERT (optional)

3.1.4. Risk and Contingency Plans

The project activities will be continuously monitored against the Action programme and the objectives of CLIMO. A continuous evaluation process on the level and degree of success in achieving the project objectives will be established along the whole Action duration. In the first part of the Action agenda, the principal indicators to measure the CLIMO objectives will be identified, together with their target levels; during the project the above parameters will be checked against the achieved progress results. This process will constitute a framework for the self-assessment of the Action. It will be carried on by the Management Committee and will ensure a check of the working



progress and then the possibility of detecting possible problems and take the necessary corrective actions. A Quality Plan will define different measurable objectives, their indicator parameters (and their thresholds) and their expected progress. The relationship among the different objectives will be analysed in such a way to identify the risks related to possible delays. The Action will be monitored against the quality plan, within Working Groups. The Management Committee will track whether inputs are being provided properly, while a range of process and outcome evaluations (peer-review) provide feedback on how effective inputs have been and on how to modify the program as it moves. In particular, WG1 risk of incomplete overview of CSF approaches and definitions will be mitigated involving key experts, defining project goals; WG2 risk of partial inventory of ESFONET sites will be reduced by involving local stakeholders, identifying knowledge gaps; WG3 risk of difficult communication between experimental structures will be alleviated by triggering open dialogue, developing common standards; WG4 risk of little innovation of PES schemes will be moderated by promoting expert exchange, sharing assessment plans. The periodic revision of the results of the operative plan will take place in order for the advances and results of CLIMO to be shared among beneficiaries and stakeholders.

3.2. Management structures and procedures

Management activities will take place during the whole duration of CLIMO, ensuring that all logistic and operational aspects, and complete fulfilment of administrative and financial aspects are dealt with. The management and organization of this COST Action will include:

- a. a Management Committee (MC) comprising the Project Manager;
- b. four working group leaders;
- c. a Short-Term Scientific Mission (STSM) Coordinator.

The MC will address the technical activity of CLIMO, for the assessment of tasks, for the scientific monitoring of contents, for the preparation of events and for the validation of deliverables. The MC will be in charge for modulating the work programme, for reporting to COST and for solving possible conflicts. The MC will communicate through e-consultation and meetings, adopting and reviewing the project agenda. The MC will manage CLIMO in accordance with the rules and procedures for implementing and establish its course of activities in the first meeting. The COST Action will also have a Steering Committee (SC), which will monitor the Action's progress in achieving its objectives and delivering its deliverables. The SC will comprise a Chair (the Project Manager), Vice-chair, the leaders of the WGs, and the representatives described in this proposal.

The MC will be in charge of the coordination of the implementation of the Action and will monitor the appropriate development of the networking activities explained in the WGs. Each activity dealing with the training school and workshops will have a designated leader. The MC will meet by teleconference at least every two months. An operative communication network among the partners will be early established for sharing the project documents. This networking will be based on Internet. Management activities will include the creation and maintenance of a permanent website with all shared information required (within 6 months). The strict connection between MC and SC members will ensure the overall constant monitoring of the project activities. A final conference will be carried out at the end of the COST Action.

A detailed contingency plan protocol will be agreed and established at the beginning of the project. Due to the importance of the STSMs, a Coordinator will be appointed, that will monitor and supervise the STSMs to be carried out. The Action will make efforts to find a good balance of gender and geography in the SC. International cooperation will be strongly endorsed to deliver major outputs across regions and countries.

3.3. Network as a whole

The consortium has been established to bring together institutions with different capacities, covering different mountain regions of Europe and with experience in several existing international research



initiatives dealing with mountain forests and CC. The network includes now only higher education and associated organisations; however, these are well connected with European, national and regional associations and stakeholders. The proposers have a good and proved experience in mountain forestry and related issues. The expertise of partners is very wide, ranging from forest ecology, geography, forest management, plant genetics, microbiology, remote sensing, and soil science to economy, providing policy support based on relevant research. The Action provides thus a European framework and a multidisciplinary approach to contribute with guidelines for a European CSF, ensuring knowledge transfer across Europe. Networking will provide the right framework for information compilation, review and dissemination. The number of proposers is 18 from 14 countries, 6 of which are included within the category of COST inclusiveness target countries. At the moment the distribution of gender of proposers is 67% male vs 33% females, the proposal intends to reach a 50% for each gender for all activities. The SC and MC will continuously monitor the implementation of COST Policies on inclusiveness, gender balance and Early Career Investigator participation and will put in place measures to redress any imbalances. The network of proposers is well connected with relevant stakeholders on a national and international scale, and their integration throughout the proposal will be chased in the early stages of CLIMO to address the relevance of deliverables.

