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**Project: Development of a common protocol to assess the impact of forest management practices on climate change**

# INTERIM REPORT

IMPACT
FOREST MANAGEMENT
&
CLIMATE CHANGE

**15 March 2018**

## Contents

# 1. Introduction

The aim of the Action is to evaluate not only technical but also financial the first six months of the project. The Action involves the preparation of literature review, sampling design, field sampling and common guidelines (Protocol) for the assessment of carbon storage in planted forests through afforestation/reforestation projects.

# 2. The Activities in the First six-month of the Project

In the first six months, the following activities were carried out.

**WP1. Preparation activities 2 (Literature review)**

Document D1.1 was prepared by searching the literature about the project subject (Annex I).

**WP1. Preparatory Activities 3 (Sampling Plan)**

A sampling plan has been prepared by designing the sampling plan to be used for the purpose of the project. Document D1.2 had been developed (Annex II).

**WP4. Project Management Activity 1 (kick-off meeting)**

A kick-off meeting was held in Orestiada, Greece, from 12-14 October 2017. The meeting lasted two days and the third day returned. A memorandum on these meetings was arranged and signed, and a document on the topics discussed at the meeting was arranged. Visual information about the meeting was also available and a joint document on the interviews and evaluations held at the meeting was prepared and taken into protection in the project folders.

**WP4. Awareness Raising Activity 1 (Logo creation)**

In the framework of this activity, not only the logo was created but also published on our website http://europeaid-ktu.duth.gr/. The project logo is attached (Annex III).

In the second quarter of the season, two minor notifications have been made and one of them is subject to notification of the activity plan. No activity was planned in the fourth and fifth months after the activity of the field study was put into action plan in the last month. The main reason for such a change is; because the project is carried out in the forests, it is not possible to conduct field studies in the second trimester due to winter months. The planned changes and the activities planned for the second quarter are as follows:

**WP2. Execution Activity 1 (Field sampling)**

WP2 Execution Activity 1 (Field sampling) is carried out is planned in the latter half of the sixth month of the project with the change in activity plan. Because of the small change notification because of the realization of the project on forests as expressed coincides project's fourth and fifth months of the winter months the forests of no fieldwork covered with snow but did not make it possible to take place in early March. For this reason WP.1 Execution Activity 1 (Filed sampling) in the six areas covered field study was conducted in the second three-month quarter. Details of the sample areas taken as a result of the field studies given in detail D1.2 are detailed below as Table 1.

**Table 1. Sample plot data**

| | Stand type | Age class | Mean diameter (cm) | Quadratic mean diameter (cm) | Basal area ($m^2$/ha) | Number of trees |
|---|---|---|---|---|---|---|
| 1 | Knbc3 | 4 | 22.7 | 23.6 | 40.9 | 925 |
| 2 | Knbc3 | 3 | 15.9 | 16.8 | 33.0 | 1500 |
| 3 | Knbc3 | 3 | 14.7 | 15.4 | 26.6 | 1425 |
| 4 | Knbc3 | 3 | 15.0 | 16.0 | 24.0 | 1200 |
| 5 | Knbc3 | 4 | 16.9 | 18.1 | 27.1 | 1050 |
| 6 | Knbc3 | 3 | 15.8 | 16.9 | 38.1 | 1700 |

**WP4. Project Management Activity 2 (Intermediate Project Meeting)**

This activity was planned to be done at the end of the field studies with our project partner DUTH team. However, with the notification made in the activity plan and the time period for the field studies to be done, the meeting planned in the midst of the project has to be done as electronic. Because the project partner, DUTH group completed field measurements did not put the cost of the budget for the coming to Trabzon for this meeting to make such a meeting obligation or Although eliminated the reason for the project was provided nevertheless negotiations between partners. The project partner DUTH group has to participate in the last two days of field work. Instead of analyzing the data obtained from the field work, the above-mentioned meeting had to be directed at the operation of the project. For this reason, the DUTH group reached a consensus by negotiating official documents (such as payroll, insurance documents, etc.) that our party should send to ensure smooth operation of the project. E-mail record related to this has been attached (Annex IV).

# 3. Financial Report in the six months period

Payments in the first six months period of the project were presented in Table 2.

Table 2. Payments of the project for first six months

| Costs | Planned | Spent until today | |
|---|---|---|---|
| | | First Three Months | Second Three Months |
| 01. Human resources | 36 166 | 11 992, 50 | 413 |
| 02. Travel | 1140 | 203, 08 | 0 |
| 03. Equipment and supplies | 2000 | 0 | 0 |
| 04. Local Office / Project Costs | 0 | 0 | 0 |
| 05. Other Costs, Services | 7020 | 400 | 0 |
| 06. Other | 0 | 0 | 0 |
| 07. Subtotal Direct Eligible Costs of the action | 46 326 | | |
| 08. Indirect costs | 1 482, 43 | 0 | 0 |
| 09. Total Eligible Costs of the Action, excluding Reserve | 47 808, 43 | | 0 |
| 10. Reserve Cash | 0 | 0 | 0 |
| 11. Total Eligible Costs | 47 808, 43 | 12 595, 58 | 413 |

## 4. ANNEXES

### Annex I: D1.1 Literature Review Report

**Project: Development of a common protocol to assess the impact of forest management practices on climate change**

# Report on best practices and policies regarding forest management in response to climate change

## (Literature Review Report)

**Deliverable 1.1**

**15 December 2017**

## Contents

# 1. Introduction

Forest functions traditionally included wood production, protection and forest recreation. However, a fourth category was added concerning environmental impacts, after realizing the magnitude of environmental issues worldwide in relation to climate change (Galatsidas, 2012).The twofold role of forests as both sources and sinks of greenhouse gases (GHG) makes their influence on the climate extremely significant (SFC, 2010).

This fact has led to climate change adaptation and mitigation being set as a current priority in forest management. However, there are trade-offs between stand-level strategies aimed at climate-change mitigation and those aimed at adaptation (D'Amato *et al.*, 2011; Sharma *et al.*, 2016). The Action focuses on the mitigation of climate change impact through increasing the size of the carbon pool in forests, which is a worldwide recommended mitigation measure (FAO, 2010; D'Amato *et al.*, 2011; Jandl *et al.*, 2015; Behera *et al.*, 2016).

Maintaining the carbon stock and enhancing carbon sequestration of forests in Europe contributes to the implementation of the UNFCCC and the Kyoto Protocol. It is also one of the commitments of the Signatory States of the Ministerial Conference on the Protection of Forests in Europe and the European Community (Forest Europe, 2015). Mitigation is achieved either through the creation of new forest areas or through sustainable forest management. Both approaches provide carbon sequestration and storage in forest biomass and soils, as well as in harvested forest products. Therefore, carbon stock and carbon stock changes need to be incorporated in sustainable forest management by supporting research and analysis on these topics (MCPFE, 2003).

Over the period 1991–2015, planted forest, representing 7% of the total forest area, accounted for a global average carbon sink that was comparable to the sink of natural forest (-1.08 vs. -1.44 Gt $CO_2$ $yr^{-1}$), driven by continuous increases in total area (Federici *et al*., 2015). In Turkey, planted forests increased by more than 50% after 2010 due to the implementation of the Afforestation and Erosion Control Mobilization Action Plan (2008–2012) and due to the Combating Erosion Action Plan (2013-2017) (FAO, 2014).

Towards the same direction, the Intended Nationally Determined Contribution (INDC) of the Republic of Turkey for the period 2021-2030, which aims to achieve the ultimate objective of the UN Framework Convention on Climate Change, proposes, amongst others, specific actions for increasing forest sink areas and a National Afforestation Campaign. The contribution of those actions is mainly achieved by new forest plantations.

Sustainable forest management contributes to climate change mitigation by preserving and expanding carbon stocks in the forests (including above- and below-ground biomass, deadwood, litter, and soil) (SFC, 2010). In view of this fact, the project aims to foster transnational cooperation to investigate alternative management practices in order to identify the most efficient in terms of carbon sequestration and storage in planted forests. Planted forests represent approximately 30% of the forests in Turkey, covering 3,386,000 hectares according to FAO (2015).

## 2. Forest management and climate change: EU legislation and policies

Recently EU strengthened its climate change strategy by increasing the 20-20-20 targets to 40-27-27 till the year 2030.The corresponding roadmap for a low carbon economy towards 2050 regards the development of Renewable Energy Sources (RES) and the storage of $CO_2$ as key elements for reducing GHG emission by 80% compared to 1990 levels. The forest sector is a net primary source of RES and also the greater carbon pool after the oceans. Therefore, appropriate adaptation of forest management is expected to play a strategic and twofold role in the new low carbon economy: on one hand by contributing to the targets of 2050 as RES provider and on the other hand as a major carbon pool. Forest conservation (or prevention of deforestation) has been officially recognized in COP16 (2010) as one of the most important options to the post-Kyoto climate policies for combating climate change though stabilizing Greenhouse Gas (GHG) emissions (Ding *et al.*, 2016).

Moreover, decision 529/2013/EU, on accounting rules regarding GHG emissions and removals stipulates that all land use should be considered in a holistic manner and land use, land-use change and forestry (LULUCF) should be addressed within the Union's climate policy. Therefore, Member States have to prepare and maintain accounts that accurately reflect all emissions and removals resulting from forest management. Carbon stock changes need to be estimated in an unbiased, transparent, and consistent manner to allow for uncertainties to be determined and reduced over time, as prescribed in the IPCC Good Practice Guidance for LULUCF activities (IPCC, 2003; Beets *et al.*, 2011). According to Federici et al. (2015), enhanced country data to cover carbon stock gains and carbon stock losses separately, and disaggregated by forest type (primary forest, other naturally regenerated forest, and planted forest) would significantly improve the 2020 Forest Resources Assessment (FRA) made available by the Food and Agriculture Organization of the United Nations.

The incorporation of adaptation and mitigation aspects of climate change in sustainable forest management is necessary in order to fully utilize its potential. However, a broad range of policy measures is still required to support this task (e.g. incentives for afforestation and reforestation, taxation, public procurement rules to promote the use of wood, national and regional legislation to enhance the use of timber in the construction sector, proper technical and biological forest education) (SFC, 2010).

# 3. Forest management practices to address climate change

The development of forest management strategies for addressing climate change has become an increasingly important issue around the globe. Currently, management approaches are being proposed that intend to mitigate climate change by enhancing forest carbon stores (D'Amato *et al.*, 2011). While sustainable management, planting and rehabilitation of forests are efficient ways to conserve or even increase forest carbon stocks, it should be noted that deforestation, degradation and poor forest management do reduce carbon stocks (UNFCCC, 2016).

In this scope, mitigation activities include conserving forests with large stocks of biomass from deforestation and degradation, avoiding significant carbon emissions to the atmosphere and sustainably managing forests in order to restore their carbon sequestration potential (Keith *et al.*, 2009).

Incorporating carbon sequestration and storage in forest management raises a lot of questions regarding age, rotation period, stand structure and mixture, as well as management practices. Different analyses of national or local forest systems reveal that cessation of forest management in productive forests would yield much lower mitigation effects than those provided by the substitution effect of the currently harvested wood (SFC, 2010).

Carbon stocks can be maintained and increased through the use of extended rotation periods. This recommendation is supported by widely documented positive relationships between aboveground carbon stores and stand age (D'Amato *et al*., 2011, Yavuz *et al*., 2010). The net carbon balance in forests between 15 and 80 years of age (including the soil), is usually positive and old-growth forests seem to continue to accumulate carbon (Luyssaert *et al.*, 2008). However, young forests have high carbon sequestration rates which decline as they age. Mature forests eventually reach equilibrium in which no or little further sequestration takes place, leading to limited mitigation potential and carbon storage capacity in time (SFC, 2010). Moreover, the resilience of forests to climate change impacts is often decreased with increasing stand age and basal area (Seidl *et al.*, 2017).

The critical question to consider is when should the carbon stock of the living biomass, the forest floor carbon and the soil carbon be replaced. Carbon pools and fluxes are strongly determined by the applied rotation lengths, the thinning intensity, and the resulting age–class distribution of the forests. While short rotation length increases the carbon sequestration rate, it accounts for lower average carbon stock in the biomass and other conflicts e.g. regarding nature conservation (SFC, 2010).

Regeneration methods and thinning treatments that retain a large proportion of mature trees are more efficient in maintaining carbon stores compared to more intensive removals, even in cases when off-site storage is considered (D'Amato *et al.*, 2011). Furthermore, the soil temperature may go up in open spaces created after intensive thinnings which may lead to increased decomposition of soil organic matter. However, moderate thinning in young stands does not seem to give a net flux of $CO_2$

to the atmosphere (SFC, 2010). Therefore, multi-aged stands are proposed as an effective means to strengthen forest resilience against disturbances *(Kuuluvainen et al.*, 2012; Lafond *et al.*, 2014; Seidl *et al.*, 2017).

Uneven-aged management creates overall more complex stand structure (Stand Structural Diversity) and maintains a steady flow of yields and aboveground carbon stocks (Sharma *et al.*, 2016). Selection cuttings maintain late-successional forest characteristics and species assemblages better than even-aged stands at least at the stand scale and in the short term (Kuuluvainen *et al.*, 2012). Both even- and uneven-aged management options have the potential to improve production and carbon storage and are a substantial improvement over no action (Sharma *et al.*, 2016).

There are still many uncertainties regarding the impacts of climate change on forests, despite the significant body of existing research. As a result, climate change may impact forests in ways that are partly opposing and therefore can require adaptation activities that are difficult to design and to plan (Lindner *et al.*, 2014). Carbon sequestration should only be one of the goals that drive forest management decisions in relation to climate change. Optimal achievement of multiple benefits across the landscape may require maintaining an assortment of management strategies to enhance ecosystem resilience while improving production and carbon storage (Lindner *et al.*, 2014; Sharma *et al.*, 2016).

Another management practice that needs to be considered is favouring species mixture. The effects of mixed stands on growth and forest production can vary from no effect to productivity increases up to 50 % when species make different use of available resources, either in space or in time. Mixed stands are more resilient to disturbances and are therefore a favourable practice for adaptation (SFC, 2010).

# 4. Forest management practices and climate change in the project area

## 4.1. Historical development of Forest Management Planning in Turkey

There are several studies on the history of forest management in Turkey. The most important of these are Eraslan (1982), Misir (2001) and Zengin et al. (2013). Due to the fact that these works are newer as of the year they were published, Zengin et al. (2013) study, the history of Forestry Management planning in Turkey is as follows:

The first contemporary management plan was prepared in 1918 (General Directorate of Forestry, 2007) by a team composed of Turkish and Austrian foresters. This was also the first application of the age classes' method for regulating even-aged forests. Some have characterized this process as German-led neoclassical area control management (Zengin *et al.* 2013). By comparison, Hufnagl's method of managing diameter classes (Roth, 1914) was used to calculate the allowable cut from uneven-aged high forests. A 1973 forest regulation defined the main and auxiliary management methods for forests, which were based on stand form (Asan, 1992).

Today about 96% of the forests in Turkey are even-aged. In the last four decades, a portion of the even-aged forests have been managed using a single-tree selection system, which did not consider the biological characteristics of forests. In its implementation in Turkey, many irregular and unusual forest structures occurred through the use of these treatments, and these forests are still the subject of debate among forest managers (Zengin *et al.*, 2013). Concern over how to transition even-aged forests to an uneven-aged structure and how to maintain shade-intolerant tree species through uneven-aged management is not unique to Turkey and can be accomplished under the right conditions (Malcolm *et al.*, 2001; Nyland, 2003).

From 1918 through the mid-1980s timber production was viewed as the most important forest function and thus was the main objective of many forest plans. As a result, forest plans were monotypic, and the same management approach was used everywhere without consideration of the diverse forest characteristics of the country. Plans prepared using these conventional methods were therefore called conventional forest management planning models. The plans were revised on a 10-year cycle, and in them the annual allowable cut was based on sustainable wood production principles.

However, the plans did not pay attention to the improvement of relationships between forest enterprises and the forest villagers living within the planning units. About 43% of the forests in Turkey continue to be managed with plans developed using this process. In the 1970s, Mediterranean region planning models were introduced and applied to forests in this region (Asan, 1989). They were developed by special planning groups to introduce new planning approaches and concepts for forests along the Mediterranean coast. These regional plans were a major step toward the sustainability of forest functions and benefits were also used to sustain timber production in Turkey. However, these plans did not involve nor incorporate the management of livestock and rangeland resources, important issues that needed to be addressed to ensure the sustainable management of Turkish forests.

These management plans also proposed an intensive forestry direction that used an area control method for determining the allowable cut. They were prepared for the whole area of a Forest Enterprise, despite the previous conventional plans that were prepared for planning units. Some minimum rotation age principles were continued, but others were adjusted. For example, in 1977 the minimum rotation age for *Pinus brutia* was decreased from 60 to 40 years. Furthermore, a longer planning horizon was assumed (100 years) to determine whether modeled forest policies were sustainable in the long-term and whether forest resources were sustainable as a supply for the integrated manufacturing facilities of each region (Zengin *et al.*, 2013).

In the 1990s, Western Black Sea region planning models were introduced. Also known as Turkish-German collaborative projects (individual plan), Western Black Sea region planning models were prepared to address a regeneration problem that occurred in forests along the Black Sea as a result of the application of management techniques (regeneration period, rotation ages, and others) that did not consider site conditions and tree species requirements. These plans addressed stand-level silvicultural direction more than the attainment of forest-wide goals and thus focused on natural sustainability of deciduous forests through stand-level decisions.

These regional plans were different from conventional plans through the use of longer rotations and regeneration periods and the use of continuous cover forestry concepts (uneven-aged concepts) (Asan, 1995). Although these three types of management planning processes had been used either universally or regionally to develop forest plans, a fourth process is now used throughout Turkey (Asan, 2005). The main concept of forest management planning in Turkey today is to manage forests in such a way as to maintain biological diversity, productivity, regenerative capacity, and vitality and to fulfil relevant ecological, economic, and social functions (Eeronheimo *et al.,* 1997). This philosophy encourages the development and maintenance of both ecosystem processes and multiple uses. Therefore, this fourth type of planning process is considered an ecosystem-based functional planning approach (Zengin *et al*., 2013).

In essence, the process can be perceived as either a segregation or an integration method, as this is determined based on the function(s) an area within a forest is assumed to accommodate. These functional areas need to be separated when the functions conflict with each other. If there is no major conflict among forest functions, a forest area is managed based on the dominant function, with some modifications used to recognize other functions. The perceived flexibility of the current planning process seems to have increased its applicability and acceptability among forest planners and managers. The planning process proposes treatments suitable for the function that the forests serve. In this endeavor, the planning process must use the forest structure created under the older management planning processes; therefore, the treatments applied may need to be designed in a manner to adjust structural components so that different societal goals can be met. In addition, some aspects of the process involve fairly complex assessments, which can include, for example, the determination of carbon sequestered; oxygen produced, and dust filtered (Asan, 2010).

The ecosystem-based functional planning process consists of several phases. These phases are similar to planning processes used on public land in the United States (Bettinger *et al.,* 2009). There are a few minor differences; for example, in Turkey, public input is gathered near the end of the process rather than at the beginning. After current and future conditions of forests are estimated and after plan alternatives have been developed, the outcomes obtained by the management planning groups are presented to stakeholders before preparation of the management plan report. In this participatory process, management objectives primarily relate to the maximization of wood production, resolution of social conflicts, facilitation of recreational and aesthetic goals, improvement of social welfare, water production and soil protection.

In a way, the management of forests in Turkey can be viewed as the management of the people who are interested in forestry. By determining functional areas and by using a participatory approach, along with technical analyses and the application of forestry techniques based on forest functions, conflicts between stakeholders should decrease. Although initially there were social reactions to the application of this planning process, people now generally support forestry activities because of the information they receive during the public participation in the process.

However, the sustainability of forest resources tends to take precedence over the alleviation of social issues such as poverty (Güneş and Coşkun, 2008).The pursuit of ecosystem-based functional planning can be viewed as a way to introduce modern forestry organization to a country with a long forestry history. Modern land allocation methods, participatory planning processes, and the emphasis on both ecosystem function and multiple uses illustrate this evolution. One main drawback is the generally limited use of operations research methods, yet this was a distinct drawback of the conventional forest management planning model and Western Black Sea region planning model processes as well.

On a positive note, the ecosystem-based functional planning process does not disregard experience gained through the implementation of previous planning processes. Even with this perceived evolution in thought and philosophy, there are people who believe ecosystem-based management is too utopic and that it can never be successfully applied, given a lack of certain basic data necessary for modeling multiple forest functions. However, the planning process used tends to recognize these shortcomings, and attempts are being made to integrate modern planning techniques with analytical models. To add knowledge and to inform the process, studies concerning the development of appropriate criteria and indicators for local planning units have been undertaken.

As an example of the extent to which ecosystem-based approaches are used, two management plans were elaborated in 2009 for the Artvin-Yusufeli Forest Directorate (Yusufeli and Altıparmak Forest regions) within the framework of an international project titled “Sustainable Forest Use and Protection Project for Kackar Mountains.” Further, 14 management plans were developed in 2011 and 2012 for the urban forests belonging to the Istanbul Metropolitan Municipality. In addition, three management plans were developed by the management planning groups in 2011 for the Bahçeköy, Kanlica, and Demirköy Forest Directorates of Istanbul, and plans are being developed for Vize and Demirköy Forest Directorates. In 2013 these planning groups have finished four more management plans using the ecosystem-based functional planning model approach. Formal planning groups working in various parts of the country are also continuing to apply the new process.

Although the ecosystem-based functional planning model approach to forest planning is the only type of process used to develop plans today in Turkey, only 57% of the forest area is currently managed under ecosystem-based plans. When the conventional plan time horizon ends for a forest area, an ecosystem-based plan will be developed. The various planning processes that have been used can be compared according to how timber and non-timber products, social concerns, and economic values were recognized and assessed. Interestingly, modern quantitative decision-making techniques have only been used in the development of Mediterranean region planning models. Despite simulation models developed by Soykan (1978), Misir (2001) and others in recent years, these types of processes have not generally been put into practice. Therefore, from the standpoint of recognizing the various quantitative functional relationships that exist between competing uses of the land, none of the approaches are considered better than the others along these lines. In the plans developed through conventional forest management planning models, Western Black Sea region planning models and ecosystem-based functional planning models, the sustainable allowable cut was determined, in general, for one planning period.

However, because Western Black Sea region planning model plans used silvicultural considerations in the determination of the allowable cut amount and various other planning methods for the regulation of yields, it was usually impossible to guarantee equal wood production levels during sequential planning periods. Equal wood volume production was desired to meet wood production demands, rather than local village demands for fuelwood.

In contrast, plans developed through Mediterranean region planning models determined an allowable cut over a 100-year planning horizon. The forest planning techniques used in forest planning only addressed timber production; therefore, it was nearly impossible to achieve multiple objectives by means of the conventional or the Mediterranean model plans. With a continuous forest approach, the ecosystem-based functional planning models and Western Black Sea region planning models were better along these lines. From an economic perspective, the Western Black Sea region model plans were the most expensive to develop because of more intense data collection and assessment procedures. If conventional forest management planning models were the basis of comparison, it has been expressed that the Western Black Sea region model plans were twice as expensive for each plan, the Mediterranean region model plans were about 80% more expensive, and the ecosystem-based functional planning model cost is about 70% more expensive. Whereas the ecosystem-based functional planning models recognize that changes in tree species, landscape condition, and forest function require different silvicultural techniques in different parts of the country, none of plans that have been prepared for Turkish forests have acknowledged regional peculiarities in marketing circumstances, transportation facilities, and managerial intensities. The value of timber and other forest benefits is not equal and vary across the country. Therefore, the content and detail of management plans should change as managerial intensity and the economic importance of the planning unit changes. Furthermore, the social benefits of forest resources change with the expectations of people living in or near the forests. Conflicts cannot be mitigated unless the opinions and desires of all people can be incorporated into management plans.

Currently, the implementation of forest plans in Turkey faces many challenges. Centralized planning is necessary because of a lack of skilled personnel and qualified decision-makers at the local level. Compounding this issue of institutional capacity are ineffective forest protection programs, occasional poor communication with local residents, and social conflicts, and these have limited the implementation of forest plans, even though the planning process has evolved. Local villagers have employment rights for certain forestry activities and access rights to forests for recreational purposes and for non-timber forest product collection (Güneş and Coşkun, 2008).

However, fuelwood and construction-grade lumber are necessary resources for many people, and access to these resources is critical. Lumber needed for the development of new buildings or the repair of older ones is generally available to local villagers at a cost that reflects the stumpage price of the wood and some transportation and stacking costs. Fuelwood is also made available using a variable cost and volume schedule that depends on the number of people living in a house. As an example, villagers who live in a house containing up to six people and who cut the fuelwood themselves can acquire about five cords of wood at a cost equivalent to the stumpage price of the wood. The impact of these wood product demands on the allowable cut for each working circle will vary due to the timing of local needs and the existing supply of goods (Zengin *et al.,* 2013).

As described above, there are 4 forest management scenarios applied in Turkey. A brief description of each one is provided along with their impact on carbon storage. The first two scenarios are those widely applied whereas scenarios 3 and 4 are only pilot implemented or as part of research projects.

1. **Conventional (Sustainable wood production) - German-led neoclassical area control management**

Even-aged management, characterized by short rotation length, large clear-cut blocks, no vegetation control on clear-cut areas, high grading, clear cutting on steep slopes, and over-harvesting the accessible sites. Forest characteristics were not taken into account.

+ high C sequestration rate during the establishment of new stands after clear cuts

- low average carbon stock, decomposition of soil organic matter, soil erosion and degradation, increased $CO_2$ emissions due to deforestation, endangerment of biodiversity, difficult or non-existing natural succession or artificial regeneration

2. **Mediterranean region planning model (Sustainability of forest functions and benefits)**

Even-aged management, intensive forestry direction characterized by shorter rotation length for some species but longer planning horizon and no clearcuts.

+ high C sequestration rate during the establishment of new stands after intensive harvesting

- low average carbon stock, difficult or non-existing natural succession or artificial regeneration

**3. Western Black Sea region planning (Turkish – German collaboration)**

Stand-level silvicultural direction focusing on natural sustainability of deciduous forests through stand-level decisions. Longer rotation and regeneration periods and the use of continuous cover forestry concepts (uneven-aged concepts)

+ high average carbon stock by increasing and sustaining constant forest cover, soil protection, biodiversity conservation
- low C sequestration rate, especially for beech forests. However, while generally fast growing species accumulate carbon more rapidly (Behera *et al.*, 2016), slow growing species have advantages for long-term carbon storage in the forest advantages (SFC, 2010).

**4. Ecosystem-based functional planning**

Aiming to maintain biological diversity, productivity, regenerative capacity, and vitality and to fulfil relevant ecological, economic, and social functions. Flexible, integrated, oriented towards the dominant function of the forest.

Incorporate carbon storage in the forest management plan: baseline, monitoring and reporting process.

+ high average carbon stock by increasing and sustaining constant forest cover, soil protection, conservation of biodiversity, productivity, regenerative capacity, and vitality
- low C sequestration rate.

## 4.2. Comparison of forest management practices related to climate change in Turkey and Greece.

Nowadays, a single type of planning process is used for forest management in Turkey, which takes into account ecological and environmental conditions, multiple uses of the landscape and social concerns but still focuses on wood production. Although management and planning are evolving, the planning concept needs to be steered towards holistic management with the integration of various forest values based on ecosystem sustainability (Zengin *et al.*, 2013).

Similar is also the situation in Greece, with forest management and planning still targeted mainly to wood production, although the need for a comprehensive management of all forest functions has been recognized (Galatsidas, 2012). No steps have been taken towards the estimation of existing carbon stock in forests or the adaptation of management to incorporate climate change.

The management of forests in Greece has been based on the same principles since the 1950s , with minor modifications regarding the management goals. Initially, wood production was the main forest function considered and other products and functions, which could pose limitations to wood production, were determined as secondary benefits (Regulations 1959 & 1965). Forest recreation and other uses of forests gained significance in the '80s and suggestions to manage forests for multiple uses were made (Gatzojannis, 1984, 1988). Models to incorporate protective functions of forests into management plans have also been proposed in the decades that followed (Gatzojannis *et al.*, 1997; Kalabokidis *et al.*, 2002; Galatsidas 2001; Gatzojannis 2002; Galatsidas *et al.,* 2015a,b), but wood production still remains the main planning goal of the forest practice and other forest functions have not been practically included in the management plans.

In general, forest management planning in Greece follows an ecosystem-based functional planning model, similar to the one applied in Turkey. However, the dominant function is determined for the entire forest administrative unit, which is often delineated using natural break lines (rivers or ridges) and administrative boundaries (municipalities, prefectures, etc.).

The basic functions of the nowadays managed Greek forests are sustainable wood production, soil protection, recreation and other uses (i.e. conservation of biodiversity). Management is based on 10 year management plans. The minimum planning and management unit in Greek forestry is the sub-section, which covers an area of few hectares and is defined by natural topographical break lines in most cases, so that it is easily recognized in the field.

The management practices are based on species specific silvicultural treatments that favour natural regeneration and sustainable wood production. The main productive species are located on medium and high altitudes, whereas forests at lower altitudes are generally degraded (Oak coppice forests and pine reforestations) or cover areas where wood production is not the main forest function but protective functions (of soil, water and biodiversity) prevail.

**Table 2. Comparison of forest management practices in the two countries**

| | Turkey | Greece |
|---|---|---|
| Planning method | Ecosystem-based functional planning | Ecosystem-based functional planning |
| Dominant function area | Functional area | Forest administrative entity (related to municipal boundaries) |
| Minimum planning unit | Functional area | Management unit (sub-section) |
| Planning period of forest management plans | 10-year | 10-year |

Biodiversity conservation needs in Greece have led to the establishment of an extended network of protected areas. In 1937, Greece started to identify natural areas of specific ecological importance (forests, wetlands etc.) and place them under special protection. While in the early stages of this special protection, all human activities were prohibited later on, this concept was abandoned and a new approach was followed, that of associating nature protection with the sustainable use of its resources (GBWC, 2017).

The protection status of the areas may be at national, European or international level. In many cases the same area is listed in both national legislation and international conventions or international or/and European initiatives. The NATURA 2000 network of protected sites in Europe is an important initiative for the conservation of natural habitats and species of wild fauna and flora of Community interest. The management of protected forests incorporates considerations regarding biodiversity conservation.

The management practices applied in Greece until today have resulted in intertemporal reduced wood production and increased biomass in forests (therefore increased carbon storage). Efforts are being made at research level, to upgrade the forest management planning procedures and include all potential forest ecosystem services. Climate change impacts on forests and vice versa is an issue that needs to be addressed in contemporary forest management plans. Carbon storage potential, carbon sequestration rates in forests, as well as carbon accounting and reporting are required according to decision 529/2013/EU on accounting rules on removals resulting from activities relating forestry.

## 5. Project area description and management history

The study area is located in the Maçka State Forest Enterprise which covers part of Trabzon Province located in the eastern Black Sea region of Turkey (Fig.1). The 21471.6 ha study area consists of three planning units and contains a forested area of 20562.2 ha. The altitude ranges from 400 to 2,280 m above the sea level and average slope is about 57 %.

The Black Sea climate is characterized by mild winters and cool summers and is rainy during all four seasons. The average annual temperature is 12.2 °C, reaching a maximum of 20.2 °C in summer, a minimum of 4.5 °C in winter and with an average annual precipitation of 640.9 mm (Altun 1995). Forest vegetation is typical and the dominant tree species include oriental spruce (*Picea orientalis* (L.) Link), scots pine (*Pinus sylvestris* L.), Nordmann's fir (*Abies nordmanniana* (Stev.) Spach subsp. nordmanniana), oriental beech (*Fagus orientalis* Lipsky), oriental hornbeam (*Carpinus orientalis* Mill.), and alder (*Alnus glutinosa* (L.) Gaertner).

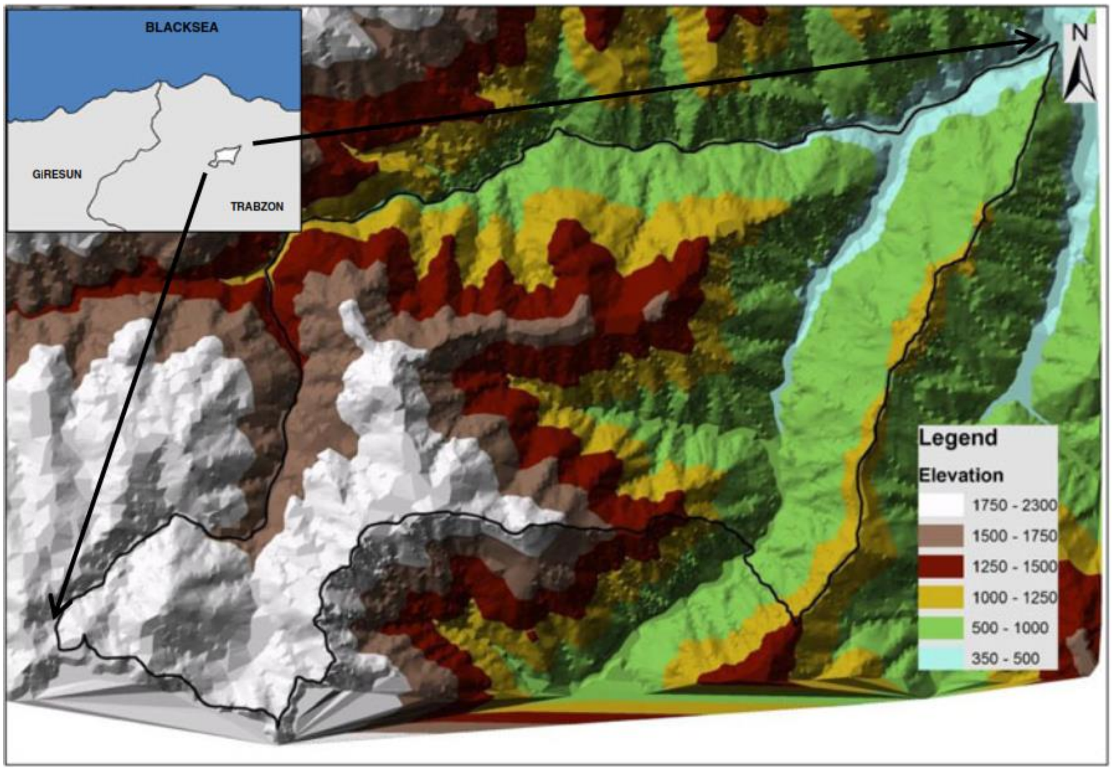


**Figure 1. Topography of the study area**

Natural stands dominate the study area. However, there are also planted beech forests under three Forest Management Chiefs of the Maçka State Forest Enterprise; Esiroğlu, Yeşiltepe and İpekyolu. The Ipekyolu Forest Management Chief was formerly known as the Chief of Education and Research Forest Management. Forest Management Chiefs is considered a planning unit in Turkish Forestry.

Beech plantations are being established in the study area since 1983. This was because the regeneration success of the beech species in this region was lower than that of other species (e.g. oriental spruce) and also due to the extreme destruction of beech stands (social pressure, etc.). During the application of the final allowable cut, afforestation was carried out in order to prevent the area from becoming damaged due to the inability of the natural beech seedlings to reach the area. This process started in 1983 and no such method had been applied before. Beech planting has been continued almost every year since then. In this way, approximately 80 ha in the Esiroğlu planning unit, 50 ha in the Yeşiltepe planning unit and 70 ha in the İpekyolu planning unit are present.

**History of management practices applied & Current management practice**

Until the early 1970s the Maçka State Forest Enterprise forests were managed under national defence policies in Turkey. With this management policy, harvested areas were not regenerated properly nor were appropriate forest composition and structure created, leaving sustainable timber production in jeopardy resulting in a decrease in standing timber volume. It was after 1973 when tree species that were semi-tolerant and intolerant to climatic conditions in Turkey were planted using an even-aged management method. Since adequate knowledge for implementing a new management approach was not available at that time, clear-cut harvesting was implemented haphazardly in larger areas and the cut areas failed to regenerate to forest quickly. Stands in the forest landscape were all designated as having timber production as the prime management objective. As a result, forest structure was created messily, especially in oriental spruce forest. Because trees were planted prior to 1984 which could not tolerate local climatic conditions, all the management plans in Eastern Black Sea region were revised in 1984. In the new plans, optimal target forest structure was determined using newly established yield tables and well defined age classes were designated (Misir, 2013). In 2002 a new planning method was adopted, called the Turkish-German collaborate model plan (individual plan), which is still in effect until today.

Even though the current management method is based on sustainability principles, it remains oriented towards wood production. This is a significant improvement in relation to the previous management practices, which is documented by the 48% increase in forest carbon stock in Northern Turkey between 1973 and 2006 (Misir, 2013). The estimation of carbon stock only includes live above-ground tree biomass. Carbon sequestration in standing dead trees, lying dead wood, shrubs and litter has not been included in the overall carbon stock of the forests.

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**Annex II: D1. Sampling Plan**

**Project: Development of a common protocol to assess the impact of forest management practices on climate change**

# Sampling Plan

## Deliverable 1.2

**15 December 2017**

## Contents

## 5. Scope

The aim of the Action is to establish reference levels and monitor inter-annual fluctuation of net carbon storage (or loss), focusing on $CO_2$ (no other GHG) in forests. The Action involves the development of common guidelines (Protocol) for the assessment of carbon storage in planted forests through afforestation/reforestation projects. This common protocol will also assess and validate forest management practices and applied measures in these types of areas, aiming to improve the $CO_2$ removal/sequestration balance through management treatments.

The Action incorporates the identification and measurement/assessment of carbon Sources Sinks or Reservoirs (SSR), as defined bellow by IPCC (2001):

**Source**: *Any process, activity, or mechanism that releases a GHG*[1]*, an aerosol, or a precursor of a greenhouse gas or aerosol into the atmosphere*

**Sink**: *Any process, activity or mechanism that removes a GHG, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere*

**Reservoir**: *A component of the climate system, other than the atmosphere, which has the capacity to store, accumulate, or release a substance of concern (e.g., carbon, a GHG, or a precursor).*

The main 'carbon pools' or reservoirs which can be included in a forest carbon sampling program are five, according to the Intergovernmental Panel on Climate Change (IPCC, 2006):

1. Aboveground biomass, which can be divided into tree and non-tree pools (e.g. shrubs etc)
2. Belowground biomass (live tree roots)
3. Dead wood (including debris such as fallen branches and logging residues)
4. Litter (i.e. fallen leaves)
5. Soil organic matter

The scope of the sampling plan includes the following activities:

- Identification of SSRs to be measured/assessed
- Planning for SSRs measurement/assessment (carbon stock sampling, GHG sources measurement, etc.)
- Measurement/assessment of SSRs
- Data analysis and interpretation
- Development/use of growth models to predict biomass and carbon stocks

The purpose of the inventory is to obtain knowledge about carbon stocks stored in planted forests in order to set a baseline and monitor their changes. The Action will provide insight into the impact of different management practices on the carbon stock of planted forests.

[1] In this case $CO_2$

## 6. Identification of SSRs

Carbon Sources, Sinks and Reservoirs are related or affected by the forest management practices applied. Therefore, it is necessary to identify them beforehand and set a baseline in order to assess future changes due to the implementation of different management scenarios.

Only the 'key categories' should be included within the project in order to make the most efficient use of available resources. 'Key categories' refer to the carbon SSRs that have the greatest contribution to the carbon stock and GHG emissions. The SSRs that are related to the Action have been identified and are described in Table 1. Depending on their contribution as either a source or a reservoir they have been included or excluded from the sampling and analysis process.

Greenhouse gas emissions are linked to the use of fossil fuels in industry (2/3) and 1/3 is due to land use change and agricultural activities. Therefore, the emissions from forest management (establishment, treatment, harvesting) are not considered significant and are excluded. The carbon pools that will be included in the Action are aboveground and belowground biomass, dead wood and litter, in accordance with the accounting rules for all afforestation and reforestation project activities under the Clean Development Mechanism (UNFCCC, 2015). The first two pools are mandatory (above- and below-ground biomass), whereas deadwood and litter are optional.

**Table 3. Carbon Sources, Sinks and Reservoirs in planted forests (adapted from Tree Canada, 2015)**

| Stage | Identified SSR | Description | Include/ Exclude | Justification for Exclusion |
|---|---|---|---|---|
| Production of planting material/ Establishment of plantation | 1a. Fossil fuel combustion – seedling production, labour and materials transport | Fossil fuel used (for heat or electricity production) in seedling production and for transport of planting stock, labour and equipment to project site for the establishment of planted forests | Exclude | The emissions from fossil fuel that is combusted to heat the greenhouses where the seedlings are produced is not considered significant. |
| | 2. Fertilizer use | Non-$CO_2$ GHG emissions ($CH_3$ and $N_2O$) | Exclude | The emissions from fertilizer used to produce the tree seedlings is not considered to be significant. |
| | 1b. Fossil fuel combustion — labour and materials transport | In vehicles and equipment used for site preparation and plantation establishment | Exclude | The emission from fossil fuel that is combusted to transport labour and materials to the project site is not considered significant. |

| Stage | Identified SSR | Description | Include/ Exclude | Justification for Exclusion |
|---|---|---|---|---|
| Onsite forest SSR | **3. Above-ground C reservoir** | Biomass in live trees, including branches and foliage | **Include: live trees and shrubs** | Live tree, above-ground biomass must be considered in the baseline, as well as the project. Live aboveground shrub biomass must also be included where the shrubs have a diameter of at least 2 cm at a stem height of 10 cm. The amount of live herbaceous biomass will also be measured. |
| | **4. Below-ground C reservoir** | Live tree root biomass | **Include (estimation)** | No measurements can be carried out during the project implementation period due to the weather conditions |
| | **5. Standing Dead Wood** | **Biomass in standing dead wood** | **Include** | Dead wood must be quantified at the project start, and forecast in both the baseline and the project. |
| | **6. Lying Dead Wood** | **Biomass in lying dead wood** | **Include** | Dead wood must be quantified at the project start, and forecast in both the baseline and the project. |
| | **7. Litter C reservoir** | **Biomass in litter** | **Include** | Project is likely to increase the amount of litter |
| | 8. Soil Organic C reservoir | Organic C, dead root and live fine root content of soil | Exclude | Project impacts are likely to be positive over the project period. Any changes will not be significant. |
| Management activities/ Harvesting | 1c. Fossil fuel combustion | In vehicles and equipment used for plantation maintenance, monitoring and any harvesting activities. | Exclude | Not significant and exclusion results in more conservative estimate |
| Transport to facility/ Production of wood products | 1d. Fossil fuel combustion — transport of harvested biomass | Transport of any harvested biomass to processing facility | Exclude | Emissions from combusting fossil fuel to transport harvested wood /agricultural products to a processing facility are judged to be not significant since the amount of harvesting permitted in a project is limited. |

| Stage | Identified SSR | Description | Include/ Exclude | Justification for Exclusion |
|---|---|---|---|---|
| | 9. Processing facility | Process emissions at wood product or biomass energy facility. Emissions related to energy used in processing of crops /food products | Exclude | Exclude, for reasons analogous to those for excluding emissions associated with transport of product to mill. |
| | 10: Harvested wood products | Wood from thinning or partial harvests may be converted into wood products. A proportion of the products remains for some time in the products pool and can be considered as offsets. | Exclude | Exclude, since the scale of the projects is very small relative to the regional landbase and supply capacity. |

Carbon stock in the belowground biomass will be estimated as a fixed percentage of the carbon stock in the aboveground biomass (root:shoot ratio). Generally, belowground C stock is lower in broadleaved species than in coniferous forests (Dar and Sundarapandian, 2015; Tufekcioglu *et al.*, 2004).

# 7. Planning for measuring/ assessing Carbon Sink & Reservoir

The project site (Maçka forest) covers 21471.6 ha overall, with approximately 200 ha of scattered planted areas of beech (*Fagus orientalis*), up to 34 years old (Image 1). Past management was based on previous management plans (1973, 1984, 2006 & 2016), with different priorities.

Field measurements will be applied to estimate the aboveground live tree volume, using allometric equations (Misir *et al.*, 2013). Field measurements will also be applied to estimate the aboveground live tree biomass in branches and foliage, as well as the shrub volume. Other measurements will provide data for standing dead wood, lying dead wood and litter. The parameters to be measured/assessed are included in the Inventory sheet (Annex I).

The beech plantations were stratified into 10-year age classes (4 age classes overall) and 3 types of site quality in the forest (good, medium, poor). In order to efficiently estimate the carbon stock, random stratified sampling will be applied. Stratification minimizes the variation within each stratum therefore providing a more precise estimate, with less effort and cost. Effort has been made to equally allocate at least three sample plots to each age classes. For each age class, effort was also made to include the full range of site conditions (from poorest to best). Sampling will therefore be carried out in 3 plots for each age class – site quality combination (stratum) which sums up to 32 plots overall (Table 2).

The selection of the size and shape of the plots was based on capturing the variation of the stand at each sampling. The plot size will vary between 400 to 800 $m^2$ depending on the age class and site quality (smaller area for trees of smaller dimensions). Each plot will include at least 30 trees, which exceeds the 10–20 trees set as a rule of thumb in order to obtain a representative sample (ForestWorks ISC, 2014). The number and area of the plots per stratum is shown in Table 2.

**Table 4. Plot area and number per stratum**

| Site Quality | Age class | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| | 0 - 10 | 10 - 20 | 20 - 30 | 30 - 40 |
| Good (A) | 3 | 3 | 3 | 3 |
| | 400 $m^2$ | 800 $m^2$ | 800 $m^2$ | 800 $m^2$ |
| Medium (B) | 3 | 3 | 3 | 3 |
| | 400 $m^2$ | 400 $m^2$ | 800 $m^2$ | 800 $m^2$ |
| Poor (C) | 2 | 2 | 2 | 2 |
| | 400 $m^2$ | 400 $m^2$ | 400 $m^2$ | 800 $m^2$ |

Number of Plots

Plot Area

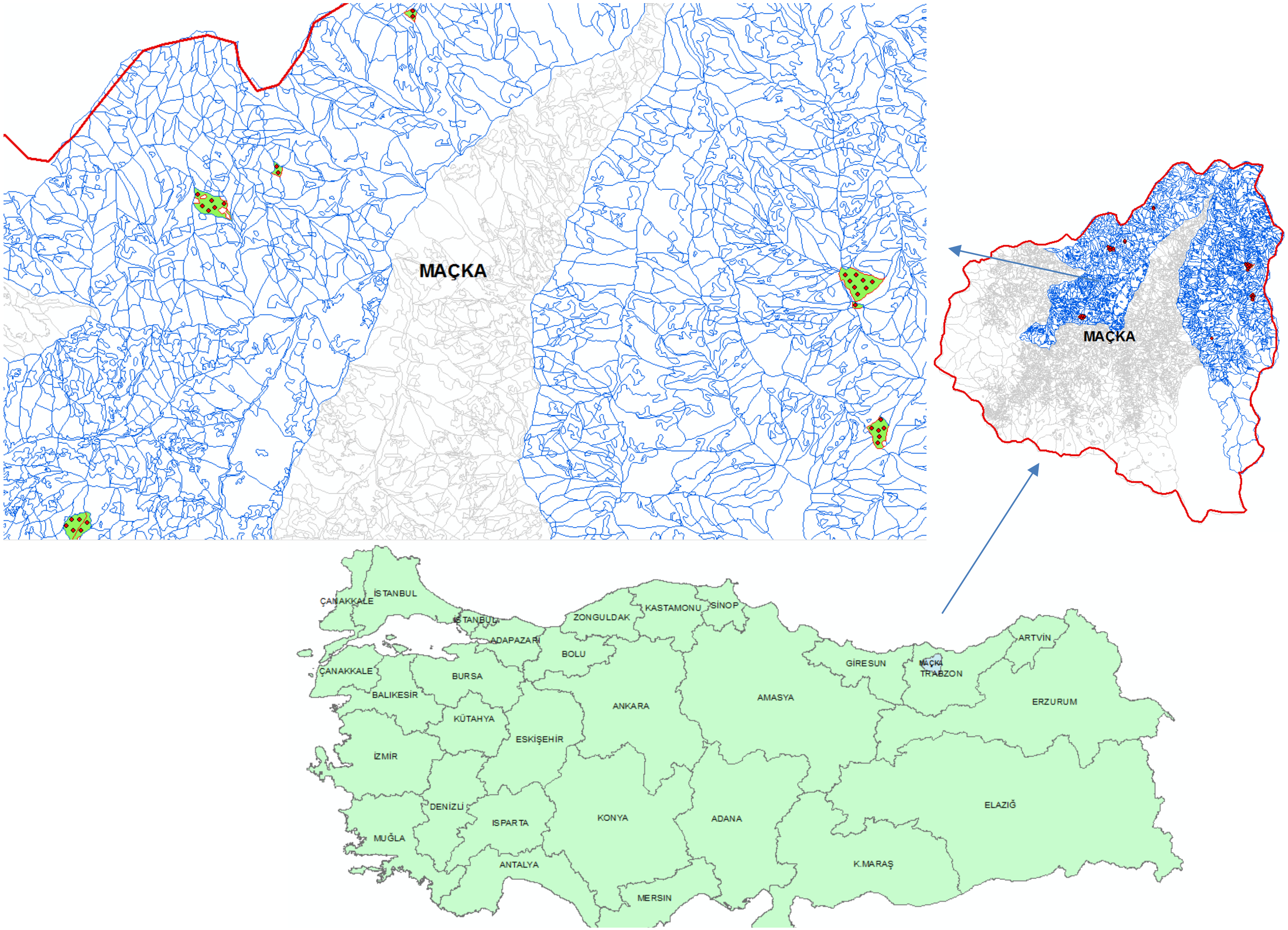


**Image 1. Overview of the project area**

The sampling plots will be allocated between planning units of the Maçka State Forest (Image 2) as follows:

Esiroğlu planning unit: 16 sampling plots

Yeşiltepe planning unit: 10 sampling plots

İpekyolu planning unit: 6 sampling plots

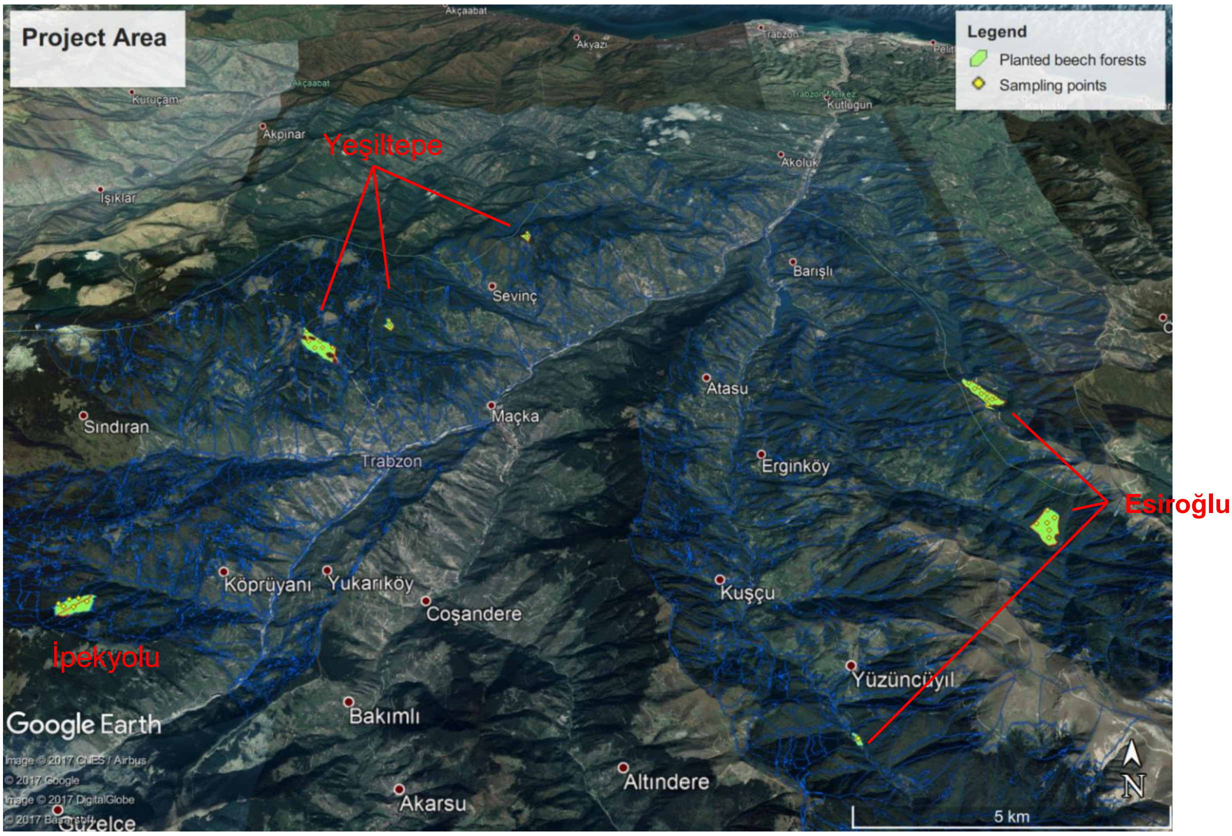


**Image 2. Allocation of sampling plots within the project area**

A design of nested quadrats of different sizes will be implemented in order to measure vegetation of different sizes and strata, and for collecting litter to estimate carbon stock (Figure 1). The 1m X 1m quadrat will be used for small shrubs biomass (< 2cm DBH), herbaceous species and litter.

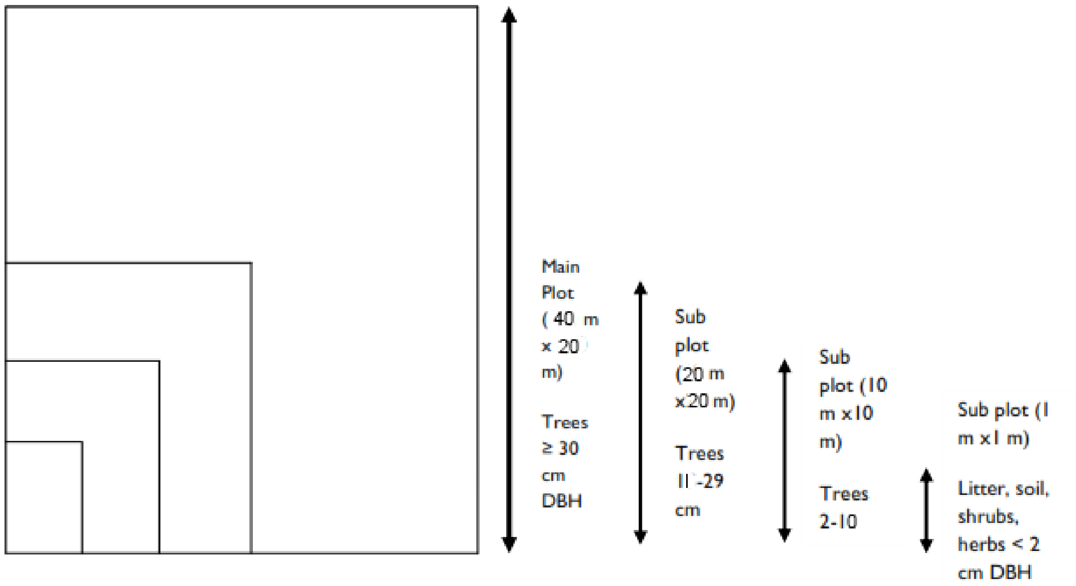


**Figure 2. Nested plot design for sampling various carbon pools in homogeneous stratum (adapted from Assefa *et al.*, 2013)**

The 10m X 10m quadrat will be used for sampling above ground live trees with 2-10 cm DBH and dead wood. The second quadrat will be used for trees with *DBH* between 11 – 29 cm. Trees with *DBH* ≥ 30 cm should be counted in the entire sample plots. The size of the sampling plots will depend on the stratum (age class and site quality).

# 8. Measurement/ assessment of Carbon Stock (Sinks & Reservoirs)

## 4.1 Determination of Living tree Biomass and Carbon Storage

**Above-ground live biomass:** Includes all live vegetative biomass above the soil including stem, stump, branches, bark, seeds and foliage. The biomass contained in the trees is the primary source of carbon stocks. For each tree the diameter is measured at 1.3 m above the soil surface, except where trunk irregularities at that height occur (plank woods, tapping or other wounds) and necessitate measurement at a greater height (Hairiah *et al.*, 2001).

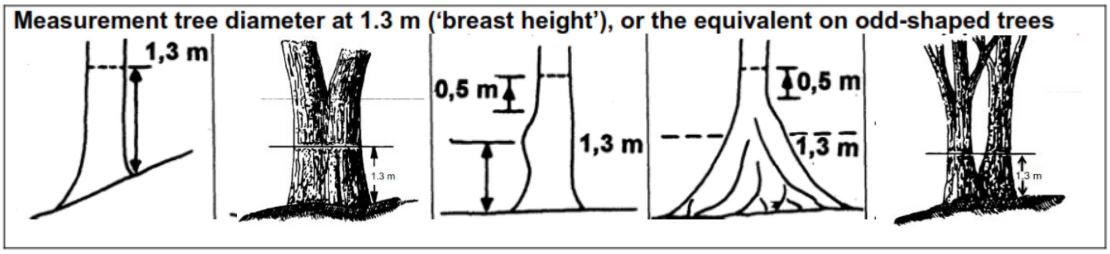


**Figure 3. Tree measurement at breast height diameter (Hairiah *et al.*, 2001; Climate Action Reserve, 2017)**

The aboveground biomass measurement will include all trees and shrubs within each plot that are greater than 2 cm diameter at breast height (*DBH*), and also their branches and foliage. The living tree biomass and carbon storage capacity of beech plantations will be determined using the biomass and carbon storage models developed by Misir et al. (2013) for tree and tree components. In other words, whole tree biomass and carbon storage capacity will be estimated from *DBH* for oriental beech using allometric biomass equations proposed by Misir et al. (2013).

Since the diameter at breast height and total height of each tree in the sample plot are measured, they are used to fill in the corresponding places for diameter and height in the biomass and carbon storage models. Stem, branch, bark, leaves, and tree biomass and the amount of carbon stored in the tree biomass will be estimated. By correlating with the size of the sample area, stem, branch, bark, leaf, tree biomass and the amount of carbon stored in these biomass will be found in the hectare.

General information (aspect, slope, elevation) and stand characteristics will also be recorded during the samplings (structure, cover, etc.). The cover within the sample area of the shrubs or herbaceous species will also be determined. After that, it will be cut from the soil ground with motorized saws and scissors, and the leaves, shrubs and herbaceous layer will be weighed individually in the field. Each component will then be subjected to sub-sampling and transported to laboratories for biomass measurements and carbon analysis. In addition, all of the fine woody debris and coarse woody materials will be collected and weighed from the sample plots; sub-samples will be taken and brought to the laboratory for further analysis.

### 4.2 Determination of Belowground Biomass and Stored Carbon

The belowground biomass will be estimated using the root to shoot ratio, which is based on the relationship between biomass in shoot and roots for a tree of a given species as well as for a given forest or plantation type.

According to (Cairns *et al.*, 1997) the average below-ground (root) biomass to average above-ground (shoot) biomass ratio for tropical, temperate and boreal areas is 0.26.

### 4.3 Determination of Standing Dead Tree, Lying Dead Wood and Shrubs Biomass and Stored Carbon

Dead woody materials with a diameter of 1-10 cm will be categorized as fine and those larger than 10 cm will be categorized as coarse woody material and their biomass will be determined. Each sample will be pulverized by grinding in a grinding mill and three sub-samples will be taken from this powder mixture. Their carbon content will be determined with COSTECH's elemental analysis device. Thus, the amount of carbon stored in each sample will be found and converted into tons per hectare.

### 4.4 Determination of Litter Biomass and Stored Carbon

**Litter:** Material that is too small to be considered lying dead wood is classed as litter. This includes branches, stumps, leaves and duff.

In order to determine the amount of litter on the forest floor, the litter organic matter of 25 x 25 cm size in 4 points which are not destroyed in sample areas and determined by random sampling will be collected up to mineral soil and transported to laboratories. Thus, for each sample plot, the amount of litter (litter biomass) in the unit area and the amount of carbon stored in the litter will be determined. Litter samples will be kept in a drying oven at 65 ± 3 °C for 48 hours and when they reach constant weight, their dry weights will be measured (sensitivity 0.01 g). Utilizing the biomass of this sample, several transformations will be found on the hectare of litter biomass. In addition, samples are grinded in a grinding mill and analyzed by COSTECH's Elemental Analyzer to determine the amount of carbon stored.

## 9. Equipment and supplies

The following list includes the basic equipment and supplies that will be required for the carbon sampling field crew:

- GPS, for navigation to plot locations and Maps
- Diameter tape for measuring Diameter at Breast Height at 1.3 m
- Laser rangefinder/distance measuring device, for measuring tree height (if required). Otherwise, a clinometer and measuring tape can be used.
- Measuring tape, for laying out plots
- Corner posts/stakes
- Metal sampling frame (for litter measurements)
- Satellite phone, two way radio or mobile phone (if there is reception)
- Data recording device (i.e. waterproof paper-based sheets, or electronic data logger), pens/pencils
- Flagging tape
- Motorized saws and scissors
- Camera
- Safety equipment such as a first aid kit, hard hat, sun protection, high visibility vest, etc.

Work health and safety, environmental and organizational requirements that apply to any forest operation in Turkey will be taken into account when carrying out the carbon stock sampling.

## 10. Abbreviations and Acronyms

| | |
|---|---|
| DBH | Diameter at breast height (1.3m) |
| FAO | Food and Agriculture Organization of the United Nations |
| FRA | Forest Resources Assessment |
| GHG | Greenhouse gases |
| IPCC | Intergovernmental Panel on Climate Change |
| LULUCF | Land Use, Land Use Change of Forestry |
| MCPFE | Ministerial Conference on the Protection of Forests in Europe |
| SSR | Sources Sinks or Reservoirs |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WBCSD | World Business Council for Sustainable Development |
| WRI | World Resources Institute |

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# Annex I: Field Inventory Sheet

## A. GENERAL INFORMATION

| | |
|---|---|
| **Forest Management Unit** | |
| **Stand** | |
| **Location** | |

| | | |
|---|---|---|
| **Plot No/ Area** | | 400/ 800 $m^2$ |
| **Date** | | |
| **Inventory Personnel** | | |

| | |
|---|---|
| **Aspect (°)** | |
| **Slope (%)** | |
| **Elevation (m)** | |

| | |
|---|---|
| **Plot coordinates (left bottom point of quadrat 1x1m)** | |
| **Longitude** | |
| **Latitude** | |

## B. STAND CHARACTERISTICS (overall plot area)

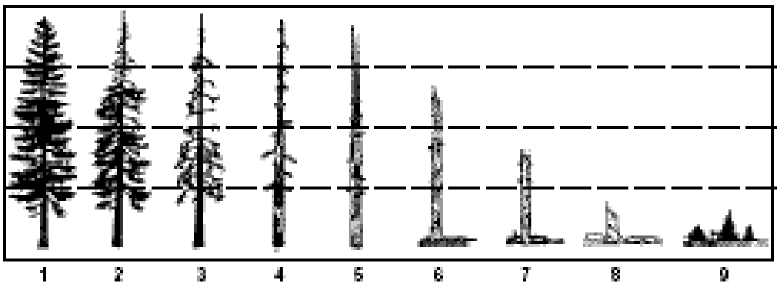
| | | | | |
|---|---|---|---|---|
| **Canopy closure (%)** | | | | |
| **Main wood species** | | | | |
| **Stand structure** | **Even-aged ☐ Uneven-aged groups ☐ Uneven-aged individuals ☐** | | | |
| **Maturity stage** | **Saplings☐**<br>**(d<7 cm)** | **Poles ☐**<br>**(DBH 7 - 20 cm)** | **Mature trees ☐**<br>**(DBH 20 - 35 cm)** | **Mature trees ☐**<br>**(DBH>35 cm)** |
| **Number of stems per diameter class (percentage %)** | **<25cm:** | **25-50cm:** | **>50cm:** | |
| **Stand storeys** | **One-storey ☐ Two-storey ☐ Multi-storey ☐** | | | |
| **Mean overstorey height (m)** | | | | |
| **Mean height of 2nd storey (m)** | | | | |
| **Forest edge – Ecotone** | **Yes ☐ No ☐** | | | |
| **Water locations** | **Yes ☐ No ☐** | | | |

## C. TIMBER CRUISING

| No | Type (LT, DST, BT)[2] | Branched (Y or N)? | Species | DBH (cm) | Total height (m) | Time of necrosis (for DST)[3] |
|---|---|---|---|---|---|---|
| 1 | | | | | | A ☐ B ☐ C ☐ |
| 2 | | | | | | A ☐ B ☐ C ☐ |
| 3 | | | | | | A ☐ B ☐ C ☐ |
| 4 | | | | | | A ☐ B ☐ C ☐ |
| 5 | | | | | | A ☐ B ☐ C ☐ |
| 6 | | | | | | A ☐ B ☐ C ☐ |
| 7 | | | | | | A ☐ B ☐ C ☐ |
| 8 | | | | | | A ☐ B ☐ C ☐ |
| 9 | | | | | | A ☐ B ☐ C ☐ |
| 10 | | | | | | A ☐ B ☐ C ☐ |
| 11 | | | | | | A ☐ B ☐ C ☐ |
| 12 | | | | | | A ☐ B ☐ C ☐ |
| 13 | | | | | | A ☐ B ☐ C ☐ |
| 14 | | | | | | A ☐ B ☐ C ☐ |
| 15 | | | | | | A ☐ B ☐ C ☐ |
| 16 | | | | | | A ☐ B ☐ C ☐ |
| 17 | | | | | | A ☐ B ☐ C ☐ |
| 18 | | | | | | A ☐ B ☐ C ☐ |
| 19 | | | | | | A ☐ B ☐ C ☐ |
| 20 | | | | | | A ☐ B ☐ C ☐ |
| 21 | | | | | | A ☐ B ☐ C ☐ |
| 22 | | | | | | A ☐ B ☐ C ☐ |
| 23 | | | | | | A ☐ B ☐ C ☐ |
| 24 | | | | | | A ☐ B ☐ C ☐ |
| 25 | | | | | | A ☐ B ☐ C ☐ |
| 26 | | | | | | A ☐ B ☐ C ☐ |
| 27 | | | | | | A ☐ B ☐ C ☐ |

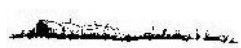
[2] Live tree (LT), Dead standing tree (DST), Big tree with diameter over 30 cm (BT)
[3]

**A**: recently (1, 2), **B**: a few years ago (3, 4), **C**: a lot of years ago (5 – 9).



| No | Type (LT, DST, BT)[2] | Branched (Y or N)? | Species | DBH (cm) | Total height (m) | Time of necrosis (for DST)[3] |
|---|---|---|---|---|---|---|
| 28 | | | | | | A ☐ B ☐ C ☐ |
| 29 | | | | | | A ☐ B ☐ C ☐ |
| 30 | | | | | | A ☐ B ☐ C ☐ |
| 31 | | | | | | A ☐ B ☐ C ☐ |
| 32 | | | | | | A ☐ B ☐ C ☐ |
| 33 | | | | | | A ☐ B ☐ C ☐ |
| 34 | | | | | | A ☐ B ☐ C ☐ |
| 35 | | | | | | A ☐ B ☐ C ☐ |

**D. UNDERSTOREY: LYING DEAD WOOD & SHRUBS (10 X 10 m Quadrat)**

| LYING DEAD TREES | | | | |
|---|---|---|---|---|
| **No** | **Species** | **Average diameter (cm)** | **Length (m)** | **Stage of Decaying** |
| 1 | | | | A ☐ B ☐ C ☐ |
| 2 | | | | A ☐ B ☐ C ☐ |
| 3 | | | | A ☐ B ☐ C ☐ |
| 4 | | | | A ☐ B ☐ C ☐ |
| | | | | |
| | | **A. Early stages**  | **B. Middle stages:**  | **C.Final stages:**  |

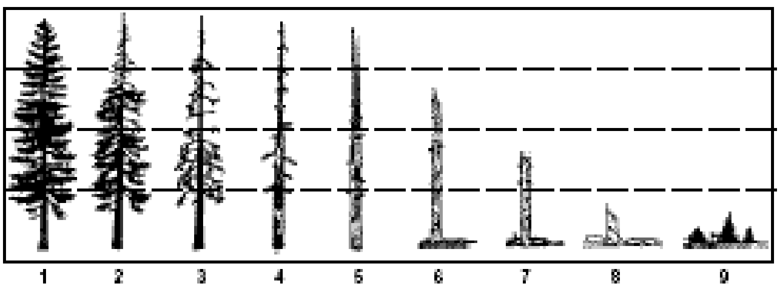
| UNDERSTOREY | |
|---|---|
| **Shrub understorey** | **Yes** ☐ **No** ☐ |
| **Dominant species** | |
| **Cover (%)** | |
| **Mean height (m)** | |
| **Herbaceous understorey** | **Yes** ☐ **No** ☐ |
| **Cover (%)** | |
| **Mean height (cm)** | |

## C. TIMBER CRUISING

| No | Type (LT, DST, BT)[4] | Branched (Y or N)? | Species | DBH (cm) | Total height (m) | Time of necrosis (for DST)[5] |
|---|---|---|---|---|---|---|
| 1 | | | | | | A ☐ B ☐ C ☐ |
| 2 | | | | | | A ☐ B ☐ C ☐ |
| 3 | | | | | | A ☐ B ☐ C ☐ |
| 4 | | | | | | A ☐ B ☐ C ☐ |
| 5 | | | | | | A ☐ B ☐ C ☐ |
| 6 | | | | | | A ☐ B ☐ C ☐ |
| 7 | | | | | | A ☐ B ☐ C ☐ |
| 8 | | | | | | A ☐ B ☐ C ☐ |
| 9 | | | | | | A ☐ B ☐ C ☐ |
| 10 | | | | | | A ☐ B ☐ C ☐ |
| 11 | | | | | | A ☐ B ☐ C ☐ |
| 12 | | | | | | A ☐ B ☐ C ☐ |
| 13 | | | | | | A ☐ B ☐ C ☐ |
| 14 | | | | | | A ☐ B ☐ C ☐ |
| 15 | | | | | | A ☐ B ☐ C ☐ |
| 16 | | | | | | A ☐ B ☐ C ☐ |
| 17 | | | | | | A ☐ B ☐ C ☐ |
| 18 | | | | | | A ☐ B ☐ C ☐ |
| 19 | | | | | | A ☐ B ☐ C ☐ |
| 20 | | | | | | A ☐ B ☐ C ☐ |
| 21 | | | | | | A ☐ B ☐ C ☐ |
| 22 | | | | | | A ☐ B ☐ C ☐ |
| 23 | | | | | | A ☐ B ☐ C ☐ |
| 24 | | | | | | A ☐ B ☐ C ☐ |
| 25 | | | | | | A ☐ B ☐ C ☐ |
| 26 | | | | | | A ☐ B ☐ C ☐ |
| 27 | | | | | | A ☐ B ☐ C ☐ |

4 Live tree (LT), Dead standing tree (DST), Big tree with diameter over 30 cm (BT)

5 **A**: recently (1, 2), **B**: a few years ago (3, 4), **C**: a lot of years ago (5 – 9).



| No | Type (LT, DST, BT)[4] | Branched (Y or N)? | Species | DBH (cm) | Total height (m) | Time of necrosis (for DST)[5] |
|---|---|---|---|---|---|---|
| 28 | | | | | | A ☐ B ☐ C ☐ |
| 29 | | | | | | A ☐ B ☐ C ☐ |
| 30 | | | | | | A ☐ B ☐ C ☐ |
| 31 | | | | | | A ☐ B ☐ C ☐ |
| 32 | | | | | | A ☐ B ☐ C ☐ |
| 33 | | | | | | A ☐ B ☐ C ☐ |
| 34 | | | | | | A ☐ B ☐ C ☐ |
| 35 | | | | | | A ☐ B ☐ C ☐ |

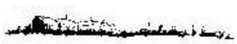
**D. UNDERSTOREY: LYING DEAD WOOD & SHRUBS (10 X 10 m Quadrat)**

| LYING DEAD TREES | | | | |
|---|---|---|---|---|
| No | Species | Average diameter (cm) | Length (m) | Stage of Decaying |
| 1 | | | | A ☐ B ☐ C ☐ |
| 2 | | | | A ☐ B ☐ C ☐ |
| 3 | | | | A ☐ B ☐ C ☐ |
| 4 | | | | A ☐ B ☐ C ☐ |
| | | | | |

**A. Early stages**

**B. Middle stages:**

**C.Final stages:**

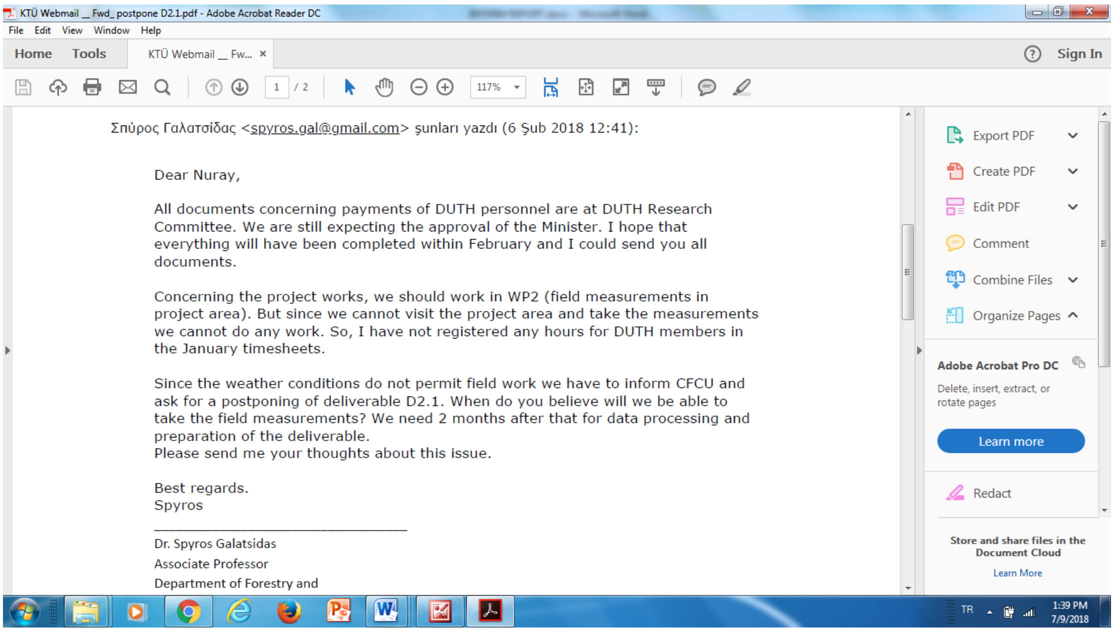


| UNDERSTOREY | |
|---|---|
| Shrub understorey | Yes ☐ No ☐ |
| Dominant species | |
| Cover (%) | |
| Mean height (m) | |
| Herbaceous understorey | Yes ☐ No ☐ |
| Cover (%) | |
| Mean height (cm) | |

## Annex III: The project Logo

IMPACT
FOREST MANAGEMENT
&
CLIMATE CHANGE

# Annex IV: The e-mail dated February 06, 2018



Σπύρος Γαλατσίδας <spyros.gal@gmail.com> şunları yazdı (6 Şub 2018 12:41):

Dear Nuray,

All documents concerning payments of DUTH personnel are at DUTH Research Committee. We are still expecting the approval of the Minister. I hope that everything will have been completed within February and I could send you all documents.

Concerning the project works, we should work in WP2 (field measurements in project area). But since we cannot visit the project area and take the measurements we cannot do any work. So, I have not registered any hours for DUTH members in the January timesheets.

Since the weather conditions do not permit field work we have to inform CFCU and ask for a postponing of deliverable D2.1. When do you believe will we be able to take the field measurements? We need 2 months after that for data processing and preparation of the deliverable.
Please send me your thoughts about this issue.

Best regards.
Spyros

Dr. Spyros Galatsidas
Associate Professor
Department of Forestry and