THE SECOND REPORT
ON THE STATE
OF THE WORLD'S

FOREST GENETIC RESOURCES

COUNTRY REPORT

LEBANON

This country report was prepared as a contribution to the FAO publication, *The Second Report on the State of the World's Forest Genetic Resources*.

The country reports had two elements: (1) an online questionnaire to gather data and information on forest genetic resources; and (2) a complementary written report. For the written reports, countries were invited to follow the structure of the global report and reporting guidelines adopted by the Commission on Genetic Resources for Food and Agriculture at its Seventeenth Regular Session in 2019.

Republic Of Lebanon

Ministry Of Agriculture

Forest Genetic Resources

Lebanon Country Report
The second report on the state of the world's forest genetic resources

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The present report was prepared by:

Anwar Kozah
National Focal Point, Ministry of Agriculture

with the collaboration of

Chadi Mohanna
Director of Rural Development and Natural Resources, Ministry of Agriculture

Jean Stephan, Lebanese University

and of

- **Ministry of Agriculture, Directorate of Rural Development and Natural Resources:** Sylva Koteich, Helene Ayoub, Zeina Tamim, Carla Jamous, Edwar Antoun
- **Lebanese Agricultural Research Institute:** Joelle Breidy
- **SALMA Poject :** Salim Roukoz, Michel Bassil
- **Green Plan:** Raymond Khoury and Elie Namroud
- **Lebanese University, Faculty of Agriculture:** Lamis Chalak
- **Saint Joseph University, Faculty of Science:** Magda Bou Dagher Kharrat
- **University of Balamand:** Georges Mitri
- **Université Saint Esprit-Kaslik:** Nabil Nemer
- **Protected Areas (Tannourine Cedar Reserve, Ehden Reserve, Al-Shouf Cedar Reserve, Bentael Reserve, Jabal Moussa Biosphere Reserve, Cedars of God Forest):** Nabil Nemr, Sandra Koussa Saba, Raymond Khoury, Nizar Hani, Kozhaya Hanna,
- **Association for Forest Development and Conservation:** Sawsan Bou Fakhreddin and Hicham Salman
- **Lebanese Reforestation Initiative**: Maya Nehme and Joseph Bechara

LIST OF ACRONYMS

AFDC: Association for Forest Development and Conservation
AFLP : Amplified Fragment Length Polymorphism
AUB : American University of Beirut
CBD : Convention on Bio-Diversity
CBOs : Community-Based Organizations
CGIAR: Consultative Group on International Agricultural Research
CNRS: Conseil National de Recherche Scientifique (National Council for Scientific Research)
FAO : Food and Agriculture Organization
FGR : Forest Genetic Resources
FRA : Forest Resources Assessment
GEF:Global Environmental Fund
GIZ: German Development Agency
ICARDA : International Center for Agricultural Research in the Dry Areas
INRA: Institut National de Recherche Agricole (France)
IPGRI: International Plant Genetic Resources Institute
ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture
LARI: Lebanese Agricultural Research Institute
LMOs: Living Modified Organisms
LU: Lebanese University
MOA: Ministry of Agriculture
MOE: Ministry of Environment
NDVI: Normalized Difference Vegetation Index
NGOs: Non Governmental Organizations
PAs: Protected Areas
UNCCC: United Nations Convention on Climate Change
UNCCD: United Nations Convention for Combating Desertification
UNEP: United Nations Environmental Program
UNDP: United Nations Development Program
UOB: University of Balamand
UPOV: International Union for the Protection of New Varieties of Plants
USD: United States Dollar
USEK: Universite Saint Esprit a Kaslik (Holy Spirit University at Kaslik)
USJ: Universite Sainnt Joseph (Saint Joseph University)
SALMA : Smart Adaptation of Forest Landscapes in Mountain Areas

SECTION I: EXECUTIVE SUMMARY

Lebanon is a small Middle Eastern republic located on the eastern coast of the Mediterranean sea. Forests cover 13.6% of the total surface of Lebanon, which is 10,452 Km^2 . When Other Wooded Land are accounted, natural ecosystems embedding forest tree species would cover around 24% of the total area of the country. It has a rich diversity of plants, accounting more than 2600 species out of which 92 are endemic.

This biodiversity includes important forest genetic resources. Forest genetic variability has been studied for few forest species, including *Cedrus libani, Juniperus excelsa, Pinus pinea, Ceratonia siliqua, Pistacia spp., Prunus spp.,* and *Ficus carica.*

Many tree species have a notable economical importance such as *Pinus pinea, Quercus calliprinos*, *Ceratonia siliqua* and *Laurus nobilis* while other species have prominent cultural and social importance, like *Juniperus excelsa* and *Cedrus libani*, the emblem of the country. Shrub species, are of equal importance, whether for economical, social or cultural aspects. Among these we mention *Origanum syriacum*, *Rhus coriaria*, *Myrtus communis* and *Salvia fruticosa*. The exploitation of these species and many others contributes directly into poverty alleviation and food security. All forest species have environmental services, including soil, water and biodiversity conservation. Many of these species are encountered in specific ecosystems like relic subhumid ecosystems and are located on the southern limits of their area of extension (i.e. *Ostrya carpinifolia, Fraxinus ornus, Sorbus spp., Juniperus drupacea, Acer tauricolum, Cornus australis, Amelanchier ovalis,* etc.) while *Malus trilobata* is endemic to Lebanon.

The envorinmental importance, although not explicitly studied , reveals the impact of human actions on the different forest and other wooded lands ecosystems. Disturbances are significant and include forest fires, overgrazing and inappropriate exploitation of wood resources. The most threatenning anthropic action is unquestionably the change of land cover into urban or agriculture uses which reduces the habitat of many rare and endemic species. Another disturbance factor of an increasing importance is climate change, which results in recurrent and intense insect and pest outbreaks (i.e. *Cephalcia tannourinensis* in cedar groves, *Thaumethopea wilkensonii* in Brutia pine forests, Lamantrya in Quercus calliprinos etc.), and frequent forest fires, especially in pine forests.

Initiatives for *in situ* conservation are illustrated in the creation of several natural reserves or protected areas under the supervision of both Ministries of Agriculture and Environment (MOA, MOE). These areas include 3,500ha of strictly protected areas. The major targeted species are *Cedrus libani, Abies cilicica, Juniperus excelsa, Quercus cedrorum, Quercus brantii* and *Quercus cerris var. pseudocerris*. From the other hand, several laws and decress aim at the protection of conifer forests in general (Law 85; Law 558). *Pinus pinea* remains the only forest tree species that is actively managed. Improving i*n situ* conservation requires overcoming several barriers such as land fragmentation and ownership, unsustainable use of forest products, lack of budget for Protected Areas (PAs), lack of awareness, and the limited enabling legal framework for the empowerment of laws and priority settings. Nevertheless, the upcoming National Forest Policy would tackle Forest Genetic Resources (FGR) issues.

Ex situ conservation is of FGR is limited to the collaboration of the Lebanese Agricultural Research Institute (LARI) with the Royal Botanical Gardens (Kew Gardens, UK) which resulted into the collection and conservation of most forest tree and shrub species. A seed bank is being created, however seed orchards are absent. In parallel, a botanical garden for mediterranean species is expected to be established under the supervision of FAO and the MOA. The major constraints for *ex situ* conservation could be summarized in the lack of human and financial resources, lack of land, and lack of experience.

Cedrus libani is currently the only species that is subject to an imporvement program, with drought tolerance as a major objective for imporvement. This programme is conducted by Saint Joseph University (USJ) in Lebanon and INRA-Avignon in France. However, several additional institutions are active in fields related to botany, phyto-ecology, taxonomy, genetic variability, conservation of germplasms, pollen studies, forest fire monitoring, forest pest management, mapping, ethnobotany and other related fields to forest genetic resources. These incude: LARI, National Council for Scientific Research (CNRS), Lebanese University (LU), American University of Beirut (AUB), Holy Spirit University in Kaslik (USEK), University of Balamand (UOB), and the committees of the different PAs.

The MOA holds the National Forest Policy and Program. It is responsible for creating, amending and empowering forest laws and regulations. The ministry has mandates of surpvising forest management and reforestation activities. It holds the UNCCD focal point. MOE is responsible for creating and amending forest laws and regulations in protected areas (Natural Reserves). It is currently implementing a reforestation programme. The Ministry of Environment holds CBD and UNCCC focal points.

These institutions collaborate with several international organizations and institutions and are members of several networks, that are cited within the core of the report.

Regulations with respect to access and benefit sharing of FGR are limited and mainly elaborated for PAs, where access is limited and controled. On another level, exports of forest products and seeds need to be licensed from the MOA. A national seed policy is currently under preparation at the MOA, however, forest seeds are not evoqued. Lebanon has not established any mechanism for recognizing intellectual property right, nor for benefit sharing arising from the use of forest genetic resources. These are currently the major constraints for any research programme aiming at genetic improvement of native species or for sharing the benefits arising out of the use of forest genetic resources.

The elaboration of this report relied on a participatory approach joining all the stakeholders that are acknowledged and listed at the end of the report through Emails due to covid 19 problem which forbidden meetings and due to the economic crisis in Lebanon. All the parties contributed in gathering valuable information, but also in the setting of priority needs of Lebanon for the diffent aspects of forest genetic resources. The major findings of these priority needs are:

- Capacity building of the technicians of public institutions and research institutions in the fields of Botany, phyto-sociology, taxonomy, species identification, plant genetic

resource analysis techniques, protocols for *in situ* and *ex situ* conservation and creation of germplasm.

- Procuring of Equipments, documentation, software and creation of online database
- Setting of priority species and identification of centres of diversity of forest species
- Embedding *in situ* conservation actions within the upcoming National Forest Policy/Program
- Enhancing the germplasm bank and provenance unit at the national level
- Conducting ethno-botanical and socio-economic studies on economical, social, cultural and ecological values for priority species
- Mainstreaming of FGR into the National Seed Policy Program
- Networking with neighbouring countries, coordination among local stakeholders
- Raise awareness at all levels of the society on FGR including the improvement of the understanding of access to FGR and benefit sharing
- Educational program on FGR to be embedded in university and technical schools' curricula
- Law upgrading taking into account access to FGR and benefit sharing
- Identification of provenances and Plus trees

To avoid ambiguity and for the sake of harmonization, the nommenclature of the species used within the report is as adopted by Paul Mouterde references.

SECTION II: INTRODUCTION

The Republic of Lebanon is situated on the eastern shores of the Mediterranean. It covers a total area of 10,452 Km^2 most of it being mountainous. The Mount-Lebanon and the Anti-Lebanon chains run parallel to the sea, separated from each other by the Bekaa plain.

Its topographical and landscape diversity and the presence of high mountains close to the coast and oriented north-south with numerous perpendicular valleys in the east-west direction, resulted in five geomorphological regions that give rise to around 22 bioclimatic zones and many types of habitats (Abi-Saleh and Safi, 1988)

Lebanon's climatic conditions are determined by its geography and physiography. They vary from Mediterranean climate along the coastal plain and in the middle mountain range, to reach the sub-alpine or mountain Mediterranean climate on the highest slopes, covered by snow during most of the year; they become sub-desertic and almost too dry for agriculture in some of the northern plains.

Most of the rainfall falls between November and March, in the form of heavy showers. The mean annual rainfall on the coast ranges between 700 and 1,000mm; it peaks in the central mountains at 1,400mm; it ranges in the Bekaa plain from less than 200mm in the north-eastern part to 800mm in the southern part; while on the Anti-Lebanon chain it ranges from 300mm to 1,000mm in Mount Hermon.

Lebanon is a highly populated country with the bulk of the population living in the urban areas. Forests are playing an important social role with the rise of ecotourism and environmental concern. Although uncontrolled urban expansion has destroyed many landscapes, the concern for the social and aesthetic values of the forests is gaining a great importance. This uncontrolled expansion with the resulting land fragmentation could be the major threat on the forest genetic resources.

Forests in Lebanon constitute an important natural resource. The main forest species widespread in Lebanon are *Quercus calliprinos, Quercus infectoria, Quercus cerris var. pseudo cerris, Juniperus excelsa, Cedrus libani, Abies cilicica, Pinus pinea, Pinus halepensis, Pinus brutia* and *Cupressus sempervirens.* The bulk of the forest area consists of Oak and Pine stands. In addition, the Lebanese forests contain a wide range of aromatic, wild, and medicinal plants.

Lebanon is considered as the Southern limit of distribution of many forest species like: *Cedrus libani, Abies cilicica, Ostrya carpinifolia* and *Fraxinus ornus.* It is also the meeting point of two Mediterranean pine species, *Pinus halepensis* and *Pinus brutia,* which implies the existence of some hybrid forms because of the co-existence of the two closely related species. The existence of several oak species within the same habitats, suggests the appearance of several hybrid forms. It is important to note here that forest of *Quercus cerris var. pseudo-cerris* is found in North Lebanon. This species is usually found as part of the accompanying flora in some vegetation stages, but never in pure stands.

Several wild relatives of fruit tree species are found in the different vegetation stages such as: *Malus trilobata, Pyrus syriaca, Prunus ursina, Prunus mahaleb, Amygdalus sp.*

Unfortunately, very little research has ever been undertaken in the field of forest genetic resources. Private universities have started research programs, mainly on cedars and junipers. Cooperation projects were initiated in the past with FAO, INRA-Avignon and other international organization.

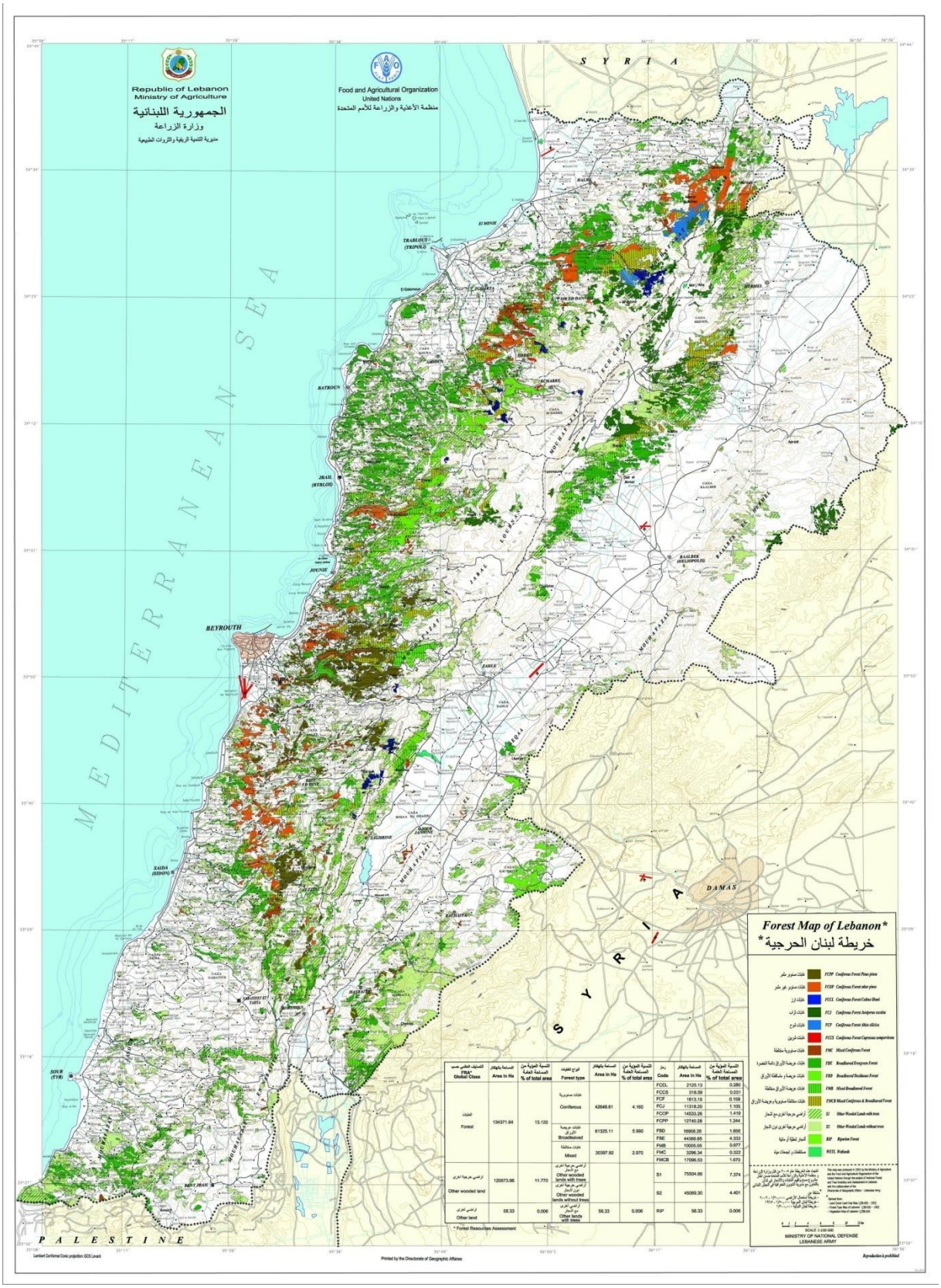

Figure 1. Forest Map of Lebanon.

Part 1: The contributions of forest genetic resources to sustainable development

Chapter 1. Value and importance of forest genetic resources

The most representative species are Pinus, Quercus, Cedars, and Juniperus species. The Lebanese forestry system has been seriously affected during the last three decades mainly because of overgrazing, over-harvesting quarrying and urbanization.

The most important forestry products include pine seeds, fire wood and charcoal.

Broadleaved species are a major source of fuel wood and exploited for charcoal production (Quercus calliprinos, Q. infectoria, Ostrya carpinifolia, Styrax officinialis, Acer syriacum, Cercis siliquastrum, Fraxinus ornus, Phillyrea media).

Conifers, which exploitation is banned serve illegally for fuel wood (Juniperus spp., Pinus spp., Cedrus libani, Abies cilicia and Cupressus sempervirens).

The majority of forestland has a multiple use function providing wide range of wood and non-wood products

1 - Wood forest products

In Lebanon, as in most of the Mediterranean countries, wood does not constitute a major forest product due to the present structure, cover and distribution of the forests.

No value is given for the commercial growing stock as timber harvesting is currently forbidden in Lebanon. Wood is only used as fuel and charcoal. Several rural communities still depend on fuel-wood and on charcoal production for their livelihoods. However, some of the Lebanese tree species, like the cedars, the junipers and some oaks have a potential of producing a very good quality wood.

Major wood production in Lebanon uses oaks and to a lesser extent pines. In Lebanon, there are around 62,000 ha of oak forests. Every 100 m2 of oak trees generally produces 2 tons of oak wood. Therefore, the estimated production of oak wood from the Lebanese forests is at 12.4 million tons. The current price of oak wood is at 150 USD/ ton, and therefore the estimated economic value of oak wood in Lebanon is at 1,860,000,000 USD.

Furthermore, every ton of oak wood can produce approximately 250 kilograms of charcoal. Every 100 m2 can produce around 500 kilograms of charcoal resulting in a total potential production of 3,100,000 tons of charcoal. At the current price of charcoal, which is around 667 USD (1 million L.L. at the rate of 1$ = 1500LL) per ton, the economic value of oak in Lebanon if used for the production of charcoal is 2,067,700,000 USD (3,100,000,000,000 L.L.).

On the other side, pine wood production is relatively 4000 tons annually with a value of 5$/kilogram. This gives a value of pine wood production at 20 million USD yearly.

MoA has recently revised the laws related to wood production. As a result, the ban on the production of charcoal was cancelled to allow a controlled exploitation.

The charcoal production in addition to its contribution to the reduction of the highly flammable biomass is expected to contribute to poverty alleviation if managed in an environmentally sustainable approach.

2 - Non-wood forest products

Non-wood forest products are considered as the main income generating harvest from the Lebanese forests. Rural communities depend on these products for their livelihoods.

2.1 - Pine cones

Pine nuts are the main forest products from Pinus pinea forests in Lebanon. It is estimated that 300 pine trees are present on average in every one ha of land. Each tree gives around 75 kilograms of pine cone every year. Thus it is estimated that 1 hectare of pine trees gives an average of 22,500 kilograms of cones/ha/year. These 22,500 kilograms of pine cones can give around 900 kilograms of edible pine nuts/ha/year. A kilogram of pine nut has a value of 28 USD (retail value). Consequently, the pine nut production gives an annual value of 25,200 USD/ha/year. In addition, the 22,500 kilograms of pine cones/ha generate around 4,050 kilograms of pine nut wood, which can be sold at a relatively low price. It is worth mentioning that the percent production of white pine nuts from pine cones differs with the locations over the Lebanese territories. The Maten and Barouk areas give higher production of nuts in comparison to other areas.

According to FAO (2000), the majority of the total Lebanese pine nut production is located in Mount Lebanon area (80%), with South Lebanon rated as second in production (18 %). The highest number of pine nuts producers is located in the area of Ras al Maten.

A tax policy is being applied by MoA that sets a maximum price for the kilogram of pine nuts as well as imposing taxes on the imports of nuts.

2.2 Carob products

The Ceratonia siliqua specie is commonly exploited for the production of molasses or for the raw carob pods. Molasses are usually used as a sweetener in Lebanese recipes or as dessert. The residues of the production of molasses are commonly used as compost or animal feed.

In addition, carob molasses has some medicinal properties, such as regulating the gastro-intestinal tract activities. The annual production of carob in Lebanon was estimated by MoA to be around 50 kg/tree.

2.3 Medicinal/Aromatic plants

According to MoA, more than 212 species of plants in Lebanon have an economic capacity for medicinal or consumption purposes. Medicinal/aromatic plants are mostly extracted from forests. As a part of its policy to protect the natural resources, the Lebanese Government issued decisions to protect aromatic and medicinal plants and to control their exploitation.

Origanum sp. and Salvia sp. (sage) are two very common aromatic species that exist in the Lebanese forests. The annual production of sage was estimated to be 50 tonnes (MoA, 2001). These species are frequently harvested by an uncontrolled exploitation and uprooting, for local or commercial purposes due to their economic value. That is why MoA has issued regulations to control the overexploitation and regulate the random harvesting of both species. The issued decree allows harvesting only after the flowering season and prohibits uprooting. Picking Origanum is only permitted between August and December, while exporting dried material is permitted all year round. Picking and exporting the sage is also only permitted between August and December, with a prior permit from DRDNR. Uprooting both sage and Origanum is completely forbidden.

An undetermined number of plant species are extracted more commonly for local use (i.e. for infusions). Rosa damascene, Rosa sentifolia, Sambucus nigra, and other species are also cultivated for aromatic and medicinal use.

Eleagnus angustifolia and Crataegus spp. are two tree species that are exploited for use as infusions. Other tree species having medicinal properties include Laurus nobilis, Ficus carica, Cupressus sempervirens, Juniperus, Quercus infectoria and others.

The Ferrula hermonis known as the Zallouh root, which grows on the high mountains of Lebanon, became on high demand at a certain period since it is thought to improve the over-all health conditions. This has led to the over uprooting of this plant before a decree was issued by MoA which prohibited its uprooting.

Most common medicinal plants in Lebanon:

Anethum grveolens, Rhus coriara, Artmesia arborescens, Rosa canina ,Ecballium elaterium, Taraxacum officinale, Inula viscisa, Trigonella foenum-graecum, Nigella sativa, Tussilago farfara, Plantago psyllium, Vinca libanotica, Punicia granatum, Ziziphus vulgatris. (AFDC Source: Baalbaki 1997)

The primary trees and some medicinal trees found in Lebanon:

Ceratonia siliqua, Crataeagus azarolus, Cupressus sempervirens, Ficus carica, Fraxinus ornus, Juglans regia, Juniperus, Laurus nobilis, Melia azedarach, Myrtus communis, Quercus infectoria, Rhamnus cathartica, Rhus coriaria, Ulmis minor. (AFDC)

MoA estimated the market value of medicinal and aromatic plants produced by forests in Lebanon to be around 18,600,000 USD annually.

2.4 Honey

There are two main sources of honey production:

1- forest and shrubland /forest-based honey from honeydew (oak and cedar honey), and from wild flowers, such as Syrian oregano.
2- Orange blossom honey which is 33% less expensive than forest and shrubland based honey.

There are approximately 6200 Lebanese beekeepers (MOA/FAO.2010). In 2013, honey production was estimated at around 1620 tons per year for a total estimated value of 32million USD from which the value of forests and shrubland honey is 23 million USD (USAID. 2013). Lebanon exports 50 tons of honey per year for a value of 0.63 million USD while imports are much more important; around 250 tons of honey for a value of 2.54 million USD in 2014 (based on Lebanese customs data).

The honey production sectors still not well exploited although it can play an important role in rural development and poverty alleviation in many areas and can be a tool for the valorization of local forests and natural resources.

Honey production is a significant trade in Lebanon, where the number of beehives is estimated around 120,000 distributed all over the country. This high number of beehives is distributed on all land types including forests. The annual honey production in Lebanon is estimated to be around 1,070 tons, evaluated at L.L. 22 billion.

2.5 Forest services

- Grazing:

Grazing is a common activity in Lebanese forests, due to the open nature of these lands and the frequency of fodder species. This activity is most frequent in non-protected forests.

Grazing activities in and around forests occur in Lebanon during the summer. Shepherds traditionally move their sheep and goats to the coast in winter. As in all Mediterranean countries, it is the goat which dominates the livestock picture of Lebanon where it is estimated that the country has more than 500,000 heads of goats (Baladi race).

The forests, especially oak forests, are used for grazing by more than 350,000 goats and 150,000 sheep originating from the Bekaa, North Lebanon and the Mountain Highlands (i.e. Kfarselwan, Baskinta) (Tellawi, 1993).

In the previous years to the Lebanese civil war, grazing was an organized activity where herders had to pay the land owners for access. Today, the herders do not pay any fees for the exploitation of forests.

- Recreation and tourism:

Recreation and tourism ranks as the third most exploited service in the forest sector. A number of associations offer different forms of tourism and recreation trips in the country's forests. Their offered activities include climbing and rappelling, rafting, canoeing, cross-country skiing, mountain biking, speleology, paragliding, and camping.

As for ecotourism, it is a growing activity in Lebanon in general. An increasing number of organizations are specializing in organizing eco-tours throughout the country.

While there is no single definition for ecotourism, different organizations have put characteristics defining it. The ecotourism sector in Lebanon is operating on a small scale and actively contributing to the economic benefit of local communities. Moreover, it minimizes negative impacts on the natural and socio-cultural environment and supports the protection of natural areas.

Lebanon's rural eco-tourism sites represent a great tourism attraction for local and international tourists due to their diversity. Forests in Lebanon are major players in ecotourism.

- Employment:

Sources of employment in the Lebanese forests come in different forms. Some common forms of employment are in wood and non-wood product exploitation, such as pine nut collection, charcoal production, timber production and medicinal/aromatic plants extraction.

Other forms of employment in forests include tourist guides, forest guards and scientists.

No data is currently available on the number of people working in the forests and in forest related activities except for forests guards that are employed by MoA.

- Providing valuable services
    - Preservation of water quality
    - Soil conservation and reduction of runoff
    - Protection of Biodiversity
- Mitigation of Climate change

- Socio-economic benefits and services:
    - ❖ Job opportunities in rural areas (hunting)
    - ❖ Improve family income in rural areas
    - ❖ Eco-tourism and recreation : the Lebanon Mountain Trail connecting all mountain forest reserves and major forest areas
- Decrease migration from rural areas

3- Economic Importance

As in most of the Mediterranean countries, wood does not constitute a major forest product, despite the fact that some of the Lebanese species, like the cedars, the junipers and some oaks could produce a wood of a very good quality. However, the present structure, cover and distribution of the forests do not allow for such a production. This could partially explain the lack of interest in tree improvement programs. Several rural communities still depend on fuel-wood and on charcoal production. Non-wood forest products are the main income generating activity from the forests and several rural communities depend on these products for their living. These are mainly pine nuts, carob pods (for the production of edible molasses), aromatic and medicinal plants and grazing. An estimated number of 212 species in Lebanon have an economic value and are considered as medicinal plant species or edible crops. The current expansion of ecotourism, agri-tourism and rural tourism is leading to a sharp increase of the role of the forests in poverty alleviation. The appropriate management of the forests and other wooded-lands would play a very important economic role, allowing for the sustainable harvesting of wood and non-wood products and for the provision of services with a high market value, such as eco-tourism. This sustainable management would have a direct and tangible effect on the different efforts aiming at the alleviation of poverty

4- Environmental Importance

The different ecosystems in the country are mainly threatened by deforestation, over-grazing, urban development, road development, bad agricultural techniques, excessive use of chemical products, waste mismanagement, over-hunting and industrial development.

Agricultural habitats could contain wild ancestors and relatives of several cultivated species. These habitats and their precious species are threatened by mismanagement of modern agricultural techniques.

Forest fires add to the problems the ecosystems are facing. The frequency and intensity of these fires are a real threat on the sustainability of the forest ecosystems. They usually occur at the end of the summers and are followed a few weeks later, by the heavy showers of rain, which cause severe soil losses.

Rural exodus has had impacts on land degradation, as abandoned agricultural lands are easily eroded. The war situation, which prevailed in the country during several years, has enhanced poverty, mainly in some remote rural areas.

The requirements of the urban development and the rehabilitation and reconstruction operations after the long years of war have led to a particular threat, that of the quarries. In addition to the degradation they are causing, their anarchic development has caused severe scars in the landscape throughout the country.

These risks and threats are also affecting the forest genetic resources. Land fragmentation, one of the main effects of increasing urbanisation could have a serious impact on FGR by reducing gene flow and movement of species.

5- Provision of Energy

The poorest rural communities depend on fuel-wood as source of energy for cooking and for heating, while most of the population depends on petroleum products, electricity and a minor part use solar energy. This wood is collected in the forests or in the agricultural fields, shelterbelts and windbreaks. A fee has to be paid upon the delivery of the permit allowing the pruning of broadleaves forest plots. The current legislation forbids the exploitation of all conifer species. Although charcoal production was banned during several years, some communities were still depending on this product. In these communities, charcoal was either produced from non-forest wood, or through illegal production. The legislation has been amended recently thus allowing for a controlled production of charcoal under certain conditions.

6- Forestry Contribution to Food Security

Wood production is a minor activity of the forestry sector in Lebanon. Non-wood forest products constitute a major aspect of this sector and a major activity in several rural areas. As

other low forest cover countries in the Mediterranean region, the wood production in Lebanon is very limited and restricted to fuel wood in some areas. However, future plantations could play an important role in this aspect, if the appropriate species are planted.

The exploitation of non-wood forest products is tolerated in some cases and encouraged in some other cases. As a matter of fact, *Origanum syriacum* and *Salvia fruticosa* are harvested for local consumption and for export. The exploitation of the *Pinus pinea* forests for the production of the pine nuts is strongly encouraged, along with that of the *Ceratonia siliqua* for the production of the carob molasses, which is locally used and exported as a desert. Residues of the molasses production are used as animal feed and as compost. Seeds are exported to be utilised in several industries. The Ministry of Agriculture encourages reforestation with those two species in the appropriate areas (500m and below for the *C. siliqua;* non-alkaline soils for *P. pinea*). Several rural communities depend on these two species for their living

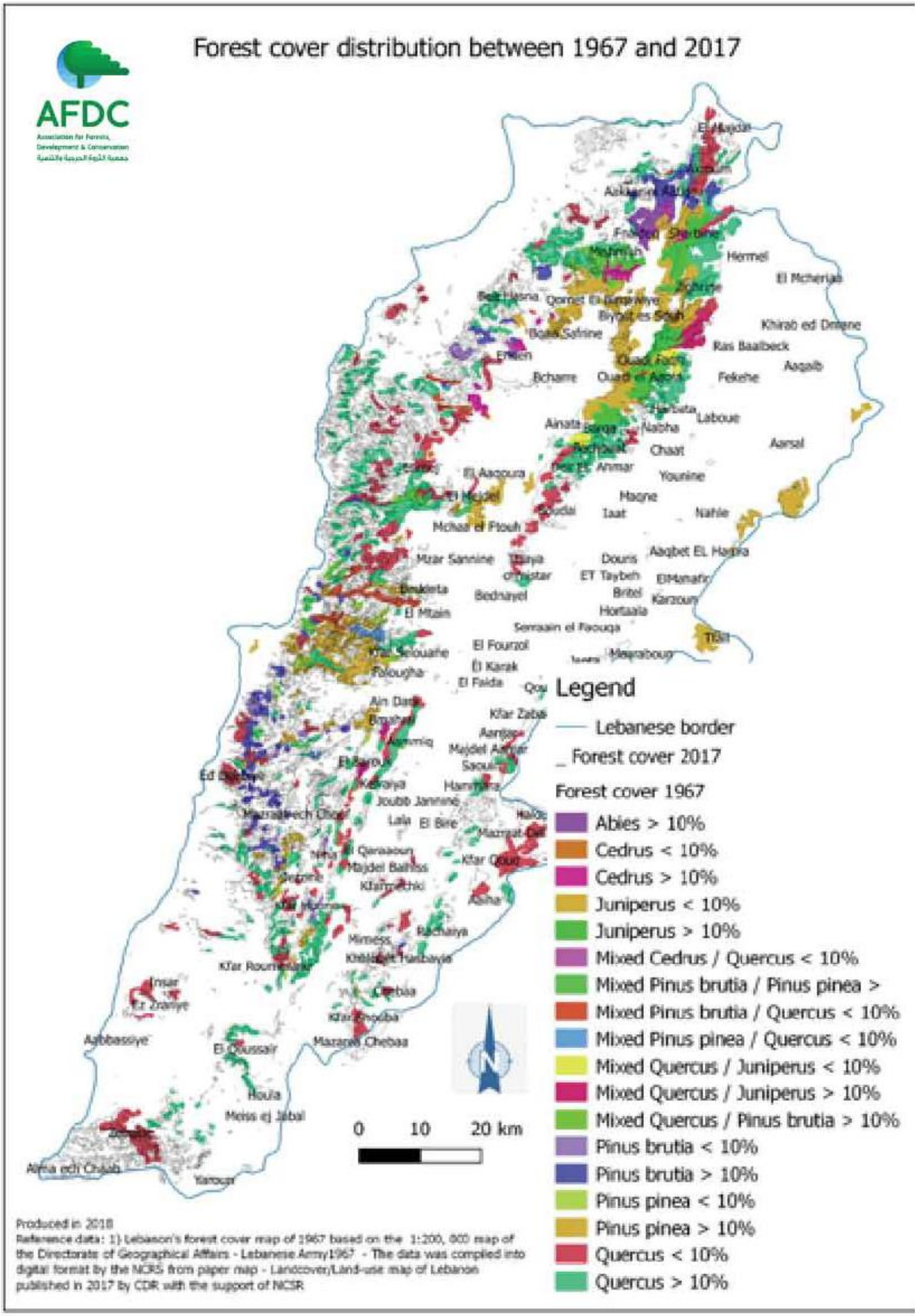

Figure 15. Map of forest covers in 1967 and 2017

Part 2: State of diversity in forests and woodlands

Chapter 2. State of forests

Since 2005, forestry and forest resources topics in Lebanon are evolving distinctly. The first national forest resources assessment was realized in close collaboration with FAO. This assessment was the first in the country, since the last inventory was achieved in 1964. The results were striking, putting Lebanon outside the list of countries with low forest cover. Forests occupy more than 13% of the total area of the country, in addition to 10% of other wooded land.

Accordingly, forestry sector evolved towards reemitting the exploitation of fuel wood and charcoal in broadleaved forests after a decade of prohibition. This change which was partly demand driven, was followed in parallel by the reinforcement of the number of forest guards in order to better control forest exploitation. These decisions enabled the ministry of agriculture to increase the public revenues from forestry sector, as well as the increase of job opportunities related to this field.

On the other hand, coniferous forests exploitation remains far-off due to law restrictions. Consequently, the absence of management resulted into the increase of disturbances in these forests. Insects and fungi outbreaks, winter storms damages and forest fires are more frequent, and more aggressive, thus reducing the biomass and carbon stock of coniferous species.

July war in 2006 was also a major millstone that hampered forestry activities (forest fire fighting, forest management and reforestation), namely in southern Lebanon. Nevertheless, several recovery projects and funds following July war, enabled Lebanon to restore to certain extent its infrastructure in relation to forest fire fighting and reforestation activities. These joined efforts between concerned ministries, donors and NGOs lead to the proposal of a forest fire fighting strategy and a reforestation plan.

The socio-economical conditions had a direct impact on the natural resources (including fuel wood and non-wood forest products), with a higher pressure on these resources coupled with lower public revenues.

Towards the end of 2009, the Ministry of Agriculture adopted a new strategy (2010-2014).

Since then, things have changed drastically. The forest sector gained increased importance and attention and is more and more considered as a national asset.

The new policy of the Ministry of Agriculture considers the forest sector as vital from social, economic and environmental points of view.

Moreover, forest legislation is currently under review for updating and aligning it with the international conventions..

A lot of NGOs, municipalities and government institutions are implementing reforestation projects in the country.

In order to organize these reforestation activities, and coordinate those efforts, the Lebanese Government launched the ambitious national initiative to plant 40 million forest trees in public

lands within the next 20 years. A roadmap for this longterm reforestation program was prepared.

This roadmap proposes ways of sharing responsibilities and coordination mechanism like partnerships between the different stakeholders.

In the same context, Smart Adaptation of Forest Landscapes in Mountain Areas (SALMA) project was launched. It is a joint effort by the Ministry of Agriculture (MOA), through its Rural Development and Natural Resources Directorate (RNDRD/MOA), local stakeholders, FAO and the GEF to support the above mentioned areas of intervention and the improvement of the populations' standard of living in fragile mountain forest ecosystems.

The second national forest resources assessment is planned to be carried out in 2019. Done in 2020 and is under processing by RNDRD/MOA to analyse the results.

In June 2015, MoA launched the main instrument of the national forest policy for the upcoming decade 2015-2025: the first Lebanese National Forest Program (NFP).

It constitutes and identifies the government's interventions in the forest sector and beyond it, aiming at sustainably managing the Lebanese Forest Resources, while defining the coordination and cooperation mechanisms among all public and private sectors.

The UN Food and Agriculture Organisation (FAO) and the Lebanese Minister of Agriculture have agreed to establish a national center for forests seeds. The center is established with financial support from Norway. Several trainings on Forest seeds collection and manipulation happened.

The different ecosystems in the country are mainly threatened by deforestation, over-grazing, urban development, road development, bad agricultural techniques, excessive use of chemical products, waste mismanagement, over-hunting and industrial development.

Agricultural habitats could contain wild ancestors and relatives of several cultivated species. These habitats and their precious species are threatened by mismanagement of modern agricultural techniques.

Forest fires add to the problems the ecosystems are facing. The frequency and intensity of these fires are a real threat on the sustainability of the forest ecosystems. They usually occur at the end of the summers and are followed a few weeks later, by the heavy showers of rain, which cause severe soil losses.

Rural exodus has had impacts on land degradation, as abandoned agricultural lands are easily eroded. The war situation, which prevailed in the country during several years, has enhanced poverty, mainly in some remote rural areas.

The requirements of the urban development and the rehabilitation and reconstruction operations after the long years of war have led to a particular threat, that of the quarries. In addition to the degradation they are causing, their anarchic development has caused severe scars in the landscape throughout the country.

These risks and threats are also affecting the forest genetic resources. Land fragmentation, one of the main effects of increasing urbanisation could have a serious impact on FGR by reducing gene flow and movement of species.

2.1 Previous and current trends of forests and forestry in the country

Forests, trees and rangelands

Vegetation Cover

The Forest Resources Assessment (FRA) reports submitted in 2005 and 2010 and 2015 show the following figures:

Table, Trends in forest and other wooded land area

Categories	**Areas (1000ha)**			
	1990	**2000**	**2005**	**2015**
Forest	131	131	136.5	137.3
Other wooded land	117	117	106	106
Other land	775	775	780.5	779.7
..of which with tree cover	114	114	114	114

In 2017, the council for development and reconstruction (CDR) published the new land cover/land use map of Lebanon as produced by NCSR.

The areas of main natural green land cover categories are presented in table below:

categories	**Areas (1000ha)**
Scattered forest	138.5
Dense forest	79.2
Pasture	154.1
Moderately dense grassland	84.2
shrubland	73.4
Burned land	0.2
Artificialized green space	0.5

Although the total forests and other wooded lands cover is quite important, this vegetation seems to be regressing. However, it is currently very difficult to calculate this rate of regression, because of the lack of consistency between the current and the previous data, as different definitions and land use classes were utilized. The implementation of the monitoring system through will allow for a better knowledge of the trends of land use changes in the future.

It is clear that the forests and other wooded lands in Lebanon are subject to different kinds of stress leading to their regression. Land fragmentation, forest fires and urban sprawl constitute the major threat on this vegetation. However these aggressions on forests are counterbalanced by :

i) Reforestation activities conducted by several actors including the Ministry of Agriculture, the Ministry of Environment (assisted by UNDP), the Lebanese Reforestation Initiative (funded by USAID), and the activities of different other NGOs such as AFDC, CBOs and municipalities.

ii) Spontaneous forest expansion in some areas due to abandon of agriculture land, reduced grazing intensity, and protection.

Despite the degradation of the vegetation cover caused by human activities, Lebanon is still regarded as very diverse, sheltering an estimated number of 4,200 species. This diversity is mostly the result of the physiography of the landscape and the country's location at the crossroad between continents.

The Lebanese mountains are characterized by the presence of a considerable number of northern species, which may be regarded as relics of past humid vegetation and are still growing sporadically in the remaining forest patches such as *Ostrya carpinifolia, Acer tauricolum, Acer hermoneum, Rhododendron ponticum, Fraxinus ornus*…On these mountains, a fairly large number of forest trees find their southernmost limits. These thrive in forests such as *Juniperus spp., Abies cilicica, Quercus cerris var.pseudocerris, Sorbus spp., Acer spp….*

The Mediterranean Mountains in their seaward aspects can be differentiated along the altitude into the Thermo-Mediterranean, Eu-Mediterranean, Supra-Mediterranean, Mountainous Mediterranean and Oro-Mediterranean zones. A belt of evergreen maquis and garrigue characterizes the formers, while the later are respectively covered by summer-green forests and dwarf thorny vegetation characterizing the alpine and sub-alpine zones.

The Thermo-Mediterranean zone, ranging 0-500 m altitude, comprises, at the sea level, a coastal strip once harboring two plant communities currently severely degraded. Plant community degradation is also shown in the upper vegetation characterized by an evergreen garrigue. In this zone *Ceratonia siliqua, Pistacia lentiscus* and *Pistacia terebinthus subsp. palaestina* trees grow along with their accompanying flora.

At an altitude ranging from 500 to 1,000 meters, lays the Eu-mediterranean zone, mainly covered by maquis vegetation dominated by *Quercus calliprinos* and *Pistacia terebinthus subsp.*

palaestina. Additionally, Pine forests (*Pinus pinea* and *Pinus brutia*) are largely found in these areas together with the associated species to the oak maquis like *Cercis siliquastrum*, *Acer obtusifolium (A.syriacum)*, *Laurus nobilis* and *Styrax officinalis*.

The Supra-Mediterranean zone (1,000-1,500) situated above the evergreen vegetation is characterized by a deciduous forest. In this zone, the vegetation cover is denser as the population density is lower and major human settlements are more recent. At present, this zone is occupied by *Quercus calliprinos* and *Q. infectoria, Pinus brutia* and *P.pinea,* accompanied in humid cool areas by *Ostrya carpinifolia, Fraxinus ornus, Juniperus drupacea* and *Malus trilobata.*

A higher zone of coniferous forest, ranging from 1,500 - 2,000 meters' altitude, replaces usually the zone of the summer-green forest. This mountainous Mediterranean zone harbors relic formations of *Cedrus libani, Abies cilicica* and *Juniperus excelsa*. Plant communities encountered comprise *Quercus cedrorum*, *Q. brantii*, *Q. cerris var. pseudo-cerris*, *Q. pinnatifida*, *Juniperus drupacea, J. foetidissima*, *Acer tauricolum, A. hermoneum, Sorbus torminalis, S. flabellifolia, Prunus ursina* and *P. mahaleb*.

In the high summit dominating the Mount Lebanon chain, lie the Oro-Mediterranean zones where the leading plant community is xerophytes vegetation comprising a formation of cushion-like dwarf thorn shrubs and *Juniperus excelsa*, the only tree present at this altitude. In these al pine uplands, a high endemism level is marked as the result of the isolation effect.

The Eastern Mount Lebanon foothills are steppic and desiccated. They are either occupied by a heavily degraded garrigue or barren, and the sub-desertic soils support a poor, overgrazed rangeland.

The pre-steppic vegetation zone ranging between 1000 and 1500 m is mainly composed of heavily grazed forestlands of *Q. calliprinos*. In the Supra-Mediterranean zone, *Q. calliprinos* and *Q. infectoria* are found. Then follows sparse *Juniperus excelsa* stands, which extends to higher altitude and figures as sporadic tree mixed with dwarf thorny shrubs. However, the dominant formation on these slopes is a degraded garrigue used for grazing. On the Western slopes of the Anti-Lebanon chain, the pre-steppe vegetation is similar to the one present on the eastern slopes of the Mount Lebanon chain. However, Mount Hermon presents some particularities including the presence of endemic species such as *Ferula hermonis*.

2.2 Bio-climate Zones and Forest Types in Lebanon

Bio-climate	Substrate	Forest Habitat Type	Dominant species	Companion tree/shrub	Herbal species
Thermo-Med. (< 500 m)	Limestone	Carob-Lentisk Scrub	*Ceratonia siliqua; Pistacia lentiscus;* *Myrtus communis; Olea europaea*	*Rhus tripartita; Calicotome villosa; Poterium spinosum; Viburnum tinus; Rhamnus alaternus; Retama raetam; Rhus tripartita*	*Hyparrenia hirta* *Aristida coerulescens* *Stipa capensis*
		Pine woodlands	*Pinus brutia* *Pinus halepensis*		
		Evergreen oak woodlands	*Quercus calliprinos; Ceratonia siliqua; Myrtus communis; Pistacia lentiscus*	*Calicotome villosa; Poterium spinosum; Hypericum thymifolium; Cistus creticus; Viburnum tinus; Rhamnus alaternus; Retama raetam; Rhus tripartita*	*Hyparrenia hirta; Andropogon distachyus*
		Mixed oak-pine woodlands	*Pinus brutia; Q. callirpinos; Myrtus communis; Pistacia lentiscus*		
	Marl and marly-limestone	Pine forests	*Pinus brutia* *Pinus halepensis*	*Gonocytisus pterocladus; Cytisopsis dorycniifolia; Satureja thymbra; Coridothymus capitatus; Myrtus communis; Pistacia lentiscus; Ceratonia siliqua;*	*Hyparrenia hirta; Trachyna distachya; Stipa bromoides*
		Mixed conifer forests	*Pinus brutia; Cupressus sempervirens*		
		Cypress forests	*Cupressus sempervirens*		
	Sandstone	Pine forests	*Pinus pinea; (P. brutia)*	*Erica manipuliflora; Cistus creticus; Cistus salvifolius*	*Hyparrenia hirta; Stipa bromoides*
Eu-Med. (500-1000 m)	Limestone	Evergreen oak forests	*Quercus calliprinos*	*Pistacia therebinthus subsp. palestina; Arbutus andrachne; Phillyrea media; Crataegus azaerolus; Acer syriacum; Laurus nobilis; Viburnum tinus* <u>Degradation</u>*: Calicotome villosa; Rhamnus*	*Lotus judaicus; Cyclamen persicum; Rubia tenuifolia;* <u>Grasslands</u>*: Hyparrenia hirta; Andropogon distachyum*
		Mixed oak-pine forests	*Quercus calliprinos; Pinus brutia; (P. pinea)*		

Bio-climate	Substrate	Forest Habitat Type	Dominant species	Companion tree/shrub	Herbal species
				punctata; Hypericum thymifolium; Cistus creticus; Salvia fruticosa; Poterium spinosum	
		Deciduous oak forests	*Quercus infectoria; Q. calliprinos*	*Styrax officinalis; Cercis siliquastrum.* *Degradation: Spartium junceum; Origanum syriacum*	*Brachypodium pinnatum*
	Marl & marly-limestone	Mixed conifer forests	*Pinus brutia; Cupressus sempervirens*	*Genista acanthoclada* *Degradation: Calicotome villosa; Poterium spinosum; Saturea thymbra; Thymbra spicata*	*Hyparrhenia hirta*
		Pine forests	*Pinus brutia*		
		Cypress forests	*Cupressus sempervirens*		
	Sandstone	Pine forests	*Pinus pinea; (Quercus infectoria; P. brutia)*	*Juniperus oxycedrus; Lavandula stoechas.* *<u>Degraded</u>: Cistus salvifolius*	*Briza maxima; Phleum montanum; Anthoxantum odoratum* *<u>Grassland</u>: Tuberaria guttata; Aira elegans; Trifolium medusaeum*
Supra-Med. (1000-1500 m)	Limestone	Evergreen oak forests	*Quercus calliprinos*	*<u>Degraded</u>: Calcotome villosa; Origanum syriacum; Teucrium divaricatum*	*Brachypodium pinnatum; Melica angustifolia*
		Mixed oak and juniper forests	*Q. calliprinos; Arceuthos drupacea*		
		Deciduous oak forests	*Q. infectoria; Q. calliprinos*	*Malus trilobata; Prunus ursina; Pyrus syriaca; Pistacia terebinthus*	*Brachypodium pinnatum; Melica angustifolia; Poa*

Bio-climate	Substrate	Forest Habitat Type	Dominant species	Companion tree/shrub	Herbal species
				palaestina; Styrax officinalis *Degraded: Spartium junceum; Origanum syriacum; Calicotome villosa; Poterium spinosum*	*bulbosa*
			Q. cerris		*Lathyrus niger; L. digitatus*
		Hop-hornbeam mixed forests	*Ostrya carpinifolia; Fraxinus ornus; Q. infectoria; Q. pinnatifida*	*Sambucus ebulus; Spartium junceum; Acer tauricolum; Coronilla emeroides; Genista libanotica*	*Melica uniflora; Brachypodium pinnatum; B. sylvaticum; Paeonia kesrouanensis*
	Sandstone	Stone pine forests	*Pinus pinea; Q. infectoria*	*Cytisus syriacus; Adenocarpus complicatus; Halimium umbellatum; Cytisus drepanolobus; Genista lydia*	*Tuberaria guttata; Aira elegans; Briza maxima*
		Deciduous oak forests	*Q. infectoria*	*Juniperus oxycedrus; Malus trilobata; Cytisus syriacus; Adenocarpus complicatus; Cytisus drepanolobus; Genista lydia*	*Origanum ehrenbergii*
			Q. cerris	*Cytisus syriacus; Adenocarpus complicatus*	*Origanum ehrenbergii; Luzula forsteri*
Mountain-Med (1600-		Mixed conifer forests	*Abies cilicia; Cedrus libani*	*Sorbus flabellifolia; Berberis libanotica; Cotoneaster nummularia; Acer tauricolum;*	*Dactylis glomerata; Agropyrum panormitanum;*
			Abies cilicica		
			Cedrus libani		
		Mixed	*Cedrus libani; Q. cedrorum;*		

Bio-climate	Substrate	Forest Habitat Type	Dominant species	Companion tree/shrub	Herbal species
1900 m)		conifer/oak forests	*Q. pinnatifida*	*Sambucus ebulus; Coronilla emeroides; Colutea cilicica; Sorbus torminalis, Genista libanotica; Rosa dumetorum; Rosa glutinosa*	*Poa diversifolia; Sesleria anatolica; Lathyrus libani; Doronicum caucasicum; Trifolium physodes; Trifolium stellatum; Lathyrus digitatus; Vicia tenuifolia; Medicago lupulina; Medicago minima; Medicago radiata*
			Cedrus libani; Q. brantii		
		Oak forests	*Q. brantii*		
			Q. cedrorum		
		Juniper woodlands	*Juniperus excelsa; J. foetidissima*		
Oro-Med (>1900 m)		Juniper woodlands	*Juniperus excelsa*	*Rhamnus libanotica; Berberis libanotica; Prunus prostrata; Pirus syriaca; Lonicera nummulariifolia* *<u>Degradation</u>: Astragalus spp; Acantholimon* *libanoticum*	*Onobrychis cornuta; Agropyron libanoticum*
Steppe non-forest		Hammada scrub		*Hammada eigii; Artemisia herba-alba; Salsola villosa; Atriplex leucoclada; Atriplex lasiantha; Salvia palestina*	*Carex stenophylla; Vicia plaestina; Vicia cinerea; Medicago blanchea; Trifolium*

Bio-climate	Substrate	Forest Habitat Type	Dominant species	Companion tree/shrub	Herbal species
					tomentosum; Lathyrus pseudocicera; Onobrychis hemicycla
Steppe-Med (900-1500 m)		Evergreen oak forests	*Q. calliprinos*	*Pyracantha coccifera; Acer hermoneum; Amygdalus korschinskii; Jasminum fruticans* *<u>Degradation</u>: Poterium spinosum; Calycotome villosa*	*Stachys nivea; S. cretica*
Steppe-Supra-Med (1500-1800 m)		Mixed oak forests	*Q. calliprinos; Q. infectoria; Juniperus excelsa*	*Pyracantha coccifera; Acer hermoneum; Amygdalus korschinskii; A. orientalis; Jasminum fruticans; Pirus syriaca; Berberis libanotica*	*Ziziphora capitata; Thelegonum cynocrambe; Ononis pusilla; Trigonella monantha*
Steppe.Mountain-Med (1800-2400 m)		Juniper forests	*Juniperus excelsa*	*Berberis libanotica; Astralagus spp*	*Onobrychis cornuta; Agropyron libanoticum*
Steppe-Oro-Med (>2400 m)		Juniper woodlands		*Rhamnus libanotica; Berberis libanotica; Prunus prostrata; Pirus syriaca; Cotoneaster nummularia* *<u>Degradation</u>: Astragalus spp; Acantholimon libanoticum*	*Onobrychis cornuta; Agropyron libanoticum*

Bio-climate	Substrate	Forest Habitat Type	Dominant species	Companion tree/shrub	Herbal species
Riparian forests		Lowland Plane tree forests	*Platanus orientalis; Salix alba; Laurus nobilis; Tamarix spp*	*Vitex agnus-castus; Nerium oleander*	*Hypericum hircinum; Pteris vitata*
		Plane tree and alder forests	*Platanus orientalis; Alnus orientalis; Salix libani*		
	Sandstone	Alder forests	*Alnus orientalis; Salix libani*	*Rhododendron ponticum*	*Osmunda regalis; Equisetum telmateia; Blechnum spicant*

Source: Abi-Saleh, B. & S. Safi (1988) Carte de la Végétation du Liban. *Ecologia Mediterranean XIV (1/2);* Tohmé G. & H. Tohmé (2007) Illustrated Flora of Lebanon. *CNRS*

2.3 Forest land ownership and other socio-economic factors

The forest ownership in Lebanon is almost equally distributed between the private sector, the public sector and the religious communities, under several tenure systems. However, cadaster is not always updated and surface areas and boundaries are not always clearly set. The different land ownership systems are the following:

The Mulk: they are private lands, owned by individuals. Waqf are usually lands owned by religious communities or by extended families. They are managed by individuals assigned by the group of owners or by the community. These are part of the Mulk or private lands.

The Macha'a: they are communal lands owned by one or several communities and managed by the municipal council or the federation of municipalities or a committee. Natural resource management in communal lands is supervised by the Ministry of Agriculture. These fall under the FRA category "Municipality".

The Amiri: they are lands owned by the state, normally managed by the Ministry of Agriculture; they fall under the FRA category "State". In some cases, communities have rights of use of Amiri lands, and in that case, they are under the category "Community".

The users of the forest areas may not be the owners. Rentals, usufructs, customs and agreements are used to regulate this system. Forest workers, private rural companies or shepherds may be allowed to use the space under these usage systems.

The distribution of the land ownership among the different groups, according to the FRA 2005 and 2010:

Land tenure	**(1000 Ha)**
Private	84.183
State	38.189
Municipality	14.521
Community	1.672
Not known	1.394
Total	**139.959**

Chapter 3. State of other wooded lands

Trends in forest and other wooded land areas

Categories	Area (1000 Ha)			
	1990	2000	2005	2015
Forest	131	131	136.5	137.3
Other wooded land	117	117	106	106
Other land	775	775	780.5	779.7
… of which with tree cover	114	114	114	114

In 2017, the council Development and Reconstruction (CDR) published the new land cover/land use map of Lebanon as produced by CNRS. The areas of main natural green land cover categories are presented (table 3)

categories	Area (1000 Ha)
Scattered forest	138.5
Dense forest	79.2
Pasture	154.1
Moderately dense grassland	84.2
shrubland	73.4
Burned land	0.2
Artificialized green	0.5

Chapter 4. State of diversity between trees and other woody plant species

4.1-Antecedents of intraspecific variation studies.

Intraspecific variation studies were done for *Amygdalus spp. (Talhouk et al.,* 2000*), Cedrus libani* (Asmar, 1990; Bou Dagher *et al.*, 2001, Bou Dagher *et al.,* 2007, Fady *et al.,* 2007), *Ceratonia siliqua* (Talhouk *et al.*, 2005), *Juniperus excelsa* (Douaihy *et al.,* 2011, Douaihy *et al*., 2012), *Pinus pinea* (Vendramin *et al*., 2008), *Pistacia spp.* (Talhouk *et al.*, 2001 ; Talhouk *et al.*, 2008), *Prunus spp.* (Chehade *et al.*, 2001) *Ficus carica* (Chalak *et al.*, 2009) and *Quercus spp.* (Douaihy *et al.*, 2020).

4.2-Methods employed to analyze and assess intraspecific variation in Lebanon

The methods employed were:

- morphological markers (needles, cone, seeds and leaves measurments based on IPGRI and UPOV descriptors)
- Genetic markers:
    - Isozymes
    - Molecular markers such as RAPD (Random Amplified Polymorphic DNA), AFLP (Amplified Fragment Length Polymorphism), SSR (Simple Sequence Repeats), ITS (Internal Transcribed Spacers)…

4.3-Actions taken to survey and inventory intraspecific variation in Lebanon

For *Juniperus excelsa*, quadrat were defined and trees inside the quadrat were sampled for morphological and genetic analysis.
For *Ceratonia siliqua*, a field survey with random sampling was conducted in its area of distribution.
For herbaceous species, quadrates of 1 m^2 are sampled along transects within each monotiring area with 25 meters equidistances for botanical surveys in 4 sites (Irsal, Ham, Maaraboun and Nabha) (Agrobiodiversity project, 2001-2005).
For fruit trees, quadrates of 20 m^2 are sampled along transects within each monotiring area with 30-50 meters equidistances for botanical surveys in 4 sites (Irsal, Ham, Maaraboun and Nabha) (Agrobiodiversity project, 2001-2005).

4.4-Initiative and information systems established on intraspecific genetic variation patterns

Web sites describing population distribution, and species inventory: www.lebanon-flora.org;

4.5-Objectives and priorities for improving the understanding of intraspecific variation

Identification of imported species and material used in reforestation campaigns; Identification of mother trees; Identification of features of adaptation to climate variability.

4.6-Capacity-building needs to enhance assessments and monitoring of interspecific and intraspecific variations

- Botany, phyto-sociology, taxonomy and species identification, for the technicians of the Ministry of Agriculture, Ministry of Environment and the staff of the Protected Areas and Natural Reserves.
- Plant genetic resource analysis techniques for staff of research institutes.
- Protocols for *in situ* and *ex situ* conservation and creation of germplasm for protected areas and LARI technicians.

4.7-Main trees and other forest plant species actively managed for human utilization in Lebanon (Table 4.a)

Table 4.a Forest species currently used in Lebanon

Species (Scientific name)	Native (N) or Exotic (E)	Current uses (code)	If managed, type of management system (e.g. natural forest, plantation, agroforestry)	Area managed if known (ha)
Cedrus libani	N	1, 6	Natural forest	n.a
Pinus pinea	N	4,6	Plantation	n.a.
Quercus calliprinos	N	3	Natural forest	n.a.
Q. infectoria	N	3	Natural forest	n.a.
Ceratonia siliqua	N	4,5	Natural forest, plantation, agroforestry	n.a.
Laurus nobilis	N	4, 6	Natural forest, plantation	n.a.
Populus spp.	N	1, 6	Plantation	n.a.
Rhus coriaria	N	4,5	Natural forest	n.a.
Paulownia imperialis	E	1	Plantation	n.a.
Eleagnus angustifolia	N	4,6	Natural forest, plantation	n.a.

Crateagus azerolus	N	4,5	Natural forest	n.a.
Juglans regia	N	4	Plantation, natural forest	n.a.
Myrtus communis	N	4,6	Natural forest, plantation	n.a.

1 Solid wood products
2 Pulp and paper
3 Energy (fuel)
4 Non wood forest products (food, fodder, medicine, etc.)
5 Used in agroforestry systems
6 Other (Ornamental)

4.8- Main forest trees or other woody plant species actively managed or identified for environmental services in Lebanon (Table 4.b)

Table 4.b. Main tree and other woody forest species providing environmental services or social values. For each species please indicate (N or E) whether native or exotic.

Species (scientific name)	Native (N) or Exotic (E)	Environmental service or social value (code)
Cedrus libani, Abies cilicica, Quercus spp.	N	3, 4, 5
Juniperus spp.	N	3, 4
Pinus brutia, Pinus halepensis	N	1
Cupressus sempervirens	N	1, 5, 4, 7
Accacia spp.	E	5
Casuarina equistefolia	E	7
Sorbus torminalis, Sorbus falbellifolia	N	3,5
Acer taiuricolum, Acer hermoneum	N	3, 5
Malus trilobata	N	3, 5
Pyrus bovei	N	3
Cornus sanguinea	N	3,5
Pyracantha coccinea	N	3,5
Nerium oleander	N	1, 5
Platanus orientalis	N	1, 5
Salix spp	N	1, 3, 5
Alnus orientalis	N	1, 3
Populus spp.	N	1, 5, 7
Tamarix spp.	N	1, 3, 5

Services and values include:

1 Soil and water conservation including watershed management
2 Soil fertility
3 Biodiversity conservation
4 Cultural values
5 Aesthetic values
6 Religious values
7 Other (windbreaks)

4.9-Main forest tree species considered as threatened in Lebanon

Amelanchier ovalis, Salix australior both mentioned as "not found recently" by Tohme & Tohme, *(2007); Ficus sycomorus.* No assessment has recently been conducted.
Based on surveys conducted in the field (Stephan et al., 2020; Stephan and Teeny, 2017), several species could be added to the list. Based on the existing information in the IUCN red list of threatened species, and another work with SALMA project on mainstreaming biodiversity in forest management plans, and the identification of rare tree and shrub species allowed to update the list:

- *Quercus kotschyana*, endemic to Lebanon and threatened.
- *Quercus look*, endemic to Lebanon and Syria and threatened.
- *Pyrus bovei* endemic to Lebanon and Syria and threatened.

In addition to those a list of rare species includes among others *Salix acmophylla, Salix libani, Alnus orientalis, Sorbus persica, Sorbus umbellata, Juglans regia* (in the wild), *Pistacia palaestina*.

Chapter 5. State of diversity within trees and other woody plants species

Diversity within and between forest tree species:

5.1 Main ecosystems and tree species in Lebanon

Table 5.a Major forest type categories and main tree species (FRA 2005).

Major Forest Types	Area (covered by forest type in ha)	Main species for each type	
		Trees	**Other species if applicable**
Evergreen Broadleaved Forests	32,975	*Quercus calliprinos*	*Ceratonia siliqua, Laurus nobilis, Arbutus andrachne*
Deciduous Broadleaved Forests	15,304	*Quercus infectoria*	*Prunus ursina, Pistacia terebinthus palaestina, Pyrus syriaca*
		Q. Cerris var. pseudocerris	*Sorbus spp., Acer spp.,*
		Ostrya carpinifolia	*Fraxinus ornus, Styrax officinalis*
Mixed Broadleaved Forests	30,608	*Q. calliprinos, Q. infectoria*	*Acer spp., Pistacia terebinthus palaestina, Arbutus andrachne, Crateagus spp., Styrax officinalis, Cercis siliquastrum*
Mixed Conifer and Broadleaved Forests	15,610	*Cedrus libani*	*Quercus cedrorum, Q. pinnatifida*
		Pinus brutia	*Quercus calliprinos*
		Juniperus drupacea	*Quercus spp., Fraxinus ornus*
		Abies cilicica	*Quercus cerris*
Stone Pine Forests	7,943	*Pinus pinea*	
Other Pine Forests	17,952	*Pinus brutia*	*Pinus halepensis;*
Juniper Forests	10,502	*Juniperus excelsa*	*J. foetidissima, J. drupacea*
Cedar Forests	2,019	*Cedrus libani*	
Cypress Forests	1,257	*Cupressus sempervirens*	
Mixed Conifer Forests	5,206	*Abies cilicica*	*Cedrus libani, Juniperus spp. Pinus spp., Cupressus sempervirens*

Other Wooded Land			
Coniferous shrublands	1,301	*Juniperus excelsa*	*Juniperus drupacea, J. oxycedrus, Cedrus libani*
Broadleaved shrublands	56,465	*Quercus spp.*	*Ceratonia siliqua, Laurus nobilis, Pistacia spp., Prunus spp.*
Mixed Shrublands	14,414	*Juniperus spp., Quercus spp.*	*Pinus spp., Prunus spp., Acer spp., Pistacia spp., Crateagus spp.*
Grassland with trees	36,198	*Juniperus excelsa*	*Prunus spp., Juniperus drupacea, Ceratonia siliqua, Quercus spp.*
Other Land (OL)	7,174	Woodlots	*Pinus spp., Quercus spp, Platanus orientalis, Salix spp., Populus spp.*
	459,160	Grassland	
	224,000	Cultivated Land	
	23,914	Barren Land	
	82,904	Artificial Area	

5.2 State of genetic diversity for each main species: increasing, decreasing, remaining the same or unknown

According to Bou Dagher et al. 2007 and based on AFLP polymorphic loci, genetic diversity was highest and non-significantly different in *C. libani* (78% polymorphic loci and gene diversity of H=0.317). But this high level of diversity detected within *C. libani* should be considered with caution. *Cedrus libani* is made of fragmented, genetically distant groups of populations, which suggests that gene flow among populations is not currently effective. However, such fragmentation is not affecting the level of within-population diversity that is higher in *C. libani* than in the other *Cedrus* species. However, this high within-population diversity might also be explained by two other factors: (1) a recent origin of the fragmentation coupled with a high initial level of diversity in this species, and (2) the fact that relic populations consist mainly in very old trees, generally highly heterozygous, thus retaining a certain level of diversity.

For *Juniperus excels*a and according to Douaihy et al. 2011, High levels of genetic diversity were observed at species and population levels. There is also a high level of differentiation in the high-mountain Lebanese populations reflecting a long period of isolation or possibly a different origin.

A preliminary characterization of wild *Prunus* in Lebanon is studied. A total of 32 sites throughout Bekaa region were visited. Eight species were collected: *P. amygdalus*, *P. orientalis*, *P. korschinskii*, *P. spartioides*, *P. ursina*, *P. microcarpa, P. cerasifera* and *P. mahaleb*. Species were characterized by 15 quantitative and qualitative traits of leaves and fruits. The Shannon index revealed a high genetic diversity for *P. orientalis* (0.77), *P. ursina* (0.73) and *P. spartioides* (0.72) and low diversity for *P. mahaleb* (0.59) (Chehade *et al,* 2001).

An initial genetic characterization allowed to discriminate seven Quercus species in Lebanon (Douaihy et al., 2020) including *Quercus calliprinos, Quercus ithaburensis, Quercus kotschyana, Quercus look, Quercus cerris, Quercus infectoria* and *Quercus cedrorum (Q. petraea pinnatiloba)* and their hybrids. The reseach used four plastid markers for discrimination, and the study alloed to assess the convergence between morpho-ecological anlaysis (Stpehan et al., 2016; 2018) and molecular characteristics.

Part 3: State of forest genetic resources conservation

Chapter 6. In situ conservation of forest genetic resources

In situ conservation can have different purposes. Here we refer to genetic conservation but do not exclude protected areas that were established for other purposes but also provide protection for genetic resources.

Protected Areas Management

In order to better enhance the managements of PAs, the MOE has prepared a new categorization system for Pas defining criteria for the establishment of each category in addition to their management objectives and modality. In 2002, the MOE created a first draft of the Pas law; which was further amended in 2006 and then in 2012. The amendment included the following four categories with unique management objectives:

1- Nature reserve which is defined as terresterial or marine zone in which ecosystems, habitats and species of specific importance must be protected because they are either endemic, or rare or endangered. The conservation of those species and ecosystems may require maintenance or rehabilitation activities if needed, in a way that suits with the protection objectives, and that are described in a management plan; in order to ensure the conservation of those habitats and the species that they harbor.
2- Natural park which is defined as a vast rural territory , partially inhabited, with exceptional natural and cultural heritage, recognized nationally and deserving protection on the long term. A Natural Park can include one or more PAs or areas that might eventually become protected.
3- Natural site and monument which corresponds to an area containing one or more natural features of exceptional importance which deserve protection because of their rarity, representativeness or beauty.
4- Hima which is defined as community-Bazed natural resources management(CBNRM) system that promotes sustainable livelihood, resources conservation, and enviromental protection for the human wellbeing (UNU-INWEH). A Hima is under the supervision of the municipality, the union of municipalities or the Qaimaqam.

6.1-The Protected natural sites of forests and landscapes by MoE

1. Qadisha Valley site Decision no.151 (Kanobeen & Kizhaya) /1997
2. Forests between Ain El Hour- Daraya- Debiyeh- Berjin; Decision no. 132 /1998 Sheikh Osman Forest; Deir al Mokhalis surrounding; Ain w Zein Hospital surrounding; Dalboun forest; Al Mal valley; Kafra wells; Ainbal valley sites
3. Al Makmel Mountain Decision no. 187 (Black summit) of 1998
4. Al Kammoua Area (Akkar) Decision no. 19 of 2002

5. Dalhoun Forest (Al Shouf) Decision no. 22 of 2002
6. Al Qaraqeer Valley (Zgharta) Decision no. 21of 2002
7. Baatara Sinkhole site (Tannourine) Decision no. 8 of 2004

6.2-The different Himas and protected forests declared by MoA decisions are :

1. National hima from Maaser Al Shouf to Dahr El Baydar Decision no. 127 of 1991

2. National Marine hima at Marine Sciences Center (Batroun) the Decision no. 129 of 1991

3. National hima in Al Kammoua mountain (Akkar) Decision no. 165 of 1991

4. National hima in Kfar Zabad village (Zahleh) Decision no. 71 of 1992

5. National hima in Hbaleen Decision no. 152 of 1992

6. Tannourine, Hadath El Jebbe, Jaj and Al Arz forests, Decision no. 499 of 1996

7. Cedar forest in Swaysi area (Hermel) Decision no. 587 of 1996

8. Cedar, Shouh, juniper forest in Al Kammoua (Akkar) Decision no. 588 of 1996

9. Cedar, Shouh and juniper forest in Karm Chbat (Akkar) Decision no. 589 of 1996

10. Cedar, Shouh, juniper, oak, and malloul forest in Bezbina Decision no. 591 of 1996 (Akkar)

11. Knat forest Decision no. 592 of1996

12. Bkassine forest Decision no. 3 of 1997

13. Cedar, Shouh, juniper, oak, afis, and malloul forest in Ain al Hokaylat and Albkeif Kirnet and shalout (Al Diniyé), Decision no. 8 of 1997

14. Cedar and juniper forest in Jurd Al Njass - Al Arbaen mountain Decision no. 9 of 1997 (Al Diniyé)

15. Cedar forest in Sfineh village (Akkar) Decision no. 10 of 1997

16. Cedar, Shouh, juniper forest in Marbine - Jhanam Valley (Akkar) Decision no. 11 of 1997

17. Chebaa valley Decision no. 174 of 1997

Conservation and management of FGR through protected areas Concern for in situ conservation and management of genetic resources, including FGR, has increased in Lebanon over the recent years. This is reflected by an increase in the number of protected areas spread across the country.

6.3-Nature Reserves have been established by law since 1992.

We mention here those that are within terrestrial ecosystems

1. Al Shouf Cedars (Law 532, 24/7/1996),
2. Tannourine Cedar Forest (Law 9, 20/2/1999),
3. Horsh Ehden (Law 121, 9/3/1992),
4. Bentael (Law11, 20/2/1999),
5. Yammouneh (Law 10, 20/2/1999),
6. Tyre Coast (Law 708, 5/11/1998),
7. Wadi Hujeir Reserve (Bent Jbeil, Marjayoun, and Nabatieh cazas; Law 121, 23/7/2010),
8. Shnanir Nature Reserve (Kesrouan; Law 122, 23/7/2010),
9. Kafra (Bent Jbeil; Law 198, 18/11/2011),
10. Ramia (Bent Jbeil; Law 199, 18/11/2011),
11. Debl (Bent Jbeil; Law 200, 18/11/2011),
12. Beit leef (Bent Jbeil; Law 201, 18/11/2011),
13. Jaj Cedars (Jbeil caza, Law 257, 15/4/2014),
14. Rachaya-Jabal el Cheikh (Rachaya caza)
15. Karm Chbat (AKkar)
16. Jabal Mouss nature reserve (Keserwan caza)

The largest Nature Reserve is “Shouf Cedars” with an area of approximately 16 000 Ha; the smallest are the “Palm Island” and the “Tyre Coast” Nature Reserves with an area of around 500 Ha each.

Altogether, Protected Areas in Lebanon constitute a surface area of around 200 km2, representing around 2% of the country, still far less than the world average of 10.8%.

In addition to areas with full protection status by law, others are under limited legal protection. In most cases, the exact boundaries of those have not been defined legally; therefore the total surface area is not known.

In Horsh Ehden, the amount of plant species recognized till now accounts for nearly 40% of plant species in Lebanon (1,058 plant species).

Management plans were developed for some of the nature reserves and other protected areas to identify the activities needed for the protection and conservation of biodiversity and for

the sustainable use of the sites. Additionally, several relevant projects on in situ conservation of biodiversity have been undertaken by MoE particularly the “Strengthening of National Capacity and Grassroots in situ Conservation for Sustainable Biodiversity Protection” project or Protected Areas Project (MoE/GEF/UNDP; 1996-2001); The Conservation of Wetlands and Coastal zones in the Mediterranean or MedWetCoast project (MoE/FFEM/UNDP; 2002-2006); The “Integrated management of cedars forests in Lebanon in collaboration with other Mediterranean countries” Project (MoE/ UNEP/GEF in collaboration with AUB; 2004-2007); The “Stable Institutional Structure for Protected Areas Management (SISPAM) Project” (MoE, EC LIFE; 2004-2007).

Furthermore, MoE has implemented some initiatives related to rehabilitation and restoration of the forest sites outside protected areas mainly through the development and implementation of the National Reforestation Plan (NRP) (2002-present) which aims at the rehabilitation of degraded forest land through the reforestation activities by the use of native forest trees, and the “Safeguarding and restoring Lebanon’s woodland resources” project (MoE/GEF/UNDP; 2009-2014) which aims at developing a strategy for safeguarding and restoring Lebanon’s woodland resources and implementing it through capacity building and execution of appropriate sustainable land management (SLM) policies and practices.

Sustainable forest management and reforestation are a major component of the implementation plans of the three Rio Conventions signed by the Government of Lebanon i.e. the CBD, UNCCD, and UNFCCC. The country reports for CBD and UNCCD highlited the role of forests as a major contribution for achieving the convention’goals and objectives in Lebanon. Lebanon has prepared five national reports for the CBD. The latest of which was published in 2015. The ministry of Environment has aleady started the process of publishing the six national report (MOE/ UNEP/ GEF, 2015). Lebanon encompassed inportant component of the Mediterranean vegetation Nature Reserves occupy around 2.7 % of the country’s area and incorporate rich biodiversity with about 370 different kinds of birds and 2000 types of plants and wild flowers, many of wich are endemic to Lebanon.

These include natural landscapes which were protected by Decrees 343/1942 and 836/1950 (8 sites), sites protected through MoE decisions (several river beds and forests, mainly in the Shouf area, and some remarkable natural sites), in addition to areas protected through decisions issued by MoA and MoE prior to the Nature Conservation Law of 1996.

The Forest Code (Law 2585 date 12/9/1991), amended by the Parliament in 1996 (Law 558 date 24/7/96) specifies that all cedar, fir, juniper forests and “other coniferous forests” in Lebanon are protected.

Fifteen forests were declared protected explicitly by ministerial decisions issued from MoA under the amended Forest Code.

Management plans were developed for some of the nature reserves as well as other protected areas. The management plans identify the activities needed for the protection and conservation of biodiversity and the sustainable use and proper management of the sites. In addition, the draft law for the establishment and management of nature reserves in Lebanon, prepared by MoE, addresses the issue of sustainable use. It divides the nature reserve into two zones:

"Zone for strict conservation" and "Zone for sustainable development", with management guidelines restricting activities in the first zone while allowing and promoting sustainable activities with economic returns for the local communities in the second zone.

6.4-**Target species included and actively managed within *in situ* conservation programmes**

There is no specific study that is elaborated to evaluate genetic conservation of forest trees in protected areas. However several actions and studies are being undertaken in these protected areas. Targeted forest species included within in situ conservation are mentioned in the table6.a below.

Table 6.a . Target forest species included within *in situ* conservation programmes/units.

Species (scientific name)	Purpose for establishing conservation unit	Number of populations or stands conserved	Total Area
Abies cilicica	Biodivesity conservation	9	1613ha
Cedrus libani		23	2125ha
Juniperus excelsa		22	11318ha
Quercus look		3	
Quercus cedrorum		3	
Quercus cerris		3	
Quercus kotschyana		3	
Juniperus drupacea		1	

6.5 -**Categories of *in situ* conservation areas established (managed production forests, provenance zones, strictly protected areas**

Law 85 in the ministry of agriculture protects all conifer forests cover a surface of around 42000ha. Out of these:

- *Pinus pinea* is conserved in managed production forests (around 12700ha).
- Forests in protected areas and natural reserves account for around 3500ha, or 3.5% of the country (FRA, 2010). These reserves or protected area target all conifer species as well as accompanying rare broadleaved species. All natural reserves have a major goal of biodiversity conservation, and protection of the landscape. Most of the native tree species are conserved *in situ* in these protected areas.

These forests are considered as strictly Protected Areas under both ministries of Agriculture (Law 558) and Environment (Law 444).

6.6 -**Actions for sustaining *in situ* collections and to improve inventories and surveys of forest genetic resources**

Population surveys and mapping as well as biodiversty assessment studies are conducted in Protected Areas and Natural Reserves and in potential sites for protection (i.e. Higher Akkar and Danniyeh forests, Kaftoun maquis,etc.). Several natural reserves and protected areas established nurseries (Jabal Moussa, Ehden, Shouf) for their own species and are conducting germination tests. Management plans have been developped for Tannourine Cedar Forest Nature reserve (2008-2012; extended to 2016), Horsh Ehden Nature Reserve (2012-2017) and Shouf Biosphere Reserve (2012-2017). Population study on forest age structure at Tannourine with particular emphasis on *Cedrus libani* populations. Forest fire fighting strategy was developed for Bentael Reserve.

6.7-**Actions taken for promoting *in situ* conservation**

- Ecotourism strategies are currently being developed for the three reserves mentioned above.
- Awareness raising for locals on sustainable use of forest resources (i.e. Jabal Moussa).
- Several initiatives for conservation or sustainable use of species, including forest species, rose since the past decade. These include several projects, namely:
    - "Conservation and sustainable use of dry land Agro-biodiversity" (LARI/UNDP/GEF; 1999-2005)
    - "Protection of the Forests with particular emphasis on the new pest *Cephalcia tannourinensis* infesting Lebanon cedars" FAO project TCP/LEB/0169 (E)
    - "Conservation of wetlands and coastal zones in the Mediterranean-MedWetCoast" Project (MoE/UNDP, 2002-2006)
    - "Sustainable use of natural resources Project (Private Initiatives/IBSAR; 2004-2006)

- "Integrated management of cedar forests" Project (MoE/AUB/UNEP/GEF; 2004-2007)
- Mainstreaming biodiversity conservation through management plans (MoA; FAO SALMA project, ongoing activity)
- Step for nature (MoE/UNDP, started in 2021 for two years): improving the biodiversity conservation within nature reserves.

6.8-**Main constraints to improving *in situ* genetic conservation programmes**

- Lack of a National Forest Policy (in process) tackling the issue of forest genetic resources,
- Limited enabling legal framework, as for example for the interdiction of alien gene flow from imported species and the eradication of invasive species in Protected Areas, etc.
- Land fragmentation and land-use practices
- Need for the empowerment of the ministry of agriculture for the implementation and amendment of Forest Law including Law 558 and Law 85.
- Financial constraints namely for *in situ* conservation within protected areas
- Lack of priority setting
- Unsustainable use of forest resources
- Lack of awareness
- Land ownership (access to private land)

6.9-**National priorities for future *in situ* conservation actions**

- Identification of centres of diversity of forest species (Important Plant Areas; Yazbek *et al.*, 2010)
- Embedding *in situ* conservation actions within the upcoming National Forest Policy/Program.

6.10-**Capacity-building needs and priorities for *in situ* conservation actions**

Capacity building needs can be summarized into 4 axis:

- Training
- Education programs
- Research
- Equipment

6.11-**Research priorities to support *in situ* conservation**

Research priorities include: population studies, basic taxonomic studies including distribution, identification keys, phytosociology, dynamic evolution, impact of land use and land practices and impact of climate change, etc.

6.12-**Priorities for policy development to support *in situ* conservation actions**

The National Forest Policy which is currently being elaborated by the Ministry of Agriculture is a high priority to support *in situ* conservation.

Chapter 7. Ex situ conservation of forest genetic resource

The Lebanese Agriculture Research Institute (LARI) have an operational ex situ conservation system for FGR. It was established since 2013 and developed a seed conservation program (*ex-situ*) in collaboration with Royal Botanical Gardens (Kew Gardens, UK) which includes several forest tree species namely landraces of wild fruit trees which could serve for further applied research. The tree and shrub native species include: *Acer monspessulanum subsp. microphyllum (A. hermoneum), Acer tauricolum, Acer obtusifolium (A. syriacum), Alnus orientalis, Cedrus libani, Cupressus sempervirens, Ceratonia siliqua, Cercis siliquastrum, Cotoneaster nummularia, Crateagus azerolus, Crateagus monogyna, Fraxinus angustifolia (Fraxinus syriaca), Juniperus excelsa, Juniperus oxycedrus, Myrtus communis, Nerium oleander, Phillyrea media, Pinus brutia, Pinus pinea, Platanus orientalis, Prunus korshinskyi, Prunus cerasia, Prunus cerasifera, Prunus mahaleb, Prunus prostrata, Pyrus syriaca, Rhus coriaria, Rhus tripartita, Rosa canina, Rosa glutinosa, Rosa phoenicia, Sorbus flabellifolia, Sorbus torminalis, Styrax officinalis,* and *Viburnum tinus*. Progeny tests and arboreta conservation are not implemented; however, a seed bank is currently being established. A herbarium and a seed bank are established. Kew Garden will resend to the institute a duplicate collection of its germplasm, with data on seed provenance.

The National Seed Bank of the Lebanese Agriculture Research Institute (LARI) is conserving ex situ seed collections of the wild plants (Lebanese Flora including trees) under long term conditions at -20°C.

LARI in collaboration with ICARDA were collected more than 1969 accessions of wild wheat relatives and forage from Bekaa valley and conserved them in CGIAR (ICARDA) gene banks. Among them 1095 accessions of 16 crops listed in Annex of the ITPGRFA (1992-1994).

Other accession enabled INRA France to conserve seeds form local species including *Cedrus libani*, *Cupressus sempervirens* and *Pinus halepensis*.

7.1- Actions for promoting *ex situ* conservation

The Green Hands NGO is currently establishing a Botanical garden with the assistance of the FAO and the Ministry of Agriculture in North Lebanon, with an arboretum of Mediterranean species (over 40ha). In parallel, an arboretum is being established at Agriculture Research and Education Center (American University of Beirut). LARI has established a nursery of wild fruit trees. ICARDA and AUB have collections of wild herbaceous species and landraces, however no forest species are accounted in these collections. Several arboreta were established by the ministry of agriculture in the late sixties-early seventies with the objective of developing plus trees and provenance tests, however all records were lost during the war (1975-1990). The plantations are currently abandoned and degraded.

Protected areas and NGOs are promoting the use of native species through the establishment of local nurseries (Protected Areas, AFDC, Ibsar).

7.2- Main constraints to improving *ex situ* conservation in Lebanon

The major constraints include:

- Lack of human resources
- Lack of experienced staff
- Lack of equipment for conducting progeny tests.
- Need for land for the establishment of arboreta and seed orchards
- Lack of experience in seed handling
- Lack of experience in the reproduction techniques of native forest species

7.3- Priorities for future *ex situ* conservation actions

The identified priorities include:

- Mainstreaming forest genetic resource issue within the National Forest Policy
- Enhancement of the germplasm bank and provenance unit at the national level (LARI), in order to collect and conserve seed samples from all forest species, from different bioclimatic zones of the country
- Capacity building on seed handling and conservation techniques
- Seed orchards establishment
- Use the existing old reforestation sites of the MoA as seed orchards (i.e. Chaat, Hammana, Ibl el Saqi, etc.)

7.4- Capacity-building needs and priorities for *ex situ* conservation actions

Capacity building is required for LARI, NGOs, nursery technicians for the identification of provenance, conducting of progeny tests, seed handling and conservation, etc.

LARI has been recently equipped with processing machines and tools for seeds of native trees, but still need fund and capacity building to expand its seed bank to be able to conserve seeds of all forest genetic resources in the country.

Part 4: State of use, development and management of forest genetic resources

Chapter 8. The state of use

8.1- Forest Tree Nurseries

During recent years there has been increasing interest in restoring the forest landscapes of Lebanon. A number of initiatives supporting different reforestation activities are being developed in the country. Most initiatives, however, have been focusing on no more than three tree species, partly because of the lack of technical references for native species production. As a result, a handbook on forest nurseries in Lebanon for native species production was published in 2011 by IUCN in partnership with AFDC and University of Cordoba (poyatos et al, 2011) to provide a tool that covers all the technical aspects of reforestation, from seed collection, through seedling production in the nursery, to planting out in the field.

-Initiatives by NGOs

Over the past 15 years, several NGOs, working with government agencies and with the support of local and international donors, undertook many reforestation campaigns throughout Lebanon. Although there is no reliable information on the scale and impact of these campaigns, the survival rate of transplanted trees is believed to vary in most cases between 10 and 40 percent at best. This low performance is due to harsh climate conditions and grazing, amplified by poor follow-up and maintenance. In the light of these shortcomings, several reforestation efforts have started tackling the issue differently.

-Initiatives by MoA

In the 1960s, the Lebanese Government put in place a “Project for the Improvement of the Lebanese Mountains”. This national project focused on the issue of reforestation.

MoA was the main liable for the forestry sector and consequently of national reforestation and afforestation activities in Lebanon until the establishment of MoE in 1993.

During the period 1960-1975, large-scale reforestation projects were initiated with the establishment of mixed stands, including conifers, and the creation of forest nurseries (Talhouk et al. 2001). Unfortunately, this activity was interrupted by the Lebanese war. Today, the trees are densely aligned and stunted.

Several plantations were undertaken by MoA before.

the responsibility of MoA, the yearly government allocation of LBP 5 billion (about US$3.3 million) was transferred to MoE in 2001.This budget allocation was significantly larger than MoE' s total budget in 2000 (US$1.7 million).

Recognizing the importance and complexity of reforestation, MoE initiated the National Reforestation Plan (NRP) with the objective of restoring the green cover loss of Lebanon. The implementation strategy of the NRP comprised a short term (5 years) and a long term (30 years) reforestation plan in order to reach a land cover of 20%. MoE has prepared a reforestation/afforestation plan for 18,000 hectares of abandoned land.

In 2003, a total of 305 hectares distributed over the five Mohafazas (23 sites) were replanted by MoE with indigenous species. These species included cedar (Cedrus libani), juniper (Juniperus excelsa), fur (Abies cilicica), pine (Pinus pinea, Pinus brutia, P. halepensis), cypress (Cupressus sempervirens), oak (Quercus calliprinos, Q. infectoria, Q. cerris), Carob (Ceratonia siliqua), bay laurel (Laurus nobilis), wild almonds (Prunus amygdalus), and pistacio of Palestine (Pistacia palestina).

The 23 planted sites were distributed as follows: 60 ha in Mount Lebanon, 60 ha in North Lebanon, 80 ha in the Bekaa, 50 ha in South Lebanon and 55 ha in Nabatieh

In 2004, phase two was launched; however, it was paused in 2006 during the Israeli war. The scheduled number of sites that were assigned for reforestation was twenty-four, constituting a total area of 361.5ha all over the different Mohafazas. Finally, until 2007, MoE through the NRP has planted 600 ha with local species of forest trees such as cedars, oaks, pines, etc. in 45 municipalities all over the Lebanese territory. However, the survival rate of these reforested trees is still not known.

8.2- Cooperative of native tree producers of Lebanon

The international expertise brought into the country enabled the shift from conventional seedlings production techniques, often produced in plastic bags (polybags), and with no specific regimens all through the planting phases, into customized scientific approaches that allowed for the germination of more than 50 forest species. The LRI project developed guidelines, in collaboration with AUB Nature conservation center, for native nursery management detailing the best practices for seedlings production.

Also, LRI contributed to the improvement of production practices in up to 10 native tree nurseries across the country, and supported the nurseries in creating the cooperative of native tree producers of Lebanon (CNTPL), currently the only cooperative that has the capacity of producing up to 400000 high quality seedlings for reforestation at international standards.

Currently, CNTPL is a Lebanese cooperative, registered at MOA under the number 1/1753 September 2013. It groups more than 19 nursery managers representing 10 native nurseries throughout Lebanon working together to produce high-quality native tree seedlings for reforestation (table 8.a).

In 2014 the CNTPL in collaboration with LRI started an initiative to build capacities of the MOA nurseries, empowering them with the technical knowledge towards adopting advanced nursery guidelines and best practices.

Table 8.a List of CNTPL nurseries

Name of the nursery/owner(s)	**Location**
AFDC	Andket (not operational), Ramlieh and Badde(shouf)
Committee of the cedars forest friends	Bcharre
Tannourine cedar's forest nature reserve	Tannourine
Association for the protection of jabal Moussa	Mchate and Yahchouch
Native nurseries	Ramlieh
Bkessine nursery	Bkessine
Nabat Agri nursery	Tyre
Kouroum nursery	Deir El Ahmar

Outside the CNPTL, few initiatives are starting to build their own production such as the nursery of the NGO oaks and cedars in Chahtoul, and the nursery of Akkar Trail Association in Mechmech.

Chapter 9. The state of genetic improvement and breeding programs

9.1- Development of a national native seed zone scheme

One of the major challenges facing effective landscape restoration is the proper use of native genetic resources successfully and sustainably. Lebanon faces some limitations in large part due to a limited management of native seed sources and lack of developed practices for proper seed collection. Many Lebanese initiatives focus on managing native genetic resources and improving propagation and field protocols to sustain restoration efforts. Through implemented research and collaborative partnerships at the national level, between public and private sectors, a national data platform can be developed to integrate all related works, making the resources available for involved stakeholders/public. USJ has worked extensively on the genetic identification of native species and the distribution of their populations in Lebanon. LRI, in collaboration with IDAF at the university of Cordoba, has worked on establishing a first national network of forest stands for sustainable seed production. The research aimed at identifying seed sources of major native species and regions of provenances in Lebanon, which were areas subject to sufficiently uniform ecological conditions in which stands showed similar phenotypic or genetic characters are found. More research and collaborations between stakeholders should be made to fill gaps in developing a national native seed zone and collection scheme.

- LARI does some for productive species. The Cooperative of Native Tree Producers of Lebanon have detailed protocols for tree production but not for breeding. the USJ laboratories have been working on tree breeding.

Chapter 10. Management of forest genetic resource

10.1- Forest inventories and management plans

The development of a management plan comes in line with the law N'' 85 (1991) and the forest law materials issued in 1949. Since the DRDNR at the MOA is in charge of the protection of forest wealth, it is the only party that can bring, accompany, and monitor the implementation of a forest management plan.

In 2013, management plans of two pine forests were elaborated in view of sustainable forest management and forest fire protection (CDR/GFA/EU, 2013). In 2015, UNDP-CEDRO developed and published Bkessine's and Andket's forests' inventories and management plans in collaboration with LNR-IOE-UOB (EU/UNDP-CEDRO/MOEW/MOA, 2016a).

Initiated in 2016, and in close coordination with MOA and other relevant stakeholders, the SLMQ project has developed national forest management guidelines to guide the development of future management plans. Training sessions were conducted to managers, practitioners and experts in the field to build the local capacities in the preparation, monitoring, and evaluation of these plans. Based on the developed guidelines, the project was set to cover 10000 Ha of forests with specific plans and also aimed at rehabilitation of up to 300 Ha of degraded land directly or through replication, with on-going reforestation of 114 Ha in a first phase. It is worthwhile nothing that reforestation sites were selected based on a detailed land degradation assessment in the districts of Zahle, west Bekaa and Rachaya and that the species used were identified following an ecological assessment both undertaken by the project. While the above reflects work done by the project on forest ecosystems, similar approaches are adopted for the management and rehabilitation of rangelands. Initially, the project compromised the development of national guidelines for rangelands management. Characterization of rangelands in Lebanon came in line with the provisions of these guidelines. More specifically, the characterization of rangelands included developing a set of biophysical and topographic conditions for use in the delineation of rangelands at the national level. Subsequently, the project comprised mapping potential grazing areas (including part of existing forests) in efforts to improve their management and adopt practical tools and methods by managers and practitioners for such purposes. Accordingly, grazing lands (rangelands) were classified and mapped into four rangeland vegetation types:

- Grasslands (dominance of herbaceous vegetation over 85% of the plant cover, woody vegetation less than 10%

- Garrigue and /or phrygana rangelands

- Shrublands (dominance of shrubs with dispersed trees)

- Open woodlands (forest cover less than 40% of the area excluding cedar, fir, and juniper forest).

The SALMA project will also contribute to forest management through the development and implementation of sustainable forest management plans on around 1000 Ha, with a particular focus on increasing the resilience of the forests to climate change, forest fires and insects, pests and diseases, and improving the livelihoods of the local communities. The project funds community-based initiatives that promote green jobs and diversifies income sources of forest dwellers/users in response to the impacts of climate change. It also includes assessing ecosystem services provided by different ecosystems. One of the activities planned to be implemented in the framework of the SALMA project is a forests, trees and range resources assessment. The assessment will be based on the previous assessment (FAO, TCP/LEB/2003). Using the same methodology, while providing more detailed information on the herbaceous strata, range species and other important aspects. The SALMA project will update the forest map, including information on the publicly owned forests and on sites suitable for reforestation/afforestation. Also, the SALMA project will develop and implement a forest registry system at the DRDNR. This registry is an important tool for monitoring all forest and range related activities. The registry will integrate the criteria and indicators of sustainable forest and range management.

Several forest management plans were conducted by the UNDP projects such as the Litani upper watershed project, and the current Land Degradation Neutrality project. The activities focus on the pruning and biomass reduction to ensure the needs of the local population through the sustainable management of the forest, while conserving its environmental services for protection against vegetation and land degradation. Another project is also implemented by the International Association for Mediterranean forest and the Lebanese Reforestation Initiative to restore and manage forest ecosystems for better resilience to climate change.

Part 5: State of capacities and polices

Chapter 11. Institutional framework for the conservation, use and development of forest genetic resources

11.1- National programmes

- Institutions engaged in conservation and sustainable use of forest genetic resources. (Table11.a)

Table 11.a Institutions involved with conservation and use of forest genetic resources**.**

Name of Institution	**Type of Institution**	**Activities or Programs**	**Contact Information**
Lebanese Agriculture Research Institute (LARI)	Public research institute	Creation of a germplasm bank; Diversity studies of wild species and local varieties.	Joelle Breidy: jbreidy@lari.gov.lb Ali Chehade alichehade@hotmail.com
MOA	Public institute	National Forest Policy and Program; Forest laws and regulations. Reforestation. UNCCD focal point.	Anwar Kozah; ankozah@hotmail.com Chadi Mohanna Chadi.mohanna@gmail.com Pascal Milan
MOE	Public institute	Forest law and regulations in PAs. Reforestation. CBD and UNCCC focal points.	Lara Samaha L.Samaha@moe.gov.lb Georges Akl g.akl@moe.gov.lb
National Scientific Research Council (CNRS)	Public research institute	Botany and phyto-ecology studies; mapping	Carla Khater: ckhater@cnrs.edu.lb
Lebanese University	Public University	Phyto-ecology studies, forest pest management, conservation of plant genetic resources, tissue culture	Bouchra Douaihy : bouchradouaihy@gmail.com Jean Stephan : dr.jeanstephan@gmail.com Lamis Chalak (F. Agriculture) :
Saint Joseph University (USJ)	Private University	Genetic variability studies and conservation of germplasm; taxonomy of endemic species	Magda Bou Dagher-Kharrat : boudagher@fs.usj.edu.lb

American University of Beirut (AUB) - IBSAR	Private University	Geneteic variability studies and conservation of germplasm; establishement of nurseries promoting native forest species	Salma Talhouk : ibsarplt@aub.edu.lb; ntsalma@aub.edu.lb
University of Balamand (UOB)	Private University	Mammals monitoring, forest fire monitoring, pollen studies	Georges Mitri: george.mitri@balamand.edu.lb
Holy Spirit University (USEK)	Private University	plant taxonomy, ethnobotany and medicinal plants	Marc El Beyrouthy: marcelbeyrouthy@usek.edu.lb
Protected Areas committees	Official entities	Fauna (mammals, insects) monitoring, forest structure survey, biodiversity assessment, establishement of nurseries promoting native forest species	Joelle Barakat Sandra Saba Raymond Khoury Challitah Tanios Hatem Chreif Nizar Hani

11.2 - Different policies exists in Lebanon that supports SFM.

Various policies, frameworks and initiatives governs forest management in Lebanon:

11.2.a - **MoA National Strategy for agriculture sector for period 2015-2019;**

The Ministry of Agriculture of Lebanon (MoA) with the support of The Agriculture and Rural Development Programme (ARDP), funded by the EU, prepared its strategy for the period 2015-2019, which is meant to face agricultural challenges, enhance food safety and improve the contribution of the sector to the national GDP to $3 billion by 2019.

The general objective of the strategy is to develop the institutional capacities, empower MoA and allow it to overcome agricultural challenges, improve the contribution to the economic and social development of the country, and promote sustainable management of natural resources.

In the third course of action: Improve the good governance and sustainable use of Natural Resources, five areas of intervention were identified in order to strengthen the good governance in the management and the sustainable use of natural resources. These are summarized as follows:

Strengthening good management and sustainable use of forests

Promoting sustainable investment and management of pasture lands

Improving the management of medicinal and aromatic plants and wild fruit trees sector

Supporting investment in the fisheries and aquaculture and improving sustainable management of the sector

Modernizing the irrigation system in Lebanon and promoting the use of alternative sources of water and energy in agriculture

http://www.agriculture.gov.lb/Arabic/NewsEvents/Documents/MoA%20Strategy%202015-19%20-%20English-for%20printing.pdf

11.2.b **- National Forest Program (NFP);**

In June 2015, MoA launched the main instrument of the national forest policy for the upcoming decade 2015-2025: the first National Forest Program (NFP). It constitutes and identifies the government's interventions in the forest sector and beyond it, aiming at sustainably managing the Lebanese Forest Resources, while defining the coordination and cooperation mechanisms among all public and private sectors.

National Afforestation and Reforestation Programme (NARP), known as the Roadmap for 40 million trees program in Lebanon

The Ministry of Agriculture with the FAO assistance developed the National Afforestation/Reforestation Programme (NARP), which aims at restoring and developing forest land and tree cover to increase forests from 13% of Lebanon's total area (currently) to 20% over a period of 20 years. This objective will be achieved by increasing total forest cover in Lebanon by 7% through a 40 million forest trees planting program.

Implementing the NARP will have huge economic, social and environmental impacts on the Lebanese society. The NARP is closely aligned with the Country Programming Framework (CPF) which attempts to address the agriculture sector, including forests, from a sector-wide and integrated perspective, since all subsectors (forests, livestock, water; crop production, etc.) are mutually dependent.

11.2.c - **National strategy for Forest Fire Management;**

The National Strategy for Forest Fire Management that was approved by the Council of Ministers by virtue of Resolution No 52, dated 13 May 2009.

11.3- National Legislation

Existing legislation or regulations relevant to forest genetic resources:

In the National Reforestation Plan executed by the MOE since 2002 in all the Lebanese territories for rehabilitation and restoration of degraded forest areas only the use of native forest trees in the reforestation activities was allowed with specific ban of the utilization of introduced species. Only one ministerial decision was issued by the MOA in 12 sep 1995 to stop the introduction in response to the uncontrolled introduction of alien trees from *Cedrus* genus through the ornamental industry this decision 108/1 prohibits the import and introduction of

any cedar seeds, seedlings and plants. However *Cedrus* species are still imported by nurseries for ornamental purposes.

Laws establishing nature reserves prohibit the introduction of any alien species to the reserve and the developed management plans recommend the eradication of those alien species that may threaten ecosystems habitats or species.

Within the national biosafety framework elaborated under the biosafety project 2003-2005 the issue of trading partners and neighboring in relation to the introduction of LMOs and control of threats of LMOs which might be invasive species to biodiversity is being addressed, however the biosafety regulations are not applied yet.

In addition the Law 444 has dedicated an entire chapter for the management of natural resources and conservation on biological diversity specifically articles 47 to 49 which call for the protection and sustainable use of biodiversity, the establishment of nature reserves regulating access to genetic resources and for public participation as well public and private institutions participation in the conservation of biodiversity and sustainable use of natural resources furthermore the Law 444 endorsed the Envirnmental Impact Assessment principle in its article 4 , the law states that this principle should be used as a planning and management tool for preventing pollution and minimizing degradation of natural resources.

- Policy and legal framework:

Forest laws :

- Law of forests, year 1949
- Law No. 85, year 1991
- Law No. 558, year 1996 "forest protection"

Other laws related:

- Law No. 444, year 2002 (protection of the environment)
- Law No. 92, year 2010 (burned areas)

11.4 - Public Awareness

The general public is unaware or has limted awareness level.

There is no specific awareness programme for forest genetic resources. Nevertheless, the Ministries of Environment and Agriculture, UNDP and NGOs are promoting the use of native species in reforestation, their use as ornamental plants, sustainable harvesting of medicinal/aromatic plants, and natural resource management. Eco-guide manuals and biodiversity (mammals and fauna) monitoring manuals are elaborated for protected areas.

- National needs and priorities for raising awareness on forest genetic resources issues. (Table 11.b)

Awareness campaigns are required at all levels to sensitize the general public, researchers, decision-makers and forest users on the sustainable management, use and conservation of forest genetic resources.

Table 11.b. Awareness raising needs.

Needs	Priority level			
	Not applicable	Low	Moderate	High
Prepare targeted forest genetic resources information				x
Prepare targeted forest genetic resources communication strategy				x
Improve access to forest genetic resources information				x
Enhance forest genetic resources training and education				x
Improve understanding of benefits and values of forest genetic resources				x

Forest genetic resources were covered by some Ms or PhD thesis in universities such as American University of Beirut and Saint Joseph University.

- **Universities and research centers**

Until present, only one university in Lebanon, namely the Lebanese university, provides a comprehensive degree in forestry. More specifically, the faculty of Agronomy and veterinary sciences at the Lebanese university offers M.S.c degree in Forestry and Environmental Engineering (LU, 2017). Also the faculty of Sciences at the Lebanese university offers a course on forest ecology, while the faculty of fine arts offers a course on Forestry and a course on Rural Development in the curriculum of the M.Sc of landscaping and environment. Also, private universities such as the university of Balamand (UOB), the Saint-joseph university (USJ) and the Holy spirit university of Kaslik (USEK) offer courses related to forestry. The faculty of science of the UOB provides the course '' Restoration and Reclamation Ecology'' as an elective for the minor degree of Environmental Sciences, and Forest Resource Management'' as a mandatory course for the Master's degree of Environmental Sciences (UOB, 2017).'' The ecole superieure d'ingenieurs d'agronomie Mediterraneenne'' of USJ offers an optional forestry course for the students majoring in Agronomy and agricultural Engineering and Agronomy Engineering (usj, 2017). The faculty of Agriculture and food Sciences of USEK offers an Agroforestry course as an elective for the Agricultural Engineering major (USEK, 2017).

The LNR-IOE-UOB has undertaken a large number of research and development projects and studies in the forestry sector. In addition, different departments at private universities conduct focused research on different topics related to forestry. The laboratory of Genomic Characterization of plants together with the Laboratory of seed Germination and Conservation at USJ carrying both fundamental and applied research activities in many fields (e.g., genetic characterization of native plant species and development of the Lebanon-flora database http://www.lebanon-flora.org which aims at providing easy access to Lebanese plant species, and seed conservation and germination of native plant species in association with a local NGO jouzour loubnan).

The American university of Beirut-Nature conservation center (AUB-NCC) is an interdisciplinary academic research center which strives to provide an open and collaborative platform based on research, education, community outreach, and knowledge dissemination. The faculty of Agricultural and food sciences at USEK works on identifying and managing plant diseases and insect pests.

Needs are related to human, technical and financial resources. Forest genetic resources need to be introduced as an explicit course at University Master degree level

11.5 - Identified needs for developing or strengthening forest genetic resources legislation. (Table 11.c)

Table 11.c Needs for developing forest genetic resources legislation.

Needs	Priority level			
	Not applicable	Low	Moderate	High
Improve forest genetic resources legislation				x
Improve reporting requirements				x
Consider sanction for non-compliance				x
Create forest genetic resources targeted regulations				x
Improve effectiveness of forest genetic resources regulations				x
Enhance cooperation between forest genetic resources national authorities				x
Create a permanent national commission for conservation and management of forest genetic resources				x

- National needs and priorities for research, education and training to support the conservation and sustainable use of forest genetic resources

-National legal framework for forest genetic resources strategies, plans and programme

-National networks to initiate a coordination mechanism for forest genetic resources

-Research, Education and Training

-Public and Private Institutions involved in reseach and education

-Budget allocated to forest genetic resource research in the country.

- Patents related to forest genetic resources

. Chapter 12. International and regional cooperation on forest genetic resources

12.1- International Collaboration

-Lebanon's current international collaboration

During the past decade LARI developed and implemented many projects, activities and workshops tackling *in-situ*, *ex-situ* conservation and sustainable use of biodiversity, including forest genetic resources in collaboration with many national, regional and international partners such as Ministry of Environment, farmers, NGOS, Universities and ICARDA including:

1. Implementation of a UNDP-GEF funded project entitled "Conservation and sustainable use of dryland Agrobiodiversity" (1999-2005).
2. Collection of more than 1969 accessions of wild wheat relatives and forage from Bekaa valley in collaboration with ICARDA. Among them 1095 accessions of 16 crops listed in Annex 1 of the ITPGR (1992-1994).
3. Signature of an access and benefit sharing agreement (ABSA) with the Royal Botanic Gardens Kew in July 2000 in order to study and conserve the Lebanese flora (ex-situ conservation). More than 1351 wild accessions representing 972 species are stored both at LARI and RBG seed banks. 47 accessions of 44 species are among the crops listed in Annex 1 of the ITPGR.
4. Organization of a regional workshop on the management of plant genetic resources which was held in Tal Amara (18-21/10/2009) in cooperation with Arab Organization for Agricultural Development. The workshop aims at formulizing the required legal and administrative framework for the Lebanese plant genetic resources system. The latter workshop successfully led to development of Lebanese draft law on the management of plant genetic resources for food and agriculture by a specialized committee including members from different ministries and governmental institutions involved in plant genetic resources activities and those are: Lebanese Agricultural Research Institute (LARI), Ministry of Agriculture (MOA), Ministry of Environment (MOE), Lebanese University and National Council for Scientific Research (CNRS).

Participation in different mediterranean and international conferences led to conscretise research collaborations: IUFRO network; OPTIMA (Organisation pour l'Étude Phyto-Taxonomique de la Région Méditerranéenne); AIFM (Association Internationale Forets Méditerranéennes); EFIMED (European Forest Institute – Mediterranean region office); Sylva Mediterranea; INRA d'Avignon, Fance; Institute of Plant Genetics, Firenze, Italy; Polish Academy of Sciences- Institute of Dendrology, Poland; University of Cordoba, Spain; Technical Forestry Center of Catalunya, Spain; University of Arizona-Dendrochronology laboratory, USA.

12.2- International Agreements

- Impact of international conventions, treaties or agreements that Lebanon has signed with regard to the conservation and sustainable use of forest genetic resources :

Lebanon has signed and ratified most of the conventions, treaties, and international agreements relative to environmental issues. National action programs are under development and implementation with the assistance of international organizations and bilateral and multilateral partnership agreements. Civil society is directly involved at different levels and is playing a major role in the implementation of the conventions and treaties. As a result, these conventions and treaties have helped increase the level of awareness and concern of the population towards natural resources and environmental issues. These conventions, treaties and agreements are as follows:

• The convention on Biological Diversity (CBD) ratified through law No. 360 (1/8/1994). The objective of this convention was to develop national strategies for the conservation and sustainable use of biological diversity. Under the CBD, several natural reserves were created or sustained by the Ministry of Environment. Biodiversity assessments, fauna monitoring and other activities enabled the protected areas/natural reserves to elaborate management plans, enabling the conservation of forest genetic resources. Reforestation plans banned the use of non-native species.

• The United Nations Convention to Combat Desertification ratified through law No. 469 (21/12/1995). The objective of this convention was to combat desertification and mitigate the effects of drought through national action programs that incorporate long term strategies supported by international cooperation and partnership arrangements. A National Action Plan to Combat Desertification was elaborated. This process has contributed in elaborating a map for prone areas to desertification, accounting forest fire risk and practices related to over exploitation of natural resources.

• The United Nations Framework Convention on Climate change ratified through law No. 359 (1/8/1994). The objective of this convention was to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low level to prevent dangerous anthropogenic interference with the climate system. The UNCCC process enabled the identification of forest ecosystems vulnerable to climate change. This resulted into an increasing need to adapt national forest policy and forest law to climate change.

• The UNESCO World Heritage Convention (WHC) ratified through law No. 19 (30/10/1990). This convention aims to protect and conserve natural and cultural heritage for future generations.

• The Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean ratified through law No. 292 (22/2/1994).

One of the main objectives of the Protocol is to safeguard habitats which are in danger of disappearing in their natural area of distribution in the Mediterranean, or which have a reduced natural area of distribution as a consequence of their regression, or on account of their intrinsically restricted area.

• The International Treaty for Plant Genetic Resources for Food and Agriculture Resources was

also signed by Lebanon in 2002 and ratified in 2004.

Based on the Law No. 559 dated 11/2/2004 Lebanon has signed and ratified the International Treaty on Plant Genetic Resources for food and Agriculture. The Lebanese Agriculture Research Institute introduced 44 species for 19 crops under the conditions of the Standard Material Transfer Agreement of the International Treaty on Plant Genetic Resources for Food and Agriculture in order to facilitate access to plant genetic resources and to share, in a faire and equitable way , the benefits arising from the utilization of these resources. These crops are: Atriplex, Beet, Brassica complex, Yams, Faba Bean/Vetch, Lotus, Medicago, Melilotus, Trifolium, Agrostis, Arrhenatherum, Dactylis, Festuca, Lolium, Phalaris, Phleum, Pearl Millet, Sorghum and Solanum (Chehade, 2010).
However, surveying, inventorying and collecting plant material has never been implemented.

The Cartagena Protocol on Biosafety which was ratified but not implemented yet.

12.3- Saint Joseph University

Researchers at USJ focused on in-situ and ex-situ conservation methods to improve consevation of biodiversity. Ex-situ research included a wide investigation on the genomic characterization of lebanease flora. This supported the development of an online database on the flora of Lebanon (www.lebanon-flora.org). Moreover the team worked on the development of conservation and germination protocols for native and endemic seeds, ensuring the continuous propagation of native species crucial for the restoration of ecosystems in Lebanon. Ex-situ research guided in-situ protocol development for restoration and rehabilitation of degraded mountain ecosystems to relate genetic characterization to geograpic variation, range and adaptibility of native species.

Since 1999. Bou Daher-Kharrat et al (2017), Fady et al (2003) and Jasinka et al (2013) have worked elaborately on the genetic differenciation of cedar species in Lebanon and the Mediterranean, analyzing geographic diversity, distribution and genetic relationships among the different species. Several genetic tools and protocols were used to identify ways of conservation of the cedar genus gene pools.

Douaihy et al(2013a); Douaihy et al, (2013b); Douaihy et al, (2011) and Adams et al (2014) studied juniperus excelsa populations, the second most widespread conifer species in Lebanon, on both ecological and genetic levels to differentiate subspecies, assess its current and future distribution and regeneration capacities. Morphological studies together with genetic and

biogeographical studies contributed to the understanding of juniperus excelsa evolution trends in Lebanon which was crucial for better conservation. Sobieraj (2016) studied the genetic and morphological differentiation of juniperus drupacea between European and Asian populations and the effect of the Aegean Sea barrier between Europe and Asia. It was shown that there was a significant genetic and morphological differentiation between European and Asian populations, also present between same populations from the Taurus and Lebanon mountains.

Douaihy et al (2013a) also worked on studying the evolution patterns of Eriophyoid mite reported on juniperus excelsa and the consequences on the regeneration capacity of j. excelsa due to infestation of cones, leading to very low percentages of viable seeds, thus low regeneration capacity.

Sekiewicz (2015) studied the effect of range fragmentation of Abies cilicica on gene flow between populations, thus encouraging among population differentiation, and its effect on taxonomic differentiation between species. It was noticed that morphological and anatomical distinctiveness justified the recognition of subspecies.

At the level of broader forest management, Fady (2016) described in their research approaches and principles which may be used for the management and conservation of peripheral forest populations, where environmental challenges were or would become most acute, being affected by the complex interaction between demographic processes and natural selection. Gauquelin (2016) demonstrated how linking hard sciences and humanities and social sciences is necessary to understand the complex nature of Mediterranean forests and improve their management practices.

12.4 - National needs and priorities for future international collaboration (Table 12.a)

Table 12.a. Awareness raising needs/ Needs for international collaboration and networking

Needs	Level of priority			
	Not applicable	Low	Medium	High
Understanding the state of diversity			x	
Enhancing *in situ* management and conservation			x	
Enhancing *ex situ* management and conservation				x
Enhancing use of forest genetic resources				x
Enhancing research				x

Enhancing education and training				x
Enhancing legislation				x
Enhancing information management and early warning systems for forest genetic resources.			x	
Enhancing public awareness				x
Any other priorities for international programmes				

Part 6: Challenges and opportunities

Chapter 13. Recommended actions for the future

13.1- Information Systems

National information management systems to support efforts to sustainably use, develop, and conserve forest genetic resources should be established

13.2- National campaigns and awareness

National campaigns to plant forest tree seedlings have been launched since 2008 by various ministries and NGOs. The private sector established strong partnership with NGOs in such reforestation campaigns. In this context, the Lebanese armed forces civil-military cooperation (CIMIC) launched in 2015, the ''campaign to expand Lebanon's forests'' in Rachaya with the support of LRI. The NGOs AFDC, LRI and jouzour loubnan launched also various campaigns for planting forest tree seedlings in different areas across the country.

AFDC published different awareness toolkits and guidebooks for forest conservation and fire management, including green trails book and the teacher's guide for non-timber forest products.

Also, AFDC organized several awareness workshops and activities addressed to school and university students, scouts, youth club, civil defense, municipality members.

LRI conducts yearly awareness campaigns at the national level, starting with a social media awareness raising campaigns, followed by a national planting day, tackling different environmental issues every year, i.e. climate change, forest fires, linking Lebanon's forests. Other campaigns are as well organized yearly, mentioning the International Women's Day, highlighting the role of women in reforestation, the Earth Day campaigns, and the Lebanese Army Forces campaigns, among others. LRI implemented an advocacy project, the '' I-dvocate'' in 2017, as of main purpose to raise awareness among communities and municipalities on the importance of forest classification for the conservation of Lebanon's forests.

Jouzour Loubnan promotes environmental awareness yearly through conducting seed conservation trainings. Capacity building workshops on ecotourism, fire prevention and mapping, awareness sessions and workshops to schools and university students, scouts, youth clubs, civil defense and municipality members.

Many NGOs participate in fairs, exhibitions, local and international workshops and seminars, local TV and radio programs to highlight forest conservation awards issues.

Public agencies such as the ministries of Agriculture, environment, Interior and Municipalities, the National Disaster Risk Management Unit and the NCSR have been involved in developing initiatives to monitor and report risk of forest fires at the national level.

MOA has recently managed to acquire new shredding machines to process combustible material from cleaning and pruning of vegetated lands. At the local level, a cooperation initiative between the Water Authority and the Directorate of Civil Defense Centers in Batroun (North Lebanon) was launched to secure water outlets across the districts to facilitate fire suppression activities.

Municipalities in collaboration with local NGOs have worked at the local level mainly for reducing fire risk (cleaning, pruning, raising awareness, etc.)

13.3- Creation of a research platform

A research platform could be a mean to document all related research studies and create a network between researchers and practitioners to facilitate collaboration among research institutions, sharing of main research outcomes and acquired knowledge and identifying main gaps in forestry research in Lebanon. A virtual platform could be developed and accessed by public and private entities. The mentioned research in this report might not represent all published research conducted for the last decade at least, thus a research platform could be a means to ensure proper dissemination of all conducted research of related results.

Sources of Information

List of participatants contacted by E

mails

- Anwar Kozah (Ministry of Agriculture, National Focal Point)
- Jean Stephan, Lebanese University
- Chadi Mohanna (Ministry of Agriculture, Rural Development and Natural Resources Directorate)
- Zeina Tamim (Ministry of Agriculture, Rural Development and Natural Resources Directorate)
- Sylva Koteich (Ministry of Agriculture, Rural Development and Natural Resources Directorate)
- Pascale Milan (Ministry of Agriculture, Rural Development and Natural Resources Directorate)
- Carla Jamous (Ministry of Agriculture, Rural Development and Natural Resources Directorate)
- Helene Ayoub (Ministry of Agriculture, Rural Development and Natural Resources Directorate)
- Joelle Breidy (Lebanese Agricultural Research Institute)
- Ali Chehade (Lebanese Agricultural Research Institute, Plant Biotechnology Department)
- Salim Roukoz, Michel Bassil (SALMA Project)
- Raymond Khoury (Green Plan, Bentael Reserve)
- Lamis Chalak (Lebanese University, Faculty of Agriculture)
- Magda Bou Dagher Kharrat (Saint Joseph University, Faculty of Science)
- Nabil Nemer (Holy Spirit University-Kaslik)
- Georges Mitri (University of Balamand)
- Layal Boustani (Association pour la Protection de Jabal Moussa)
- Hicham Salman (AFDC)
- Sawsan Bou Fakhreddin (AFDC)

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ANNEX

Priority forest tree and other woody plant species in Lebanon and reason for priority (Table 1)

Table 1. Priority species (scientific names)

Priority species			Reasons for priority
Scientific name	Tree (T) or other (O)	Native (N) or exotic (E)	
Abies cilicica	T	N	Southern limit of the species
Acer tauricolum	T	N	southern limit, ornamental
Acer hermoneum	T	N	ornamental
Acer syriacum	T	N	ornamental
Alnus orientalis	T	N	Threatened riparian ecosystems
Amelanchier ovalis	O	N	Rare, threatened, southern limit
Arbutus andrachne	T	N	Ornamental
Arbutus unedo	T	N	Rare, ornamental
Capparis spinosa	O	N	Edible, medicinal
Cedrus libani	T	N	Wood resource, oranmental, cultural value
Celtis australis	T	N	Ornamental
Ceratonia siliqua	T	N	Edible, industrial, ornamental
Cercis siliquastrum	T	N	Ornamental
Cornus australis	O	N	Rare, southern limit
Crataegus azarolus	T	N	Agro biodiversity
Crataegus monogyna	T	N	Agro biodiversity
Eleagnus angustifolia	T		medicinal aromatic, ornamental
Fraxinus ornus	T	N	Ornamental, southern limit, biodiversity
Fraxinus syriaca	T	N	Ornamental, riparian ecosystem,
Juniperus excelsa	T	N	Declining population
Juniperus drupacea	T	N	Declining population, southern limit, biodiversity
Laurus nobilis	T	N	Medicinal aromatic tree, ornamental
Malus trilobata	T	N	Agro biodiversity and ornamental, threatened endemic species
Myrtus communis	O	N	Agro biodiversity, medicinal, culture value and ornamental
Nerium oleander	O	N	Ornamental, riparian ecosystem
Ostrya carpinifolia	T	N	southern limit, biodiversity, wood

			resource
Pinus pinea	T	N	Edible nuts, wood resource
Pistacia palaestina	T	N	Agro biodiversity and ornamental
Pistacia atlantica	T	N	Agro biodiversity and ornamental
Platanus orientalis	T	N	Ornamental, wood resource, riparian
Populus alba	T	E	Ornamental, wood resource, windbreak
Populus nigra	T	E	Oranmental, wood resource, windbreak
Prunus argentea (Amygdalus orientalis)	T	N	Agro biodiversity and ornamental
Prunus agrestis	O	N	Endemic, agro-biodiversity
Prunus dulcis subsp. *amara (Amygdalus communis)*	T	N	Agro biodiversity
Prunus korshinskyi	O	N	Threatened, agro-biodiversity
Prunus mahaleb	O	N	Agro-biodiversity and ornamental
Pyrus syriaca	T	N	Agro biodiversity
Quercus brantii subsp. *Look*	T	N	Endemic, wood resource
Quercus cerris var. pseudocerris	T	N	Endemic, wood resource, declining population,
Quercus calliprinos	T	N	Wood resource,cultural value
Quercus ithaburensis	T	N	Rare
Quercus infectoria	T	N	Wood resource, cultural value
Rhus coriaria	O	N	Aromatic, ornamental
Rhododendron ponticum brachicarpum	O	N	Endemic, ornamental, southern limit, threatened ecosystem
Sorbus flabellifolia	T	N	Biodiversity, ornamental
Sorbus torminalis	T	N	Biodiversity, ornamental
Styrax officinalis	T	N	Medicinal and ornamental
Tamarix smyrnensis	O	N	Ornamental, threatened ecosystem
Tamarix tetrandra	O	N	Ornamental, threatened ecosystem
Viburnum tinus	O	N	Threatenend ecosystem, ornamental
Vitex agnus castus	O	N	Medicinal, oranmental, threatened riparian ecosystem
Ailanthus altissima	T	E	Invasive priority for removal
Melia azedarach	T	E	Invasive priority for removal

Forest tree and other woody species endemic to Lebanon

Forest trees: *Malus trilobata*

Other woody species: *Berberis libanotica, Halimium umbellatum syriacum, Origanum ehrenbergii, Origanum libanoticum, O. ehrenbergii x syriacum, Prunus agrestis, Rhododendron ponticum var. brachycarpum, Pentapera sicula subsp.libanotica (Etude de la diversite biologique du Liban, tome 3: flore terrestre, MOA/UNEP, 1996).*

Tree species for which there is insufficient information to determine whether or not they are threatened

All rare species including: *Acer hermoneum, Acer tauricolum, Amelanchier ovalis, Alnus orientalis, Cornus australis, Ficus sycomorus, Juniperus foetidissima, Malus trilobata, Prunus mahaleb, Prunus agrestis, Prunus korshinskyi, Quercus ithaburensis, Quercus pinnatifida, Salix australior, Salix dinsmorei, Salix libani, Viburnum tinus, etc.*

Annual quantity of seeds and seedlings produced and state of forest reproductive material (Tables 2a and 2b)

Table 2a. Annual quantity of seeds produced and current state of identification of forest reproductive material of the main forest tree and other woody species in Lebanon

Species		Total quantity of seeds used (Kg)	Quantity of seeds from documented sources (provenance/ delimited seed zones)	Quantity of seeds from tested provenances (provenance trials established and evaluated)	Quantity that is genetically improved (from seed orchards)
Scientific name	Native (N) or Exotic (E)				
Pinus pinea	N	n.a.	n.a.	n.a.	n.a.
Cedrus libani	N				
Juniperus excelsa	N				
Cupressus sempervirens	N				
Quercus calliprinos	N				
Abies cilcica	N				
Ceratonia siliqua	N				
Cercis siliquastrum	N				
Pistacia palaestina	N				
Crateagus monogyna	N				
Pyrus syriaca	N				
Laurus nobilis	N				
Eucalyptus spp.	E				
Casuarina equistefolia	E				
Nerium oleander	N				
Paulownia imperialis	E				

Table 2b. Annual number of seedlings (or vegetative propagules) planted and the state of identification of the reproductive material used for the main forest tree and other woody species in Lebanon

Species		Total quantity of seedlings planted	Quantity of seedlings from documented sources (provenance/ delimited seed zones)	Quantity of seedlings from tested provenances (provenance trials established and evaluated)	Quantity of vegetative reproductive material used	Quantity of seedlings that are genetically improved
Scientific name	Native (N) or Exotic (E)					
Populus spp.	N	n.a.	n.a.	n.a.	n.a.	n.a.

Current state of genetic characterization of the main forest tree and other woody plant species (Table 3)

Table 3. Forest species for which genetic variability has been evaluated

Species		Morphological traits	Adaptive and production characters assessed	Molecular characterization
Scientific name	Native (N) or exotic(E)			
Cedrus libani	N	x		x
Ceratonia siliqua	N	x	x	x
Juniperus excelsa	N	x		x
Pinus pinea	N	x		x
Prunus spp.	N	x		x
Pistacia spp.	N	x		x
Amygdalus spp.	N	x		x

Species conserved on-farm (*circasitu*)

Most species are found outside forest and conserved within agro-forestry systems. These include species which have mainly a non-wood forest use or service: *Cedrus libani, Ceratonia siliqua, Crateagus monogyna, Crateagus azerolus, Cupressus sempervirens, Eleagnus angustifolia, Fraxinus syriacus, Juniperus excelsa, Laurus nobilis, Nerium oleander, Pinus pinea, Platanus orientalis, Prunus dulcis, Prunus cerasia, Prunus cerasifera, Pyrus syriaca, Quercus calliprinos, Quercus infectoria, Rhus coriaria, Salix alba micrans.*

Table 4. 38 tree species in the attached table. For some of the 38 tree species only DNA barcodes were generated in order to facilitate their genetic identification, while for others especially conifers intraspecific genetic diversity is also evaluated...

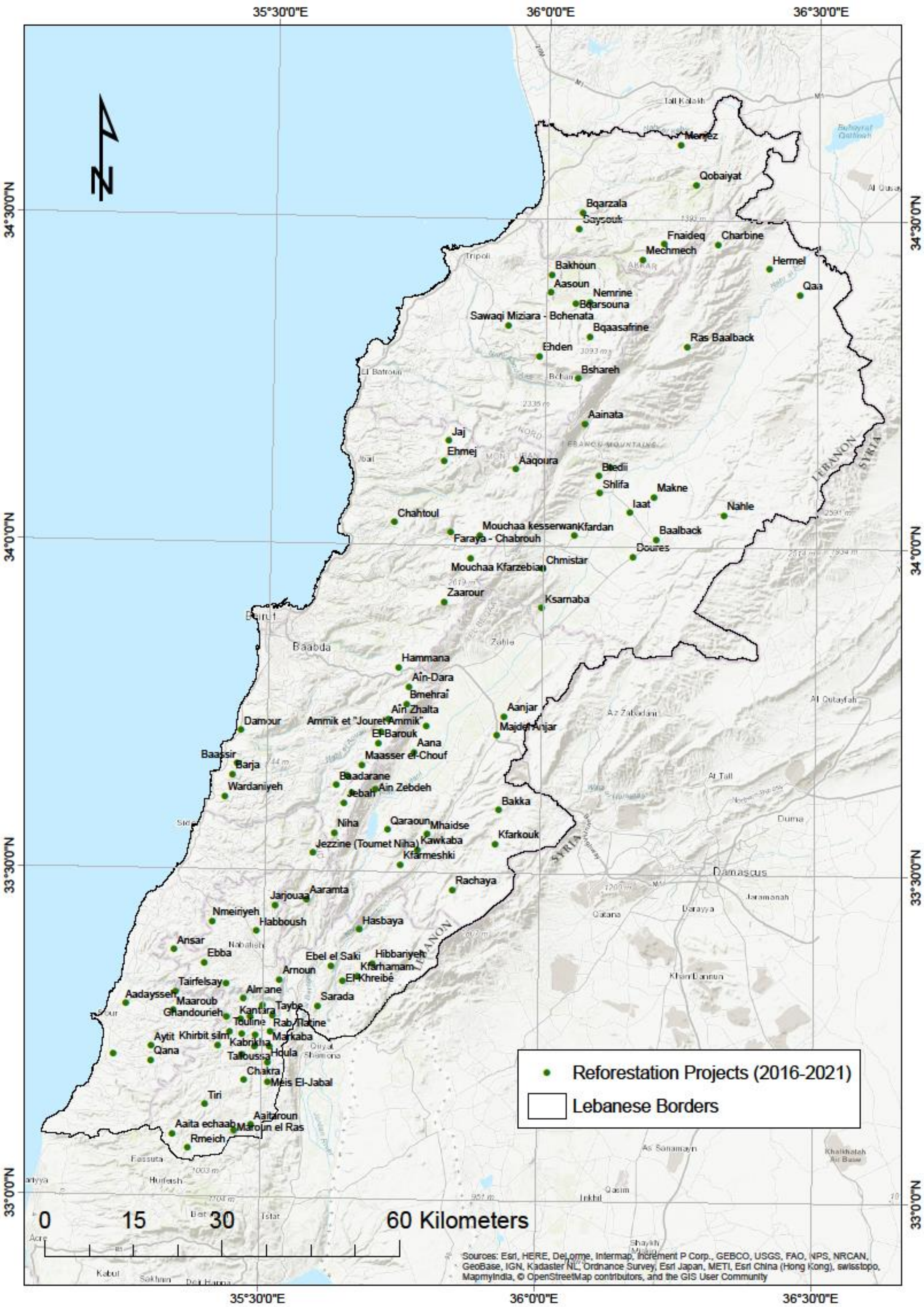
	Species	Family
1	Abies cilicica	Pinaceae
2	*Acer tauricolum (Synonym of A cer hyrcanum)*	Sapindaceae
3	*Arbutus andrachne*	Ericaceae
4	*Arbutus unedo*	Ericaceae
5	*Cedrus libani*	Pinaceae
6	*Cercis siliquastrum*	Fabaceae
7	*Cornus australis* (Synonym of *Cornus sanguinea*)	Cornaceae
8	*Cotoneaster morulus*	Rosaceae
9	*Cotoneaster nummularia*	Rosaceae
10	*Crataegus azarolus*	Rosaceae
11	*Crataegus monogyna*	Rosaceae
12	*Cupressus sempervirens*	Cupressaceae
13	*Fraxinus ornus*	Oleaceae
14	*Juniperus drupacea*	Cupressaceae
15	*Juniperus excelsa*	Cupressaceae
16	*Juniperus foetidissima*	Cupressaceae
17	*Juniperus oxycedrus*	Cupressaceae
18	*Juniperus polycarpos*	Cupressaceae
19	*Laurus nobilis*	Lauraceae
20	*Lonicera nummulariifolia*	Caprifoliaceae
21	*Malus trilobata*	Rosaceae
22	*Ostrya carpinifolia*	Betulaceae

23	*Pinus brutia*	Pinaceae
24	*Pistacia palaestina*	Anacardiaceae
25	*Platanus orientalis*	Platanaceae
26	*Prunus mahaleb*	Rosaceae
27	*Prunus prostrata*	Rosaceae
28	*Prunus ursina*	Rosaceae
29	*Pyrus syriaca*	Rosaceae
30	*Quercus calliprinos* (Synonym of *Quercus coccifera*)	Fagaceae
31	*Quercus cedrorum* (Synonym of *Quercus petraea*)	Fagaceae
32	*Quercus cerris*	Fagaceae
33	*Quercus infectoria*	Fagaceae
34	*Quercus pinnatifida* (Synonym of *Quercus pubescens*)	Fagaceae
35	*Salix libani*	Salicaceae
36	*Sorbus flabellifolia* (Synonym of *Sorbus umbellata*)	Rosaceae
37	*Sorbus torminalis*	Rosaceae
38	*Styrax officinalis*	Styracaceae

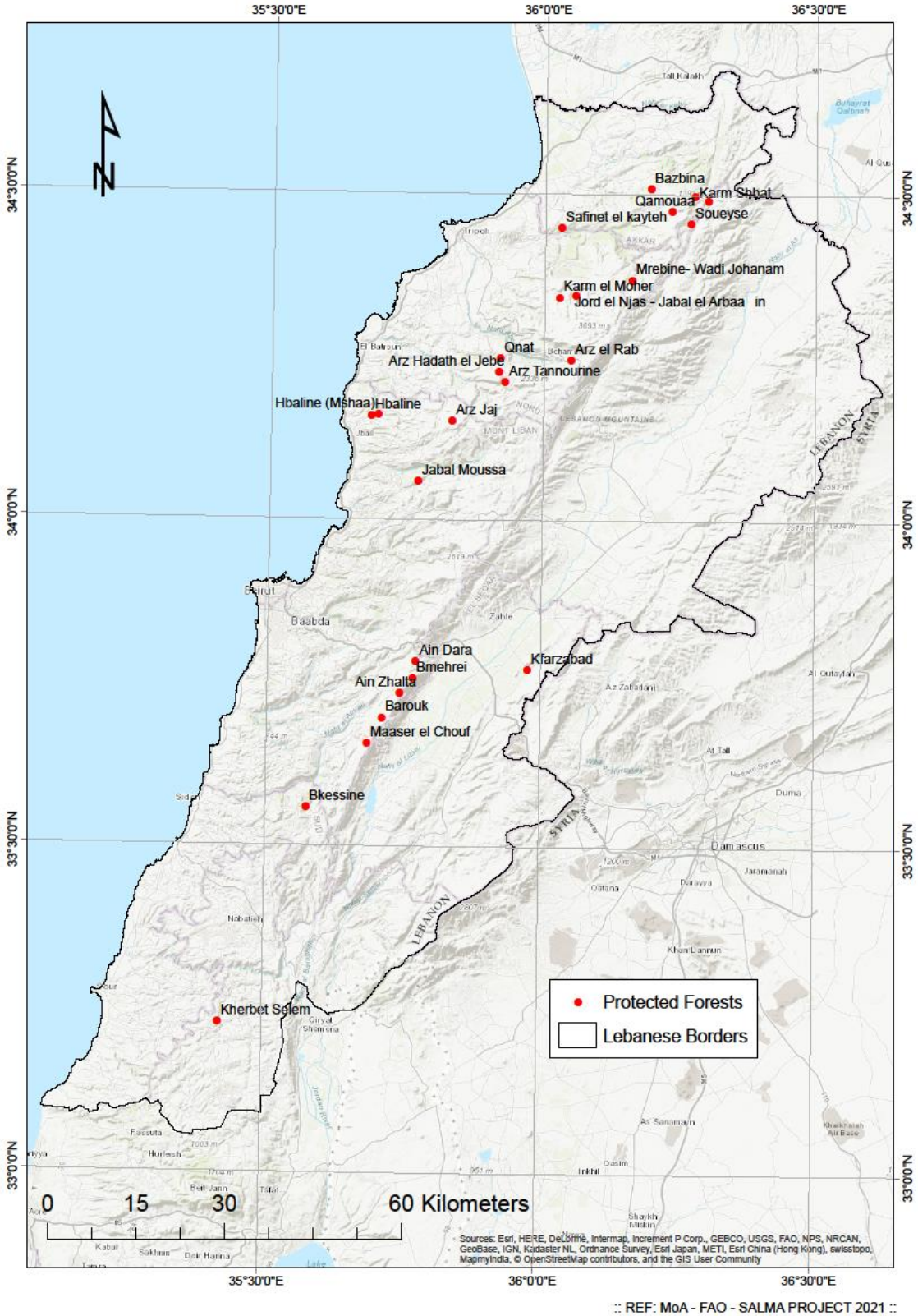
Group	Species	English and Arabic Name	Height	Flowering Period	Fruiting Period	Altitude	Vegetation Levels	Soil
Coniferous	*Abies cilicica*	Cilician fir, تنوب تركي, شوح	25 - 35 m	July	September - October	1500 - 1900 m	Mon-M	Calcareous soil
	Cedrus libani	Lebanese cedar, أرز لبنان	30 - 40 m	October - November	Autumn	1200 - 2000 m	Mon-M	Well aerated calcareous soil
	Cupressus sempervirens	Evergreen cypress, شربين	5 - 25 m	Spring	Autumn	1000 - 1400 m	T-M, Eu-M and S-M	Calcareous and marl-calcareous soils
	Juniperus drupacea	Syrian juniper, العرعر السوري ، لزّاب السوري، دفران	10 - 25 m	Spring	August	800 - 1700 m	S-M	Rocky sites
	Juniperus excelsa	Grecian juniper, لزّاب	6 - 20 m	March - April	Autumn	1700 - 2000 m	Mon-M, Or-M, Mon-M-pS and Or-M-pS	
	Pinus pinea	Stone pine, صنوبر جُوّي	10 - 30 m	April - May	September - October	1100 - 1500 m	Eu-M and S-M	Sandstone
Deciduous Broadleaved	*Acer hyrcanum tauricolum*	Taurus maple, قيقب توروس	< 12 m	March - April	October - November	1500 - 2000 m	Mon-M	Calcareous soils
	Acer monspessulanum microphyllum	Hermon maple, قيقب حرمون	< 5 m	April - May	October - November	1000 - 2000 m/ 1400 - 1800 m (pS)	S-M, Mon-M and S-M-pS	Calcareous soils
	Amygdalus orientalis	Silvery leaved almond, لوز برّي	< 2 m	February - March	April - May			

Group	Species	English and Arabic Name	Height	Flowering Period	Fruiting Period	Altitude	Vegetation Levels	Soil
Deciduous Broadleaved	*Cercis siliquastrum*	Judas tree, زمزريق, زمزرك	5 - 12 m	April - May	Autumn	100 - 800 m	T-M and Eu-M	
	Crateagus azarolus	Mediterranean medlar, زعرور أصفر	2 - 10 m	May - June	Autumn	500 - 1000 m	Eu-M	Calcareous soils
	Fraxinus ornus	South European flowering ash, مرّان زهري	< 20 m	March - April	May - September			Rocky places
	Malus trilobata	Three-lobbed apple, تفاح ثلاثي الفصوص, تفاح برّي	2 - 5 m	May - June	Late summer	0 - 1600 m	S-M and Mon-M	
	Quercus cedrorum	Cedar oak, بلوط الأرز	< 15 m	Spring	Autumn	1800 - 2000 m	Mon-M	Calcareous soil
	Quercus cerris	Turkey oak, بلوط أشعر, لك, عزر	30 - 35 m	May	Autumn	0 - 1800 m	S-M and Mon-M	Calcareous soil
	Quercus infectoria boissieri	Gall oak, مللول أو بلوط العفصى	< 10 m	March - April	Autumn	500 - 800 m	Eu-M	Calcareous soil
	Quercus ithaburensis	Vallonea oak, سنديان طابوري	< 15 m	April	Autumn			
	Quercus look	Brant's Oak, بلوط برانت	< 10 m	April - May	Autumn	1500 - 1900 m	Mon-M and S-M	Calcareous soil
	Quercus kotschyana					1650 - 2000		

Group	Species	English and Arabic Name	Height	Flowering Period	Fruiting Period	Altitude	Vegetation Levels	Soil
Deciduous Broadleaved	*Pyrus syriaca*	Syrian pear, إجاص سوري، نجاص بري, إجاص برّي	5 - 10 m	February - May	September - October	0 - 1500 m	T-M, Eu-M, S-M, S-M-pS and M-pS	Calcareous and rocky soils
	Sorbus torminalis	Wild service tree, غبيراء المغص	< 30 m	May - June	Mid to Late Autumn	1400 - 1600 m	S-M and Mon-M	
	Styrax officinalis	Storax, اميعة, حوز	2 - 6 m	March - May	July - September	0 - 1400 m	Eu-M and S-M	
Evergreen Broadleaved	*Acer obtusifolium*	Syrian maple, قيقب سوري, القيقب العريض الأوراق	< 8 m	February - March	September - October	500 - 1300 m	Eu-M and S-M	Calcareous soils
	Arbutus andrachne	Oriental strawberry tree, قطلب, جناء أحمر	1.5 - 3 m	February - April	Fall	500 - 1000 m	Eu-M	Calcareous soils
	Ceratonia siliqua	Carob, خروب شائع	< 10 m	July - October	September - October			
	Laurus nobilis	Laurel, غار	3 - 15 m	March - April	September - October	0 - 800 m	Eu-M	
	Quercus coccifera calliprinos	Kermes oak, سنديان	< 20 m	February - April	Autumn	0 - 1500 m	T-M, Eu-M and S-M	



:: REF: MoA - FAO - SALMA PROJECT 2021 ::



:: REF: MoA - FAO - SALMA PROJECT 2021 ::