



# FOREST ECOSYSTEMS

## AT THE SERVICE OF DEVELOPMENT AND ADAPTATION TO CLIMATE CHANGE

Forest Ecosystem-based Adaptation  
Case of the Tannourine Cedar Forest Nature Reserve in Lebanon

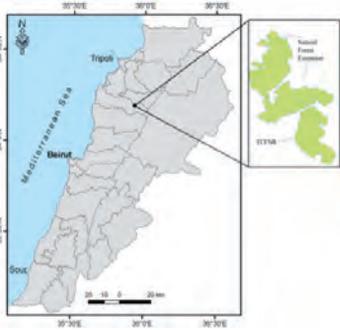




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## Tannourine



The municipality of Tannourine is located in the District of Batroun (Governorate of N-Lebanon) at approximately 75 km distance from Beirut. Being the largest (area) municipality in whole Lebanon, Tannourine has around 35,000 inhabitants. However, due to outmigration, only around 5,000 stay all year – summer residency being much higher than winter (pers. Comm. Municipality of Tannourine 2012). The most important economic sector is fruit production. Animal husbandry only plays a role for subsistence.

Apart from agriculture, the village hosts the bottling plant of the second largest mineral water factory. Further governmental and municipal institutions can be listed as important employers for Tannourine. The majority of the income though is secured by remittances from emigrated Tannourinians, sending back money to their relatives. Tourism is a continuously growing sector in Tannourine providing incomes through home stays, guiding activities, restaurant services and souvenir sale.

Natural attractions like Tannourine Cedar Forest Nature Reserve (TCFNR) attract significant numbers of tourists. TCFNR hosts the largest Cedar Forest Complex in Lebanon (*Cedrus libani*) extending on an area of approximately 150 ha. The approximate number of plant species is estimated at around 300, with 23 endemic and 3 rare and localized species. In terms of fauna, the site has a significant importance for birds, mammals, amphibians and reptiles as well as insects hosting numerous endangered, endemic or vulnerable species. The total area of the reserve including its buffer zone sums up to 625 ha. The reserve expands over an altitude 1300–1850 m a.s.l.





## Current signs and projections of climate change in Tannourine

Tannourine is located in the humid bioclimatic zone ( $P > 800\text{mm}$ ). Because of the change in altitude and topography the climate varies significantly, with the temperature decreasing and precipitation increasing with altitude. The climate can be characterized by a mean annual temperature of  $8.9$  to  $11.1^\circ\text{C}$ . Precipitation ranges between  $1060$  mm to  $1650$  mm with a peak in the winter months, and a hot and dry season in summer. Several climate signals show a gradual change. Weather data from Tannourine shows a trend of increased mean temperatures for the years 2001 to 2010. Further, a shift from rain-fed to irrigated fruit production has been observed, possibly reflecting an extension of the summer drought period.

PRECIS model's scenarios for North-Lebanon project an increase of  $1\text{--}2^\circ\text{C}$  in mean temperature by 2040 and  $3.5\text{--}5^\circ\text{C}$  by 2090. Precipitation is projected to decrease by 10 to 20% by 2040 and 25–45% by 2090, the drought period is expected to become longer. Reduction of 40% to 70% of the snow cover of Lebanon is expected for 2090, as well as a shift of elevation of snow and a decrease in snow residence time. This combination of significantly less wet and substantially warmer conditions is expected to result in a significant change in bioclimatic levels in terms of an extension in aridity by 5–15% in area. For Tannourine, UNFCCC's Second National Communication (2011) forecasts a shift to a semi-arid bioclimate severely affecting the forest ecosystems.





## Forests and Climate Change Adaptation

Due to their role in carbon sequestration forests are already recognized as important factor in climate change mitigation. Today more and more attention is given to the role of forests in adaptation to climate change.

The goods and services that forest ecosystems provide deliver essential direct and indirect economic benefits on local and national levels, but also for the human well-being.

In order to maintain forests' resilience to climate change and to contribute to increased resilience of territories a twofold approach should be followed :

- 1) Fostering the adaptation of forests through adopting adaptation strategies in sustainable forest management (so-called "Adaptation of Forests").
- 2) Integrating Forest Goods and Services in programmes and development policies in order to promote the role of forests for sustainable development and adaptation of territories and people to climate change (so-called Forest Ecosystem-based Adaptation or "Forests for Adaptation", see figure 1).





## Forest Ecosystem-based adaptation (FEbA)

Forests provide vital goods and services that contribute to vulnerability reduction of territories and people :

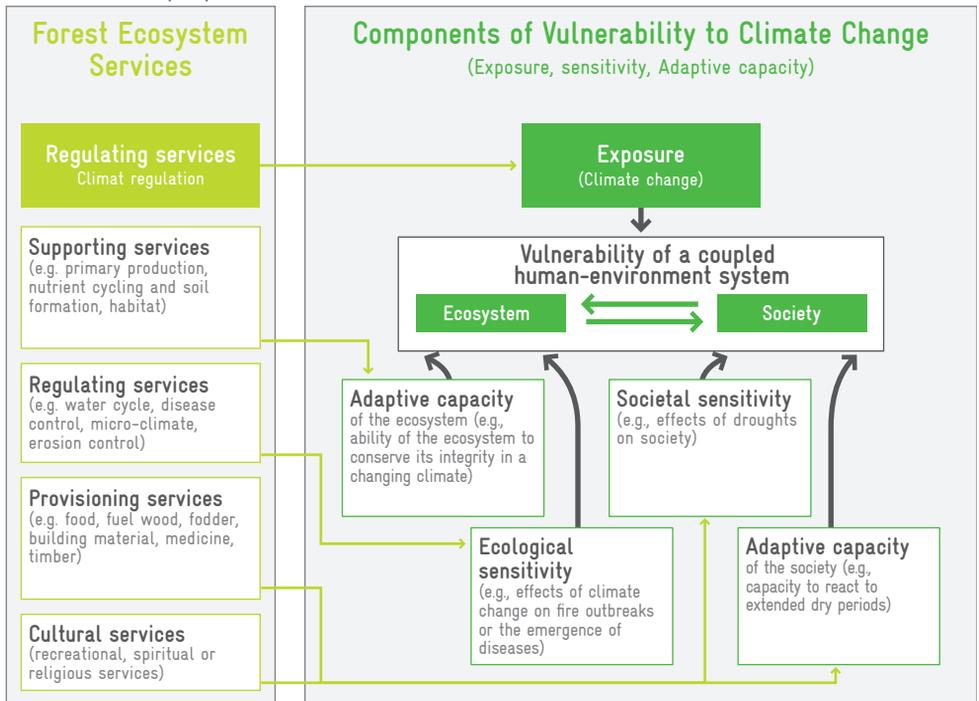


Figure 1: Relationship between forest ecosystem services and the different components of vulnerability to climate change (Adapted from: CIFOR, World Agroforestry Centre and USAID (2009))

Forests provide lots of services to other sectors. These services are called ecosystem services, e.g. erosion control, oxygen production, carbon sequestration, protection of biodiversity, stabilization of water flow, soil protection, food for livestock, and additional income for forest villagers through ecotourism, collection of medicinal and aromatic plants etc.

Total Economic Value of Lebanese forests amounts USD 296 / ha / year (Merlo & Croitoru, 2005, updated in 2010 prices) which represents about 1% of Lebanese GDP. Nonetheless these figures might be underestimated because they do not integrate the all range of NTFP values and forest ecosystem services for biodiversity conservation, ecotourism and watershed protection.

Non-wood forest products that may provide important source of income for the Tannourine Nature Reserve and surrounding villages are honey, mushrooms, berberis, oregano, Quercus caliprinos, Gundelia toumefortii and Crataegus monogyna. Forest goods and services also strengthen other sectors to improve their adaptive capacity to cope with climate change, e.g. through providing additional income for villagers. Forest ecosystems of the Tannourine have similar functions, too.



Continuity of services provided by forest ecosystems depends on health of forest ecosystems against biotic and abiotic stresses. Climate change is one of the main stressors for the forest ecosystems in Tannourine Cedar Forest Nature Reserve. Climate change will negatively affect forest goods and services and thus reduces the benefits they provide to the other sectors in the watershed (e.g. water purification, erosion and flood control, non-wood forest products etc.).

In general, impacts on forest ecosystems are expected to be very severe. SNC (2011) identifies forest fires (not relevant for TCFNR), ecosystem fragmentation and land use change, pest attacks, quarries and grazing as major threats to terrestrial ecosystems projected to be exacerbated by the effects of climate change.

Generally, it is projected that climate change will significantly reduce timber production, carbon sequestration, water quality, soil stabilization, erosion control, the forest potential for recreation, ecotourism, non-wood forest products (berberis, oregano, mushroom, honey, etc.) and biodiversity functions of forests of Tannourine. To cope with these challenges, climate change adaptation measures need to be carefully implemented in the forest reserve. Climate change is a significant threat for the TCFNR as it is for the other parts of the Mediterranean Region.

In particular, TCFNR is expected to be among the areas most affected by the impacts of climate change due to two major reasons:

- 1) location in North Lebanon, most vulnerable to climate change due to an expected shift of the bioclimatic zone.
- 2) low natural adaptive capacity of the upper zone coniferous forests (*Cedrus libani*, *Abies cilica*) and high mountain forest formations (*Juniperus excelsa*) as there is no possibility to migrate to higher altitudes. Also pest damage of the endemic cedar feeding insect *Cephalsica tannourensis* may increase.





To meet challenges that climate change brings to Tannourine Cedar Forest Nature Reserve, sector's vulnerabilities should be reduced and adaptive capacities should be strengthened. Also, research related to adaptation of major ecosystems, forest tree species and agricultural crops to climate change, need to be done as early as possible by the universities and research institutions in the region. There are also changes that need to be developed on policy level to strengthen cooperation among sectors. In addition to these measures, training of NGO's, staff and managers is necessary to have a good adaptation progress in the forest reserve.

A training course was organized in Beirut (12-15 February 2013) to raise awareness on adaptation to climate change in Tannourine. The training has been based on OECD's guidelines on "Integrating climate change adaptation into development co-operation"<sup>1</sup>. It emphasized cooperation among sectors using a forest ecosystem-based adaptation approach. At the end of the training, participants (coming from various sectors: Environment, Agriculture, Economy and Trade, Tourism, Defense, etc.) came up with ideas for forest ecosystem-based adaptation measures for Tannourine Cedar Forest Nature Reserve. Some of these adaptation measures are listed in the table, page 10.

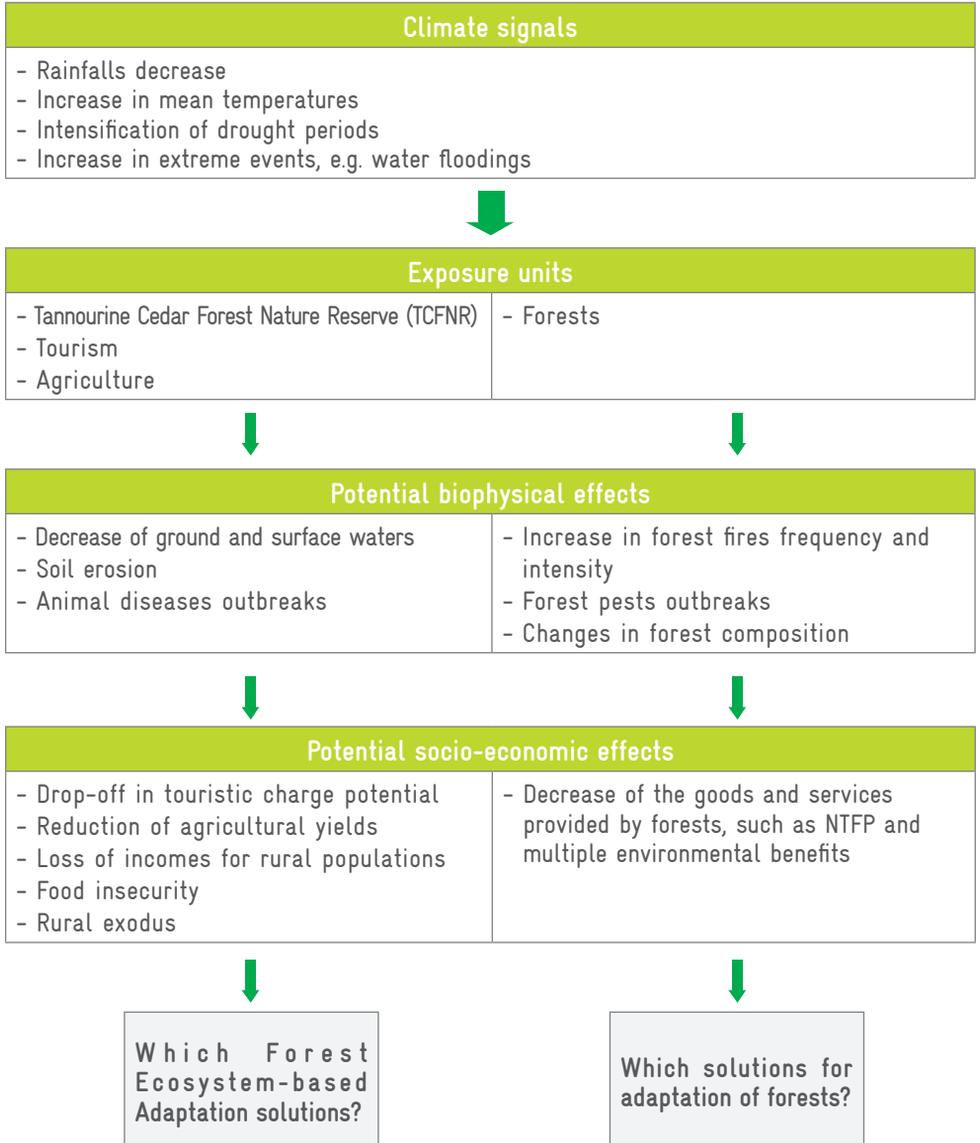
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<sup>1</sup> OECD (Organization for Economic Cooperation and Development), Link to the Policy Guidance on integrating climate change adaptation into development cooperation <http://www.oecd.org/env/cc/integratingclimatechangeadaptationintodevelopmentco-operationpolicyguidance.htm>



# Impacts chain

The impact chain enables to identify possible effects of climate change on the priority exposure units in the area of interest. It is not exhaustive and can be precised according to the availability of climatic and sectoral data.





## Suggestions for forest ecosystem-based adaptation (FEbA) measures in the TCFNR

N.B. : the following table is based on the outcomes of the workshop in Beirut, 12-15 February 2013. It corresponds to a non-exhaustive summary of potential FEbA measures for the TCFNR

|   |  |   |
|---|--|---|
| <b>Overall objective</b>  | <b>Optimizing the role of Forests Goods and Services for Climate Change Adaptation and Development in the Tannourine Cedar Forest Nature Reserve</b> |   |
| <b>Forest Ecosystem-based Adaptation measures ("Forest for Adaptation")</b>                                       |  |   |
| <b>Sector concerned/Exposure unit</b>   | <b>Possible measures</b>   | <b>Responsibility for implementation</b>  |
| TCFNR   | Income diversification through encouraging the production of NTFPs (Mushroom, oregano, berberis, honey etc.) and MAPs                                | TCFNR, cooperatives, local communities, NGOs, universities, Ministries of Agriculture, Environment, Economy and Trade                     |
|   | Reforestation of degraded areas  | TCFNR, local communities, Ministries of Agriculture, Environment  |
|   | Engaging into integrated watershed management (Preserving the valuable water source)   | TCFNR, local communities, Ministries of Agriculture, Environment, Water, Tannourine water company/private sector                          |
| Tourism   | Promoting ecotourism activities  | Local Guides, NGOs, local communities, Private Sector, Ministry of Environment, Ministry of Tourism                                       |
| Agriculture   | Encouraging erosion control through tree restoration and terracing   | local communities, Ministries of Agriculture, Environment   |
| <b>Other adaptation solutions necessary to secure FEbA measures</b>   |  |   |
| <b>"Adaptation of Forests" measures</b>   |  | <b>Necessary partners</b>   |
| Extension of the reserve to a bigger area   |  | Ministries of Agriculture and Environment, TCFNR, Private sector, local communities   |
| Encouraging the sustainable use of forests  |  | TCFNR, local guides, NGOs, Ministries of Agriculture and Environment, Education and Information, Private Sector, local communities, media |
| Building dams/hill lakes for water provision in drought periods (multiple benefits: forests, animals, irrigation) |  | CDR, local communities, Ministries of Agriculture, Environment, Water, private sector   |
| Guide training through education on protection of cedar forests   |  | TCFNR, Local Guides, NGOs, local communities, Private Sector, Ministry of Environment, Ministry of Tourism                                |
| <b>Measures concerning non CC related pressures on forests</b>  |  | <b>Necessary partners</b>   |
| Awareness raising among visitors, land owners, local communities, school children                                 |  | TCFNR, local guides, NGOs, Ministries of Agriculture and Environment, Education and Information, Private Sector, local communities, media |
| Assessing/reviewing the legal framework for collection and production of MAPs/ NTFPs                              |  | Ministries of Agriculture and Environment   |
| Improving communication between stakeholders  |  | Municipality and local communities, TCFNR, NGOs Private sector  |



## **GI2 regional project** **Silva Mediterranea-CPMF**

« Adapting forest policy framework conditions to climate change in the MENA region (Middle East North Africa) »

Website : [www.giz-cpmf.org](http://www.giz-cpmf.org)

The GI2 regional project operates in the framework of the Collaborative Partnership on Mediterranean Forests (CPMF) and in support to the Silva Mediterranea committee on Mediterranean forestry issues.

The overall objective of this project is to improve the framework conditions for the sustainable management of forest ecosystems in order to preserve the supply of goods and services in the context of climate change. The project concerns selected countries in the MENA region whose forest resources are significant : Algeria, Lebanon, Morocco, Syria, Tunisia and Turkey.

**The project is designed around four components:**

- 1) Capacity building of the forest administrations in terms of climate change and enhancement of the value of goods and services provided by forests;
- 2) Inter-institutional relations with partner sectors to increase the appreciation and acknowledgement by these sectors for the goods and services provided by forests;
- 3) Communication, information and awareness raising of the general public, particularly as to the expected impacts of climate change and the socio-economic importance of the goods and services provided by forests;
- 4) Mobilization of external support and partnerships.

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## Legal mentions

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## Download this booklet under :

<http://www.giz-cpmf.org/thematic-issues/climate-change-adaptation/forest-ecosystem-based-adaptation/>

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