Environmental Fund for Lebanon
Second call for proposals, 14 May 2010

Technical Guidance on Agriculture
Category 1. Environmental interventions with income generating potential related to adaptation to Climate Change in North Lebanon

1. Introduction

The Environmental Fund for Lebanon (EFL) is funded by the German Government with a budget of €8.5 million and is executed by the German Technical Cooperation (GTZ). The Ministry of Environment (MoE) and the Council for Development and Reconstruction (CDR) are responsible for coordinating implementation of the EFL. The EFL was initiated in July 2007, a first call for proposal was launched in February 2008, and 17 local initiatives were funded with a total budget of around €3 million. A second call for proposals is planned in May 2010 to allocate around €3million for additional local interventions.
The areas of intervention under the Second Call for Proposals are the following:

- *Category 1.* Environmental interventions with income generating potential related to adaptation to Climate Change in North Lebanon
- *Category 2.* Abatement of industrial wastewater pollution in private enterprises in the Kesrwan area and the Litani Basin.

Under Category 1, the sectors vulnerable to Climate Change which will be addressed by EFL are the Natural ecosystem, Agriculture, Water resources and Coastal ecosystem.

This paper describes the assessment of climate change impact and vulnerability to climate change in the agriculture sector in North Lebanon and the identification of priority adaptation measures under this sector. The priority measures which are eligible for funding under the Second Call for Proposal are listed in Annex 1 below. This paper also includes examples of concept notes for each proposed measure which can be used by applicants as a model for developing their own proposal in Annex 2.

2. Impact of Climate Change on Agriculture sector in North Lebanon

The different scenarios and model simulation for the current and future climatic conditions for the Middle East region show an increase in temperature varying between 1.1 and 1.8 degrees and a decrease of rainfall between 3% and 18% for the period of 2030-2045. Although these differences in temperature and rainfall are limited during the timeframe of our scope, they will be increasing dramatically by the end of the century. Relative humidity will be increasing on coastal zones, and evaporation and transpiration as well. Extreme climatic conditions will be significantly higher in the proximate future[1].

The agriculture sector is directly affected by the climatic conditions, and thus any changes in the proximate future in the features of the local agro-climatic zones characteristics will have a direct impact on agriculture. Lebanon has several agro-climatic zones due to its mountainous landscape. Each zone is characterized by its cropping pattern.

North Lebanon, which is the administrative region concerned by this study, has several agro-climatic zones:

[1] 2009, Lange and Hadjinicolaou.

- The coastal area (0-200m): a narrow plain that starts in Batroun and becomes of a significant importance in Akkar plain. Citrus, olive, grapevine, potato and other vegetables are dominant in this area. Cereals and legumes and some forage crops are also found in Akkar.
- The middle mountainous area (200-1000m): Olive is largely dominant in this area, followed by stone fruits (almond, peach, plums and apricot) and kaki. Vineyards and vegetables are present on a smaller scale.
- The higher mountainous area (1000-1800m): pome fruits (apple, pear) are largely dominant, followed by stone fruits (peach, plums, cherry…) and to a lesser extent vegetables.

Animal production is present in all the agro-climatic zones, especially small ruminants which herds are subject to annual transhumance between the coastal zones and the highest altitudes.

North Lebanon is the second most important agriculture area after the Bekaa and integrates the major production areas for olive, pome and stone fruits. It occupies the second rank for citrus, grapevine and potato[2].

Olive, almond, cereals and legumes are rainfed, while pome fruits, citrus, vegetables and the largest part stone fruits are irrigated. Irrigation water relies mostly on water springs. Surface irrigation is predominant, leading to seepage in water resources and low water efficiency.

Most of the crops that are cultivated in North Lebanon, are of a high economical importance and vulnerable to climate change as well. The impact of climate change varies from one crop to another.

Higher temperatures will hinder the accumulation of starch in potato, and thus affect tuber formation. Warming will also affect the chilling requirements (number of hours where $T < 7.2^{\circ}C$) of fruit crops, especially pome and stone fruits (by order of importance: apple, pear, cherry, peach, plums, apricot and almond). These requirements vary with the species and cultivars as well. Olive, vines and citrus need also a certain minimum of chilling hours. If chilling requirements are not ensured, fruit set is affected and thus the production. Early blossom due to heat followed by frost will also affect the production.
The decrease of precipitation and changes in precipitation patterns negatively affects the yield of rain fed crops like olive and wheat. Pastures of small ruminants are also directly affected, leading to changes in biomass availability, green cover duration, and the fodder quality of the pasture (C/N ratio is affected).
The indirect effect of precipitation and snow decrease would result in a shortage of water for irrigation. Since most of the crops are highly demanding for irrigation during the fruit development stage, the production will be negatively affected in most irrigated crops (apple, pear, peach, potato, citrus, tomato…). Higher temperatures will worsen the situation and increase water demand of crops during summer period.
The increase of humidity on the coastal zone, and the higher temperature will induce more frequent insect and fungi outbreaks in most crops (SNC, ongoing). The changing climatic conditions will affect the life cycle of insects and diseases, and the date of different phenological stages of plants as well. Consequently, the schedule and efficiency of pest and disease chemical control is affected.

[2] 2007, Ministry of Agriculture.

3. Vulnerable agriculture subsectors in North Lebanon: major aspects

The identification of the impact of climate change on the major agriculture crops of North Lebanon enabled us to identify the following vulnerable crops:

- Apple (and pear: lack of irrigation water; pest outbreaks. All the production zones are vulnerable.
- Stone fruits (Peach, Nectarine and Plums): chilling/heating requirements not met eventually (depending on the combination variety-altitude). Vulnerable areas are mainly in Goumi area (Akkar) and lower Danniyeh (below 800m). Pest outbreaks and lack of irrigation water for late cultivars will be an additional problem.
- Olive: insect and pest outbreaks (low and middle altitudes); yield affected by precipitation patterns. All production zones between up to 800m are vulnerable.
- Potato: yield reduced for summer cropping (improper tuber formation); lack of irrigation water; fungi diseases outbreak more frequently for winter cropping. Spring/summer cropping is the mostly vulnerable.
- Small ruminants (rangeland-pastures): lower pasture quality and land degradation (C/N ratio higher due to carbon fertilization; changes in pasture seasons due to temperature and rain pattern changes). Most vulnerable areas are in higher altitudes (above 1500m).

4. Priority vulnerable subsectors in agriculture in North Lebanon

The vulnerability of the subsector to climate change is also influenced by external factors such as demographic pressure, farmer's resilience to climatic changes and other socio-economical aspects. Adaptation can occur spontaneously and the general policy of the government, are also to be considered. The weight of these considerations as well as the economical importance of some crops determines *the prioritization of pome fruits and stone fruits*. Although other subsectors are equally vulnerable, nevertheless, their economical weight and the possibility of intervention remain insufficient (i.e. grapevine, potato, tomato, small ruminants and cereals).

5. Priority adaptation measures in agriculture in North Lebanon

Institutional, research and legislative measures are not relevant to short term projects. Field measures that are eligible to our scope are limited by time and budget frame conditions. The proposed measures within the agriculture chapter for the SNC[3] can be summarized as follows:

[3] 2010, MoE. Unpublished.

Activities	Budget constraints	Time constraints	Remarks
Substitute varieties that have high chilling requirements by others requiring low chilling in vulnerable areas which are the lower limits in altitude of the area of cultivation of each crop. This measure concerns apple, peach and nectarine, some plums, and grape.	No	Yes	Field studies and screening of all farmers is prerequisite. Consultants, promotion needed. Follow up and training sessions for appropriate tree training and pruning are essential.
Replace water-consuming crops with less water consuming crops or shift to early harvesting species and varieties with lower water demand as well as replanting the same perennial crops or varieties, but on drought tolerant rootstocks	No	Yes	Field studies and screening of all farmers is prerequisite. Consultants, promotion needed. Follow up and training sessions for appropriate tree training and pruning are essential.
Shift the cropping area in altitude (300 m higher by the end of the century) in order to cope with the increase in temperature.	Yes	Yes	The limited arable and agricultural lands at higher altitudes and the availability of water are limiting factors.
Adopt sustainable agriculture practices such as no tillage and organic farming.	No	Variable according to activity and crop	The majority of farmers is not aware of such practices and not ready to adopt them.
Shift to irrigation systems that are more efficient such as drip irrigation	No	No	
Adopt integrated pest management techniques (IPM), when organic farming is not an option, to decrease chemical use and lower the cost of production.	No	Variable according to activity and crop	

Based on the above analysis, the priority adaptation measures which will be selected under EFL will focus on the improvement of the efficiency of irrigation and the adoption of integrated pest management (IPM) or sustainable agriculture practices for the major vulnerable crops.

The priority measures are the following and are summarized in Annex 1 below:

Priority measure 1. The improvement of the efficiency of irrigation through shifting from surface to drip irrigation will increase the resilience of farmers to climate change. An increase in temperature will increase water demand of plants. Fruit growth period is the most critical and vulnerable for water deficiency. The longer the fruit growth period is the higher is water consumption. Fruits like apple, pear and peach late varieties are the most requiring for water. Drip irrigation enables farmers not only to have a higher efficiency of irrigation, but also to obtain better fruit caliber and production. The cost of irrigation (labor) and weed control are considerably reduced. Better fruit quality and higher marketed production imply an increase in farmers' income. Around 30% of the available water is saved (fewer losses through infiltration and evaporation). Such savings are expected to counterbalance the increase of water demand (demographic growth and plant needs) and the predicted reduction of water resources from climate change.

Priority measure 2. The adoption of IPM or sustainable agriculture practices through monitoring pest outbreaks is another form of increasing the resilience of farmers to climate change. Climatic extreme conditions, warmer winters, higher relative humidity…etc will increase pest and diseases outbreaks, affect their life cycle, and change the phonological stages of plants (bud burst, leaf development, blossom, fruit set, fruit maturity…). Consequently, farmers are unable to control appropriately pests and diseases which will negatively affect the production and its quality. The installation of traps for specific insects and linking farmers to regional meteorological stations will enable them to better monitor insects and diseases and undertake more efficient control methods and reduce the number of chemical sprays. Thus, the cost of spraying is diminished between 30 to 50% and pesticide residues are minimal. Add to this, the production is not jeopardized and the percentage of marketed products is higher. Therefore, farmers' income is increased; the environment and water resources are preserved as well. Combining IPM to other sustainable agriculture practices such as non-tillage and maintaining green cover in the fields would also be beneficiary to farmers; soil fertility and water retention are optimized, biodiversity increases the presence of insect natural enemies and the cost of weed control is notably reduced.

Annex 1. Priority adaptation measures in the agriculture sector in North Lebanon.

Fruit trees* production	Summary description of measure	Estimation of budget required	Timeframe required	Potential partners in the measure	Potential for income generation	Potential risks
Shift from surface to drip irrigation	Water consumption tends to increase with climate change and demographic pressure. Installation of irrigation systems in orchards in order to: i) increase water efficiency, ii) reduce its consumption and iii) reduce the cost of production.	350-500 $/ dunum. The cost per area unit varies with the scale. Reservoirs and head units are not included and could be around 1000$/exploitation. Additional cost should be considered for installation and training the farmers	15 months	Water associations Farmers/land owners Municipalities Agriculture enterprises MOA,LARI and MOPWR Potential NGOs working on apple in North Lebanon (Moawad and Safadi foundations, WV…) Villages: Akkar Atiqa, Fneideq, Mechmech, Ehden, Kfar sghab, Ban, Hadchit, Bcharri, Beqaa Kafra, Berqacha, Hasroun, and Tannourine…etc.	Increase production by 10-15% Homogeneity of the production and better caliber: increase in prices by 10% Decrease in the eventual cost of labor for irrigation. More water is available (30%) which could be used for other income generating activities	Conflict of interest between water users. No easy access to orchards. No infrastructure for water distribution. Farmers left alone are not able to contribute in any minimal funding
Installation of traps for insect monitoring and control	Insect outbreaks tend to increase with climate change. Monitoring insect outbreaks through traps enables accurate pest management and reduces the number of sprays and thus the cost of production and pesticide residues. Traps are crucial for organic farming and IPM. Traps for the following insects can be provided: *Cydia pomonella*, *Zeuzera pirina* and *Ceratitis capitata*.	Budget includes the cost of traps and their accessories as well as training the farmers to identify the insects and undertake the necessary measures for their control.	8 months	Farmers, and farmer groups and associations Agriculture enterprises MOA, LARI Potential NGOs working on apple in North Lebanon (Moawad and Safadi foundations, WV…) Villages: Akkar Atiqa, Fneideq, Mechmech, Ehden, Kfar sghab, Ban, Hadchit, Bcharri, Beqaa Kafra, Berqacha, Hasroun, and Tannourine…etc.	Decrease the cost of pest management by 30-50% Products are cleaner and do not show pesticide residues which increases the opportunity for marketing in higher prices, and for export.	Traps and their accessories (pheromones) are not always available on the local market and should be imported. Farmers do not rely on traps to control the insects.

* This approach can be applied to apple and other stone fruits (peach, nectarine, plums, and apricot) and pear in Akkar, Danniyeh, Zgharta and Bcharri, as well as olive trees.

Annex 2.1 Concept note on Improving irrigation efficiency through shifting from surface to drip irrigation

Justification

Water availability for irrigation will be reduced in the near future due to climate change and demographic pressure. Fruit crops which are of major importance in North Lebanon will be the most vulnerable to water shortage. Since most orchards are surface irrigated, the shifting to drip irrigation system will spare the producers from this millstone and improve their income through the reduction of the cost of production and the improvement of fruit quality and yield.

Objective

The objectives of this measure are to increase irrigation efficiency in fruit orchards by shifting from surface to drip irrigation. This will lead to direct benefits which could be improving water availability for more agricultural land and other sectors' demand as well as the increase of generated income for farmers.

Activities

The activities required to meet this objective include:

- Implementation of a field survey to assess the water flow, the concerned irrigated surfaces, the topography, the cropping pattern, the number of exploitations, the existing infrastructure (reservoirs, water ducts, …)
- Preparation of the irrigation scheme design including maps and bill of quantities at both irrigated scheme and orchard levels.
- Installation of the irrigation system.
- Assessment of water requirements of plants according to the cropping pattern, climatic and soil conditions
- Training the beneficiaries on managing irrigation schedule (frequency and quantities) and maintaining their irrigation system

Beneficiaries and target groups

The project can be executed by a private company or an NGO as well as a local authority…with at least one irrigation engineer recruited for the period of the project.

The target group includes mainly farmers and farmers associations in areas which have pome and stone fruit orchards, and relying on surface irrigation from water springs. Municipalities and their unions as well as active cooperatives and water associations could also be part of the target group, since they are responsible of the management of water springs. Municipalities and their unions could for instance provide an in-kind or cash contribution through the installation of the necessary infrastructure at the water spring (concrete tunnel, water reservoir, ducts…). Potential villages include: Qobayat, Akkar el Atiqa, Fneideq, Mechmech, Ain Yacoub, Bazbina, Al Oyoun, Rahbeh, Beino, Nimrine, Bqarsouna, Beqaa Sofrin, Kfar Bebnine, Sfireh, Baslouqit, Ehden, Aarbet Qozhaya, Seraal, Ain Tourine, Kfar Sghab, Ban, Hadchit, Bcharri, Beqaa Kafra, Berqacha, Hasroun, Bazaaoun, Diman, Hadath el Jebbeh, Tannourine, Beit Chlela, Kfar Hilda and Bsatin el Ossi.

Annex 2.2. Concept note on Adopting IPM through monitoring pest outbreaks

Justification

Pest outbreaks will increase in the near future, in accordance with temperature and humidity changes. Pest life cycles will be modified as well as the phonological stages of fruit crops. North Lebanon, which is a major fruit producing area, will be vulnerable to those changes. Since farmers will tend to intensify their sprays, the cost of production will be higher and fruits will be less marketable due to pest and disease damages and pesticide residues.

The adoption of IPM practices which include the use of different types of traps and rely on local meteorological stations enable fruit growers to better monitor insects and diseases, and hence better position the time of intervention and consequently obtain better efficiency and fruit quality as well.

Objective

The main objective of this measure is to promote efficient pest monitoring and control. This will be achieved by distributing the necessary material for pest monitoring as well as training the farmers on the use of these materials in order to undertake an efficient control.

Activities

The activities required to meet this objective are:

- Assess the cropping pattern of the concerned areas, define the key pests that are a major problem and subject to frequent outbreaks in order to define the number of traps, pheromones to be distributed as well as the closest meteorological station to be linked to.
- Import the required material in collaboration with the necessary stakeholders (MoA, local NGOs, private agriculture enterprises…)
- Distribute the necessary material (traps, pheromones…) to the farmers through local authorities or NGOs or farmer groups and associations.
- Conduct training for farmers on the use of traps, the identification of pests as well as the methods of control
- Link local meteorological station to LARI and local authorities, through a memorandum of understanding to define how to sustain the station and how to warn farmers.
- Dissemination of existing flyers, booklets…etc dealing with IPM topic, and implement an early warning system to farmers.

Beneficiaries and target groups

The project can be executed by a private company or an NGO as well as a local authority…with at least one IPM engineer recruited for the period of the project, or already working with local NGOs or LARI. The target group includes mainly farmers and farmers associations in areas which have pome and stone fruit orchards. Potential villages include those mentioned above as well as villages in lower altitudes within Akkar (Joumi area), Danniyeh (Sir, Bakhoun, Btormaz areas) and Zgharta area (Sebaal, Mazraat el Nahr, Toula, Bhayret-Toula…).