COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

LEBANON

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SECOND REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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ACRONYMS

ABSA	Access and Benefit - Sharing Agreement between the Lebanese Agricultural Research Institute (LARI) and the Board of Trustees of the Royal Botanic Gardens (RBG), Kew, United Kingdom
ACSAD	Arab Center for the studies of Arid Zones and Dry Lands
CBD	Convention on Biological Diversity
CDP	Community Development Plan
CGIAR	Consultative Group on International Agricultural Research
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
ESCWA	United Nations Economic and Social Commission for western Asia
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (German Technical Cooperation)
ICARDA	International Center for Agricultural Research in the Dry Areas
ICU	Istituto per la Cooperazione Universitaria
IOOC	International Olive Oil Council
IPGRI	International Plant Genetic Resources Institute
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LARI	Lebanese Agricultural Research Institute
MOA	Ministry of Agriculture
MOE	Ministry of Environment
MoU	Memorandum of Understanding
NBSAP	National Biodiversity Strategy and Action Plan
NCRS	National Center for Scientific Research
NGO	Non Governmental Organization
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
RBG	Royal Botanic Gardens
SMTA	Standard Material Transfer Agreement
UNCCD	UN Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UPOV	International Union for the Protection of New Varieties of Plants
WANA	Regional Office for West Asia and North Africa

EXECUTIVE SUMMARY

The present report is the second assessment of the state of plant genetic resources for food and agriculture (PGRFA) in Lebanon and follows the one presented at the Fourth International Technical Conference on PGRFA in Leipzig in 1996. This second report has been prepared through a consultative participatory process which has involved 14 national institutions and led to the establishment of the Lebanese Information Sharing Mechanism on the implementation of the Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. The national data collected under the GPA Mechanism has allowed to comprehensively review, for the first time, all the activities related to PGRFA in the country and has served as a basis for the preparation of the report.

Agriculture has always been an essential sector of the Lebanese economy through its contribution to food production and the export of several agricultural commodities. Nonetheless, the budget allocated to the agricultural sector has never exceeded 0.8% of the annual national budget. As a consequence, agricultural services have been limited and lacked sufficient funds, staff and skills to adequately meet farmers' needs. After having been negatively affected by 16 years of civil conflict (1975-1990) and several successive wars (the last one was in July-August 2006), the development of the agricultural sector is being addressed by the Ministry of Agriculture through a priority setting and planning process within the framework of an open market economy. Plant genetic resources for food and agriculture have been, are and always will be a primary element around which agricultural systems develop and evolve. Their conservation and sustainable utilization should therefore be thoroughly considered in the development and implementation of any agricultural developmental policy.

1. PGRFA status

Though a small country (10 452 km^2), Lebanon hosts various ecosystems that allow for a large number of PGRFA ranging from cold requiring crops to subtropical crops to live and flourish. More than 80 species for food and agriculture are currently cultivated and/or utilized in the country, excluding ornamental, medicinal, forest and forage plants. The main crops grown in Lebanon are olives, fruit trees and cereals each representing over 20% of the total cultivated area in the country, followed by tubers and fruity vegetables. Furthermore, as a result of the local ethno-botanical heritage and traditional food consumption habits, a number of species of the wild flora are harvested and used as food including aromatic plants, spices and condiments.

2. PGRFA *in situ* management

Concern for *in-situ* conservation and management of genetic resources has increased in Lebanon over the recent years. This is reflected by an increase in the number of protected areas spread across the country. Seven Nature Reserves have been established between 1992 and 1999 through laws approved by the Parliament.

Few projects have been implemented to support *in-situ* conservation and sustainable use of biodiversity, including PGRFA. They followed community-based approach and worked with local communities, farmers and NGOs. Focus was given to target crops of global significance for food and agriculture such as wheat, barley and many local fruit trees. Agro-ecological and eco-geographic studies, as well as socio-economic, indigenous knowledge, and botanical surveys were conducted in some rural villages. Nurseries and seed-cleaning units have also been established.

3. PGRFA *ex situ* management

National infrastructures for *ex situ* conservation such as gene banks and arboreta are absent. Actually, many collections have been made and field gene banks established at LARI. *In vitro* facilities are already available but no conservation activity in this regards has been undertaken. Long-term conservation of seeds is applied to around 1 000 Lebanese wild

species at both LARI and the Royal Botanic Gardens. The material stored in the Lebanese collections is only characterized by its morphological traits.

The establishment of *ex situ* collections is limited by multiple constraints due mainly to the absence of a national action plan. Thus, regional and international support are needed to ensure the sustainability of existing collections and to establish new collections based on both field and seed gene banks, and cryo-preservation techniques.

4. PGRFA uses

In Lebanon, the characterization and evaluation of PGRFA is mostly limited to morphological descriptors and agronomical traits. It has been applied so far to landraces and improved varieties of fruit trees, field crops and some vegetables. Molecular characterization has only been applied to a limited number of crops using European funds. Financial and technical support is needed to expand PGRFA characterization and evaluation by using advanced techniques and by strengthening skills and adopting adequate equipments.

Only few breeding activities have been carried out in Lebanon. They are limited to wheat, barley, chickpea and lentil. Regarding fruit species, breeding activities are restricted to some clonal selection activities that have been recently conducted for stone fruits and grapevines. There is an urgent need to establish a national strategy for the breeding and improvement of the Lebanese PGRFA for target crops. As a precaution, some actions are needed now to broaden the genetic basis used on-farm.

An increasing attention is being paid to the wild edible flora which is harvested from its natural habitat and for which domestication attempts are being produced. There is a need to establish a legal framework to support the sustainable use and marketing of under-utilized crops, and the domestication of wild edible species.

Regarding seed production, there is no official program in Lebanon for most of the major PGRFA except for wheat and barley which are produced and distributed to farmers by LARI. For vegetables, seeds of improved varieties are regularly imported by the private sector from different countries and sold to farmers at high prices. For fruit trees, the production and distribution of planting materials is predominantly carried out by the Ministry of Agriculture and the private sector.

5. National programmes, training and legislation

To date, no Central National Program related to PGRFA exists in Lebanon. The conservation and sustainable use of PGRFA is not yet officially recognized as such by local authorities and decisions makers. Nevertheless, several National Projects related to PGRFA conservation have been executed and others are being implemented by the Ministry of Agriculture and LARI mainly, in collaboration with partners such as the Ministry of Environment, farmers, NGOs, Universities, ICARDA.

Public awareness regarding PGRFA conservation is not yet recognized as a national priority. The main constraints facing the development of public awareness programmes include an insufficient number of staff, insufficient skills and knowledge, and insufficient funds.

6. Regional and international collaboration

Lebanon has signed several PGRFA agreements. In addition, it has taken part or has contributed to different PGRFA related conventions and has ratified most of them, including the Convention on Biological Diversity (1994), the UN Convention on Combating Desertification (1995), the International Treaty on Plant Genetic Resources for Food and Agriculture (2004), and the UN Framework Convention on Climate Change (1994). However, the full implementation of these international agreements needs further work at country level, *inter alia* to satisfy monitoring and reporting obligations. In this regard, Lebanon should have a unified and regularly updated PGRFA database and a platform for better information exchange and dissemination at the national, regional and international levels.

On the other hand, Lebanon is one of the few countries that have not signed the "Convention on International Trade of Endangered Species of Wild Fauna and Flora" (CITES). This convention is a strong tool for the control over international trade of endangered animal and plant species. Since Lebanon has not ratified CITES, Parties have no obligations towards trade affecting the endangered species of Lebanon.

At the regional level, a friendship collaboration has taken place between LARI and ICARDA since 1975 focusing mainly on wheat and barley breeding and variety release.

7. Access to PGRFA, Sharing of Benefits and Farmers' Rights

Within the Biosafety Project framework and as per the third objective of the Convention on Biodiversity, the Ministry of Environment has drafted a decree to control access to genetic resources in Lebanon and share benefits arising from their use. The decree is still under preparation and will be enacted once finalized and approved by the various relevant authorities in the country.

With regard to plant genetic resources for food and agriculture (PGRFA), Lebanon, as Party to the International Treaty on PGRFA is committed to provide access to all materials listed under Annex I of this Agreement[1], according to the terms set under the Multilateral System of Access and Benefit-Sharing[2] and the Standard Material Transfer Agreement, adopted by the Treaty's Governing Body in 2006[3].

8. Government role

The Government of Lebanon should consider the *in situ* and *ex situ* conservation of plant genetic resources and their sustainable use as a National Priority. In this regard, there is a need:

- To develop National Laws, Legislations and Policies for an adequate PGRFA management and exchange, and for the compliance of ratified international treaties and agreements related to plant genetic resources;
- To establish a national public PGRFA institution responsible for coordinating all PGRFA activities in the country and to assign to it adequate resources in terms of staff and equipment;
- To develop a strong National PGRFA Programme, based on the improvement of institutional and sector related linkages including community efforts, and on the development of national capacities in the scientific, research, technical, managerial, public awareness and policy areas
- To optimize the use of highly variable natural ecosystems allowing the cultivation of diversified and well adapted PGRFA;
- To implement a diversification strategy based on the adoption of improved high yielding varieties in addition to the traditional, landraces and well adapted varieties.

Finally, Lebanon should seek funds and regional and international collaboration for enhancing PGRFA related activities. Such support should mainly be in the form of capacity building and funds needed to acquire the adequate equipments.

[1] International Treaty on PGRFA. Annex I. page 20, ftp://ftp.fao.org/ag/cgrfa/it/ITPGRe.pdf
[2] International Treaty on PGRFA. Part IV. page 6, ftp://ftp.fao.org/ag/cgrfa/it/ITPGRe.pdf
[3] Report of the First Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture. Appendix G. ftp://ftp.fao.org/ag/cgrfa/gb1/gb1repe.pdf

INTRODUCTION

Agriculture in Lebanon dates back to the Phoenician civilization in the 3rd millennium B.C. Since that time, the Lebanese have found uses for renewable resources as witnessed by their exploitation of cedar wood to build floats and temples. Though a small country, Lebanon's diverse topography, microclimates and varieties, produce extra quality agricultural products.

The Lebanese population has grown from 2.5 million in 1970 to 4 millions in 2006. During the last 36 years, however, agricultural and rural population has been declining at an annual rate of about 2.4%, thus reaching around 10% of the economically active population in 2006. In this regard, about 40% of the Lebanese population is currently working in the agricultural sector and the agro-food industries. Only 34% of this sub-population is entirely counting on agriculture. The Lebanese economy is essentially based on services offered by a strong banking sector and an attractive and diversified tourism sector.

Out of the total Lebanese area of 10 452 km^2, about 36% are cultivated lands, 7% are covered by forests and 57% are non-cultivated lands or temporary pastures. In 2004, the cultivated area was about 268 000 Ha out of which 135 000 Ha are irrigated. The agricultural lands are located mainly in the narrow coastal plains, in Akkar, in the in-land Bekaa valley, and in the terraces along the mountain sides.

The country is characterized by various types of soils namely red and brown Mediterranean soils, calcareous soils, sandy soils, and heavily weathered fersialitic soils of volcanic origin.

Although Lebanon is a coastal Mediterranean country, there is a wide variability in its microclimatic conditions. While the coastal plains are typically Mediterranean with a long hot summer and a mild winter with rare frost occurrences, the nearby mountains (Mount Lebanon chain up to 3 081 m) are cold and snow-covered from December to May. The in-land Bekaa plain is characterized by a semi arid climate with some snow and frost and with low rainfall (250 mm/year).

The precipitations of rain and snow constitute the main renewable source of water in the country providing water for both rain fed and irrigated crops. The annual precipitation varies from an average of 750 mm in the coastal area to an average of 1 000 mm along the Western mountain chains. In the Bekaa valley, rainfall decreases from South to North with an average ranging from about 700 mm near the Quaroun Lake to about 250 mm in the Hermel-Kaa region. Only one third of the surface water available is used for irrigation.

According to topography and soil characteristics, rainfall level, and the availability of water for irrigation, various agro-ecological zones can be identified (Figure 1), hosting around 3 000 wild species and allowing the cultivation of a large number of crops.

1. Crop production system

The crop production system includes mainly fruits, olives, vegetables and field crops. The total cropped area in 2004 was about 268 000 Ha of which around 29% were reserved for fruit crops, 22% for olives, 22% for cereals, and 16% for vegetables.

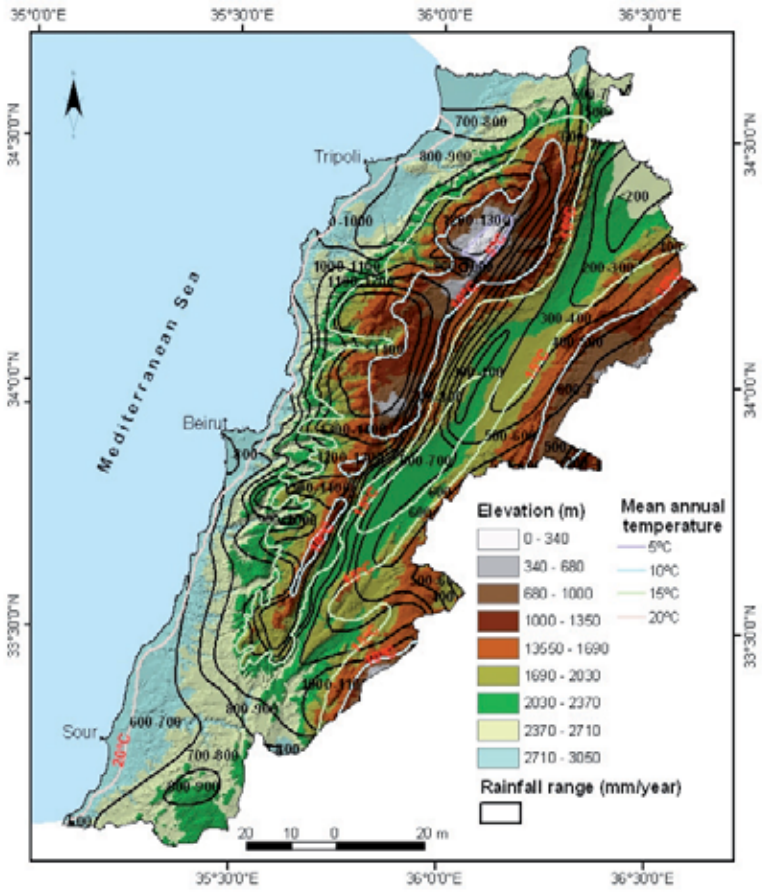
Fruit crops

Citrus, apples, grapes and stone fruits are the main fruit crops, constituting about 90% of the fruit production area and accounting for 80% of the total Lebanese fruit production. The total fruit production has increased during the last three decades by about three folds to reach 1.5 million tons in 1994.

Leguminous and vegetable crops

About a quarter of the Lebanese cultivated land is used for vegetable production, whether irrigated, rain fed or protected. Vegetable crops are grown in the coastal plains, Bekaa valley and medium elevation mountains. Main crops include tomato, eggplants, cucumbers, squash, watermelons, melons, beans, cabbages, cauliflowers, strawberries, carrots and lettuce. The production estimated to around 1.3 million tons in 2004 is reserved for local consumption and export to the Arab countries.

FIGURE 1
Climatic map of Lebanon



Field crops

The field crops occupy about one third of the cultivated area in the Bekaa and Akkar plains. They include mainly cereals, potatoes, sugar beets, onions, forages, tobacco and food legumes. Cereal production was estimated to 172 000 tons in 2001. Most of the cereals including wheat, maize and rice are imported. Potato is one of the most important crops grown in the Bekaa and Akkar plain and its production in 2001 was estimated to 257 000 tons.

Cut flowers

Floriculture is an organized sector in the country. Mostly, flowers as gerberas, carnations and roses are produced under a protected environment (greenhouses, plastic tunnels), and represented an area of 536 Ha in 2004.

Medicinal and aromatic plants are underexploited at both wild and cultivated levels but constitute a sizable share of the local and export markets.

Forests

the area covered by forests is relatively low and ranges between 70 000 and 80 000 Ha. 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.

2. Main constraints facing the agricultural sector

The role of the agricultural sector in the Lebanese economy has been diminishing since the 1960's. In 2004, its contribution to the national economy was estimated to less than 10%, with 73% of agricultural production attributed to crops and 23% to livestock production systems.

The last census of 2000[1] conducted by the Ministry of Agriculture showed that 75% of the landholders had farms of less than 1 Ha (around 63% had less than 2 Ha). About 6% of the landholders had half of the total cumulative area with farm sizes ranging from 20 Ha to more than 200 Ha. The census showed that around 52 % of the farming area is operated by land owners while the remaining 48% is either leased on seasonal basis or crop shared, or run under a certain combination of leasing and crop sharing.

The main constraints facing the agricultural sector in Lebanon are[2]:

- Lack of equilibrium between the self-sufficiency of food products and the reliance on imports to meet the local demands;
- Deficiency in incentives to farmers to expand their production while keeping reasonable food prices for consumers;
- Absence of a clear market strategy and regional market agreements for present and potential commodities;
- Inequity in the distribution of the agricultural research benefits among various sectors and interest groups in the society;
- Displacement of the rural populations during the years of the internal conflict;
- Fragmentation of the agricultural land properties;
- Chronic insignificant contribution of the national budget allocated to the Ministry of Agriculture (0.5% of the total budget);
- Inefficient management of land and water use;
- Absence of on-farm testing trials and lack of transfer of adequate technologies especially those relevant to small farmers;
- Poor breeding and seed technology programs intended for the development of high-yielding varieties and improved seed quality;
- Use of traditional poor quality cultivars and breeds;
- High agricultural production costs compared to neighboring countries;
- High levels of pesticide residues mostly in fruits and vegetables.

3. Economical, social and political constraints

As in many other sectors, agricultural development in Lebanon has always been negatively affected by political problems and successive wars. However, even if the Lebanese agricultural development has a wide array of objectives including the achievement of a high level of food security, the budget allocated to the Ministry of Agriculture never exceeded 0.5% of the national budget per year.

The development of the agricultural sector has a wide range of objectives including the achievement of a higher level of food security, the contribution to national trade balance improvement and the decrease of imbalances between the urban and rural sectors (the rural per capita incomes averages 35% of national per capita income in the eighties). Other related agriculture development goals of specific importance to Lebanon can be linked to the return and the establishment of the Lebanese that have been displaced by wars and to the provision of alternative sources of income to previous growers of illicit crops.

Agricultural development in Lebanon should emphasize some of the country's characteristics that reside in its climatic and geographic diversification, its relatively abundant water resources and in its information access facilities which can be enhanced by the presence of several agricultural academic institutions. On the commercial level, Lebanon should take advantage from its important trade experience within the region. More than four fifths of Lebanon's agricultural exports have always targeted the Arab world which is characterized by the world's highest population growth rate, and which therefore represents an ideal promising market.

Various problems are however hindering the development of the Lebanese primary sector:

- The Lebanese agriculture still emphasizes the few major crops with little diversification of other cash crops;
- The shortage of adequate facilities for storage, grading and packing of agricultural products, as well as the deficiency in the number of agro-food industries;

- The high proportion of small agricultural properties constitutes a serious obstacle against efficient irrigation, mechanization and land reclamation;
- The absence of an adequate extension service and the poor performance of cooperatives is highly felt by farmers;
- The general deficiency in research activities related to agriculture;
- Market fragmentation and the absence of an appropriate infrastructure for the marketing of agricultural products, and subsequently, the weak bargaining power of farmers. These factors have increased the role and profits of the middlemen. In addition, the market for agricultural inputs is held by several companies which enjoy high levels of profit. Furthermore, the absence of governmental control increases the power of these companies which besides supplying inputs, provide economic extension services.

4. Process followed in the preparation of the report

Within the framework of the Global Plan of Action (GPA) for the Conservation and the Sustainable Utilization of Plant Genetic Resources for Food and Agriculture, LARI, has acted as the coordinating body for the establishment of the GPA Mechanism in the country and which involved the participation of more than 30 experts from 14 national stakeholders (Annex 1). An informal Steering Committee of key stakeholders has been formed to guide the GPA monitoring process and to prepare the Country Report (Annex 1).

The implementation of the GPA Mechanism has been preceded by a short preparatory phase which consisted of reviewing all materials, getting necessary permissions to undertake a collaborative information sharing process including both public and private sectors, and meeting with the representative of FAO to clarify the terms of agreement and discuss and finalize a Work Plan (Annex 1) for the implementation phase.

Activities towards the establishment of the GPA Mechanism included an initial stakeholders' workshop held in May 2006, at LARI, with the objective of gaining the understanding and commitment of stakeholders in this process and initiating them to the use of the computer application for GPA monitoring. A second stakeholders' workshop was held in September 2006 at LARI, to assist stakeholders in gathering and recording information on the Reporting Format using the software.

Finally a reporting phase was carried out based on the analysis of the information provided by the participating stakeholders and recorded under the Mechanism's database, resulting in the preparation, by the Steering Committee, of this report.

CHAPTER 1

THE STATE OF DIVERSITY

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1.1 Background

The phyto-geographic position of Lebanon as a geo-centre between the three continents of the Old World makes it an exile for regional surrounding biodiversity. Despite its limited area of 10 452 km^2, 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, create the following diverse agro-ecosystems[4] (Figure 1):

- Coastal plain: It is located between the Mediterranean Sea and Mount Lebanon chain It is characterized by shallow or deep soils, winter rainfall with an annual average increasing from 650 mm in the South to 900 mm in the North, and the cultivation of subtropical fruits and various vegetable crops. About 90% of the cultivated land is irrigated.
- Fertile Bekaa plain: It is located between the two Lebanese mountain chains. It has mainly shallow soils and winter precipitations with an annual average of about 700 mm in the South and 250 mm in the North. It is cultivated with rain fed crops and where water is available, with irrigated cereals, fruits and field crops. The whole plain is suitable for mechanization.
- Akkar plain: It is located in the northern end of the western Mount Lebanon chain. It is characterized by deep soils and an average annual winter rainfall of 700-800 mm. It is cultivated with rain fed and irrigated vegetables and field crops and is suitable for mechanization.
- Medium elevation mountains (< 1 000 m): Located mainly in the western slopes of Mount Lebanon chain, these elevations have shallow to deep soils, wide and narrow terraces and valleys, and winter rainfall between 800-1 200 mm. They are cultivated with rain fed and irrigated fruit trees, vegetables, wheat and tobacco.
- High elevation mountains (> 1 000 m): Located in the western slopes of Mount Lebanon chain, these elevations are characterized by shallow to deep soils, narrow terraces and valleys, and winter rainfall and snowfall between 1 000-1 500 mm. Fruit trees mostly pome and stone fruits and vegetables are grown in this zone.
- Marginal lands: These have an annual rainfall of about 250 mm or less and are mainly located in the Hermel-Kaa region of the Northern Bekaa plain and in the Hermon mountain. Cereals, field crops and some vegetables are grown there as rain-fed crops. Where irrigation water is available, some irrigated crops can be grown. A major part of these lands is used for sheep grazing.

The above agro-ecosystems diversity allows the cohabitation of subtropical crops (annona, banana, guava) and cold requiring crops (cherry, apple) within a distance of less than 20 km.

[4] Abi Saleh B. et Safi S., 1988. Carte de la végétation du Liban. In: Ecologia Mediterranea, XIV (1/2): 123-141.

FIGURE 2
Agricultural map of Lebanon (CNRS, 2002)

1.2 The state of diversity of major crops

Major crops in Lebanon include many species corresponding to an important land occupation and a large contribution to food security in the country. They belong to cereals, tubers, fruit trees and legumes. Most of them are listed among the crops covered under the Multilateral System of the International Treaty on Plant Genetic Resources. They are presented below based on the cultivation area according to the statistics of the Ministry of Agriculture in 2004[5] (Annex 2).

Olive

The total cultivated area has been estimated to 58 531 Ha with a production of 167 300 tons. Most of the production is locally consumed, since export represents only 2.4% of the import. More then 12 varieties are currently cultivated from both local and foreign origin. The local variety denominated *Souri* (or *Baladi*) remains the most commonly planted variety and is used for olive and oil production. In collaboration with FAO, LARI is producing and promoting, through cuttings, foreign varieties such as Ascolana, Manzanilla, Picholine and Nabali. Moreover, the introduction of Syrian olive cuttings for more than ten years has led to the introduction of varieties grown in Syria such as Kaythi and Abou Ajweh. Globally the diversity of cultivated genotypes is increasing via the introduction by LARI of new foreign varieties such as Frantoio, Leccino and Pendolino. In parallel continuous efforts are undertaken to characterize and inventory the Lebanese olive diversity and to broaden the local genetic base and make it available for farmers.

Cereals

Wheat comes in the first place with a total cultivated area of 46 675 Ha and a production of 136 800 tons. Most of the consumption is covered through import and the latter is 3.5 times greater than local production. Landraces such as Hourani, Bekaii, Salamouni, Douchani, and Nabeljamal are still used in the main plains (Bekaa and Akkar) by farmers. Many improved varieties such as Lahn 2, Masarra and Stork, released through collaborative projects between LARI and ICARDA, are also cultivated. Given this continuous collaboration, new varieties well adapted to the Lebanese conditions can be released in the coming years. With the exception of Bekaii variety which is used for parboiled wheat (bourghol),

[5] Ministry of Agriculture - FAO, 2004. Global Agricultural Census in Lebanon.

varieties grown in Lebanon are commonly used for bread making as a mixture with flour of winter varieties imported mainly from Australia and USA.

Barley is the second cereal cultivated in the country (12 586 Ha, 23 800 tons) as feed crop. Its culture is located in South Lebanon and the North of Bekaa. Several improved varieties such as Rihan, Assi and Litani, released through collaborative projects between LARI and ICARDA are cultivated.

Potato

Potato is considered as the most important field crop in Lebanon. The cultivated area has increased from 14 800 Ha (281 000 tons) in 1999 to 19 532 Ha in 2004 (499 000 tons). For French fries, Spunta is still the preferred variety for consumers since many years. More recently, new imported varieties such as Lady Rosetta, Remarka and Fabula are being cultivated but are still facing difficulties to compete with Spunta. Agria is the main cultivated variety for chips industry. Recently it is also being used in households.

Currently, efforts are made to increase the number of cultivated varieties via the import of new improved varieties. The production is constrained by low profitability due mainly to the absence of a local seed production system and high production costs.

Grapes

The total cultivated area has been estimated to 10 950 Ha with a production of 109 700 tons. About 60% of it is locally consumed, while the remaining 40% is exported to the Arab countries. There are at least 30 local varieties, among these, the most famous ones are *Beytamoni, Tfayfihy* and Merwah, used for fresh consumption. Currently, grafts are locally produced. About 97 clones have been collected in the country by LARI. These are under characterization in order to sort out eventual duplications, finalize a list of cultivated varieties and make them available to farmers.

Fruit trees

Citrus ranks in the first place with orange (10 572 Ha, 234 000 tons) and lemon (3 844 Ha, 106 500 tons). About 60% of the production is locally consumed, while the remaining 40% is exported to the Arab countries. Globally, the Lebanese plantations are constituted of both traditional and improved varieties. The most cultivated varieties of orange are Hamlin, Baladi, Yafawi, Chammouti, Soukari, Mawardi, Valencia, Washington navel, Navelina, Navelate, Tarocco, Lanelate, and New Hall. Those of lemon are Ashouri, Kabbad, Semaani, Saasali, sabsabi, Eureka, Malti, Meyer, Dona, and Santa Theresa.

Apple comes in the second place (9 390 Ha, 113 300 tons). The main varieties belong mostly to the traditional Starking and Golden groups thus limiting the export to the Arab countries. An increasing number of modern improved varieties are currently being introduced from France, Italy, and recently from the USA, through nurseries and private companies. Certified plants are not yet locally produced.

Cherry is the most cultivated stone fruit in Lebanon (7 733 Ha, 30 700 tons). Plantations are located in high altitude areas (more than 1300 m) and are mainly constituted of traditional varieties such as *Ferawni, Kalbeltair, Kaws kozah, Nouwari, and Zahri*. Plants are produced locally. Fruits are used exclusively for fresh consumption and more than 40% are exported to the Arab countries. This crop is of great interest for the country since it is not competing with cherries of neighboring countries and is a luxury fruit. Currently, efforts are made to introduce modern cultivars and new well adapted rootstocks.

Apricot is also one of the major fruit crops in the country (6 251 Ha, 28 600 tons). Its culture is located mainly in the North of Lebanon and northern Bekaa. Fruits are used for fresh consumption and in jam and juice industry. Plantations are mainly constituted of traditional varieties such as Ajami, Byadi and Um Hussein. Efforts are needed to import modern varieties and those more suitable for the industry of dried fruits.

Almond culture is widely cultivated in the country (6 217 Ha, 27 500 tons). Its fruits are mostly used for fresh consumption and around 10 000 tons of dried kernels are regularly imported per year to meet the local consumption. Almond commercial orchards in Bekaa valley are constituted of one or two varieties. These varieties are characterized by an early blooming and in certain years are affected by spring frost, which causes an important decrease in national production. It would therefore be important to widen the diversity of cultivated varieties in order to maintain the sustainability of the crop.

Banana is successfully cultivated in South Lebanon (2 790 Ha, 85 600 tons) for both local consumption and export to the Arab countries. The local variety denominated *Baladi* (or *Abou Nekta*) is the most cultivated one followed by *Grande Naine*. Fruits are produced in both natural and greenhouse conditions without any phytosanitary treatment. This leads to the production of fruits with less residues in comparison with those produced elsewhere in the world and could have a great potential on the international market.

Legumes and vegetables Several vegetable crops are considered important in Lebanon namely tomato (3 104 Ha, 225 300 tons), cucumber (3 476 Ha, 159 000 tons), water melon (2 384 Ha, 85 600 tons), cauliflower (1 903 Ha, 90 500 tons), cabbage (1 368 Ha, 36 500 tons) and lettuce (1 281 Ha, 32 100 tons). Green pulses like common beans (1 762 Ha, 18 300 tons) and faba beans (1 874 Ha, 14 400 tons) are widely cultivated legumes. Plantations are mainly constituted of improved varieties that are regularly imported by seed companies.

1.3 The state of diversity of minor crops and underutilized species

With respect to the crops covered under the Multilateral System of the International Treaty on Plant Genetic Resources, some crops are completely absent in Lebanon as they are not endemic (i.e. triticale), not adapted to the Lebanese conditions or not included in the culinary traditions of the Lebanese consumers (i.e. coconut, yams).

Many of the crops falling under the Multilateral System of the International Treaty on PGRFA are considered as minor crops due to their low contribution in land occupation and food security. The final product is regularly imported to meet the local needs consumption. They are presented below based on their cultivation areas according to the statistic of the Ministry of Agriculture in 2004[2] (Annex 2).

Concerning cereals, maize has been recently introduced in the country particularly for feed crop and human consumption (12 586 Ha, 23 800 tons) by using improved varieties. Its culture is located in the Bekaa valley but remains limited mainly because of the lack of mechanization and its exigency in irrigation. Efforts to introduce sunflower culture failed to promote this crop and this is essentially due to the lack of oil industry in the country. Official available data is limited.

Leguminous are considered as minor crops. The most cultivated ones are chick pea (1 810 Ha, 1 500 tons) followed by beans (479 Ha, 700 tons), lentils (712 Ha, 600 tons) and green pea (828 Ha, 4 600 tons). Both traditional and improved varieties are used. The local consumption is covered through import and the latter is 3.5 times greater than local production.

Regarding fruit trees, many crops well adapted to Lebanese conditions lack sufficient exploitation but represent a potential for local and regional markets. Their culture is generally neglected and localized in marginal lands or scattered at the periphery of the orchards. This is mainly the case of fruit crops such as pinus, walnut, pomegranate, fig, carob and pistachio. As for the newly introduced subtropical crops such as avocado and annona, they are expected to progressively increase their relative importance in the littoral zone for both local and export markets.

Sugar beet has been subsidized by the Government and thus widely cultivated for years. With the suppression of its subsidy in the late nineties, its cultivation area experienced a sudden and sharp decrease from 7 000 Ha in 1999 to 1 156 Ha in 2004.

Most of the minor crops cited above are neglected by the scientific research and the national programs. They are less and less cultivated by farmers and local communities. Most of these crops failed to be competitive due to the lack of mechanization, lack of selection efforts, poor seed production and limited adaptability to prevailing conditions. In addition, the absence of extension and orientation programs from the public sector is leading to abnormal situations and trends and is consequently diminishing or minimizing the importance of these crops.

1.4 The state of diversity of wild harvested plants for food

Numerous species are harvested from the wild and used as food including aromatic plants, spices, condiments and flavors. Official available data is limited.

These species are absent from the priority agenda of the relevant Ministries. Nevertheless, they gain more and more importance in development projects related to agriculture such as those launched by NGO's. In this context, studies on selected areas conducted in collaboration with international institutions (IPGRI, CEDRE, IBSAR) showed that hundreds of species are used for food and have a potential for cultivation. Numerous species are at the same time edible, aromatic and medicinal.

Wild harvested plants fill a food supply gap during the food shortage periods mainly in winter. Moreover they are considered as a source of revenue for women and as a factor for poverty alleviation.

The main group of edible species is the group of leafy vegetables used as salads and as cooked and snack food. Among these, most important genera are *Cichorium*, *Eryngium and Scorzonera.*

The second large group is the group of aromatic plants used as condiments, spices and flavors. It is made up of species belonging mainly to the *Lamiaceae* family[6]. These species are important for the country because of their close relationship to its ethno-botanical heritage, local food habits and to their cultural and nutritional value particularly during food shortage periods. Lebanon's ethno-botanical heritage is threatened by the rural exodus, life style changes, ready-to-use product imports, and globalization. In addition, harvesting activities without any consideration for natural regeneration are generating threats on the wild populations.

All these constraints have been the driving force for the domestication efforts of representative species such as *Origanum syriacum*, *Salvia fruticosa*, *Gundelai tournefortii*, *Cichorium* sp., *Malva* sp. and *Capparis spinosa*. Wild species domestication could also provide opportunities for increasing farmers' income and crop diversification.

A successful example of wild species domestication is the case of *Origanum syriacum*. Recently, this species has become an interesting crop in many areas of Lebanon mainly in the South basically as an alternative to replace the unsustainable subsidized cultivation of tobacco.

The third neglected group is the group of wild fodder plants comprising around 69 species belonging mainly to the *Poaceae* and the *Fabaceae* families. Efforts for the enrichment of the range land flora in fodder plants with species such as *Medicago*, *Trifolium* and *Vicia* showed promising results[3].

Recently, efforts to promote the *in situ* conservation of useful wild species and their sustainable use have been undertaken by few projects that covered species of *Aegilops, Allium, Centaurea, Gundelia, Hordeum, Lathyrus, Lens, Malva, Medicago, Pistacia, Prunus, Pyrus, Trifolium, Triticum* and *Vicia.* Lately, new markets for "Baladi" (local) products and fairs for diversity rich products are slowly gaining place.

More efforts are needed for diversity assessment, seed distribution, valorization of ethno-botanical heritage and associated use of useful wild plants and marketing. Another central point that has been neglected and which requires more attention is the study of the ethno-pharmacology properties of the local medicinal plants of traditional use such as *Capparis* species.

1.5 Surveying and inventorying PGRFA

PGRFA surveying and inventorying activities in Lebanon has been rather neglected. Only two references are available[7],[8] in this regard. As a result, cultivated varieties have not been comprehensively inventoried throughout the country, nor exists systematic studies about their distribution, market or seed system.

No mechanisms are set in place for assessing genetic erosion as its monitoring is not yet considered as a high priority in the country.

Only in recent years, there has been a growing awareness among relevant institutions and scientists about the importance of surveying and inventorying plant genetic resources. This has resulted in a few projects carried out by the Ministry of Environment to monitor and assess the diversity in Natural Reserves, as well as by LARI, the GEF/UNDP Agrobiodiversity Project-Lebanese component[9] (1999-2005) which identified three main priority areas located in the semiarid zone of Bekaa valley and experiencing a quick loss in their agrobiodiversity.

Other efforts in this regard have been undertaken mainly as research activities by universities, public institutions and NGO's. Among these is the certification project executed by LARI which aimed at performing clonal selection and pomological description of stone fruits and grapevine.

Despite these research activities, several areas in Lebanon have never been surveyed due to the constraints mentioned above. The same applies for a number of important crops, including *Citrus*.

1.6 The main factors affecting the state of diversity

Despite the modest surveying and inventorying practice, which prevents a rigorous assessment of dynamics in the state of diversity, a number of threats are endangering PGRFA in Lebanon and are contributing to their genetic erosion.

Among the main factors threatening PGRFA diversity figures the replacement of traditional and genetically diversified farming systems by modern large scale homogenous ones. The tendency of farmers to adopt one or two cultivars makes

[6] Ministère de l'Agriculture Libanaise, 1996. Programme des Nations Unies pour l'Environnement. Etude de la Biodiversité du Liban.
[7] Post G E and Dinsmore J E, 1933. Flora of Syria, Palestine and Sinai. American Press. Beirut
[8] Mouterde P., 1966. Nouvelle Flore du Liban et de la Syrie. Imprimerie Catholique, Beyrouth
[9] Assi R et.al. 2005. Conservation and sustainable use of Dry Land Agro-Biodiversity in the Near East, Final Report of the Lebanese Component. http://www.lari.gov.lb/agrobio/documentation.asp

the future of crops more vulnerable especially in case of climatic variations or occurrence of new diseases. For instance, in the Bekaa valley, all almond commercial orchards are constituted of one or two varieties which are characterized by an early blooming and are consequently susceptible to spring frost. This explains the observed decrease in national production of almonds during certain years.

Other factors affecting the state of diversity include urbanization, fires, agricultural systems intensification and expansion, over-exploitation, over harvesting and overgrazing (the latter two factors are mainly observed in upper highlands domain of endemic plants).

Market trends are also pushing towards the introduction of new improved and more marketable varieties leading to the disappearance of varieties having no competitive market traits.

In addition, activities undertaken by the Ministry of Agriculture under the Green Plan Program and initially aiming at the rehabilitation of marginal lands constitute an additional pressure since sometimes these destroy diversity rich forests in order to establish unsustainable or non competitive agriculture. Another example is the introduction of annual crops in the weak agro-ecosystems of northern Bekaa where adapted flora is destroyed. An increased salinity is expected in the near future and could eventually lead to land abandonment without any chance of recovery of the original wild cover.

This situation is even worsened by national rules and legislation which neglect and discourage cultivation of local varieties and traditional species.

Finally, the poor awareness among decision makers about the real dangers of PGRFA loss, together with the lack of skilled personnel, appropriate technology and financial resources are all responsible for the absence of a monitoring system for genetic erosion assessment.

1.7 Needs and priorities

1.7.1 For a better understanding of the roles and values of PGRFA

The value of agro-biodiversity is not easy to estimate. Besides the direct economic value, the indirect environmental, ecological and cultural landscape values and which are of high importance to eco-tourism need to be determined.

For a better understanding of the role and values of PGRFA diversity, species and varieties of potential interest should be prioritized and promoted for sustainable use and conservation.

Local traditional knowledge spread through public awareness programs and training activities among key actors of the civil society such as women, teachers, or teenagers. Exhibitions including awards for the best traditional dish, the most diverse table, the widest know-how and the most diverse home garden are different ways of communicating the message to civil society actors. Restaurants and food processing industries dealing with local traditional food recipes can be supported as well.

At the level of farmers, awareness campaigns are needed in order to prioritize the conservation of local varieties and landraces. Also, assistance should be provided to allow many small scale farmers in marginal environments to sustainably use PGRFA.

1.7.2 For a better monitoring of PGRFA

Monitoring PGRFA is essential for their conservation and for taking appropriate measures to prevent or limit genetic erosion. In this regard, there is an urgent need to develop indicators and early warning systems to monitor genetic erosion.

It is also important to expand the existing PGRFA surveying and characterization efforts for both local and imported varieties and to develop appropriate documentation systems.

This can be achieved by using advanced techniques, strengthening skills, and ensuring sufficient and sustainable financial resources. Relevant fields such as plant taxonomy, GIS mapping, breeding, molecular tools, and public awareness should be covered.

1.7.3 For a better conservation of PGRFA

For a better conservation of PGRFA, it is imperative to develop a national PGRFA conservation strategy addressing monitoring, *in situ* and *ex situ* conservation and promotion activities. Funds should be allocated in this regard.

At the institutional level, more efforts should be provided regarding the development and most importantly, the implementation of legislations related to PGRFA conservation.

The proposed conservation actions above will be exposed in more details in the subsequent chapters of the report.

CHAPTER 2

THE STATE OF *IN SITU* MANAGEMENT

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2.1 Major initiatives in Lebanon during the past decade

Many projects were implemented during the past decade tackling *in situ* conservation and sustainable use of biodiversity, including PGRFA. These projects include:

- The Protected Areas Project entitled "Strengthening of national capacity and grassroots *in situ* conservation for sustainable biodiversity protection" (MoE/UNDP/GEF; 1996-2005), which was considered as a major milestone for conservation efforts in Lebanon, promoting importance of *in-situ* conservation among decision makers and the public;
- The "Conservation of wetlands and coastal zones in the Mediterranean- MedWetCoast" Project (MoE/UNDP/FFEM; 2002-2006);
- The "Integrated management of cedar forests" Project (MoE/AUB/UNEP/GEF; 2004-2007);
- The "Stable institutional framework for protected areas management- SISPAM" Project (MoE, EC LIFE; 2004-2007);
- The "Conservation and sustainable use of dryland Agrobiodiversity" (LARI/UNDP/GEF; 1999-2005);
- The "Sustainable use of natural resources Project (Private Initiatives/IBSAR; 2004-2006);
- The "Wild edible plants: Promoting dietary diversity in poor communities of Lebanon" Project (IDRC/AUB; 2004-2006).

In addition, the Ministry of Environment has executed the national part of a PDF–B (Project Development Funds) regional project entitled "Design, testing and evaluating of best practices for *in situ* conservation of economically important wild species" funded by GEF and coordinated by FAO. Wild plant species of economic importance (such as medicinal and aromatic species), their locations and diversity sites were identified in natural or semi-natural habitats and in traditional farming systems. The regional proposal for the full project was finalized by FAO late 2005.

2.2 Conservation and management of PGR through protected areas

Concern for *in situ* conservation and management of genetic resources, including PGR, has increased in Lebanon over the recent years. This is reflected by an increase in the number of protected areas spread across the country. Seven Nature Reserves were established between 1992 and 1999 through laws issued by the parliament in Lebanon: "Horsh Ehden" Nature Reserve (Law 121, date 9/3/1992), "Palm Island" Nature Reserve (Law 121, date 9/3/1992), "Shouf Cedars" Nature Reserve (Law 532, date 24/7/1996), "Tyre Coast" Nature Reserve (Law 708, date 5/11/1998), "Bentael" Nature Reserve (Law 11, date 20/2/1999), "Yammouni" Nature Reserve (Law 10, date 20/2/1999), and "Tannourine Cedars" Nature Reserve (Law 9, date 20/2/1999). 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 km^2, 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. 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

85 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[10].

In 2001, a preliminary inventory of flora was conducted in the "Yammouneh" Nature reserve located in the Beqa'a area within the project "Income generation through sustainable use of natural resources in Yammouneh" funded by the Global Environment Facility (GEF). Later, assessments of flora in four reserves ("Shouf Cedars", "Horsh Ehden", "Palm Islands" and "Tyre Coast") were conducted in 2004 within the contest of the Protected Areas Project. The assessments included an inventory of the species with identification of threatened, rare and endemic species. The assessments revealed the presence and diversity of wild relatives of globally significant crop species such as wheat, barely, onion/garlic, and several legumes and fruit trees species particularly in "Shouf Cedars" and "Horsh Ehden" reserves.

2.3 Conservation and management of PGR outside protected areas

The involvement of land users as primary participants is fundamental to *in situ* conservation and management of PGR outside protected areas. The project on "Conservation and sustainable use of dryland Agrobiodiversity in Lebanon" (hereafter referred to as the Agrobiodiversity Project), a component of a regional project including Jordan, the Palestinian Authority and Syria, aims at promoting *in situ* and on-farm conservation of landraces and wild relatives of important field crops, food and forage legumes and fruit trees species originating in the region through the direct participation of the local farming and rural communities. Focus was given to target crops (or crop groups) of global significance for food and agriculture, all of which originated in the Near East or Central Asian region. Both wild relatives and landraces/local varieties of the selected crops were targeted by the project. The project was funded by the Global Environment Facility (GEF), managed by the United Nations Development Programme (UNDP), and executed by the Lebanese Agricultural Research Institute (LARI). The International Center for Agricultural Research in the Dry Areas (ICARDA) was responsible for the regional coordination of the project and technical backstopping in cooperation with ACSAD and IPGRI. The project started in June 1999 for a period of five years, and was extended for an additional year.

Target crop species within the project sites in Lebanon included wheat (wild *Triticum* and *Aegilops* sp.; landraces), barley (*Hordeum spontaneum*; landraces), lentil (wild *Lens* sp.; landraces), vetch (wild *Vicia* sp.), wild *Lathyrus* sp., wild *Medicago* sp., wild *Trifolium* sp., apricot (local varieties), cherries (local varieties), almond (wild *Prunus* sp.; local varieties), pear (wild *Pyrus* sp.; local varieties), pistachio (wild *Pistacia* sp.; local varieties), fig (local varieties), and onion/garlic (wild *Allium* sp.; local varieties).

The selection of the project sites was undertaken with the aim to capture the maximum genetic diversity of the target species in the minimal number of areas possible. The project sites were therefore selected to cover the widest possible range of topography, climate and species concerned. Three sites were selected by the project: "Ham and Maaraboun", with an approximate area of 35 km^2; "Nabha" and surrounding, with an approximate area of 45 km^2; and "Aarsal", with an approximate area of 300 km^2.

The project conducted agro-ecological and eco-geographic studies, as well as socio-economic, indigenous knowledge, and botanical surveys in the project sites[2]. Twenty two monitoring areas high in diversity of target species were selected within the project sites for the botanical surveys. Annual surveys were conducted in most monitoring areas for herbaceous species (years 2000, 2001, 2002, 2003 and 2004); while for wild fruit trees, the surveys were conducted mainly in the years 2000 and 2003.

The status and trends of wild relatives found in natural habitats was determined through analyzing the results of the eco-geographic and botanical surveys in the monitoring areas within each project site. GIS tools were also used, including land cover maps in the project sites for 1962 and 2000, allowing some analyses of how Agrobiodiversity has changed over the past decades.

[10] Ministry of Environment-UNDP, 2005. Third Country Report to CBD

Based on these studies, a comprehensive report "Overview of the status of Agrobiodiversity and the factors affecting its conservation in the project sites" was prepared. The frequency and abundance of the wild relatives of both field crops and fruit trees, and that of the rangeland and pasture species (e.g., *Lathyrus*, *Medicago*, *Vicia* and *Trifolium* sp.), were adversely affected by overgrazing and land reclamation (mainly for planting high cash-value trees), and the conversion of community lands to private ownership. This degradation is likely to cause severe loss of crop wild relative populations and species in the long run.

The results of the botanical surveys indicated that "Aarsal", with drier ecosystems compared to the other project sites, has less number of plant species. "Nabha" is exceptionally rich in non target as well as target species. "Ham/Maaraboun" site has 14 target fruit tree species and the other two sites have 12 species. Around 4 *Prunus*, 3 *Amygdalus*, 2 *Crateagus* and 2 *Pistachia* species are found in these project sites. Large population of *Pyrus syriaca* is found in "Aarsal" and large population of *Prunus ursina* is found in "Nabha". For herbaceous species, large number of target species is found in "Nabha" monitoring areas including 12 *Trifolium*, 9 *Aegilops*, 7 *Vicia* and 5 *Hordeum* species. *Triticum dicoccoides*, *T. urartu* and *T. boeoticum* species are found in "Ham" at an altitude exceeding 1800m (asl) but only *T. dicoccoides* is found in the other sites. Several *Aegilops* species are found in the three sites. One *Lens* wild species is found at "Aarsal" and "Nabha" monitoring areas but with very low density and frequency. Few *Lathyrus* species are found in "Ham/Maaraboun" and "Nabha" and 2-7 species of *Vicia* are recorded in the three sites. *Allium* species are rare.

Management plans were developed for two selected sites rich in diversity of targeted species within the project sites of "Aarsal" and "Nabha". They were designed to ensure the maintenance or enhancement of the genetic diversity of the target taxa within the sites (along with key associated species), to promote the general conservation of biodiversity and minimize external threats, to maintain the evolutionary processes of the target taxa within their natural habitats, to promote public awareness for the need of genetic reserve for conservation of Agrobiodiversity, and to be considered as a model for similar ecosystems. Efforts should be made to follow up and implement these plans.

Researchers from the American University in Beirut (AUB) carried out survey and characterization of almond (*Amygdalus* sp.) germplasm in Lebanon from 1995-1997. The survey was conducted throughout Lebanon and collections were made from both wild and cultivated habitats. Eco-geographic surveys were conducted and morphological characterization of leaves and nuts was performed. In addition, the identified species were characterized using the RAPD technique. The results indicated that three species (*Amygdalus communis*, *Amygdalus orientalis*, and *Amygdalus korschinskii*) could be found in Lebanon. Others studies conducted by researchers at AUB included "Surveying and characterization of pistachio (*Pistacia* sp.) germplasm in Lebanon", "Assessing the genetic diversity of *Ceratonia siliqua* in Lebanon", and "Characterization and evaluation of the biological diversity (threats and management practices) of *Pinus pinea* in Lebanon".

Two joint studies were conducted on wild *Brassicaceae* species in Lebanon by researchers from the University Saint-Esprit Kaslik and LARI: The first one on "Characterization, ecology and domestication of useful wild *Brassicaceae* of Lebanon" (2006-2007); the second one entitled "Collection of natural *Brassicaceae* populations in Lebanon" (2005-2008). Other studies conducted by the department of Plant Biotechnology at LARI included "Morphological characterization of diversity within *Prunus* genus in Beqa'a area" (1997-1998) and "Phenotypic diversity and morphological characterization of *Capparis spinosa* L. in Lebanon" (2002-2003).

University students were supported by the Agrobiodiversity Project to conduct research studies in areas related to wild relatives of targeted crops within their natural habitats. The studies included "Characterization of wild *Triticum* and *Aegilops* species in North Beqa'a" (2001), "Assessing potential uses of wild fruit trees in Northern Drylands of the Beqa'a" (2002), "Genetic variability in wild *Triticum* and *Aegilops* species from Baalbeck and Aarsal Regions" (2000), "Analysis of the relationship between the landscape physical components and cereal wild relatives in the Baalbeck region" (2002), and "Chemical composition and nutritional value of some targeted wild fruit trees" (2005).

The Agrobiodiversity Project supported Aarsal Rural Development Association (ARDA), a local NGO in "Aarsal", in establishing a local nursery for the production of around 10,000 seedlings/plantlets per year of targeted wild and local varieties of fruit trees. For four consecutive years, the nursery produced a total of around 36,000 seedlings of targeted wild fruit trees species, which were distributed to around 200 farmers and used in the reforestation activities in the area.

The project conducted a workshop for farmers and NGOs in 2000 on "Importance of indigenous plant genetic resources in sustainable agriculture". The objectives of the workshop were to increase awareness of the communities working with the project on the importance of indigenous crops and the corresponding indigenous knowledge and to link the farmers in these different communities together by making them aware of their common problems, constraints and strength. Also, the project organized in 2002 a short training course for technicians on *in-situ* conservation covering areas such as establishment of corridors, strips, and uncultivated patches, plant identification, herbarium specimen preparation, methodology of monitoring and selection of habitat strips. Several other trainings and workshops were conducted for

local communities and researchers in areas related to *in-situ* conservation and sustainable use of PGR, benefiting more than 800 individuals.

The Agrobiodiversity Project also used different kinds of public awareness methods ranging from participatory approach to mass media to bring about substantial positive changes in the attitude and behavior of communities, contributing to the strengthening of *in-situ* and on-farm conservation of Agrobiodiversity. Also, the project supported the establishment of a Public Awareness Unit at LARI, which aims at sustaining public awareness activities on values and importance of Agrobiodiversity and its conservation and exposing visitors, including students, to the principles of Agrobiodiversity.

Finally, the Agrobiodiversity Project investigated actions for involving local communities in conservation and sustainable use of wild relatives and local varieties/landraces through demonstration of opportunities for alternative sources of income. These activities included supporting agro-food processing particularly products from targeted wild relatives and local varieties, promoting eco-tourism and organic farming especially in "Ham/Maaraboun", training on honey production and introduction of medicinal plants. The promise of alternative livelihood approaches for encouraging conservation and sustainable use of wild relatives and local varieties was a major outcome of the project. Local groups were very interested and involved in activities that would generate additional income while ensuring sustainability of natural resources.

2.4 On-farm management and improvement of PGRFA

The Agrobiodiversity Project assessed the status of landraces/local varieties of target crops in Lebanon through on-farm surveys conducted at the community level within three sites. The results of these studies showed that these areas are experiencing quick loss in Agrobiodiversity. Food demands and market forces have encouraged the replacement of the locally adapted varieties of both fruit trees and field crops with higher-yielding cultivars, resulting in a significant decline in the gene pools of these crops. Few landraces are still used by local farmers namely those of wheat, barley, grape, fig, lentil, and chickpea. Although intensity of using local varieties is the highest for wheat, barley, chickpea, lentil, and grape, these species have experienced a noticeable decrease in the area planted as indicated in the analysis of the on-farm socio-economic survey conducted late 2004. While the major factor affecting the use of local varieties of fruit trees is their replacement with improved varieties, the major factor reducing the area of field crops landraces is the introduction and expansion of improved varieties of fruit trees.

Surveys and inventories of wheat varieties grown in Lebanon (landraces, improved and introduced varieties) were carried out by the Plant Breeding Department at LARI in 1999. The department at LARI conducted also several studies on improvement of landraces yield of cereals and legumes. Support was provided by the Agrobiodiversity Project to university students in areas related to targeted crops landraces/local varieties. The studies included "Morphological and genetic assessment of bread wheat landraces collected from Baalbeck Caza" (2002), "Evaluation of wheat landraces for stripe rust resistance and some agronomic traits" (2001), "Evaluation of foliar and seed-borne diseases of wheat and barley landraces in Nabha" (2002), "Evaluation of wheat landraces mixtures reactions to stripe rust progress under field conditions" (2003), "Evaluation of new mixtures in wheat and barley landraces (2003), and "Preliminary studies on diversity of figs (*Ficus carica*) in Lebanon" (2004).

Characterization of local almond (*Amygdalus communis*) varieties in Lebanon was carried out by AUB researchers from 1997-1999. The results of the survey revealed that seventeen almond varieties are currently cultivated throughout Lebanon. The most popular local varieties, "Aouja", "Teliani", "Helouani", "Melkani" and "Nahali", were further characterized both at the morphological and the molecular level. Other studies on local varieties conducted by AUB researchers included "Germplasm characterization and climatic zoning for viticulture in Lebanon", "Evaluation of cucurbit germplasms for resistance to cucurbit yellow stunting disorder virus CYSDV", and "Morphological and genetic characterization of local olive (*Olea europea* L.) varieties in Lebanon" (2002-2004).

Several experiments were undertaken by the Agrobiodiversity Project to demonstrate to the farmers the effect of seed cleaning and treatment on yield improvement of landraces. In this respect, seed bulks of wheat and barley were collected from several farmers from each targeted community. The seeds were cleaned and treated at LARI and returned to the farmers to be planted under the local field conditions next to the same seed lots that were neither cleaned nor treated to show to the farmers the differences in terms of yield. The project also supported ARDA, a local NGO in the project site of "Aarsal", in establishing a seed-cleaning unit. The unit, through the support of the project, has distributed around 10 tons of cleaned and treated landraces seeds of wheat, barley, lentil and chickpea to more than 70 farmers in the project sites.

The local nursery established in "Aarsal" for the production of seedling/plantlets of wild and local varieties of targeted fruit trees crops has also produced around 4,500 plantlets of local varieties of figs, grapes, apricots, pears, almonds, and plum. These were distributed to local farmers within the Agrobiodiversity Project Sites.

2.5 Major needs for improving *in situ* management of PGRFA

- Successful initiatives started by the Agrobiodiversity Project should continue. It is critical to build on the momentum generated by the project;
- The Ministry of Agriculture is in need of capacity building to effectively monitor activities as well as natural catastrophes within the protected forests;
- Shortage of human resources exists in the Ministry of Environment supervising the Nature Reserves;
- There is an urgent need at the national level to develop national expertise in key areas related to nature conservation especially in Taxonomy;
- Financial resources are insufficient at responsible ministries and state agencies;
- Awareness raising on the importance of PGR in Lebanon should target decision-makers;
- Institutional coordination should be enhanced;
- The Protected Areas system does not well reflect the main habitats, geological features, and species occurring in Lebanon. New protected areas should be established and the Protected Areas System should be strengthened to become more efficient and representative of the main habitats and regions of the country, especially those rich in wild crop relatives;
- Studies and activities are conducted in certain protected areas where internationally funded projects exist. Similar studies are lacking for the remaining protected areas in Lebanon;
- Mechanisms should be developed, including integrated systems of incentives, to encourage cultivation of local varieties and landraces and to promote alternative livelihoods, which result in sustainable use of wild crop relatives and genetically broad-based landraces/local varieties;
- Despite of all the existing laws and regulations, the main problem in Lebanon remains the lack of law enforcement;
- Systematic and nation wide monitoring system is lacking. No national database or proper coordination exist between different stakeholders;
- Integrated land use planning is weak and often non-existent;
- No mechanism exists to facilitate rapid acquisition, multiplication, distribution and cultivation of germplasm in case of disaster situations;
- A national strategy for the restoration of degraded ecosystems should be developed.

CHAPTER 3

THE STATE OF *EX SITU* MANAGEMENT

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Many collections have been made from the Lebanese flora through several activities related to wild species, cereals and fruits. They cover:

- Collections handled by LARI in Lebanon
- Collections located in international organizations or institutions (CGIAR Centers, Kew Gardens…).

3.1 The state of collections in Lebanon

The collection of PGRFA in Lebanon started fifty years ago, covering mainly the traditional landraces of wheat and barley. During the period 1992-1994, with the collaboration of ICARDA, LARI collected the wild wheat relatives and forage from Bekaa valley. The collected accessions are conserved at ICARDA genebanks (Table 1).

TABLE 1

Species and number of accessions from Lebanon stored at CGIAR (ICARDA) genebanks

Species	No. of accessions	Species	No. of accessions	Species	No. of accessions	Species	No. of accessions
Aegilops biuncialis	40	*Lotus ornithopodioide*	2	*Setaria italica*	33	*Ornithopus* sp.	1
Aegilops caudata	17	*Lupinus* sp.	1	*Solanum melongena*	1	*Panicum miliaceum*	1
Aegilops columnaris	22	*Lycopersicon esculentum*	2	*Sorghum bicolor*	360	*Pennisetum glaucum*	108
Aegilops cylindrica	4	*Medicago aculeata*	37	*Trifolium affine*	3	*Phaseolus coccineus*	1
Aegilops geniculata	43	*Medicago blancheana*	7	*Trifolium alexandrinum*	1	*Phaseolus vulgaris*	57
Aegilops peregrina	23	*Medicago constricta*	6	*Trifolium argutum*	6	**Genus subtotal**	**168**
Aegilops searsii	3	*Medicago coronata*	10	*Trifolium arvense*	1	*Trigonella coelesyriaca*	2
Aegilops speltoides	3	*Medicago disciformis*	1	*Trifolium aureum*	1	*Trigonella filipes*	2
Aegilops triuncialis	35	*Medicago intertexta*	8	*Trifolium boissieri*	4	*Trigonella spicata*	4
Aegilops umbellulata	5	*Medicago littoralis*	11	*Trifolium bullatum*	9	*Trigonella spinosa*	1
Aegilops vavilovii	14	*Medicago lupulina*	4	*Trifolium campestre*	35	**Genus subtotal**	**9**
Genus subtotal	**209**	*Medicago minima*	26	*Trifolium caudatum*	1	*Triticosecale* sp.	9
Aeluropus littoralis	1	*Medicago monantha*	1	*Trifolium cherleri*	7	*Triticum aestivum*	43
Allium sativum	1	*Medicago monspeliaca*	4	*Trifolium clusii*	3	*Triticum monococcum*	9
Astragalus hamosus	5	*Medicago murex*	1	*Trifolium clypeatum*	7	*Triticum secale*	4
Capsicum annuum	3	*Medicago muricoleptis*	1	*Trifolium dasyurum*	6	*Triticum turgidum*	112
Cicer arietinum	47	*Medicago noeana*	1	*Trifolium eriosphaerum*	3	*Triticum urartu*	16
Cicer pinnatifidum	1	*Medicago orbicularis*	27	*Trifolium fragiferum*	1	**Genus subtotal**	**193**
Genus subtotal	**58**	*Medicago polymorpha*	46	*Trifolium glanduliferum*	2	*Vicia ervilia*	1
Coronilla scorpioides	2	*Medicago praecox*	8	*Trifolium haussknechtii*	2	*Vicia faba*	36
Dactylis glomerata	2	*Medicago radiata*	3	*Trifolium hirtum*	3	*Vicia hybrida*	1
Hippocrepis unisiliquosa	4	*Medicago rigidula*	25	*Trifolium isthmocarpum*	1	*Vicia mollis*	2

Species	No. of accessions	Species	No. of accessions	Species	No. of accessions	Species	No. of accessions
Hordeum vulgare	52	*Medicago rotata*	12	*Trifolium lappaceum*	7	*Vicia narbonensis*	37
Hymenocarpus circinatus	10	*Medicago rugosa*	6	*Trifolium nigrescens*	2	*Vicia palaestina*	3
Lathyrus gorgoni	1	*Medicago sativa*	104	*Trifolium pauciflorum*	1	*Vicia peregrina*	3
Lathyrus hierosolymitanus	2	*Medicago scutellata*	2	*Trifolium pilulare*	12	*Vicia sativa*	9
Genus subtotal	**73**	*Medicago* sp.	2	*Trifolium purpureum*	16	*Vicia* sp.	1
Lens culinaris	84	*Medicago tornata*	3	*Trifolium repens*	3	*Vicia villosa*	1
Lens ervoides	15	*Medicago truncatula*	71	*Trifolium resupinatum*	19	**Genus subtotal**	**94**
Lens orientalis	4	*Medicago turbinata*	2	*Trifolium scabrum*	19		
Genus subtotal	**103**	**Genus subtotal**	**434**	*Trifolium scutatum*	11	*Vigna unguiculata*	2
Melilotus indica	1	*Pisum sativum*	3	*Trifolium* sp.	1	*Zea mays*	7
Melilotus sulcata	1	*Scorpiurus muricatus*	1	*Trifolium speciosum*	1		
Onobrychis crista-galli	6	*Scorpiurus sulcata*	3	*Trifolium spumosum*	6		
Onobrychis sp.	1			*Trifolium striatum*	1		
				Trifolium tomentosum	14		
Genus subtotal	**9**	**Genus subtotal**	**7**	**Genus subtotal**	**603**	**Total**	**1 969**

Source EURISCO (2007)

On the other hand, around 355 Lebanese accessions of wild and cultivated species are currently stored in European genebanks (Table 2).

TABLE 2
Species and number of accessions from Lebanon stored in European genebanks

Species	No. of Accessions	Species	No.of Accessions	Species	Number of Accessions
Aegilops markgrafii	2	*Hordeum vulgare*	5	*Triticum dicoccoides*	17
Avena barbata	2	*Hyoscyamus niger*	1	*Triticum dicoccon*	1
Avena fatua	1	*Lens culinaris*	19	*Triticum durum*	7
Avena ludoviciana	7	*Lolium rigidum*	9	*Triticum monococcum*	11
Avena sterilis	33	*Lolium* sp.	57	*Triticum* sp.	20
Cicer arietinum	6	*Lupinus albus*	4	*Triticum turgidum*	7
Citrullus sp.	1	*Lycopersicon esculentum*	1	*Triticum urartu*	38
Cucumis melo	1	*Medicago orbicularis*	1	*Vicia faba*	14
Cucumis sativus	4	*Phaseolus vulgaris*	3	*Vicia narbonensis*	14
Cucurbita pepo	6	*Pisum sativum*	5	*Vicia sativa*	2
Dactylis glomerata	1	*Pisum* sp.	1	*Vicia* sp.	1
Dactylis sp.	14	*Prunus avium*	1	*Vicia ervilia*	6
Daucus carota	3	*Solanum lycopersicum*	3	*Vitis vinifera*	1
Elymus panormitanus	1	*Trifolium purpureum*	1	*Zea mays*	2
Eruca sativa	1	*Triticum aestivum*	15		
Faba bona	1	*Triticum araraticum*	1	**Total**	**355**
Hordeum murinum	1	*Triticum baeoticum*	2		

Source EURISCO (2007)

Regarding fruit species, field gene banks were established at LARI (Table 3). The main crops are olive, grape, stone fruits and citrus species. In addition, local nurseries host a large number of fruit species and could be considered as *ex situ* collections. Many subtropical fruits, grapes and citrus exist in many private nurseries in various parts of Lebanon and olives plants are available in both LARI and seed companies.

TABLE 3
Fruit trees species conserved *ex situ* at LARI stations

Species	Number of varieties	Type of conserved varieties
Olea europaea	32	Local accessions and advanced cultivars
Vitis vinifera	40	Local accessions and advanced cultivars
Prunus domestica	32	Advanced and improved cultivars
Prunus armeniaca	24	Advanced and improved cultivars
Prunus avium	21	Advanced and improved cultivars
Prunus persica	17	Advanced and improved cultivars
Prunus dulcis	12	Advanced and improved cultivars
Prunus persica	11	Advanced and improved cultivars
Ficus carica	28	Local accessions
Citrus sp.	69	Advanced and improved cultivars
Vitis sp.	32	Traditional accessions and improved cultivars
Total	**318**	

Long-term conservation of seeds is applied to around 1 000 Lebanese wild species at both LARI (-18C) and the Royal Botanic Gardens (-25C) (Table 4). In addition, seeds of cultivated wheat, barley, lentils, chick pea and vicia are conserved as *ex situ* collections at LARI (Table 4) and are regularly regenerated every five years.

In vitro facilities are already available but no conservation activity has been achieved in this regard yet.

TABLE 4
Some PGRFA stored at LARI and Kew Gardens

Species	Number of accessions
Triticum durum and *T. aestivum*	51 (Only at LARI)
Hordeum sp.	30 (Only at LARI)
Vicia sp.	9
Trifolium sp.	4
Lathyrus sp.	2
Medicago sp.	4
Prunus sp.	12
Pyrus sp.	7
Rosa sp.	13
Crataegus sp.	5
Brassica sp.	3
Daucus sp.	2
Total	**142**

It can be concluded from Tables 3 and 4, that national *ex situ* conservation efforts are too limited if compared to the richness of Lebanese Flora (about 2 607 species) and to the amount of germplasm from Lebanon conserved outside the country (Tables 1 and 2). Much work is still needed to collect, identify, test and qualify this wide array of plants.

Regarding genetic resources of forest trees, some accessions of the coniferous species such as *Cupressus sempervir*ens L., *Pinus halepensis* Miller and *Cedrus libani* Rich. are conserved *ex-situ* at INRA France. *Cedrus libani* undoubtedly is the most important forest tree in the country. It is the symbol of the nation. Its collected accessions have been characterized and evaluated for several traits and crossed with *Cedrus atlantica*, the hybrid of which expressed heterosis for several traits.

The establishment of *ex situ* collections is limited by multiple constraints due mainly to the absence of a national action plan. Thus, regional and international support are needed to ensure the sustainability of existing collections and

to establish new collections based on both field and seed gene banks, and cryo-preservation techniques. Such support should provide funding for building human resources capacity and adequate equipments.

3.2 Security of stored material

The best technical facilities for storing genetic resources are either partly available under difficult operational conditions or not available at all. Seeds are stored in glass bottles in freezers. Vegetatively propagated plants need specialized storage conditions, qualified personnel to keep up with the specific requirements of storage and continuous care.

Proper long storage facilities available at ICARDA and Kew Garden host a sizeable amount of entries which could serve the objectives of dry land development programs.

Collections made on wild wheat species and wild relatives of wheat collected from Lebanon and stored at ICARDA could contribute to staple food production and could constitute the basic elements in the forage-feed system.

Recently, regeneration activities have been carried out by LARI, focusing only on 10 durum wheat varieties and 10 bread wheat varieties grown in the Bekaa and Akkar plains. The regeneration of other types of vegetatively propagated and seed plants has received little attention, and as the political situation in Lebanon continues to be problematic, a decrease in care is expected.

3.3 Germplasm description and exchange

3.3.1 Documentation and characterization

Until present, no program exists regarding the description and characterization of plant varieties or local PGRFA germplasm. Lebanon is still far from establishing a variety passport as usually required by UPOV (Union for Protection of Varieties) and germplasm banking systems. Nevertheless, most of agricultural activities depend on imported varieties of plants. Imported material always carries its own passport data. However, it should be mentioned that passport, characterization and evaluation data of germplasm from Lebanon stored in genebanks abroad is not always accessible.

3.3.2 Germplasm movement

The free economy and marketing system of Lebanon allowed for plant and animal germplasm movement to be almost free of any restrictions. However, when the value of biodiversity has been internationally recognized, Lebanon joined efforts to use, conserve and share all types of benefits. Farmers' rights, country rights and regional values have been discussed on a global basis. The implementation of the movement and exchange of germplasm requires further improvements. Signing international treaties as well as bilateral agreements by Lebanon is not sufficient if such improvements are not made.

3.3.3 Botanical gardens

No botanic gardens *sensu stricto* exist in Lebanon. However, a number of places may be considered as very close to mini botanical gardens. In the capital Beirut, the Campus of the American University hosts a large number of local woody plants and forest trees as well as some grasses and ornamentals. The "Sioufi" area has a number of ornamental plants, while the "Sanayeeh" garden has mostly grasses.

3.4 Future considerations

Even if *ex situ* collection of PGRFA started 40 years ago, it remains unorganized and incomplete. There is a need to establish a mechanism for covering all cultivars, landraces of cultivated plants and their wild relatives and wild species that are under threat in all eco-geographical regions of the country.

Any opportunity for further action at national or sub-regional level to establish planned and targeted collecting of PGRFA would be appreciated in order to avoid eventual losses in this regard.

The infrastructure of the public and private Lebanese institutions does not allow yet serving all the needs of *ex-situ* conservation practices. Focus should be made on the following issues to reach acceptable levels of conservation:

- Storage facilities including cold storage and cryo-preservation,
- Education including the collection, description and storage of PGRFA,
- Awareness campaigns targeting especially decision makers,
- Public services mainly power (electricity) and transport,
- Funding.

CHAPTER 4

THE STATE OF USE OF PGRFA

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Due to its topography and diversity of climatic conditions, Lebanon harbored a great diversity of plant forms including progenitors and wild relatives of major crops, which are an invaluable source to agricultural production not only for the region, but also for developed countries that are the main users of PGRFA.

The changing way of life of Lebanese has put a great pressure on arable lands. These are decreasing in area through intensive production of cash crops and the replacement of local varieties by introduced high-yielding varieties with a narrow genetic base.

Nowadays, there is a need for the establishment of core collections of major crops and for a better utilization of plant genetic resources in national plant breeding programs. Promoting diversification of crop production and organic farming in low-fertility environments may contribute to the welfare of rural populations and to a better on-farm conservation of landraces.

4.1 Characterization and evaluation of collections

In Lebanon, the characterization and evaluation of PGRFA is mostly limited to the germplasm found in cultivation including landraces and improved varieties of fruit trees, field crops and some vegetables.

Although five *ex situ* collections have already been established by LARI for nationally important crops such as stone fruits, grapes, citrus, olives and wheat, the need for core collections is not yet recognized officially. Accessions of fruit trees mainly stone fruits that are held in demonstration orchards of LARI, are characterized for morphological traits and evaluated for agronomic traits.

Collected accessions of bread and durum wheat, 2-row and 6-row barley, lentils, chickpea and their relatives have been evaluated and characterized for some traits through collaborative projects between ICARDA and LARI and academic institutions.

The lack of coordination between the involved institutions is a major constraint to the use of plant genetic resources in breeding programs. The establishment of core collections and the identification of traits, in which the plant breeder is interested in the characterization and evaluation of PGRFA, are measures that can encourage greater and more efficient use of plant genetic resources. Some attempts are being made to identify the germplasm of broad genetic base, a matter which could be of potential value for direct use by farmers.

Chemical studies have been conducted to scan the chemical composition of some useful aromatic species such as *Origanum* sp., *Salvia* sp. and *Micromeria* sp.

Molecular characterization has been achieved for a limited number of crops such as durum wheat at ICARDA and stone fruits at INRA France with European funds. Financial and technical support is needed from regional and/or international organizations to expand the characterization and evaluation of a larger number of PGRFA by using advanced techniques such as molecular markers and by strengthening skills and adopting adequate equipments.

4.2 Increasing genetic enhancement and base-broadening efforts

Lebanon still harbors a great diversity in the plant forms of wheat, barley and vetches including landraces and wild relatives. Yet, their utilization in national breeding programs is weak. Landraces of several crops are still being cultivated along with new improved high-yielding varieties.

Only few breeding activities have been carried out in Lebanon. Actually, the incorporation of new and diverse germplasms into adapted materials and the pre-breeding activities are not generally done in Lebanon, because of the high costs of such operations. In general, ICARDA and CIMMYT (until 2004) are the main providers of cereals and legumes (food & forages) germplasms for LARI. Some are also provided by ACSAD while others are locally available (landraces and local varieties). Fruit trees germplasms came mainly from local sources until 2005 when several foreign varieties have been provided to LARI from Italy through a Lebanese/Italian project coordinated by the Agronomic Mediterranean Institute of Bari (Italy) which aims basically to produce certified plant materials.

LARI is the only public institution concerned with the release of cereals, food legumes and forage legumes varieties. This is done in collaboration with ICARDA which is providing most of the advanced lines and funding most of the on-farm trials. In the period 1970-1984, eight varieties of wheat and two of barley have been released by LARI. Most of them originated from ICARDA and CIMMYT while few were bred by LARI. Between 1985 and 2000, eight varieties of wheat, three of barley, three of chickpea, three of lentil and three forage legumes, mostly developed by ICARDA, have been released by LARI. From 2001 to date, only three varieties were released and all have been developed by ICARDA.

More recently, the breeding program executed at LARI focused mainly on wheat and barley involving crosses among the improved and existing varieties and between these varieties and few local landraces that are desired for their good grain quality. Around 1000 segregating populations were evaluated and screened. Half of them originated from ICARDA and ACSAD as F3 and F4 nurseries requested by LARI's breeding program. Breeding priorities were high yield, drought and cold tolerance, resistance to rusts and smuts, resistance to lodging, good grain and baking quality characteristics.

Lately, maize was a part of the LARI breeding program (germplasm was provided entirely by the Syrian breeding program). Approximately 80 crosses were done during 2004-2005 and 500 segregating populations were evaluated and screened. No corn varieties have been released by LARI yet.

Regarding the fruit species, breeding activities are basically absent. Only recently, a preliminary clonal selection program has been initiated for stone fruits and grapevines through the Lebanese/Italian project mentioned above.

The use of biotechnology in plant breeding remains very weak in Lebanon. An EU-funded project is currently being implemented for the improvement of durum wheat for water use efficiency involving marker assisted selection (namely QTL's). However, the biotechnology part of the work has been carried out by ICARDA because of the absence of the facilities and skills at LARI.

Multiple constraints are still facing the development of a successful plant breeding program in Lebanon, the most important of which are the lack of skills and the weak knowledge in biotechnology and molecular techniques.

4.3 Promoting sustainable agriculture through diversification of crop production and broader diversity in crops

There is a wide diversity in crop growing in Lebanon. It is characterized by the cohabitation of cold requiring crops (cherry, apple) and subtropical crops that have been successfully introduced in the last century (annona, banana, guava). Given this existent crop diversity, the Lebanese agriculture has the potential to rely more and more on the diversification in crop production, and consequently, to diversify the sources of farmers' revenue.

In addition to the large range of crops produced throughout the country, at least 32 edible plants belonging to 18 botanical families are gathered from the wild to supplement the diet of rural families in the absence of irrigated agriculture and in times of food shortage. Some of these plants like *Origanum syriacum* showed an easy suitable aptitude for domestication. Additional wild plants such as caper can be addressed in the future.

Another positive aspect is the recent introduction of some new species like nectarine, broccoli, cauliflowers, Bruxelles sprouts, chicory, mushroom and certain aromatic species.

Despite this crop diversity, it is important to note that, unfortunately, modern agriculture trends are towards less genetic conservation. Local varieties are chronically diminishing. The disappearance trend of local varieties has reached a critical level for vegetables, pulses, cereals and some fruit trees due to the introduction of new improved varieties. The high number of introduced varieties, which are gradually less adapted to local conditions, is expected to lead progressively to the displacement and disappearance of local varieties.

On the other hand, genetic uniformity for some major and minor crops has become one of the most limiting factors for sustainability. For instance, apple, banana, almond, and potato plantations are constituted of a limited number of varieties that could be impressively vulnerable to climatic accidents or diseases.

One positive but controversial factor concurring with the preservation of crop biodiversity, is the limited tenure of land areas in mountain regions (75% of farmers have less than 1 Ha), which tends to limit monoculture. This situation

contributes to maintain diversity for perennial crop, particularly fruit trees, while in the case of annual crops, land tenure fragmentation is less effective in limiting varieties displacement. Further studies should address this aspect (study of periurban cultivated diversity, family garden, specific niches of high diversity, marginal lands cultivation which is less influenced by the intrusion of new varieties mainly mountain areas, remote areas, etc.).

In the future, agricultural systems will need to incorporate a broader range of crops. As a precaution, some actions are needed now to encourage breeding programs and facilitate the use of more diversity in the varieties and species used in farms. Innovative approaches in plant breeding for the purposes of domesticating new crops, developing new plant varieties and promoting higher levels of genetic diversity in crops and in farms (e.g. planting mixtures of adapted varieties or multi-line varieties), could be recognized as means for adding stability in agricultural systems and promoting agricultural production and food security.

Close collaboration and benefit sharing between owners and users of plant genetic resources on either bilateral or multilateral basis, involvement of farmers in breeding and evaluation activities, fund raising for research on characterization, crop diversification and valorization of local natural resources are important measures to promote sustainable agriculture.

4.4 Use of underutilized crops

A great number of plant species is used locally and in neighboring countries through cultivation or harvesting from their natural habitats. Some of these species are contributing to the livelihood security of several families and are thus extensively harvested, a fact that may eventually lead to their genetic erosion. A good management of these underutilized species may lead to a more widespread use of these species, the promotion of agricultural diversification, and income generation, especially in areas where cropping systems are still very extensive. At present, the national programs are paying more and more attention to the conservation, characterization, evaluation and domestication of such species.

Capparis spinosa var. *inermis, Ficus carica, Malva parviflora* and *Ceratonia siliqua* of low priority to the country and *Pinus pinea, Amygdalus communis, Punica granatum* and others of high priority are still considered as underutilized crops in spite of their importance for the national economy of the country and the welfare of the community.

Activities on characterization and evaluation, post harvest processing, marketing and multiplication of seed/planting materials are weak despite their importance.

There is a need to establish a specific policy or legal framework or even a strategy in Lebanon to support the sustainable use and marketing of under-utilized species. In addition, a specific program should focus on the domestication of natural genetic resources (edible species) with respect to the conservation principle of the intra-species diversity.

4.5 Seed production and distribution

No comprehensive seed production program covering most of the major crops exists in Lebanon. Exception is made for wheat, barley, lentil and chick pea. Seed production and distribution of wheat, barley and some pulses are predominantly public sector activities led by LARI.

Many farmers use their own saved seeds as planting material. Farmer-to-farmer seed exchange is still the dominant source of seed supply for others, a fact which constrains the dissemination of improved varieties. In addition, many farmers plant genetically heterogeneous landraces, despite their low yielding potential.

The abundance of large areas in Lebanon with a low fertility level and the prevalence of conditions that do not allow the use of high agricultural inputs, resulted in improving varieties that are not advantageous compared to landraces.

The benefit for the farmers from planting landraces could be increased if some cleaning, sizing and grading of seeding material is done. Growing landraces organically would increase their prices and consequently farmers' profits.

Seeds of high-yielding varieties and hybrids of vegetables and corn are imported by the private sector from different counties and distributed to farmers with high prices. Many farmers use their own saved seeds without processing.

Recently, a seed cleaning unit was established in one rural village (Aarsal) to aid the farmers in enhancing their seeding material and to distribute high quality seeds of cereals and legumes landraces.

For fruit trees, the production and distribution is predominantly the activity of the Ministry of Agriculture. The private sector is also actively involved in the import, multiplication and distribution of the planting materials.

Great efforts are being made by LARI regarding the production of virus-free plants of several fruit species such as stone fruits, olive, grapevine and *Citrus*. *In vitro* propagation is currently used to produce certified root-stocks of stone

fruits. Also tissue culture facilities could be used to produce certified seeds for other crops of major importance such as potato.

In addition, several nurseries have been established in different geographical zones of Lebanon for the multiplication of major fruit trees such as *Olea europaea, Citrus sinensis, Citrus reticulata, Citrus limon, Citrus grandis, Ziziphus jujuba, Vitis vinifera, Prunus avium, Pyrus communis, Prunus persica, Prunus persica, Prunus domestica, Actinidia deliciosa* and *Malus communis.*

Yet, there is an urgent need to:

- Establish a sustainable and well organized mechanism for both seed production and seed distribution for the main important crops;
- Develop incentives for releasing new varieties at the national level;
- Develop an imperative and legal registration system for all crops with an official catalogue;
- Develop incentives for quality seed production for the main important species based on international standards rules (ISTA, AOSCA, FAO);
- Encourage the country to adopt and sign the UPOV rules with respect to intellectual property rights;
- Establish a policy or regulatory framework or strategy to develop and expand local seed systems.

4.6 Developing new markets for local varieties and "diversity rich" products

The Agrobiodiversity Project – Lebanese component (LARI/UNDP/GEF, 1999-2005) has undertaken several training activities for women in less developed areas covering agro-food processing from the local varieties and wild relatives of globally significant crop species. In collaboration with the Youth Male Christian Organization (YMCA), the project has provided support for women groups to establish an agro-food processing center and agro-food cooperatives in Ham/ Maaraboun Project Site.

The nature-friendly production of fruits and vegetables may find a solution to the marketing problems of such crops if integrated pest and production management are adopted. Such products with minimum pesticide residues have the potential of being accepted in the European markets.

NGOs such as World Vision have provided great efforts to develop Organic Farming for several crops. Attempts are being made by the private sector to establish Street fairs for marketing organic products with reasonable prices. Yet, legislation and labeling of organic products are still needed.

The major constraints in developing new markets for local varieties and "diversity rich" products are mainly:

- The emphasis on modern cultivars of staple crops;
- The lack of financial support;
- The lack of consumer demand;
- The lack of trained personnel;
- Industrial processing limitations;
- The fact that the development/establishment of markets for local varieties is not yet a national priority.

To encourage the production of local varieties and "diversity rich" products, it would be necessary to:

- Establish a legal policy or legal framework to support new markets development and 'diversity rich' products;
- Promote the culture of 'diversity rich' natural resources;
- Reinforce the efforts to valorize the processing of 'diversity-rich' products for commercial purposes;
- Promote and increase the existing market for local varieties and 'diversity-rich' products.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION

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5.1 National programs

To date, no Central National Program related to PGRFA exists in Lebanon. The conservation and sustainable use of PGRFA is not yet officially recognized as such by local authorities and decisions makers. Nevertheless, Lebanon has signed several international and regional PGRFA agreements, taken part or contributed to different related PGRFA conventions and ratified most of them (as detailed in Chapter 6). Once implemented, all of these agreements and conventions should meet various areas of benefits as requested by the GPA. For instance:

- The Convention on Biological Diversity (CBD) ratified by the Ministry of Environment in 1994 has resulted in proposing various recommendations such as promoting *in situ* conservation of crop wild relatives, promoting sustainable agriculture and building strong national programs;
- The UN Framework Convention on Climate Change (UNFCCC) ratified by the Ministry of Environment in 1994 should lead to the implementation of monitoring and early warning systems for PGRFA loss and to the promotion of public awareness on the value of PGRFA conservation and use;
- The UN Convention to Combat Desertification (UNCCD) ratified by the Ministry of Environment in 1995 should ensure the promotion of sustainable agriculture, the building of strong national programs, and the development of monitoring and early warning systems for PGRFA loss;
- The International Treaty on Plant Genetic Resources for Food and Agriculture ratified in 2004 by the Ministry of Agriculture should enhance surveying and inventorying of PGRFA, supporting planned and targeted collection of PGRFA, promoting sustainable agriculture and building strong national programs;
- The Cartagena Protocol on Biosafety ratified in 2006 by the Ministry of Environment included two main GPA areas of benefit: developing monitoring and early warning systems for PGRFA loss and promoting public awareness of the value on PGRFA conservation and use.

On the other hand, some Projects related to PGRFA conservation have been executed and others are being implemented by the Ministry of Agriculture and LARI mainly, in collaboration with partners such as Ministry of Environment, farmers, NGOs, Universities, ICARDA and IPGRI. The most representative one is the "Conservation and sustainable use of dryland Agrobiodiversity" Project – Lebanese component (LARI/UNDP/GEF; 1999-2005). This project has been implemented by LARI, in cooperation with several partners such as ICARDA, IPGRI, WANA and ACSAD and has tackled *in situ* conservation and sustainable use of biodiversity, including PGRFA. Several areas of benefit have been achieved such as promoting *in situ* conservation of crop wild relatives, increasing genetic enhancement and base-broadening efforts, promoting development and commercialization of under-utilized crops and species, developing new markets for local varieties and "diversity-rich" products and promoting networks for PGRFA.

In addition to the above international agreements, Lebanese stakeholders, including individuals and organizations both public and private, held workshops and meetings to review activities on the conservation and use of PGRFA. Those activities were useful in that they helped in capacity building for the implementation of plant genetic resources programmes.

Nevertheless, a large number of challenges remain to be overcome. Among these, and as first stated in this section, is the lack of official recognition of the need to institutionalize the conservation and sustainable use of PGRFA by the authorities and decision makers. Despite all the efforts put forward to contribute to the most important international entities aiming at the protection of PGRFA, there is, yet, no institution in Lebanon that is devoted to this end.

There is an obvious need to establish such a national PGRFA institution including the necessary infrastructure in equipment and human resources, and all the legal elements as previously suggested by the Agrobiodiversity project. This future governmental structure should be supported by a strong and specialized expertise responsible for coordinating all PGRFA activities in the country.

5.2 Networks

Before the implementation of GPA info-sharing mechanism, a limited number of networks related to PGRFA have been established involving national stakeholders from regional or international institutions such as the United Nations Development Programme (UNDP), the International Olive Oil Council (IOC), the American University of Beirut (Faculty of Agricultural and Food Sciences), the Council of the European Communities, WANA Seed Network, and FAO. These networks cover particularly the following areas:

- Conservation and sustainable use of dry land agrobiodiversity based on on-farm management of PGRFA and according to a community-based approach, working with local communities, farmers and NGO's;
- Conservation, characterization, collection and utilization of genetic resources in olive (RESGEN) with the objective of conserving and promoting local olive cultivars;
- Collaborative Molecular Biotechnology Integrating Network that surveys and keeps the inventory of PGRFA;
- Improving Durum Wheat for Water Use Efficiency and Yield Stability through Physiological and Molecular Approaches to evaluate and develop Durum Wheat varieties;
- WANA seed standards (Cereals, Legumes, Oilseeds, Forages, Vegetables) with the aim of supporting seed production and distribution;
- Horticulture cultivars performance database to facilitate the access and use of information on horticultural varieties (FAO HORTIVAR network).

However, the PGRFA networks are still facing major constraints that lead to information loss and the concomitant interruption of long term continuity of network efforts. The most serious challenges include:

- Lack of financial resources
- Poor management and ineffectiveness of networks
- Poor definition of networks participation benefits
- Poor identification of suitable partners for networking
- Lack of benefit-sharing among potential partners.

Therefore, the Government should provide support to organize and host network meetings, strengthen existing networks at the national, regional and international levels and establish new networks for all PGRFA activities.

5.3 Education and training

Training in the form of courses and workshops is being done to support the sustainable use, development and conservation of plant genetic resources. Examples of such activities include:

- A workshop organized by LARI on Agronomical characterization of different varieties of grapevine and stone fruit species addressed to farmers.
- A workshop on Mushrooms, organized by Jihad el Binaa association to farmers, addressing the development and commercialization of under-utilized crops and species.
- A project implemented at LARI by the Royal Botanical Garden (RBG) dealing with the collection, study and conservation of Lebanese Flora. This project addresses surveying, inventorying and collecting of PGRFA, taxonomy, and indigenous knowledge related to PGRFA. Two participating staffs from LARI were trained.
- A LARI-ICARDA Collaborative Program aiming at collecting wild wheat species and their relatives in Lebanon for three participating staff from LARI. This project also worked on surveying, inventorying and collecting PGRFA,

taxonomy, promoting *in situ* conservation of crop wild relatives and wild plants for food production, and expanding *ex situ* conservation activities.
- A project of LARI on the survey and collection of improved wheat varieties in the Bekaa and Akkar plains. It worked on surveying, inventorying and collecting PGRFA, expanding *ex situ* conservation activities and plant breeding. The project targeted 8 participating farmers.
- The completed FAO LB/91/002 project regarding the improvement of olive culture in Chouf and South Lebanon executed by LARI and addressing seed production and distribution. The project targeted seven participating staff from LARI.
- Training by the Agrobiodiversity project for LARI technicians, farmers and NGO's on *in situ* conservation of crop wild relatives and wild plants for food production.
- Training by the Agrobiodiversity project of 9 technicians from LARI on GIS application for the management of natural habitats;
- Training by the Agrobiodiversity project of 8 LARI staff on the identification of important plant genera in Lebanon;
- A project executed by LARI on "Promotion of *Capparis spinosa* L. culture in Lebanon" addressed to farmers, NGO's and staff from public and agro-industrial sector.

In spite of the efforts in training that have been performed as indicated above, major work is still needed in other, equally important priority areas, in order to have a comprehensive set of strategies to protect and improve PGRFA. These areas include, but are not limited to the following:
- On-farm management and improvement of PGRFA;
- Assisting farmers in disaster situations to restore agricultural systems;
- Improving protected areas management;
- Establishing and sustaining *ex situ* collections;
- Increasing core collections activities;
- Increasing genetic enhancement and base-broadening activities;
- Building strong national programs and PGRFA networks;
- Constructing PGRFA comprehensive information systems;
- Developing monitoring and early warning systems;
- Improving public awareness on the values of PGRFA conservation and use.

With respect to education and training on PGRFA in Lebanon, the major weakness derives form the fact that a national strategy for education and training is totally lacking. Efforts in this direction have been too narrow and sporadic. The role of institutions, such as universities and colleges is still largely underplayed. While these are the natural place for specialized courses, targeted seminars and workshops representing good training opportunities, very little is being done in these institutions to answer the great need for improved capacity in the field of PGRFA. At the present time, the great majority of staff working in this field has been undergoing training in university courses outside the regions. The main obstacles to the provision of the required education and training regarding PGRFA in Lebanon are the lack of awareness concerning training needs in the country, the lack of trainers and the deficiency in financial resources.

Efforts to overcome these obstacles should focus on:
- Organizing training and educational programs covering 20 GPA in all agricultural institutions and universities;
- Extending GPA related trainings to local communities, farmers and entrepreneurs;
- Stressing on "building national programs" for both researchers and decision makers.

5.4 National legislation

Although the country still has a long way to go in terms of legislation regarding PGRFA, Lebanon has already passed legislations and regulations that indirectly relate to PGRFA. These legislations are originally meant to regulate and protect the Environment and include the following laws:
- **Law 256-1994:** Framework Convention on Climate Change prepared by the Ministry of the Environment, with the objective of promoting *in situ* conservation of crop wild relatives;
- **Law 260-1995:** Convention on Biological Diversity prepared by the Ministry of the Environment with the objective

of developing monitoring and early warning systems for loss of PGRFA;

- **Law 469-1995:** Convention on combating desertification prepared by the Ministry of the Environment with the objective of promoting sustainable agriculture;
- **Law 444-2002:** Protection of the Environment prepared by Ministry of the Environment and aiming at the conservation and the sustainable use of biodiversity through the protection of its natural resources.

In addition to the above-mentioned legislations and regulations, there are crop groups for which variety registration is a legal requirement in Lebanon. These include wheat, barley, lentil and chickpea. The agencies in charge of the registration are LARI and the Office of Cereals and Sugar beet. A policy framework has also been launched between LARI and farmers to develop and expand local seed systems for crops and crop varieties important to small-scale farmers. The agreement termed "Wheat Seed Multiplication in Farmer's Fields" describes all the regulations that farmers have to follow to produce goods seeds according to rules adopted by LARI from International Laws.

On the negative side, a number of significant obstacles is still hindering the development of legislation and regulations relevant to plant genetic resources. These obstacles are mainly of a policy/legal and marketing/commercial nature. The lack of a national strategy focusing on sustainability and diversification and the lack of funds are aggravating the present situation. Appropriate policies and legislation in diversifying crop production and broadening diversity in crops are strongly needed.

5.5 Information systems

In Lebanon, adequate national information management systems to support efforts to conserve and sustainably use PGRFA are sorely lacking. This occurs despite a number of projects have made use of information management systems for PGRFA, including geographical information systems, and have produced a considerable amount of relevant data. Various activities have been developed:

- Collection, Study and Conservation of Lebanese Flora;
- Conservation, characterization, collection and utilization of genetic resources in olive;
- Improving Durum wheat for water use efficiency and yield stability through physiological and molecular approaches;
- Creation of a horticulture cultivars performances database (FAO HORTIVAR).

In this context, establishing an efficient PGRFA comprehensive information system in the country is a priority.

5.6 Public awareness

Much is needed in this sector regarding the protection of PGRFA in Lebanon. In fact, public awareness concerning the roles and values of PGRFA is almost absent. Moreover, the value of PGRFA is, as yet, not integrated in the pre-secondary and/or secondary educational curricula.

The main constraints to developing public awareness programmes related to PGRFA are: the incoherence of awareness efforts that accompany some relevant projects that have been implemented in the Country, insufficient number of staff, national priorities not well established, staff does not have sufficient skills and knowledge, improper distribution of roles among organizations and insufficient financial support.

However, several isolated activities and projects related to public awareness have been implemented by three LARI, AUB and UNDP but lacked the necessary follow-up. These projects developed awareness outputs, used media, targeted audience and covered topics to create awareness on the value of PGRFA.

For instance, public awareness that has been conducted by LARI/GEF/UNDP Agrobiodiversity project laid on audio-visual outputs (TV spots, documentaries), panels and posters, fact sheets, reports and accessories (T-shirts, caps, bags, etc.) and gadgets. It used media such as press, television, radio, diversity fairs, conferences and educational events. The audiences targeted were scientists, extension agents, farmers and the general public. The topics covered stressed on the importance of PGRFA as part of biodiversity, the farmers' role and the environmental education.

Recently, the Biodiversity Program at the University of Balamand launched a campaign targeting elementary and high schools, universities an few municipalities in North Lebanon, as a first step to increase awareness on biodiversity in general and the importance of protecting PGRFA in particular. This, however, remains a modest contribution to improving

the public perception of the importance of these resources as long as it does not receive proper funding and support from local authorities and international agencies.

In conclusion, the major need and priority is to implement a national program for public awareness on the value of PGRFA in the country, with the support of regional and international organizations, stressing on the role of local communities and farmers, the environmental education and the development of relevant national policy.

5.7 Global overview of priority needs in the PGRFA

A national strategy on PGRFA conservation and use needs to be implemented at the earliest, possibly with the assistance and expertise of the international community. Its main focus should be to:

- Ensure adequate facilities and opportunities for *in situ* and *ex situ* conservation of landraces, local varieties, crop wild relatives and wild food plants in lebanon;
- Perform regenerations for self and cross-pollinated plants and for vegetatively propagated crops according to international standards;
- Promote utilization of PGRFA and of wild plant for food production;
- Provide adequate incentives and planting materials to farmers;
- Provide adequate training for a sufficient number of staff;
- Promote synergies and strengthen partnerships among national stakeholders;
- Increase access to available information; and
- Implement appropriate legislations and policies.

Finally, public awareness campaigns for the Lebanese population, especially in schools need to be organized and sustained so that all generations become sensitive to this vital issue.

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

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6.1 Regional collaboration

Lebanon is part in many regional projects related to the conservation and sustainable use of plant genetic resources. Such cooperation provides concerned parties with exchange of knowledge, expertise, and technology transfer to improve the conservation and sustainable use of PGR.

The regional project "Conservation of wetlands and coastal zones in the Mediterranean" (MedWetCoast) is a Mediterranean initiative under the Ramsar Convention. The project is implemented in Lebanon, Albania, Egypt, Morocco, the Palestinian Authority and Tunisia (2002-2006). The project in Lebanon is executed by the Ministry of Environment, managed by UNDP and funded by the FFEM (Fonds Francais pour l'Environnement Mondial). Its main objective is to conserve globally endangered species and their habitats, recognizing nature conservation as an integral part of sustainable human development while improving the capacity of governmental and non-governmental agencies to address biodiversity conservation issues in two main sites in Lebanon, "Tyre Coast" Nature Reserve and the Wetlands of "Aamiq".

The regional project "Conservation and sustainable use of dryland Agrobiodiversity in the Near East" is implemented in Lebanon, Jordan, Syria and the Palestinian Authority (1999-2005). It is executed in Lebanon by the Lebanese Agricultural Research Institute (LARI), implemented by UNDP and funded by GEF. The project aims at promoting the conservation and sustainable use of wild relatives and landraces of globally important crops by introducing and testing *in-situ* and on-farm mechanisms and techniques in three pilot sites located in the Bekaa plain in Lebanon. The four participating countries exchange technologies, methodologies and information towards conservation and sustainable use of PGR. Several training sessions, workshops and thematic meetings were conducted at the regional level for scientists, farmers and technicians.

The regional project "Integrated management of cedar forests in Lebanon in collaboration with other Mediterranean countries" covers Algeria, Cyprus, Lebanon, Morocco, Syria and Turkey (2004-2007). The project is funded by GEF, implemented by UNEP and executed by the MoE with the collaboration of the American University of Beirut. This project aims at addressing the serious threat caused by an infestation of a new insect of the genus *Cephalcia* affecting 70% of the "Tannourine" – "Haddath El-Jebbeh" forest trees located in North Lebanon, considered one of the most important surviving stands of cedar forests in the country.

Lebanon is an active member of the Mediterranean Citrus Network (MECINET), which aims at promoting cooperation on citrus production improvement in the Mediterranean region. The main goal of this network is the conservation and utilization of genetic resources of citrus and related genera through the establishment of research and information programme and an articulated plan of action.

Lebanon is also an active member of West Asia and North Africa Plant Genetic Resources Network (WANANET), which was established in 1992. The overall objectives of the network are to identify common problems and constraints facing effective conservation, utilization and assessment of PGR in member countries, and to assist in developing national plant genetic resources programmes.

Lebanon and Syria initiated in 2002 negotiations, under the umbrella of ArabMab Network, to establish a trans-boundary biosphere reserve. Representatives from both countries attended capacity building workshops of relevance to this matter between 12 and 18 November 2004 in Germany.

A Memorandum of Understanding was regionally prepared by the Agrobiodiversity Project and signed by the Ministries of Agriculture of Lebanon, Jordan, Syria and the Palestinian Authority on June 29th, 2005. The signed MoU

addresses issues aiming at promoting Agrobiodiversity conservation and exchange of plant genetic resources among the four countries.

6.2 International collaboration

The Ministries of Education in Lebanon and France have agreed since 1996 on a programme of "Cooperation for Evaluation and Development of Research" (CEDRE). The agreement promotes research studies in biodiversity and sustainable development.

Darwin Initiative Project on coastal vegetation was a collaboration between the American University of Beirut, Royal Botanical Garden Kew (UK) and the University of Reading (UK), whereby assessment and identification of the coastal flora of Lebanon was carried out (1999-2002).

Collaboration for seeds collection continues since 1996 between LARI and Royal Botanic Gardens Kew's seed bank. This partnership is one of 15 partnerships of the Millennium Seed Bank (MSB) project and is manifested through seed collections, baseline plant diversity research, and monitoring of plant genetic resources.

An agreement was signed between Lebanon and the International Center for Agricultural Research in the Dry Areas (ICARDA) in 2004 for collection of some forage species. Collected seeds are preserved in a black box at ICARDA gene bank.

The International Plant Genetic Resource Institute (IPGRI) is implementing since 2001 a project in Lebanon focusing on a number of economically important and wild harvested species mainly *Salvia* sp., *Origanum* sp., *Cichorium* sp. and *Gundelia* sp. Activities include assessing the eco-geographic distribution of these species, their level of threats, and analyzing the constraints limiting their full valorization through domestication and cultivation. Other topics covered by this project include the development of strategy for the promotion of underutilized species, identification of sites for *in situ* and on-farm conservation, recommending breeding and selection strategies for improvement, and analyzing possible seed production system for the improved material.

6.3 International agreements

Lebanon has ratified the FAO International Treaty on Plant Genetic Resources (ITRFA) on May 6, 2004. Lebanon is also party to the following relevant conventions: Convention on Biological Diversity (CBD) which was ratified in 1994, UN Convention to Combat Desertification (ratified in 1995), and Ramsar Convention on Wetlands of International Importance (ratified in 1999).

The Agrobiodiversity Project did a thorough review of international conventions and agreements related to the conservation and sustainable use of Agrobiodiversity, which have been ratified by the Lebanese government or expected to be ratified in the future. Results have indicated that there is a serious need to legally regulate and coordinate all issues related to plant genetic resource conservation, use and exchange, especially in the light of the concerned agreements and conventions developed in the region and globally. The relationship and implications of these international conventions on the present national legislation were analyzed and a proposal for the domestication of the ratified conventions was developed.

6.4 Major needs to improve international collaboration

- Lebanon is a member of a limited number of regional and international PGR networks. There is a need for the government to provide support in that regards. This can be in the form of supporting activities such as organizing and hosting relevant regional and international meetings.
- Lebanon is one of few countries which have not signed the "Convention on International Trade in Endangered Species of Wild Fauna and Flora" (CITES). This Convention is a strong tool for the control over international trade in endangered animal and plant species. Since Lebanon has not ratified CITES, parties have no obligations towards trade affecting the endangered species of Lebanon.
- According to the 2000 IUCN Red list, only the Cedar of Lebanon (*Cedrus libani*) is considered a globally endangered plant species in Lebanon. This does not reflect the real number of globally significant plant species threatened in Lebanon. This can be the result of the lack of data on species and the fact that Lebanon has not undertaken

its national Red Data Listing exercise. More collaboration should be done in this regards with IUCN and other international organizations to have a national red list.

- Lebanon should have a unified and regularly updated PGR database and a platform for better information exchange and dissemination at the national, regional and international levels.
- Lebanon should seek funds and international collaboration for the establishment of a national genebank for *ex situ* conservation of PGR. Such support should mainly be in the form of capacity building and funds for acquiring the adequate equipments.

CHAPTER 7

ACCESS TO PLANT GENETIC RESOURCES AND SHARING OF BENEFITS ARISING OUT OF THEIR USE, AND FARMERS' RIGHTS IN LEBANON

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Lebanon belongs to the Near East Crescent Fertile region which is considered as the main important center of diversity in the world and where the plant domestication started ten thousand years ago[1]. Centers as Ford Foundation and LARI were thus established since 1950 in Lebanon and worked on breeding wheat, barley and legumes. In addition, many researchers have been interested in seeking our endemic landraces and their wild relatives. The exchange of these materials was not under governmental control due mainly to the lack of laws and inadequate policies in the country. Furthermore, the low rank of agriculture in the Lebanese economy results in a lack of interest in the conservation and sustainability of PGRFA. Consequently, in order to preserve our natural plant genetic resources, there is an urgent need to control access to PGRFA and to enhance benefit sharing resulting from their use and farmers' rights.

7.1 Access to plant genetic resources

7.1.1 Agreements and conventions

Over the past 10 years, as clearly described in Chapter 6, the Government of Lebanon has signed and ratified several international agreements and conventions aiming at biodiversity conservation, PGRFA access, benefits share arising from PGRFA use and biodiversity conservation promotion. In addition, bilateral agreements between national institutes such as LARI and other international gene banks have been signed.

The Ministries of Agriculture and Environment monitored the implementation of all these agreements and conventions with the contribution of international organizations or institutes such as FAO, ICARDA and Kew Garden. However, there is no central authority empowered to follow up the implementation of these agreements and conventions in Lebanon. For this reason, it is important to create a national PGRFA institute to control the conservation and the sustainable use of PGRFA. Such institute should to be supported by strong and specialized expertise in order to coordinate all PGRFA activities in the country and ensure the compliance of Lebanon to the international treaties and agreements related to PGRFA, including the relevant Standard Material Transfer Agreement.

7.1.2 Policies and legislations

Lebanon has ratified the treaties related to biodiversity, food and agriculture and has developed the corresponding legislation. The two most important laws in this regard are:

- Law number 444 ratified in 2002 and aiming at the protection of the environment including natural resources,
- Law 360 ratified in 1994 and aiming at the conservation and sustainability of Biological Diversity.

However, these laws have not been sufficient to control and organize the access to PGRFA in the country, due to the absence of national policies and strategies in this regard and poor public awareness in promoting the use and conservation of PGRFA.

7.1.3 Use of PGRFA in Lebanon

Despite the absence of a national strategy for plant breeding, few breeding activities have been carried out in Lebanon. They are limited to durum and aestivum wheat, barley and chickpea. Certified seeds of durum and bread wheat are locally produced by LARI through an agreement with farmers. Regarding fruit species, breeding activities are restricted to clonal selection of grapevine and stone fruits.

Currently, with the exception of wheat and barley, new improved varieties are being introduced to Lebanon in the absence of national breeding programs for the local PGRFA. This fact could lead progressively to the ignorance of Lebanese consumers taste and to the threatening of local landraces sustainability. Consequently a clear strategy of breeding needs to be established in Lebanon listing the priorities in terms of traditional species such as trees and vegetables crops to be improved, with the financial and technical support of regional and/or international partners.

Only the GEF/UNDP Agrobiodiversity Project (1999-2005) developed at LARI worked on the conservation and sustainable use of landraces and traditional Lebanese varieties in some Lebanese rural villages, and on the marketing of poorly exploited species. Similar activities should be extended to a larger number of rural areas in order to further promote the sustainable use of PGRFA.

7.2 Maintenance of the access of plant genetic resources

Unfortunately Lebanon has not a strong mechanism to maintain or enhance access to plant genetic resources (please refer to Chapters 4 and 5 for details). The access of PGRFA in Lebanon is not protected by law yet despite the economical interest of these resources.

Even if PGRFA collection has started since around fifty years, it remains unorganized and incomplete in covering all the species grown in Lebanon. Neverthless, 358 plant species of major importance for food and agriculture have been accessed and conserved in LARI, ICARDA and Kew Gardens. In addition, 1 000 species from the Lebanese wild flora have been accessed and conserved in LARI and Kew Garden. These materials can be reproduced if problems such as natural disasters, overgrazing or wars arise. Most of these wild species have been identified as medicinal, edible, or poisonous species or as plants for industrial use. The collection and conservation of new species is still on going as per the bilateral agreement between LARI and Kew Garden.

On the other hand, due to the successive wars in Lebanon and the resulting poor urban planning, the threats to biodiversity have increased and made the access of plant resources more difficult. In addition, the absence of a national mechanism for assisting farmers in disaster situations and restoring the damaged agricultural system have worsened the situation even further. All these constraints might limit the access to genetic resources and consequently constitute a serious threat to the Lebanese agriculture food security.

The establishment of a strong national PGRFA network is a primordial need to assess and restore the losses of PGRFA particularly after the successive wars that have shaken the country. Such network would also allow technology transfer from the developed countries to Lebanon, the control of germplasm exchange, and the implementation of joint projects on germplasm characterization and evaluation.

7.3 Benefit sharing mechanism

The direct important benefits arising from the use of plant genetic resources in Lebanon reside in their use as edible foods and medicinal plants and their utilization in the industrial sector and in breeding programs. The exploitation of these benefits has been made possible through the signature of several agreements:

- The wild species collected by LARI and conserved *ex situ* in Kew Garden are controlled and shared according to a bilateral agreement between the two institutions with respect to the property right of the Lebanese party.
- The Lebanese species which are part of Annex I of the International Treaty on PGRFA conserved either in national genebanks or in any CGIAR Centre's genebank can be used under the Treaty's multilateral system and accesses under the Standard Material Transfer Agreement adopted by the Treaty's Governing Body in June 2006.
- The LARI/UNDP/GEF Agrobiodiversity project (1999-2005) has led to the signature of a Memorandum of Understanding (MOU) in 2004 between the Ministries of Agriculture of Jordan, Lebanon, the Palestinian National Authority and Syria. Thus, the Lebanese government may authorize to share materials with these countries.
- As Lebanon has signed and ratified the ITPGRFA (2004), it should establish the benefit sharing mechanism of PGRFA in conformity with article 13 of this treaty, and as agreed by all participants of the first Governing Body in 2006.

National laws related to the access to plant genetic resources within the country and sharing of benefits arising out of their use have not been released yet. Within the Biosafety Project framework, the Ministry of Environment has drafted a decree with the aim of controlling access to the wild Lebanese biological and genetic resources and sharing benefits from these resources as per the third objective of the Convention on Biodiversity. The decree is still under preparation and will be enacted once finalized and approved by the various relevant authorities in the country.

Because of the absence of laws specifying plants usage rights in the agricultural and industrial sectors, no mechanism has been established in Lebanon regarding benefits sharing from plant genetic resources use yet. For the same reason, no organism has been created yet regarding benefits sharing from PGRFA. LARI is the only Lebanese institution working on the development of certified varieties of durum and bread wheat and on their subsequent delivery to the farmers at symbolic prices.

7.4 Implementation of Farmers' Rights

As a party to the International Treaty on PGRFA, Lebanon recognizes the enormous contribution that its local and indigenous communities and farmers have made and will continue to make for the conservation and development of plant genetic resources which constitute the basis of food and agriculture production. It is responsibility of the Lebanese Government to take appropriate measures to protect and promote Farmers' Rights, including (i) the protection of traditional knowledge, (ii) the right to equitably participate in sharing benefits arising from the utilization of PGRFA, (iii) the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of PGRFA.

At the institutional level, LARI has conducted since the sixties and with subsidies allocated from the Ministry of Economy, a seed production program for wheat. The produced wheat seeds are distributed to farmers at a symbolic price, a fact which serves farmers' rights in PGRFA.

However, until now no farmers' rights legislation or projects serving such rights have been developed in Lebanon except the LARI/GEF/UNDP Agrobiodiversity Project. In some rural villages the project prioritized the on-farm conservation and use of local herbaceous landraces, grapevines and fruit trees and established a mechanism for processing traditional foods with added value.

With the full implementation of the International Treaty on PGRFA in Lebanon, the Government should be able to further implement Farmers' Rights according to article 9 of the Treaty and develop the adequate legislations in this regard.

7.5 Recommendations

In order to promote access to plant genetic resources, sharing of benefits arising out of their use and Farmers' Rights in Lebanon, it is important to:

- Create a governmental structure supported by strong and specialized expertise which would be responsible for coordinating all PGRFA activities in the country and ensuring the compliance of the country to the International Treaty on PGRFA;
- Develop laws in conformity with the articles of the treaties related to PGRFA access, benefits sharing arising from their use and farmers' rights, and in conformity with the relevant decisions derived from the Governing Body of the PGRFA Treaty;
- Develop policies for the implementation of Farmers' Rights in Lebanon and to ensure budgets and incentives for the use of traditional landraces;
- Optimize access to genetic resources by completing the inventory of the Lebanese PGRFA, increasing the number of *ex situ* collections and enhancing research activities with a particular attention to landraces and traditional varieties and edible wild species;
- Establish breeding strategies listing the priorities in relation to traditional species to be improved, with the financial and technical support of regional and/or international partners.

CHAPTER 8

THE CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

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Food security concern has always been a priority for people. It has also been at the origin of several conflicts and political pressures. The efforts of the green revolution to reach food security have focused mainly on increasing productivity and crop production areas. Unfortunately, this has led to the narrowing of the genetic basis of cultivated crops (through selection) and to the destruction of the agro-ecosystems either by increasing the cultivated areas or by deteriorating some weak agro-ecosystems (as a result of salinization, desertification, pollution with pesticides and fertilizers,….)

Nowadays, food security should be regarded not only in terms of the quantity of food produced from agriculture, but also in terms of quality (e.g. absence of pesticides residues) and sustainability. Sustainability implies the necessity to stop destroying agro-ecosystems by avoiding the introduction of high input crops and varieties and by minimizing the marginalization of local traditional and adapted low input landraces.

8.1 Lebanese agricultural constraints

The Lebanese Agricultural Research Strategy (LARS)[11], developed in 1996 as an initiative by LARI and in response to the urgent need for the rehabilitation of the agricultural research program in Lebanon, has reported a detailed analysis of the development of agricultural sector in Lebanon and has highlighted the main constraints facing it.

Agricultural development in Lebanon emphasizes some of the country characteristics that lie in climatic and geographic diversification and its relatively abundant water resources. Furthermore, the Lebanese population has a diversified organoleptic taste due to its consumption of various products comprising a significant proportion of the wild edible Flora. On the commercial level, Lebanon should take advantge from its important trade relations within the region. More than one fifth of Lebanon's agricultural exports have always targeted the Arab countries characterized by the the world's highest population growth rate and which consequently offer an ideal and promising market.

However, as described below, various problems hinder the sustainable development of the Lebanese agricultural sector.

In fact, due to the high population density and the mountainous landscape of the country, the arable land per capita is limited to 650 m^2. Consequently, food security as a reasonable objective for some field crops mainly cereals became an issue of debate.

In addition, the budget allocated to the Ministry of Agriculture is insignificant and did never exceed 0.8 % of the national budget per year. The contribution of the Agricultural sector to the national income is less than 10% while around 40% of the Lebanese population is currently working in the agricultural sector.

On the other hand, the high proportion of small agricultural properties constitutes a serious obstacle against efficient cultural practices such as irrigation, pest mangement, mechanization. The absence of adequate extension services and the poor performance of cooperatives does not help in compensating for this constraint.

[11] Lebanese Agricultural Research Institute, 1996. Lebanese Agricultural Research Strategy, pp. 68.

Except for wheat and barley, many commercial field crops consist of one or two varieties only. This fact could progressively narrow down the taste of the Lebanese consumers and threaten the sustainability of crops in case of climatic changes or diseases.

On the other hand, for vegetables and some fruit species, new improved varieties are currently widely introduced in the country. This might progressively endanger the sustainability of local landraces due to the serious deficiency of national breeding and conservation strategies for the local PGRFA.

Breeding programs are limited to some cereals such as wheat and barley. These programs have been executed at LARI and have led to the release of more than 30 varieties since 1970 most of which have been developed in collaboration with ICARDA. For vegetables, breeding programs are restricted to the experimentation of new imported varieties under the Lebanese conditions. For fruit trees, breeding activities are limited to the pomological characterization of local varieties.

Regarding seed production, no official program for most of the major PGRFA exists yet in Lebanon. Exception is made for wheat and barley which are produced and distributed to farmers by LARI with a subvention from the Ministry of Economy. For vegetables, seeds of improved varieties are regularly imported by the private sector from different countries and sold to the farmers at high prices. For fruit trees, production and distribution are predominantly undertaken by the private sector and to a lower extent by the Ministry of Agriculture. More recently, a national program for the production of certified plants for grapes and stone fruits has been developed by LARI with the support of Bari Mediterranean Agronomic Institute.

The market of agricultural inputs is held by private companies. The absence of governmental control increases the power of these companies, which besides supplying inputs, provide economic and technical services to farmers and organize agricultural extension programs.

Market fragmentation and the absence of an appropriate infrastructure for the marketing of agricultural products, and subsequently the weak bargaining power of farmers have increased the role and profits of the middlemen, on the expense of farmers.

Another serious constraint is the deficiency in incentives and long term credits to farmers. The share of agriculture from total commercial banking is less than one percent, while medium and long run credit facilities are virtually inexistent. For instance, loans offered by Kafalat, a Lebanese institution offering credit facilities, have been implemented by the private sector in collaboration with banks and have supported only short term agricultural projects with reduced interest (around 2%).

In terms of commodities, Lebanon is nearly self-sufficient in legumes, vegetable and fruit production but is still a substantial cereals importer. The prevailing liberalized trade system used to facilitate import processes at both regional and international levels, ensuring the reliability in access to food. However, there is no equilibrum between the selfsufficiency in food products and the reliance on imports to meet the local demands (~80%). Also, there are no clear national priorities regarding export or import for food crops.

8.2 Recommendations

In spite of the political problems and the successive wars in Lebanon, the Government of Lebanon is determined to carry out a reform of its economy based on sustainable development in several sectors with particular attention to agriculture.

Accordingly, international and regional agreements related to PGRFA have been ratified by the Ministries of Environment and Agriculture. However, conservation and sustainable use of PGRFA are not yet officially emphasized by the local authorities, and food security and sustainable development are not considered as important issues of the national agenda yet. For this reason, national policies and laws related to PGRFA activities and management are still absent.

Lebanese food security should be addressed in a way to reach more sustainability at various levels. The key element for the sustainable development of the agricultural sector in Lebanon is to secure a better utilization, maintenance and improvement of the natural resources in terms of water, soil, land, forestry and genetic diversity resources.

8.2.1 Policy and legislation level

Continuous and determined efforts should be deployed by the Government as part of the economic reform, with particular emphasis on agricultural and rural development. They must be coupled to solid commitments to social objectives and a high attention to environmental protection.

In this context, strong, fair and stable legislative frameworks and policies are necessary to guide and regulate all the players involved in PGRFA activities. Focus should be placed on the following issues:

- The consideration of the *in situ* and *ex situ* conservation of PGRFA and their sustainable use as a national priority by the Lebanese authorities and decision-makers;
- The development of national laws for an adequate PGRFA management and in conformity with the relevant international treaties that have been ratified by Lebanon;
- The development of seed and variety registration laws in the country;
- The creation of a governmental structure supported by strong and specialized expertise in order to coordinate all PGRFA activities in Lebanon and ensure its compliance to the international treaties and agreements, including the relevant Standard Material Transfer Agreement;
- The establishment of a national gene bank which should be the responsibility of the public sector only.
- The implementation of a national plan for catastrophes or disasters;
- The development of policies for the implementation of Farmers' Rights and the creation of incentives and long term credits;
- The increase of the budget allocated to the organizations and institutions involved in PGRFA management and research activities;
- Joining other international conventions such as UPOV and CITES.

8.2.2 Institutional level

Agricultural development is closely dependent on institutional support. Such support should be provided at all levels with particular attention to the following points:

- Development of Strong National Programmes related to PGRFA, leading to the improvement of institutional and sectorial linkages including community efforts, and to the development of national capacities in the scientific, research, technical, managerial and policy areas;
- Development of an early warning system to monitor genetic erosion of PGRFA;
- Optimization of the use of highly natural variable ecosystems allowing the culture of diversified and well adapted PGRFA (temperate species, subtropical species, wild and wild relatives);
- Implementation of a PGRFA diversification strategy based on the adoption of improved high yielding varieties in addition to the traditional, landraces and well adapted varieties;
- Implementation of a diversified rotation system in order to extend the useful plant basket for consumers and diversify the revenues for farmers;
- Establishment of breeding strategies listing the priorities in terms of traditional species to be improved and providing biotechnological tools to solve breeding problems;
- Establishment of a comprehensive seed production system;
- Valorization of wild species and mainly wild relatives as they are always a source of improvement for cultivated crops in a sustainable way;
- Diversification and valorization of neglected and underutilized species that are of potential locally;
- Enhancing the compliance to the international treaties and agreements related to germplasm exchange;
- Ensuring additional income by exploiting, in a reasonable way and as added value products, the Lebanese wild flora such as aromatic, edible and medicinal plants. For instance, Lebanese caper, thyme and origanum should be promoted as diversity-rich products in regional and international markets. Also, Ecotourism in rural villages should be developppped as it could be an important source of income especially for poor families.
- Allowing the transfer of rapid achievements of biotechnology such as genetically improved materials and sustainable agricultural systems like seed quality production, integrated pest management etc...
- Developing adequate and regular training programs for farmers, technicians and extentionists;
- Supporting the creation of efficient and sufficient agricultural cooperatives;
- Strengthening coordination and networking among and between the different public and agricultural institutions;
- Imropving agro-industries and food processing to increase the added value from the agricultural sector.

These objectives can not be reached without regional and international support to ensure appropriate technology, skilled personnel and financial resources.

8.2.3 Technical level

New and appropriate technologies are needed in various production systems in order to overcome the most technical constraints. In this regard, there is a need to:

- Strengthen on-farm testing trials and the transfer of adequate technologies especially those relevant to small farmers;
- Enhance breeding and seed technology programs which should develop improved high yielding varieties and better seed quality;
- Develop divsersification programs in a way to avoid monculture and monocultivar systems and promote the cultivation of new improved cultivars;
- Develop the *in situ* and *ex situ* conservation of old varieties and landraces;
- Enhance extension services for farmers and producers regarding the cultural practices such as irrigation, pest mangement, pesticides residues in fruits and vegetables, food processing, rotation …
- Establish an agronomic calendar taking into consideration agro-ecosystems specifications (cultivating crops in their suitable season) and quality and agro-economic aspects (rotation between leafy vegetables in winter and fruit vegetables in summer).
- Valorize in a sustainable way the marginal lands and maquis through selective sowing or planting of wild and useful plant forms of the neglected and underutilized species. This includes fodder plants enrichment of range lands, sowing medicinal and aromatic plants to increase the added value of the maquis and intensifying the reforestation efforts mainly for P*inus pinea* in suitable lands, *Ceratonia siliqua* in the lower Mediterranean slopes, *Rhus coriaria* in the xerotic slopes and *Capparis spinosa* in semi-arid areas and marginalized lands.

Conclusion

Finally, to ensure food security, the Government of Lebanon should support the PGRFA management in a way to meet Barraclough's theory[12] (1991). Accordingly, a food system should be characterized by:

- Maximum autonomy and self-determination, which reduces vulnerability to international market fluctuations and political pressures;
- Reliability, such that seasonal, cyclical and other variations in access to food are minimal;
- Sustainability, such that the ecological system is protected and improved over time;
- Equity, meaning, as a minimum, dependable access to adequate food for all social groups.

[12].Barraclough S.L., 1991. An end to hunger? The social origins and food strategies. A report prepared for the United Nations Research Institute for Social Development (UNRISD) and the South Commission based on UNRISD research on food systems and society. London and Atlantic Highlands, USA, Zed books Ltd in association with UNRISD.

ANNEX 1

PARTICIPATING INSTITUTIONS, WORK TEAM MEMBERS, STEERING COMMITTEE

- **Institutions Participating in the project "Establishment of a National Information Sharing Mechanism on the Implementation of the Global Plan of Action on Plant Genetic Resources for Food and Agriculture (PGRFA)"**

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- **Work plan of the project "Establishment of a National Information Sharing Mechanism on the Implementation of the Global Plan of Action on Plant Genetic Resources for Food and Agriculture (PGRFA)"**

Activity	Timeframe (deadline)	Responsible person(s)
Reviewing all documentation, briefing and raising awareness of authorities and getting necessary permissions to undertake a collaborative information sharing process	7 April 2006	National Focal Point
Development of the draft work-plan for the entire process	7 April 2006	National Focal Point
Establishment of steering committee of key stakeholders	7 April 2006	National Focal Point
Identification and formation of team work	15 May 2006	National Focal Point
Identification of participating stakeholders	15 May 2006	National Focal Point
Development of agenda and preparatory work for the 1st workshop (invitation letter)	15 May 2006	Project Team
First updating of information for "common tables" (Organizations table, Contact persons table, Projects table, Cultivars table, References table, and Agreements table)	25 May 2006	Project Team
1st Workshop (presentation of project and strategy for its implementation, stakeholders' commitment building)	1 June 2006	National Focal Point and Project Team
Development of agenda and preparatory work for the 2nd workshop	20 June 2006	National Focal Point
Complete updating of "common tables" based on information received from stakeholders (Organizations table, Contact persons table, Projects table, Cultivars table, References table)	1 July 2006	Project Team
Preparation of computer application CDs to be distributed to stakeholders at 2nd workshop	3 July 2006	Robert Kalaily
2nd Workshop (understanding of indicators and reporting format; training of stakeholders in the use of the computer application; distribution of software; agreement on data delivery timeframe)	4 July 2006	Project Team
Assistance to stakeholders for gathering and recording information on the Reporting Format using the software	31 July 2006	Project Team
Data delivery from stakeholders to National Coordinator	31 July 2006	National Focal Point
Stakeholders data are merged into the National database	15 August	Project Team
National coordinator complete reporting format by answering country-level questions, taking into consideration stakeholders data and by summarizing comments provided by the stakeholders to the last question of each priority activity area of the GPA	30 August	National Focal Point
Analysis of data recorded under the Mechanism	15 September	Project Team
Organization of a task force for the preparation of the country report on the state of PGRFA - Assignation of responsibilities for the drafting of different chapters of the country report on the state of PGRFA	10-15 September	Project Team + Authors
Preparation of draft report on the process for the establishment of the National Info-Sharing Mechanism on PGRFA	20 September	Project Team

Activity	Timeframe (deadline)	Responsible person(s)
Development of pages content and structure for the web site of the National Info-Sharing Mechanism on PGRFA	20 September	Project Team
Delivery of web pages and Mechanism database to FAO for making them available on internet	20 September	Project Team
Chapters of the country report are assembled into a coherent draft report	10 October	Authors + National Focal Point
Distribution of the country report to stakeholders for comments	15 October	National Focal Point
Development of agenda and preparatory work for the 3rd workshop	15 October	National Focal Point
Preparation of CDs with consolidated database to be distributed to stakeholders at 3rd workshop	20 October	National Focal Point
3rd Workshop (finalization of the country report; distribution of consolidated national database to stakeholders; distribution of software; agreement on plan for Mechanism sustainability)	30 October	National Focal Point, Project Team, Authors
Submission of the second country report, the report on the process and the database of the Mechanism to FAO	15 November 2006	National Focal Point
Submission of the project financial statement to FAO	15 December 2006	National Focal Point

N.B: Due to the war of July and August 2006 and its consequences, all activities after July 14 were delayed.

ANNEX 2

CROPS CULTIVATION AREAS AND PRODUCTIVITY IN 2002 AND 2003

TABLE 1

Cul tion areas of cereals, leguminous and leafy legumes (Ministry of Agriculture – FAO, Global Agricultural Census in Lebanon)

Type de culture	2002		2003	
	Superficie (Ha)	Production (10^3 T)	Superficie (Ha)	Production (10^3 T)
Céréales				
Blé	43,507	119.0	45,808	116.3
Mais	845	2.7	930	3.3
Orge	11,502	17.1	13,911	25.0
Autres	171.0	126.1	61.0	182.2
Total	**56,025**	**264.9**	**60,710**	**326.8**
Légumineuses				
Haricot sec	413	1.0	188	0.3
Fève sèche	-	-	370	0.8
Lentilles	1,600	1.8	1,117	1.5
Pois chiche	2,921	3.2	1,989	1.9
Petit pois	566	4.5	578	5.4
Haricot	2,548	29.0	1,861	20.7
Fève vert	1,346	13.6	1,653	16.1
Autres	429	0.4	390	3.3
Total	**9,823**	**53.5**	**8,146**	**50.0**
Légumes à feuillles				
Artichaut	142	3.9	142	2.9
Choux	1,193	35.8	889	20.1
Choux	1,388	52.2	1,642	58.4
Laitue	718	17.3	1,117	22.1
Cultures pour salade	842	17.0	508	16.0
Epinard	280	9.3	127	2.6
Mélochie	355	2.8	263	1.3
Autres	144	1.8	285	4.0
Total	**5,062**	**140.1**	**4,973**	**127.4**

TABLE 2

Cultivation areas of fruit legumes, tubers, industrial crops and fruit trees (Ministry of Agriculture – FAO, Global Agricultural Census in Lebanon)

Type de culture	2002		2003	
	Superficie (Ha)	Production (10^3T)	Superficie (Ha)	Production (10^3 T)
Légumes à fruit				
Melon	1,134	32.2	426	8.3
Piment	322	4.2	202	3.6
Concombre	2,472	132.1	3,787	156.0
Aubergine	964	18.3	778	19.0
Courge	1,536	23.5	1,429	21.2
Gombos	1,045	2.6	1,468	4.8
Tomate	5,163	270.5	3,815	217.1
Pastèque	2,657	67.7	2,436	86.7
Total	**15,293**	**551.1**	**14,341**	**516.7**
Tubercules Racines et Bulbes				
Pomme de terre	16,861	397.1	19,166	416.4
Oignons	2,342	72.6	1,985	62.5
Ails	510	9.2	477	5.1
Carottes	871	34.6	967	30.1
Autres	152	1.5	492	4.9
Total	**20,736**	**515.0**	**23,087**	**519.0**
Cultures industrielles				
Betterave sucrières	-	-	-	-
Tabac	8,795	9.7	8,983	9.9
Autres	1,631	1.4	719	2.1
Total	**10,426**	**11.1**	**9,702**	**12.0**
Arbres Fruitiers				
Orange	8,780	155.4	10,157	222.0
Mandarine	2,409	42.5	2,195	44.1
Citron	3,540	81.2	3,549	83.2
Pamplemousse	455	10.2	525	14.9
Pomme	9,380	150.3	9,389	152.0
Poire	3,080	27.5	3,390	38.7

TABLE 3

Import and export figures of various crops in 2001, 2002 and 2003 (Ministry of Agriculture – FAO, Global Agricultural Census in Lebanon)

Produit	Importations (Tonnes)			Exportations (Tonnes)		
	01	02	03	01	02	03
Céréales	792,509	827,079	901,056	1,110	5,831	6,361
Légumineuse	47,969	41,185	37,029	2,639	3,354	123
Sons/aliment de bétail	134,483	132,354	68,468	41,285	54,722	48,662
Légumes	137,667	149,875	165,664	105,788	165,723	149,923
Grains oléagineux	58,916	110,888	154,695	4,244	7,243	7,477
Arbres fruitiers et autres arbres	42,140	38,986	37,397	206,125	190,753	230,416
Olives	0	70	435	45	19	14
Fleurs & Roses	11,117	12,234	13,331	640	641	603
Café/Thé/ Epices	32,507	22,277	21,332	1,353	1,780	2,081
Tabacs bruts	1,229	2,858	1,708	8,882	4,532	8,389
Total	**1,258,537**	**1,337,806**	**1,401,115**	**372,111**	**434,598**	**454,049**