



## **The Hashemite Kingdom of Jordan**

### **National Center for Agricultural Research and Technology Transfer (NCARTT)**

**Draft**

### **The Second Country Report on the State of the Plant Genetic Resources for Food and Agriculture**

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## Executive Summary:

The Hashemite Kingdom of Jordan has always recognized a high priority to plant genetic resources (PGR). As early as in 1927, their conservation became part of the governmental policy with the adoption of the Forests Law, which was the first national law on biodiversity conservation. Since then, the Government of Jordan has committed itself to promote natural resources management through the implementation of a number of strategies and policies aimed at protecting the environment and its biodiversity.

With the ratification of the Convention on Biological Diversity in 1993, and of the International Treaty on Plant Genetic Resources for Food and Agriculture in 2001, efforts for the conservation and sustainable use of plant genetic resources have significantly increased at national level. A National Environmental Strategy was developed and adopted in 2002. It identifies the establishment of reserves as a top priority for wildlife and habitat preservation. Currently, 10.9% of total land areas have been established as protected areas. These include seven nature reserves, seven national parks, one marine reserve, and 28 grazing reserves. For the year 2012, the new national target is to reach 12% of Jordan total area established as protected areas.

A number of projects and activities for *in situ* and *ex situ* management of plant genetic resources, as well as for their improvement, have been implemented. The national gene bank for *ex situ* conservation was established in 1993. It now conserves, documents and makes available for utilization purposes more than 3200 accessions from 300 species. Improvement of local seed production is one of the mechanisms that have been utilized in the last 10 years to promote the sustainable utilization of local varieties. This was coupled with the involvement of local communities in on-farm participatory plant breeding programs and the development of small scale (traditional) seed production systems. Many institutions and agencies are trying to help farmers and local communities in marketing their rural and traditional products. Unfortunately there is no sustainable national strategy or plan in this area.

The diversity of wild, semi-domesticated and underdeveloped species also plays a vital role to ensure food security, and the livelihood of rural people. Their potential for further development and wider use should be given more attention, considering that more than 100 edible-wild plants are utilized by local communities in Jordan.

The conservation and sustainable utilization of plant genetic diversity is crucial to meet the country's future development needs. An increasing number of socio-economic and environmental factors, including climate changes, are posing a serious threat to this diversity. It is essential to enhance collaboration and cooperation among governmental institutions, the private sector, NGOs, and local communities for the long-term conservation, management and sustainable use of plant genetic resources. The development of participatory monitoring tools, such as the recently established National Information Sharing Mechanism on plant genetic resources, if adequately supported, can play an important role assisting decision making processes by identifying changing needs and priorities, and contributing to raise public awareness of the importance of these resources.

A major capacity development effort should be taken to increase the awareness and familiarity of decision makers with the new concepts of biodiversity and genetic resources management practices.

## 1. INTRODUCTION

The Hashemite kingdom of Jordan is a constitutional monarchy, which gained independence in 1946. Jordan is centrally located in the eastern Mediterranean between latitudes 29°30' and 32°31'. It's bordered with Syria in the north, Saudi Arabia in the south and southeast, Iraq in the east, and Palestine in the west. The country would be land blocked-in if not for the short (26 kilometers large) shore in Aqaba on the tip of the Gulf of Aqaba, which gives the country access to the sea. The area of Jordan is about 89,322 square kilometers, of which over 80% are semi-arid and arid areas.

### Climate in Jordan

The climate in Jordan varies a lot from one region to another. West of Jordan has Mediterranean climate, characterized by dry hot summer and mild wet winter and extreme variability in rainfall within and among years. Mild summer and a cold winter characterize the climate in the high lands of Jordan. Aqaba governorate and Jordan valley regions are very similar in their temperature pattern to subtropical climate; being hot in summer and warm in winter. The steppe and steppe desert regions have continental climate with large amplitudes of temperature. Topography of the land is the main factor controlling the spatial distribution of temperature.

Rainfall occurs in the period from November to March. The annual rainfall ranges 30-100 mm in the steppe desert, while it exceeds 600 mm in some areas of the highlands, with large variability between and within the regions. Rainfall decreases considerably from west to east and from north to south. The average annual rainfall volume in Jordan is 8.5 billion cubic meters. About 12% of this volume is available for use from springs, runoff or groundwater while the remaining 88% is lost through evaporation. Water consumption from all sources is divided as follows: 300 MCM for municipal and industrial use and about 700 MCM for the agricultural sector. Snowfall is rare and conferred, generally, to high elevations (e. g. Shoubak and Ajlun mountains).

Relative humidity varies largely from season to another and during the day. This variation depends on the region and the nature of soil cover. Relative humidity is low during summer. It is about 50% in highlands, while it drops to about 30% in the steppe. Maximum values of more than 75% were recorded in the high lands during winter and values of 40 - 45% in the steppe. Jordan is divided according to agro-climatic zones to five zones (Table 1)

**Table1. Land area in Jordan according to agro-climatic zones.**

<b>Zone</b>	<b>Annual Rainfall (mm)</b>	<b>Land use</b>	<b>Area (M ha)</b>	<b>% Total area</b>
<b>Semi Desert</b>	<200	Rangelands, irrigated crops	8.08	90.5
<b>Arid</b>	200-350	Wheat and Barley	0.51	5.7
<b>Semi-Arid</b>	350-500	Wheat, Barley and food legumes	0.19	2.1
<b>Semi-Humid</b>	500	Fruit trees	0.10	1.1
<b>Water Area</b>	--		0.05	0.6
<b>TOTAL</b>			8.93	100.0

**Source: Water Authority, National Water Master Plan - 2001**

## **Bio-geographical regions of Jordan**

Jordan forms part of the Mediterranean region and is characterized by the Eastern Mediterranean climate, which has a mild and moderately rainy winter and a hot dry summer. However, spring and autumn do not have specific entity. Four bio-geographical regions namely, Mediterranean, Irano-Turanian, Saharo-Arbian and Sudanian can be identified.

### **The Mediterranean Region:**

This region is restricted to the highlands of Jordan extending from Irbid in the north to Ras En-Naqab in the south. The altitude ranges from 700-1750 m above sea level. The rainfall ranges from 300-600 mm. This region comprises the most fertile part of Jordan and presents the best climate for the forest ecosystem.

### **Irano-Turanian Region:**

It is a narrow strip of variable width which surrounds the entire Mediterranean region except in the north. The vegetation is mainly of small shrubs and bushes. The Irano-Turanian region is a transitional zone between the Mediterranean region and the surrounding region. The altitudes usually range from 500-700 m, and rainfall ranges from 150 to 300 mm. The mean annual minimal temperature varies from 5 to 20°C, and the mean annual maximum temperature ranges from 15 to 25°C.

### **Eastern desert Region or “Badia”:**

Some authors refer to it as Saharo-Arabian region. This region forms most of the territory of Jordan. This region comprises the largest part of Jordan encompassing almost 80% of the total area. The altitude ranges between 500 and 700 m, yet there are recorded few places on the northeastern borders of Jordan which reach 1200m. The mean annual rainfall ranges from 50 to 200 mm. Vegetation is dominated by small shrubs and small annuals located in wadi beds.

### **Sudanian Region:**

This region started at al-Karamah in the north and continues to the south through the Dead Sea depression and Wadi Araba, which end at the tip of Gulf of Aqaba. The most important characteristic of this region is its altitude, considered the lowest point on earth (-400m below sea level), providing a unique environment and thus a unique ecosystem. Annual rainfall ranges from 50 to 100 mm. The only inland sand dunes in Jordan are restricted to this region. Vegetation is characterized by the presence of tropical tree elements in addition to some shrubs and annual herbs.

The borders of the four regions are not stable and are not well defined because of the integration of ecological elements between the two adjacent regions. Moreover, the climatic conditions, which vary considerably from year to year, affect the stability of these borders.

## **Population**

Jordan had witnessed many waves of compulsory migrations that have significantly contributed to the abnormal increase in population, of which the last was due to the influx of over 300,000 Jordanians residing in the Gulf States as well as 250,000 Iraqis and Arabs from other nationalities as a result of the Gulf War.

Rapid population increase in a narrow strip within the main cities of Amman, Zarqa, and Irbid has placed unprecedented demands on natural and water resources, as it has done on the infrastructures and the economy in general. Total demand for water resources is approaching one billion cubic meters per year, which approximates the limit of Jordan's renewable and economically developable water resources. The total population of the kingdom reached

5,480,000 individuals in 2004. The population is increasing at a growth rate of 2.8 percent per annum with a natural increase rate of 2.4%. This rate of increase indicates that the populations will double itself in a period of about 25 years. The average life expectancy at birth is 70.6 years for males and 72.4 years for females and the sex ratio is 110:100. The rise in life expectancy through a short period of time is a salient indicator to the socio-economic development in the country as well as to the efficient medical health care provided by the government, the armed forces and the private sector.

### **Contribution of agriculture to the national economy:**

Agriculture's contribution to the gross domestic product (GDP) has declined in recent years from 173.7 million JD (1 Jordanian Dinar (JD) =1.5 US\$) in 1995 to 114.6 million in 2000. Its share of the GDP has fallen from 4.26% in 1995 to 2.25% in 2000. However, when agri-business activities are considered, the contribution of agriculture to the GDP reached 22% In 2002.

### **Main farming systems, Crop farming system:**

Farming system in Jordan is mainly dependent upon water availability. The average area under rain fed agriculture in Jordan during 1980-1991 was 0.23 million hectare, 0.14 million hectare is planted with winter crops (wheat, barley, lentils, broad beans and forages). The area planted with summer crops is 8.1 thousand hectare (chickpeas, sesame, corn, and tobacco) and (8.1) thousand hectare is planted with vegetables (tomato, eggplant, squash, cucumber, cabbage, onions, potatoes, watermelon, lettuce, spinach, okra, and others), whereas, 70.7 thousand hectare were planted with fruit trees and about 10 thousand hectares with forages (Table 2).

**Table 2. Area of crops grown in Jordan during 1995-2005. (1000 ha).**

	1995	1996	1997	1998	1999	2000	2005
<b>Field crops</b>	150.0	121.0	161.0	172.0	184.0	116.0	121.0
<b>Vegetables</b>	42.9	27.2	30.3	7.4	35.7	32.9	40.2
<b>Fruit trees (bearing &amp; non-bearing)</b>	70.7	71.9	83.1	84.6	85.7	86.9	86.1
<b>Total</b>	263.6	220.1	274.4	264.0	305.4	235.8	247.3

### **The State of Food Security and Rural Development**

Due to scarcity of water and low rainfall only about 380,000 ha are suitable for cultivation and only 17% of this area is irrigated, which accounts for less than 0.1 ha/capita. Jordan imports partly the basic food commodities (wheat, legumes, red meat and fish), and some vegetables. Rice and sugar are totally imported. Food of animal origin accounts for the main food expenditure (14.4%) of families in Jordan, as found in a study conducted recently. Animals and animal products amount to 39% of the total value of imported foods. The value of imports is expected to increase with the increase in population and the improvement in the standard of living. The average per capita consumption of meat, milk, eggs and broiler per year is about 11 kg, 69 kg, 152 eggs and 24 kg, respectively.

Animal production sector has a very important role on food security in Jordan, more than 45,000 families are dependent mainly on sheep and goat raising. The poverty line, calculated as the minimum amount of money required for covering food, clothing, shelter, primary health

services, basic education and transportation, is estimated to be 15\$ per family per month, for families not paying a rent and 180\$ for families paying a rent. The percentage of families living below the absolute poverty line was 14.3% (department of statistics , 2001).

The Government of Jordan practices different types of intervention in support of the agriculture sector through price control, subsidies, enforcing cropping patterns, and adopting foreign trade policy aiming at ensuring reasonable income for local producers. For example, in support of local production, the Government purchases wheat, barley, chick peas and lentils at subsidized prices.

In 1989 the Government adopted a comprehensive package of economic adjustments aimed at increasing the rate of growth of gross domestic product. The agricultural sector has been mostly affected by this economic adjustment program especially with the removal of subsidies for agricultural products. Government employment is the main factor contributing to decreasing poverty. 60% of non-farm income for rural poor comes from government wages, while less than 20% of rural areas inhabitants receive their income from non-farm resources. The policy of the Government is concerned with increasing production of food commodities, improving the efficiency of resources allocation, adopting new technologies to increase productivity of plant and animals, improving the quality of products, improving the standard of living, producing competitive agriculture products and encouraging the rural food industry.

To achieve the aims of the food security policy the government took several measures which interested the agricultural sector, among these:

- The economic adjustment program.
- Income diversification project (introducing credit and loans that enable farmers to purchase improved sheep and goats, fruit trees plantations, feed production).
- The Jordan Badia research and development program.
- Development of integrated crop livestock production systems in low rainfall area.
- Promotion of herbal and medicinal plant sector in Jordan.
- Bio-diversity project.
- Integrated natural resources management of Yarmouk basin.
- On-farm water use husbandry.
- Integrated best management project.
- Development of agriculture at Wadi Al-Arab basin.
- Develop the rural women in food processing.
- Improve post-harvesting techniques.
- Management of natural resources in Wala basin.

## Chapter One: The State of Diversity

### The land resources of Jordan

Land resources of Jordan are utilized as shown in Table 3. Rangelands in the semi-desert regions constitute 90% of the total land area. Of the approximately 8.1 million hectares of range-lands, about 5.9 million hectares receive less than 50 mm of rainfall annually while about 2.2 million hectares receive between 50 and 200 mm. The rainfall in the semi desert regions is irregular and of uneven distribution, and moreover, these lands suffer from general state of degradation due to harsh environmental conditions and misuse due to overgrazing and cultivation especially in the marginal areas. There were 92,258 holdings in 2000, of which 75,978 with an average of 4 hectares, and about 15 hectares for the rest in the whole country.

About 41% of the total irrigated area is located in the arid and semi-arid regions, 39% in the very arid region, and the remaining 20% of the total irrigated area is located in the semi-desert region. The irrigated area of the Jordan Valley and southern Ghor is about 30.4 thousand hectares. The main source of irrigation water is from surface water.

**Table 3. Land utilization in Jordan.**

Utilization pattern	Area (M Ha)	% Total area
Rangelands	8.07	90.4
Buildings & Public Utilities	0.17	1.9
Land used for Forestry	0.07	0.8
Land registered as Afforested	0.06	0.7
Water Area	0.05	0.5
Agriculture Land	0.51	5.7
<b>Total</b>	<b>8.93</b>	<b>100.0</b>

The cultivated land under irrigated system was 83.7 thousand hectare in 2003 whereas, 222.8 thousand hectare under rain fed conditions. This increase was more than doubled within 14 years. The decrease in the cultivated rain fed areas was a result of urbanization. Moreover, the rain fed areas is suffering from small holding size, which constraint cultivation and crop mechanization. Traditional crops such as wheat, barley and lentils became uneconomical to grow; therefore there is a shift to grow more economical crops such as olives, vegetables and medicinal herbal plants on a small scale (Table 4).

**Table 4: Crop production (1000 ton) - 2000 to 2004**

<b>Crop/ year</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>
Wheat	25.4	19.3	44.0	42.50	13.2
Barley	12.1	17.3	56.0	25.80	21.0
Vegetables	966.0	844.0	1,170.0	1,137.0	1,341.0
Summer veg	503.0	387.0	604.0	474.0	595.0
Winter veg	463.0	457.0	566.0	663.0	746.0
Olives	134.0	66.0	181.0	118.0	161.0
Grapes	24.0	58.0	35.0	28.0	32.0

**Table 5: Average yield (Tons/hectare) of crops in Jordan during 2000-2005**

<b>Crop/ year</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>Average</b>
Winter field crops	1.12	1.44	1.3	1.02	0.9	1.34	1.2
Summer field crops	16	20.4	30.6	18.1	15.4	20.9	20.2
Tobacco	0.6	1.3	1.8	2.1	1.8	1.5	1.52
Total vegetables	23.33	24.31	30.16	27.87	30.18	30.00	27.62
Olives	2.11	1.02	2.80	1.83	2.49	1.75	2.00
Citrus	15.5	17.8	15.8	21.1	18.9	18.9	18
Grapes	6.4	15.4	8.9	7.7	8.9	7.5	9.5
Figs	4.4	3.1	7.3	5.9	6.4	6.2	5.6
Apple	9.4	9.4	9.9	10.8	11.0	11.8	10.4
Stone fruit	4.6	3.9	8.4	5.8	7.1	7.2	6.17
pomegranate	11.2	9.8	13.2	10.6	8.5	11.9	10.9
Pear	3.3	3.5	7.6	6.1	1.3	9.3	7.1
Guava	9.3	12.7	11.3	9.05	10.7	10.0	10.5
Date	5.0	5.4	6.1	3.4	6.6	5.1	5.3
Banana	10	11.7	20.8	17.4	28.8	25.0	19.0

## The main value of plant genetic resources:

Jordan is considered a center of origin of wheat, barley, food and forage legumes and many fruit trees such as almond and figs. A significant diversity in the country can be found among cultivated land races of grapes, olives, wheat, barley, chickpea and lentils. These crops, as well as the products derived from them such as olive oil, olive pomace, wheat dough, burgul, freeka, play a central role for the food security and livelihood of Jordanian farmers. The importance of these crops and products vary considerably. For example olive oil production amounts to about 80- 100 million JD, while olive pomace commercial value is between 2.5-3.00 million JD. Recent data shows that the olive crop in Jordan is one of the main agricultural crops as it occupies 36% of the total planted area and 72 % of the fruit trees plantation.

Through a GEF funded project on agro-biodiversity, which was completed in 2005, sixteen target crops (or crop groups) of global or regional significance and their wild relatives were studied and strategies for their conservation were implemented (Table 5).

**Table 6: Plant genetic resources studied by agro-biodiversity project during 2002-2005.**

Crop	Germplasm	Crop	Germplasm	Crop	Germplasm
<b>Wheat</b>	Wild <i>Triticum</i>	<b>Vetch</b>	Wild <i>Vicia</i>	<b>Plums</b>	Local Varieties
	Land Races	<b>Medics</b>	Wild <i>Medicago</i>	<b>Almonds</b>	Wild <i>Prunus</i>
<b>Barley</b>	<i>H. spontaneum</i>	<b>Clovers</b>	Wild <i>Trifolium</i>		
	Land Races	<b>Olives</b>	<i>Olea oleaster</i>	<b>Pears</b>	Wild <i>Pyrus</i>
<b>Lentils</b>	Wild <i>Lens</i>		Local Varieties		
		Land Races	<b>Apricots</b>	Local Varieties	<b>Allium</b>
<b>Pistachios</b>	Wild <i>Pistachio</i>	<b>Figs</b>	Local Varieties		Local Varieties
	Local Varieties	<b>Cherries</b>	Local Varieties		

### Diversity within and between Crops

Some crop species are now considered to be on the verge of national extinction. This is the result of many threats including destruction of natural habitats and ecosystems, introduction of invasive species and modernization of transportation techniques. About five species are extinct from the wild (Jordan Country Study On Biological Diversity, 1998).

Plant diversity in Jordan is facing a dramatic decline as a result of habitat loss and degradation. Such destruction has led to the isolation of many species, which, in turn has led to a loss of their genetic diversity, and to a high risk of extinction. Currently, between 200 and 250 plant species are nationally rare and 100 to 150 species are nationally threatened. *Triticum dicoccoides* the direct progenitor of durum wheat is one of the most threatened species in Jordan if conservation strategies are not applied to the sites of origin. Other crops such as wild almond and historical olive trees are under threat due to the replacement of these species by the new varieties.

Regarding the state of diversity for minor and under utilized species there is no reliable record available. Wild plants' diversity, especially medicinal and herbal plants are dramatically

decreasing from natural habitats. *Thymus* species which were once abundant in Ajlune, Salt and Amman areas, are now rarely encountered in the wild.

Activities addressing farmer's landraces conservation have begun since the year 1995. The biodiversity program at NCARTT collected about 100 vegetables landraces and conserved these resources in the gene bank. The conservation of these resources requires continuous financial support.

NCARTT identified a number of hot spots with high priority for *in situ* conservation of specific crops' wild relatives and land races. Among these are the agro-biodiversity *in-situ* sites in the Ajlune governorate. Through the Conservation of Medicinal Herbal Plants project at least 10 more *in-situ* conservation sites were identified ,and managed in the year 2007. Furthermore, *ex-situ* field gene banks for fruit trees land races and their wild relative was established at different research centers. However, without continued financial support for these and more *in situ* conservation and on farm management activities, genetic erosion of valuable germplasm will continue at high rates.

In 2005, the Government of Jordan released the National Agenda, a document which describes the national policy and targets relevant to the conservation of biodiversity.

The National Biodiversity Strategy and Action Plan constitute a major contribution to the country's development plan. This strategy was released in the year 2003. It envisages that land, water, pasture, terrestrial and marine ecosystems, as well as wildlife and aquatic resources are central to agriculture, fisheries and tourism development.

Jordan established a Genetic Resources Unit (GRU) in 1993 at the National Center for Agricultural Research and Technology Transfer (NCARTT)/Ministry of Agriculture through a project supported by the United States Agency for International Development (USAID). In 1996 this unit became part of a full program and complemented with a biotechnology lab. Presently the program is composed of two major components, one addressing agro-biodiversity and the other, medicinal and herbal plants. Activities of the program are dedicated to plant genetic resources' collection, documentation, *in situ* and *ex situ* conservation, and utilization.

Jordan still has some work to do in the field of raising public awareness, formulating policies and strategies, enforce legislations, improve national, regional and international cooperation, and finally documenting the national biodiversity work both in research and nationally-organized meetings.

### **Factors influencing the state of plant genetic diversity in the country**

A number of factors threaten country's diversity. Among these, are the loss and degradation of habitats, over-exploitation of plant species, extensive agricultural and unplanned developmental activities, pollution, invasion of introduced species, overgrazing, water extraction, intensive use of agrochemicals, population pressure, land use legislations, climatic conditions, development and urbanization. Many of them have concurred to habitat fragmentation and ecosystem degradation. Financial constraints have impeded to take appropriate and effective measures to counter-balance these negative factors, which are seriously threatening populations of wild wheat, barley, chickpeas, lentil, almond, the historical Roman olive trees, many fruit trees wild

relatives, and wild medicinal and herbal plants. Genetic diversity for some underutilized species were not studied properly including sumac, pomegranate , pistachio and fig.

### **Future Needs and Priorities**

The state of plant diversity conservation and management within the country needs to be strengthened to meet current and future challenges. The Plant Biodiversity Program at NCARTT appears inadequately staffed and funded to effectively cope with all these challenges. More capacity is required nation-wide. Financial support to implement strategies for conserving genetic resources *in situ* and *ex situ* are highly needed. Cooperation and coordination between different institutions also need to be improved. Monitoring and evaluation units for the state of the plant genetic resources at the national level should be established under the active coordination of a national committee for the conservation and sustainable use of plant genetic resources.

There is a need to establish mechanism for financial support to the local community, many of the alternative livelihood demonstrations are needed to be started. More work is needed to improve rangelands and *in situ* conservation of wild species; Issues that remain to be faced include poverty, inequitable land ownership, destructive land reclamation, inappropriate herd sizes and a lack of community empowerment and necessary policies.

The Ministries of Agriculture and Environment need to work jointly on making policy changes. Laws and legislation regarding the plant genetic resources conservation are in need to be established and implemented. Policy work did not go far enough for decision-makers to adopt it. In addition to options analysis, detailed analysis of legal changes and implementation actions are needed. There is a real need to consolidate, to fill gaps in our knowledge and to share lessons learned about what is being done and with what results. More people need to be involved, including all current partners as well as a new range of interests and expertise. Finally, it is essential to build on the activities created in the past six years to preserve plant genetic diversity.

## **Chapter two: The State of In situ Management**

### **Introduction:**

Jordan has given high priority to conservation and sustainable use of biodiversity components, in view of its position in a region of uncertain political condition, the climatic conditions, and the country's rapid development and urbanization that have led to habitat fragmentation and ecosystem degradation. This situation is also manifested in financial constraints, which have impeded adequate progress in implementing Of different national programmes As a result, the programs of work for implementing some articles of the International Treaties have not yet been integrated into national policy and to the developmental action plans, and national financial allocations for implementation have been inadequate.

### **Inventories and Surveys (Assessments and Priorities):**

The national program in the last 10 years tried to improve it's capacity in conducting inventories and surveys and maximize the benefits out of these inventories and surveys of plant genetic resources through the following actions:

#### **1. Training.**

Different types of training has been done on different subjects related to inventory and surveys including degree and non degree training in GIS, Taxonomy, Eco-geographical survey, Socio-economic survey. These training courses including the following subjects:

#### **Degree Training:**

University courses were offered for students in agricultural and several masters and Ph.D for their work on topics covering :

- Morphological characterization and seed germination of wild and landraces.
- Agro/Morphological and Molecular assessment of landraces.
- Use of GIS and Remote Sensing to evaluate Land Use and Land Cover.
- Socio-economic inventories and surveys to determine on farm agro-biodiversity contribution to the local community income.
- On Farm management practices.
- In Vitro Preservation of plant species.
- Determine phenotypic diversity for agronomic and morphological trials of landraces.
- Study biodiversity of insect plant pollinators and identify the wild flowers visited by bees.

#### **Non Degree Training:**

Staff received in country and outside country training on

- Management of Biodiversity in the different eco-systems.
- Database management training.

- Molecular markers tools and biodiversity studies.
- Rangeland and Livestock Management for Promoting the Conservation of Local Agrobiodiversity.
- Intellectual Property (IP) Management in Agriculture.
- Monitoring, evaluation and impact assessment of R&D projects.
- Plant tissue culture
- Participatory plant breeding
- Plant taxonomy and identification of target species
- In-situ conservation of plant species.

## **2. Surveys and inventory conduction:**

Different inventories and surveys have been conducting in the last 10 years by the national program at NCARTT, the NGO's and the graduate students. The list of inventories and surveys and their date are presented in **Chapter 3**.

Infrastructure improvement and laboratory equipments: The national program tried to improve the infrastructure and upgrade the laboratory facilities to improve its capacity. The following laboratories were established in the last 10 years.

- GIS Laboratories; three GIS and Remote sensing are working well in Jordan at the Royal Geographic Center, The University of Jordan and NCARTT. These laboratories are providing all support needed in land cover and land use of plant species.
- Molecular biology laboratories: Most of the Universities in addition to NCARTT have within its campus a molecular laboratory, at Jordan University of Science and Technology there is a molecular biology center which is well equipped and can support all kinds of PGR conservation and utilization studies.
- Seed unites and laboratories: In Jordan there are three seed laboratories at NCARTT, The University of Jordan and Jordan University of Science and Technology, but these laboratories need more equipments and more capacity building of the staff. .

In spite of all efforts that have been done to build the national program capacity and to improve it's capability to do useful inventories and surveys, still there are a lot of constraints that has to be taking care of. These constraints can be divided to technical, legal and institutional.

### **Technical constraints:**

- (i) Lack of expertise in plant taxonomy.
- (ii) Lack of expertise in cytogenetics and certain areas of molecular breeding.
- (iii) Lack of training and capacity building on in-situ and on-farm PGR management.

### **Legal constraints:**

- (i) Lack of a clear policy, legislative and institutional enabling environment for regulating access to genetic resources and benefits sharing:
- (ii) Lack of clear and systematic integration of the conservation, sustainable use and benefits sharing concepts in the national policy formulation process.
- (iii) Lack of economic incentives and valuation of plant genetic resources for food and agriculture.
- (iv) Lack of clear national policies for public awareness, technology transfer and education on new concepts in biodiversity management.
- (v) Weak linkages between research and policy making.
- (vi) Inadequate capacity development for resource mobilization.
- (vii) The lack of a protected area bylaw (This has been rectified recently through the issuance of the Nature Reserves and National Parks Bylaw No. 29 for (2005)
- (viii) Weak enforcement of laws and legislations.

**Institutional constraints:**

1. Lack of a long-term coordination mechanism between institutions working in the PGRFA.
2. Lack of local community and farmer institutions that enable the sustainable use of PGRFA.

The Jordanian national programs tried to study all interested areas in the country and to conduct eco-geographical, socio-economic and botanical surveys for these areas, but still there is a lot to do in this area. In this stage the inventories and surveys in the future should be directed toward areas of high level of diversity (hot spots) and fragile areas that are affected highly by drought, urbanization and displacement by new varieties. In order to support the future needed inventory and surveys for plant genetic resources, crop-associated biodiversity and wild plants for food production, the national program need help in the following areas of expertise:

*Taxonomy, in-situ and on-farm management, natural habitat management planning, integrated rangeland-livestock management and sustainable public awareness campaigns.*

**On-farm management and improvement of plant genetic resources for food and agriculture:**

On-farm management is a new concept that has been addressed in the last few years, most of the efforts in this area has been done during the implementation of the project " Conservation and Sustainable use of Agro-biodiversity in dry areas" which has been implemented by NCARTT from 1999-2005. The project promotes on-farm conservation concept of agro-biodiversity and train the farmers on techniques and mechanisms on management of biodiversity on the farm level. In addition to that the project helps the farmers to establish their field gene banks and train them on their management. The Royal Society for Conservation of Nature (RSCN ) also changed its management plans for the reserves it run from only conservation to conservation and sustainable use through the full participation of local community in planning, implementation and management of the reserve and utilize it's

biodiversity in sustainable way. In the last 10 years most of the RSCN reserves are run by local community. The RSCN role now is restricted to research and monitoring in addition to capacity building of the local community.

To promote the on-farm conservation and sustain the management of PGRFA on the farm level, the National program support farmers with in kind incentives such as:

- (i) Training farmers on management of field gene banks and utilization of PGR for food production and processing.
- (ii) Helping farmers in establishing small enterprises such as seedling nurseries, small processing unit for jams, vinegar, and dairy production.
- (iii) Training farmers on backing and marketing their products through training farmers on backing, labeling and establishing for them permanent and occasional local markets.
- (iv) Provide farmers associations and NGO's with seed cleaners, branch shredders and spraying tanks to help them in utilizing PGRFA.
- (v) The national program also helping in establishing farmer associations for utilization of on-farm PGR and directed its incentives to other established NGO's and train their leaders on project management and small enterprise establishment in order to strengthening these local community institutions and improve their capacity.

#### **Participatory Breeding and Seed production:**

Improve local seed production was one of the mechanisms that has been utilized in the last 10 years to promote the sustainable utilization of local varieties through the full involvement and participation of local community in the improvement and selection processes through on-farm participatory plant breeding programs and the development of small scale (traditional) seed production systems. The national program provide the farmers NGO's involved in this program with seed cleaners and train them on management of small scale seed production enterprises.

The national program was interested also in widening the range of utilization of wild and local medicinal plant. It works hand by hand with farmers in order to build their capacity on conservation and sustainable utilization of wild and local medicinal plant species in order to diversify and increase farmer's income, through training farmers on seed production, processing and drying, backing and marketing of these plant species.

#### **Development of markets for products originating from traditional and underutilized varieties and crops.**

Many institutions including NCARTT and RSCN are trying to help farmers and local communities in marketing their rural and traditional products. Unfortunately there is no sustainable national strategy or plan in this area. In addition to that these institutions are not coordinating among each other and most of the time these efforts depend on out side funds on the form of project and ended by the end of that fund.

#### **Restoring agricultural systems after disasters:**

I think this issue is not taking care of, except that in Jordan we have two ex-situ gene banks and two field gene banks for fruit trees and grain crops that can provide farmers with seeds in case of any environmental problem happened.

### **In situ Conservation of wild crop relatives and wild plants for food production:**

Protected Areas in Jordan are considered the main mechanism for in situ conservation of the plant biodiversity in general and PGRFA in specific. They embrace within their management key themes of the CBD like the integration of economic development with biodiversity conservation and the sustainable use of biodiversity and they are effectively managed according to international criteria.

The National Environment Strategy identifies the establishment of reserves as top priority in wildlife and habitat sector. Currently, 10.9% of total land areas are established as protected areas including seven nature reserves being managed by the RSCN forming about 1% of Jordan area. After 1996 two new reserves are established namely; ??

The national target has recently been planned to exceed the global target, were it is Jordan target to reach 12% of Jordan total area established as protected areas in the year 2012 and to approach 15% in the year 2017.

A national protected areas review was carried out in 1998 in order to identified the threaten and more fragile ecosystems and proposed new sites for protected areas. According to this review 13 sites were suggested as potential reserves. Since than two protected areas were established (Rum Protected Area and Dibbeen Nature Reserve), and eleven more are proposed to be established. Currently, seven National Parks exist and are managed by the Ministry of Tourism and Antiquities, Local Authorities, Municipalities and Private sector, in addition to Dibbin National Park, which was established in 1970s as a recreational Park and have recently been re-established as a Forest Reserve under direct management by the RSCN.

**Table.7 Proposed protected areas suggested in the protected areas review.**

<b>No.</b>	<b>Name</b>	<b>Status</b>	<b>Area/km2</b>
1	Burqu	Proposed	744
2	Jabel Mas'adi	Proposed	294
3	Wadi Rajil	Proposed	906
4	Bayer	Proposed	460
5	Abu Rukbah	Proposed	190
6	Jarba	Proposed	40
7	Aqaba Mountains	Proposed	60
8	Jordan Valley	Proposed	08
9	Yarmouk river	Proposed	30
10	Ghor Fifa	Proposed	33
11	Qatar	Proposed	50
12	Wadi Rum reserve	Established	722
13	Dibeen Nature Reserve	Established	08

### **Limitations to in situ conservation of plant genetic resources, crop-associated biodiversity and wild plants for food production in Jordan.**

There are many limitations and obstacles facing the conservation of PGRFA in-situ. The most important constraints are discussed below:

1. Lack of clear and systematic integration of the PGRFA and CBD main concepts (conservation, sustainable use and benefits sharing) in the national policy formulation process

2. Lack of a clear policy, legislative and institutional enabling environment for regulating access to genetic resources and benefits sharing:

The issue of benefits sharing and access to genetic resources is not adequately regulated through a package of re-enforcing modern policies and legislations to ensure smooth access and balancing right to access and intellectual property rights. This issue needs also technical capacity development and institutional networking.

3. Lack of economic incentives and valuation of plant genetic resources for Food and Agriculture:

A major shortcoming in the utilization of plant genetic resources for Food and Agriculture in Jordan is the absence of economic tools for their valuation. Economic tools are to be developed and advocated in decision-making processes, with particular emphasis on providing economic incentives and economic valuation. An important component of systemic capacity development is needed to develop such economic tools.

4. Lack of clear national policies for public awareness, technology transfer and education on new concepts in biodiversity management:

Although some awareness and education programs have been implemented in Jordan, there is still a need to advocate new concepts on biodiversity science and applications, especially benefits sharing, ecosystem approach and strategic biodiversity impact assessments for various stakeholders to keep up with new technical developments.

5. Weak linkages between research and policy making

6. Inadequate capacity development for resource mobilization:

Apart from one or two experienced organizations, most institutions in Jordan lack the technical and practical knowledge for resource mobilization to implement biodiversity projects. The National Biodiversity strategy and Action Plan (NBSAP) has not been effective thus far mainly due to the absence of a practical resource mobilization plan and fundraising strategy. This is a major field for capacity development at institutional and individual levels.

## **Jordan priorities and needs to enhance in-situ conservation.**

### **A) Policy priorities**

The priorities for policy development to support an improved plant genetic resources in situ management are:

#### **1) Incentives.**

Incentives are a powerful policy tool to promote the conservation of local landraces and wild relatives. The more sustainable incentives schemes are the one directed towards groups of

farmers rather than individuals, even though the farmers opinion was in favor of the individual incentives which go back to the way these incentives are provided before;

**2) Rural women involvement.**

More involvement of rural women is needed to increase the utilization of PGRFA and improve the value-added.

**3) Building farmers institutions.**

Farmers' associations are good policy instrument that can be used to improve the value-added from conservation and improving the productivity of landraces.

**4) Promote the involvement of private sector.**

A policy should be developed to promote the involvement of private sector to invest in utilization of PGRFA..

**5) Extension services should be improved.**

A better policy is needed for improving extension services in Jordan, which takes in consideration providing additional support to biodiversity conservation through improving financial resource mobilization systems and capacity building;

**B ) Agricultural Research Priorities:**

Agricultural research should be directed towards real life problems (applied research) and it should be linked with extension services. The research should concentrate on the following to support improved plant genetic resources in situ management:

- Determining the hot spots for in-situ conservation of PGRFA.
- Identify the sources of threats and methods to stop degradation in PGRFA.
- Study on-farm conservation and utilization of PGRFA.
- Valuation for Biodiversity in hot spots of PGRFA.
- Market opportunities for products of PGRFA.
- Cost/benefit analysis of utilizing PGRFA.

**C) Other strategic directions relevant to improving the state of in situ management of plant genetic resources.**

- 1) Land use policy should be developed as one of the major factors affecting property rights.
- 2) Traditional knowledge should be respected in designing new policies or reforming current policies and legislations related to the conservation of biodiversity and utilizing neglected species;
- 3) Additional efforts are still needed to provide funds and develop micro-credit systems that focus on biodiversity conservation.

## **Chapter 3: The state of Ex Situ Management**

Jordan's Strategy relates both to habitats and to key species such as endangered species, endemic species, and species of international importance. Indicators for implementation are being designated for both habitats and species

The National Center for Agricultural Research and Technology Transfer (NCARTT) , established Genetic Resource Unit in 1993. The main objective of this unit is conserving plant genetic resources (in-situ and ex-situ) from extinction and deterioration, as well as making the available to user. Due to the importance of this issue establishing a Program of Biodiversity, Genetic Resources and Medicinal Plants at NCARTT in (2002), aimed to sum up diverse efforts, experts and activities concerning conservation and sustainable use of plant biodiversity. The only gene Bank in Jordan is hosted by NCARTT.

Some universities established herbariums. The herbarium at Yarmouk University is the biggest and hold about 20,000 specimens.

### **1.National Center for Agricultural Research and Technology Transfer (NCARTT)**

#### **1.1.Seed Bank.**

Since the establishment of the Plant Genetic Resources Unit (GRU) at NCARRTT 1993, an ambitious national programs and activities regarding plant genetic resources collections, conservation and utilization have been initiated and conducted where new crops were targeted. Seed gene bank was established with well equipped 70 m<sup>3</sup> cold store, in which seeds are conserved in vacuum ceiled Aluminum foil bags under 4<sup>0</sup>c temperature as medium term storage. However, long term storage rooms, which are indeed available but need to be put into effect soon. Seed Bank at NCARTT still lacks de-humidification facility which so far hindered using capped vials to substitute the old used foil bags. As the Bank started working, NCARTT has started to host again the Jordanian various germplasm held at ICARDA Seed Bank. So far 3100 has been delivered and stored safely at NCARTT.

#### **1.2. Herbarium**

The National Herbarium at NCARTT harbors about 3070 herbarium specimens some of them historic ones. Nowadays, the herbarium has been upgraded as both infrastructure and technical applications by national and outside sources of support. The number of plant specimens preserved is growing in parallel with the seed samples stored in the Seed Bank. Specimens are identified by both NCARTT and KEW Garden at UK then preserved in a systematic procedure to be as reference for users.

In the year 2001, NCARTT represented by the PGRU has ratified a benefit sharing agreement with the Millennium Seed Bank Project (MSBP) an institution dispatched from The Royal Botanic Gardens/KEW at the UK. The agreement implies collection of Jordanian Flora from various local habitats as seeds samples and herbarium specimens to be conserved as duplicated in both NCARTT and MSBP seed banks and herbariums, respectively, so as to help in identification. The MSBP supports the missions, provides technical assistance, provides training, and allows the development of mutual research projects on certain plant species.

As a result, well organized missions have commenced targeting all the Jordanian Flora, focusing on flora of expected economic, endangered and endemic species.

### 1.3. Missions:

Targeted collection missions are listed below in table (8), however, missions with MSBP/KEW (Floral collections) started 2001 till now. In which missions were continued all year round, so each year was considered as collecting missions per se.

**Table (8) Collection missions conducted in Jordan since 1996-2005.**

Mission	Collecting Organization	Family	Genus	No. of accessions	Total accessions /missions
1996/1	NCARTT/ICARDA	Graminae	Aegilops	37	89
			Hordium	8	
			Triticum	21	
1996/2	NCARTT/FAO	Leguminosae	Cicer	23	8
		Chenopodiaceae	Salsola	1	
		Compositae	Achilea	1	
			Artimisia	1	
		Cucurbitaceae	Citrullus	1	
		Labiatae	Mentha	1	
			Thymus	2	
1997	NCARTT	Rosaceae	Sarcopoterium	1	27
		Rosaceae	Amygdalus	11	
			Crataegus	14	
1998	NCARTT	Rosaceae	Prunus	2	85
			Amygdalus	51	
			Crataegus	28	
1999	NCARTT	Rosaceae	Pyrus	6	45
			Amygdalus	31	
			Crataegus	8	
2000	NCARTT	Anacardiaceae	Pistacia	10	10
2001	NCARTT	Anacardiaceae	Pistacia	4	4

On the other hand Table (9 ) shows plant categories of species according to the local inhabitants and sometimes to the speculations of collectors

**Table(9) Plant Categories preserved at NCARTT Gene bank.**

Plant category	Collection Mission									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	1999
Cereal	1				3	2				2
Forage	2				1	2	3	2		8
Legume	2									
Food Legume										
Medicinal Plant	3	1			10	13	14	12		7
Oil seed	5									
Rangland shrub	3				3	15				
Trees	1	27	85	45	10	8	4	5	3	
Vegetables	3					1	4			
Wild Plant						2	70	80		90
Weed Plant	2				7	19				
Others	4				24	38				
	5									
	3									

#### 1.4.Field Gene Banks:

Field gene banks of fruit trees land races and cultivars in 2 locations maily Mushagar and Showbak. Table (10):

**Table(10)** cultivars and land races of fruit trees conserved as individual plants at field gene banks at NCARTT

Location	Number of Cultivars per species								
	Olive	Pistachio	Almond	Figs	Apple	Peache	Nectarin	Plum	Apricot
Mushagar	47	13	24	7	---	----	----	---	----
Showabak	---	---	---	--	62	18	8	11	4

There are more fruit trees cultivars to be included in the near future such as grape cultivars. The major need for sustained collections is the optimal storage conditions as well as regular rejuvenation, which implies the need for good equipments as well as research tools so as to fulfill the requirements of good storability of major and newly collected plants species. There is still more to explore in terms of wild relatives and progenitors of food plants. special care should be put on wild relatives of fruit trees as they are still underdiscovered. more genetic material still available in nature to be incorporated in breeding programs. Fund would be needed to accomplish floral surveys as well as to identify hotspots to focus on.

**Studies and Projects:** The Biodiversity and Genetic Resource Programme since its establishment in (2002) participated in the following activities :

- Promotion, preservation and utilization of herbal and medicinal plants of Jordan (2004-2008) GEF project.
- Collection, characterization, maintaining and estimating genetic relationships of *Pistacia* wild germplasm in Jordan. (2001-2003)
- Evaluation, Characterization and seed multiplication of cereals accessions conserved in NCARTT Gene Bank. (2000-2003).
- Characterization of cereals accessions collected and conserved in the gene bank at NCARTT, studying the genetic diversity of these accessions, and identification of promising accessions that possess certain characters with the emphasis on salt and/or drought tolerance characterization of all accessions at gene level using DNA fingerprinting techniques..
- A booklet was issued (2003) to highlight annual activities of the plant genetic resources unit at NCARTT and to inform researchers in the national institutes about the availability of particular species at NCARTT/PGRU as seeds and herbarium specimens. The booklet, includes information about collected members of 43 Genera under 24 families among which some species registered in the list of the survey of economic plants from arid and semiarid lands(SEPASAL)
- Study of genetic diversity in 34 accessions of Okra and 50 Eggplant landraces landraces in Jordan (1999)
- Study on Importance of wild germplasm of *Amygdalus* Almond and Apple species (2004), local geographical distribution, morphological variability between prevailing species and conservation status of the plant resource.

**Constraint: Lack of :**

1. Incompletion of the facilities needed for proper storage in the Seed Bank such as:
  - a. well prepared drying room that is required for moisture equilibration of seeds.
  - b. equipped seed testing lab special for frequent seed viability testing and germination test of stored material.
  - c. some machines that are needed to test soundness of seeds before being stored.
  - d. dehumidifier to be installed in the storage and drying rooms.

2. Need for a fully controlled glass house space enough for seedling growing and regeneration.
3. Need to update the Database belongs to the seed bank in terms of software as well as hardware.
4. Need to adopt slow growth storage and cryopreservation for plants that rarely produce seeds or plants that don't produce seeds in nature because of no fertilization difficulties.

## **2. The Forestry Department/Ministry of Agriculture:**

Seed Center at the Forestry Dept. consists of 4 subunits:

- a. Seed collection unit.
- b. Seed extraction Unit.
- c. Seed testing Unit.
- d. Cold Storage Rooms.

The cold storage Gene bank at the seed center maintains a vast range of genetic resources of forest trees and pastoral shrubs as medium term storage. It is interested more in collecting indigenous and threatened species, documenting accompanied data, and to carry out experiments to determine best germination procedures for each species. The seed center is well quipped and functioning all year round, it preserves seeds of more than 70 species and it provides forest nurseries with the required amounts of seeds needed every year.

### **Future prospective:**

- \*Resume assigning mother plants for all forest and pastoral seeds in the country.
- \*Establishment of mother nursery for each plant targeted plant species.
- \*Propagation of some plant species using tissue cultural techniques.
- \*Initiate relationships with similar centers abroad to exchange material and know how.

## **3. The Jordan University for Science and Technology ( JUST) :**

### **Propagation and Conservation of Wild Types of Some Plant Species Native to Jordan**

Task included in vitro propagation and slow growth storage techniques, so as to conserve Black Iris plant which represents the national flower of Jordan. Besides, cryopreservation techniques were used for preservation as long term storage.

Same techniques of Ex situ storage are being used on bitter almond (*Amygdalus communis* L.) date palm (*Phoenix dactylifera* L.) and wild pear (*Pyrus syriaca* Boiss.)

## CHAPTER 4- THE STATE OF USE

### The importance of utilization

Plants are vital for the development of human society. They are the key to food security, providing us with cereals and other foods in addition to feeding the livestock that produce milk, meat and eggs and provide farm power. The wise use of plant genetic resources can help eradicate poverty, both by lowering the price of food and other commodities and by raising and diversifying the incomes of producers and processors. They also protect and enhance the environment, for example by preventing erosion and desertification and by absorbing atmospheric carbon. The multiple uses of plants depend on a crucial characteristic of plant life, its diversity. Diversity exists at three main levels: the combinations of species that make up different ecosystems, the number of different species, and the different combinations of genes in species. All three levels help sustain agricultural systems, as well as ensure their productivity. Genetic diversity, in particular, provides species with the ability to adapt to changing stresses, such as pests and diseases or drought.

In Jordan many plant genetic resources species are particularly useful as food and medicine especially in marginal areas, where they have been selected to withstand stress conditions and to contribute to sustainable production with low-cost inputs. Unfortunately these species were neglected by researchers in the past. Therefore, the information known about their agronomy, yield improvement potential and quality it is not enough. We should recognize the vital role of a diversity of wild, semi-domesticated and underdeveloped species in food and livelihood security and their potential for further development and wider use. More than 100 edible-wild plants are utilized by local communities as food, salad, spices and traditional medicine such as (*Arum sps.*, *Eruca sativa*, *Cichorium pumilum*, *Gundelia tournefortii*, *Asparagus sps*, *Cyclamen persicum*, *Artemisia sps* and *Thymus sps* et .. )

### Utilization of conserved plant genetic resources

The wild genetic material collected from Jordan is mainly stored at the gene bank of the National Center for Agricultural Research and Technology Transfer (NCARTT) and the seed bank of the Ministry of Agriculture. Very little material is being kept at the various institutions in Jordan especially in the public universities. For cultivated species, NCARTT, the Ministry of Agriculture and the Jordan Cooperative Corporations are involved into multiplying and distribution of certified seeds of cereals, food legumes and forages. Some farmers use their own seeds. The private sector is very active in supplying seeds to farmers which include imported hybrid seeds of vegetable crops. Many commercial seed companies have started their own breeding programs for the production of vegetable seed and suitable quantities are available for distribution such as onions, cucumber, tomato, okra, potatoes, and beans. For fruit trees, the MoA is providing the farmers with seedlings of mainly olive trees, grapes, pome and stone fruits. The private sector is also very active in the production of olives and grapes seedlings for both local and export purposes, recently some of the private companies start to produce banana, date palm and potato by micro propagation technique. The source of rootstock is local and imported material. Bitter almond, Pistachio, and hawthorn are extensively utilized as root stock for stone

fruits, pistachio and pome fruits, in addition to that Jordan imports large quantities of fruit plants from wide world.

In the last decade NCARTT has established four field gene banks for fruit trees and cereals. These gene banks were probably distributed to represent different ecological environments. The pome fruits and grapes gene bank are located in south of Jordan at Shoubak agriculture research station at 1400 m above sea level. At Mushagar station which is located in central of Jordan an important field gene bank for olive and fig trees were established represent all or most of the genotypes of olive trees cultivated in Jordan (50 genotypes) and many of the genotypes of fig grown in Jordan (12 genotypes). For the increasing importance of the date palm trees at the national level another field gene bank was established. It contains many genotypes of dates and grape at Goar El Safi station, which is located in Jordan valley at 400 below sea level. In cooperation with Agrobiodiversity project a field gene bank was constructed at Marou agriculture station in north of Jordan for the conservation of cereals, legume and forage crops.

Nowadays three of the public universities teach agricultural science at the postgraduate level (one of them for PhD level). Many of the Jordanian scientists utilizing the plant genetic resources already collected and conserved at the gene bank of NCARTT for their research and study objectives. One of the main research branches at the universities for postgraduate studies deals with biodiversity and genetic variations presents in the cereals, legumes, vegetables, fruit trees and medicinal and herbal plants. Biotechnology tools are being used for characterizing the different crops .

Private companies, NGOs and farmers get benefits from the conserved materials for the breeding programs especially in the field of vegetable seed production.

NCARTT signs contracts with farmers annually for seed multiplication and maintenance for most cereal and food legumes landraces.

As one of the most important origin for many of the economically important crops, Jordan established relations with many national, regional and international institution dealing with plant genetic resources subjects , activities and through the transfer of the genetic materials.

## **Utilization activities**

Researchers mainly do most of the characterization and evaluation activities for a wide range of crop species grown in Jordan from NCARTT and scientist from universities in addition to the researches activities done by graduate students. The characterization activities done based on different makers included; morphological and biochemical and recently by DNA-based markers.

The public sector organizations started its breeding activities long time ago, going back to 50 years as in the National Center for Agricultural Research and Technology Transfer (NCARTT) and working in the field of biotechnology for the last 15 years. During the last 20 years these public organizations started a capacity building programs to upgrade the capacity of the staff, which resulted in an increase in number, and educational level of the staff. In the last 20 years the total budget for research in these organizations was increased. The private companies started their breeding activities 20 years ago, these companies working in the classical plant breeding and a few of them working in tissue culture. As in the public organizations these companies started to develop the number and the educational level of the staff.

The number of varieties released is very low compared to the human and financial resources available at the national level. A bout 100 hundred variety were released as result of the breeding

activity most of these varieties were released by the private companies. Recently and by applying classical and genetic engineering approaches four lines of tomato resistance to virus's diseases were released.

The limiting factors for the success of utilization of plant genetic resources:

- Lack of financial resources to carry out field and laboratory experiments;
- Inadequate number of breeders for each crop;
- Lack of knowledge about the use of molecular technique support plant breeding programs;
- Inadequate availability of laboratory infrastructure to carry out experiments using advanced plant breeding techniques;
- Limited access to national public and/or private genetic resources;
- Lack of support from the international community, including organizations like centers of the CGIAR system.
- Inadequate knowledge of the general plant breeding strategies;

The needs to improve the utilizations of the plant genetic resources:

- Strengthening national program capacity through investments
- Setting up of national priorities related to breeding activities and utilizations of plant genetic resources;
- Helping preparing projects for funding;
- Promoting training programs on conventional breeding methods;
- Promoting training programs on biotechnological tools;
- Facilitating germplasm exchange;

## **Chapter -5**

### **The state of National programs, Training needs and Legislation**

#### **National programs:**

Plant diversity in Jordan is facing a dramatic decline as a result of habitat loss and degradation. Such destruction has led to the isolation of many species, which, in turn has led to a loss of their genetic diversity, and to a high risk of extinction. Currently, between 200 and 250 plant species are nationally rare and 100 to 150 species are nationally threatened. The main threats to species at risk are the loss and degradation of habitats, over-exploitation of plant and animal species, extensive agricultural and unplanned developmental activities, pollution, invasion of introduced species, overgrazing, water extraction, illegal hunting.

Jordan has formulated several measures aimed at protecting, assessing, utilizing and benefiting from the conservation and sustainable use of biodiversity of plant genetic resources, including a number of significant measures to prevent pollution, habitat damage and to protect wildlife. Biodiversity and genetic resource conservation efforts are divided between various sectors and institutions, a priority need will be to develop the national knowledge management capacity for biodiversity and to upgrade laws and legislation related to improve the enabling environment. Jordan has given high priority to conservation and sustainable use of biodiversity components, in view of its position in a region of uncertain political condition, the climatic conditions, and the country's rapid development and urbanization that have led to habitat fragmentation and ecosystem degradation. This situation is also manifested in financial constraints, which have impeded adequate progress in implementing the Convention on Biological Diversity. As a result, the programs of work for implementing different articles of the Convention on Biological Diversity have not yet been integrated into national policy and to the developmental action plans, and national financial allocations for implementation have been inadequate.

The institutions involved in the conservation of biodiversity and plant genetic resources include both governmental and civil society institutions, the most relevant governmental institutions are: the Ministry of Environment; the Ministry of Agriculture; the Ministry of Planning and International Cooperation, the ministry of Water and irrigation; and the National Center for Agriculture Research and Technology Transfer. While, the most relevant non-governmental institutions is the Royal Society for Conservation of Nature (RSCN). Jordanian universities play a very important role in the field of research and studies. At the national level deferent institution have taken certain steps that affect the performance of Biodiversity and Genetic resource activities:

**1-** Strengthening the role of the National genetic resource committee (2001) which include 15 public, private and NGOs sectors, need to be activated.

**2-** In 2002 NCARTT established: Biodiversity, Genetic Resources and Medicinal Plants Research program. The objective of this program is to sum up diverse efforts, experts and activities concerning conservation and sustainable use of plant biodiversity including reconstruction National Gen bank and Herbarium. The Gen Bank and Herbarium at NCARTT hosts more than 4000 specimens, among which many duplicates from Post and Dismore who has collected during late 19 century. Establishment of field gene banks for wild and local land races of fruit trees. Establishment of database for Gene bank and Herbarium. Systematic annual collection program for seeds and herbarium specimen some in-situ conservation sites for local and wild olive and apple trees were established in Musaqar and Shobak regional centers of NCARTT.

**3-**The Ministry of Agriculture (MOA) operates through a number of Departments charged with the delivery of technical services to farmers. The most respective departments, which serve biodiversity, are Department of Forests and Department of Range. Departments of Forests and Range are involved in conserving biodiversity through their responsibility in the establishment and managing a number of reserves and protected natural habitat sites in different parts of the country. The total area of forest as protected areas is about 70,000 ha, (natural and man made forest) while the total area of range reserves is 84399 ha. In addition the Forestry Department has established seed center and botanical gardens, which represent program for biodiversity conservation at national level. The main objective of the center is to store and maintain forest and range seeds through selection, collection, processing, certification and handling seeds. Two botanical gardens were established, one in high lands (Yajoz) comprises of 150 species, while the second one in Jordan Rift Valley (Dairalla), which comprises of 70 species.

**4** In addition, some universities established herbariums. The biggest herbarium being at Yarmouk University in which about 20,000 specimens.

**5-** The Royal Society for the Conservation of Nature (RSCN), a non-governmental non-for profit organization, seeks to conserve and enhance wildlife and wildlife habitats whilst actively promoting the understanding of the natural environment, its protection and its interdependence with people.

### **Legislation and Policy Framework**

Jordan committed it self to promote natural resources conservation through the adaptation of a number of strategies and polices which resulted in legislation and regulations to protect the environment and biodiversity

During the last decade, Jordan has developed several strategies related to Biodiversity and genetic resources management. The most recent are the National Biodiversity Strategy was developed in (2003), and the Jordan National Agenda NBSAP (2005) and National Strategy for Agricultural Development: for the decade 2000-2010, was approved in 2002.

. In consistence with the implementation of different environment agreements a number of measures and steps were taken such as:

A ) Development of National Environmental Strategy and Action Plan (NESAP )

B ) Development of other sectors strategies.

C ) Adopting a number of significant legislations and regulations related to biodiversity and genetic resources conservation.

The country has implemented many projects aiming at conservation of biological heritage .It also prepared and approved several legislations to addressing Biodiversity and Genetic Resources.

#### **A) National Biodiversity Strategy and Action Plan (NBSAP):**

The Jordanian National Biodiversity Strategy is a response to the obligations of CBD and has been developed as a guide to the implementation of the biodiversity convention in the country. The Strategy presents the national vision for Jordan. The main strategic goals of the NBSAP are:

- Conserve biodiversity and use biological resources in a sustainable manner by protecting the various species of animals, plants and micro-organisms in their different agricultural environments; and productivity of environmental systems, especially wildlife habitat, forests, grazing land and agricultural land within a balanced environmental order.

- Improve our understanding of ecosystems, increase our resource management capability, and promote an understanding of the need to conserve biodiversity by using biological resources in a sustainable manner.
- Manage natural resources and distribute roles among institutions in a way that conserves the basic natural resources which are necessary for human growth and survival, such as soil, water, plant cover and climate, develop these elements and using them appropriately in a sustainable manner.
- Maintain or develop incentives and legislation that support the conservation of biodiversity and the sustainable use of biological resources

However, The NBSAP contained five main themes:

***Theme 1. Protection of biological resources***

Endangered species: National Red Data List for flora and fauna species at risk.

Protected areas: Completing the protected area networks.

***Theme 2. Sustainable use of biological resources***

Wild plants: Establishment of a national botanical garden

Forests: Establishment of green belts to combat desertification

Terrestrial and freshwater wild fauna: Enforcement of legislation and conventions concerning the protection of wildlife.

Microorganisms: Comprehensive survey and ex-situ conservation of microorganisms.

Agricultural resources:

(i) Plant production: Establishing a specialized center for plant Biodiversity.

(ii) Rangeland production: Training and capacity building for rangeland management.

***Theme 3. Reducing the impact of industry on biodiversity***

Mining: Study on the feasibility, costs and benefits of rehabilitating limestone aggregate quarry sites.

Industry and factory production: Studying the impacts of the Phosphate Company gypsum dump on marine life in Aqaba.

Biotechnology and biosafety: Establishment of a national council for the promotion and regulation of biotechnology in Jordan.

Eco-tourism: National environmental standards and guidelines for tourism projects.

***Theme 4. Promoting integrated land use planning and water resources,***

*Development, land tenure and land use planning:*

Preservation of biodiversity-rich areas through urban planning.

Water resources: Assessment and monitoring of water bodies and ecosystems.

***Theme 5: Towards a biodiversity-oriented society***

Economic valuation of biodiversity: Capacity-building on economic valuation of biodiversity.

Legislation and institutional structure: Reviewing existing environmental legislation.

Public awareness, education and participation: Establishing of a comprehensive database on Jordan's biodiversity.

**B) National Strategy for Agricultural Development: for the decade 2000-2010, stressed on sustainable agriculture and protection of natural and biological resources.**

The National Strategy for Agricultural Development 2002 – 2010 address this subject in many articles the most clear were under Objective 3 “Protect the Environment, and Agro-biodiversity, and Improve the Quality of Agricultural Produce”. This objective

Included the following specific objectives:

- Protect agro-biodiversity (plants and animals) and use of local land races for crop improvement, and apply international agreements in this respect.
- Evaluation and sustainability of resources productivities:
  - (i) Survey and classification of soils, soil fertility conservation,
  - (ii) Watersheds development, and
  - (iii) Capacity development and training in land use planning.
- Conservation of biodiversity.
  - (i) The establishment of additional natural reserves,
  - (ii) Reclamation of steppe lands,
  - (iii) Development of data bases and systems,
  - (iv) Monitoring environmental changes,

### **C - Adopting a number of significant legislations and regulations related to biodiversity and natural resources conservation**

The government of Jordan has issued and updated new legislations and regulations related directly to environment and biodiversity. These legislations include a number of by-laws and regulations with provision on environmental protection and were enforced through different governmental organizations. The laws and by laws approved after 1996 are listed below :

*Patent Rights Law No. 32, 1999.*

*Nuclear Energy and Radiation Protection Law No. 29, 2001.*

*Aqaba Special Economic Zone Law No. 32, 2000*

*Agriculture Law No. 44, 2002.*

*Protection law of new varieties No. 76, 2002*

*Environment Protection Law No. 1, 2003*

*By-laws:*

*Environmental Protection of Aqaba Special Economic Region By-law No. 21, 2001.*

*Exploitation of Private Forest No. z/12, 2003.*

*Protection of Wildlife species, their Hunting and Trade Org No. G/34, 2003.*

*Protection of New Plant Species No. z/45, 2003.*

*Regulation of Using Sewage Water for Irrigation No. z/4, 2004.*

The most related legislation to the biodiversity and genetic resources were the Agriculture Law No. (44) for the year 2002, and the Environmental Law No. (1) for the year 2003 Therefore, this chapter will deal with the most relevant articles to biodiversity and plant genetic resources which tackle the environment issue and maintain ecosystem

## **Agriculture Law No. (44**

### *Article (1)*

This Law shall be called “the Law of Agriculture for the year 2002” and shall be put into practice after thirty days as from the date it is published in the Official Gazette.

### *Article (3)*

a. The Ministry shall undertake the responsibility of organizing the agricultural sector and its development to achieve the following main objectives in cooperation with the relevant parties whenever necessary:

Increase the production of food and agricultural products.

Achieve sustainable use of the natural agricultural resources without

Harming the environment.

Develop the rural areas and increase their productive capacity.

Increase the incomes of farmers and improve their living standards.

Improve the irrigation water use efficiency at the farm level.

b. The Ministry shall endeavor to achieve the objectives set out in Paragraph (a) of this Article including provision of the basic agricultural services in the fields and areas where the private sector does not provide these services or provides them but ineffectively and inefficiently, including -among others- the following:

Combat desertification and conserve bio-diversity.

Establish and manage developmental agricultural projects.

Make available the agricultural statistical information and data.

### *Article (12)*

The Minister shall issue the directives required to organize plant production in a manner that secures efficiency of production and conservation of the agricultural resources and the environment including, specifying methods of agricultural land use in order to protect the soil and prevent its erosion. Article (13)

a. The genetic resources of plants and animals shall not be sent outside the Kingdom except upon a prior permit. And the Minister shall issue a resolution, for this purpose, specifying the genetic resources covered by the provisions of this Article.

b. Any person or party that sends out, or attempts to send out, plant or animal genetic resources from the Kingdom without a permit shall be penalized with a fine of no less than (one hundred JD), but not exceeding (one thousand JD). In addition, the seized materials shall be confiscated.

c. It shall be prohibited to enter the imported plants or plant products into the Kingdom except after completion of the plant quarantine procedures. The Minister may exclude from the quarantine process the plants or plant products the exporting country of which, or specific territories thereof, and the countries they pass through are clearly proven to be free from the pests and diseases that do not exist in the Kingdom. The Minister may also exclude from quarantine specific plants or plant products that are imported from any country the Kingdom acknowledges

that its sanitary and phytosanitary measures are equal to those of the Kingdom according to mutual acknowledgement agreement.

*Article (27)*

a. The Minister shall issue the directives that organize the management of the governmental forests and forest lands, and the means for their improvement, development, conservation and protection, as well as the conditions for grazing therein. And, in coordination with the concerned parties, the Minister shall specify the conditions related to the following:

*Article (29)*

The Minister shall have the right to issue directives that specify the conditions the private lands must meet in order to implement the forestation processes therein by the cadres of the Ministry and at its expense, provided that consent by the owner is obtained.

*Article (32)*

a. It shall be prohibited to abuse forest lands whether by erecting permanent or temporary residences, buildings or structures thereon, or digging wells or caves, or installing water, electricity or telephone lines, or opening sewerage lines or canals therein, or by cultivation or plowing, or by grazing therein, without a license.

*Article (34)*

While observing the provisions of Article (27) of this Law, the following shall be prohibited:

- Cutting forest trees or bushes or wild plants without a license from the Minister.
- Burning forest trees or bushes or wild plants or removal of their peels or leaves except in the cases and conditions specified by the Minister and therefrom.
- Collecting any forest materials, or possession, storage, processing or transport thereof without a license. The Minister shall issue a resolution specifying prices for the forest materials.
- Cutting of Ceratonia, Pistacia, or wild trees such as Amygdalus, Pyrus, Olea europea or Crataegus in the private forests. However, pruning thereof for grafting purposes is permitted; and the holder may benefit from the fruit of these trees.

*Article (37)*

The Minister shall issue the directives that organize the procedures and processes for improving and developing the range lands and conservation of such lands and their natural resources, including their soil and wild and planted plants, and management and scheduling of grazing therein in addition to the fees for their utilization.

### **Environment Protection Law No. (1) for the Year 2003:**

The main law governing environmental management in Jordan is the Environmental protection Law No. 1 for 2003 which has indeed established the Ministry of Environment in Jordan. The law considers the Ministry of Environment to be the competent authority for the protection of environment in the Kingdom, and the official and national authorities shall be bound to implement the instructions and resolutions issued under the provisions of this law which gives the Ministry all the juridical powers it requires implement the law.

The Law includes 25 articles dealing with all dimensions of environment and implies the maintenance of biodiversity by protecting various species of animals, plants and microorganisms in their different environments. The biodiversity relevant articles are the following:

*Article (2)*

This article defines the environmental protection as the preservation of the environment and its elements, its promotion and the prevention of its deterioration or pollution or reducing them, within the safe limits, the elements include: air, water, soil, the human being and their resources. Also the environment considered as the surroundings which include the living and non-living beings, the materials contained and what surrounds it and introductions of any of them as well as the establishment built by the human beings.

*Article (3)*

- a. The Ministry shall be regarded as the Authority concerns with the environment Protection in the Kingdom, and the official and national bodies shall implement the instruction and decisions issued in this respect by virtue of this law, and the A regulations issued accordingly, subject to legal responsibility, as provided in the said law and in any other legislation.
- b. The Ministry shall be the competent reference at the national, regional, and international level, with regard all the environmental issues, and the donors, in cooperation and coordination with the bodies of competence.

*Article*

(4)

To realize the objectives of environment's protection, and improvement of its various elements, the Ministry shall with cooperation and coordination of the related bodies assume the following:

- Set the public policy for the protection of the environment, and prepare the plans, programs, and projects, necessary for the realization of sustainable development.
- Prepare the specification and the standard criteria for the environment elements.
- Monitor and measure the environment elements & components, and follow them up through the scientific centers as approved by the Ministry as per specific criteria or standards.
- Issue the necessary environmental instructions for the protection of the environment, its elements, and the requirements for carrying out the agricultural, developmental, commercial, industrial, housing mining projects and others, as well as all the services related to such, in order to be observed and adhered to, within the prerequisites for authorizing or renewal of the above in accordance with the legal established principles.
- Monitor and supervise the institutions and the public & private bodies, including the companies and projects to insure their compliance with environmental standardized specification, criteria and the technical rules adopted.
- Carry out researches & studies related to environment & its protection. Issue any publications relevant to same by any other body.
- Promote the relations between the Kingdom and the Arab, regional and international states, societies and organizations with regard the matters related to the recommend to associate with and become a member as well as follow up its implementation.

*Article(5)*

The Law calls for the establishment of a bylaw for nature protection in the following areas:

- Regulation of Nature Protection.
- Regulation of environment protection from population in emergency cases.
- Regulation of natural reserves and national parks.
- Regulation or Environmental impact assessment.
- Regulation of soil protection.

### **Education and training:**

**1-** In 1998 the RSCN established a “Regional Training and Development Unit” to facilitate its regional development programme in the following subjects:

Protected area management.

Ecotourism development.

Institutional development.

Environmental awareness

**2-** The University of Jordan: established the Department of Environmental and Applied Geology

**3-** The Hashemite University: established the Faculty of Natural Resources and Environment

Jordan University offers 7 educational courses all for undergraduate studies, three of them in the field of taxonomy (one partially on animal taxonomy, plant taxonomy, and paleontology) and the rest are on biodiversity, ecosystem management, and environmental management.

The Universities as contracted institutions provided training and upgrade the qualifications of the project staff and the executing institutions.

In the last ten years different local or regional projects provided more than 50 scholarships for M.Sc. or PhD studies on bio-diversity related subjects, beneficiaries from the scholarships represented NCARTT and MOA staff, 3 Jordanian Universities were contracted to provide the M.Sc. degree; University of Jordan, Jordan University of Science and Technology and Yarmouk University.

There is substantial research going on in Jordan about biodiversity and genetic resources in different government institutions, universities and research centers. These research programmes contributed to the development of the basic information, which shaped Jordan strategies in biodiversity and genetic resource conservation.

Several research programs and baseline surveys have been conducted inside protected areas and to a lesser extent outside them. Other research activities have been conducted by academic institutions on terrestrial and marine ecosystems as well as wildlife and aquatic resources, in particular, being central of agriculture, fisheries and tourism development as well as habitat protection, natural resource conservation and sustainable use options through voluntary work.

Different local and regional projects implemented in Jordan carried out deferent research activity concerning biodiversity issue including surveys, management and public awareness.

Research to propagate and conserve rare and endangered plants is currently carried out in various research centers including universities.

Conservation and Sustainable Use of Dry land Agro biodiversity I in Jordan had several Agreements with the University of Jordan and Jordan University for Science and Technology to develop and implement research activities such as GIS, land use, taxonomy, policy and legal issues. Water harvesting infrastructure were established and maintained in two sites (Ajloun & Mouaqar).

Continue efforts in the management and conservation of endangered species and their habitats in protected areas

Rehabilitate endangered and endemic species

**Networks:**

**1-** Queen Rania Al-Abdullah Centre for Environmental Science & Technology (QRACEST) at the Jordan University of Science and Technology: The center's mandate to participate in the national and international efforts towards achieving sustainable development by preserving the environment and its natural resources against improper use/overuse and pollution in an integrated manner that takes into consideration economic growth and other factors through education, research and services through:

**2 –** The royal Society for Conservation of Nature RSCN had established a national network of protected area representing key habitats and ecosystems

**3-** The National Center for Agricultural Research and Technology Transfer NCARTT hosted and coordinate the Medicinal and Aromatic Plants Network the West Asia and North Africa since 2005 ( WANA region) sponsored and supported by AARENINA

**4-** The National Center for Agricultural Research and Technology Transfer represent Jordan in the advisory group for drafting WANA region strategy in Plant Genetic Resources which include the establishment of regional Plant Genetic Resources network in 2007. which will be supported by Global Crop Diversity Trust and IPGRI

**Public awareness**

There are weekly programs by TV and radio about the importance of biodiversity, genetic resources and its importance for future food security. They invited specialists from universities research intuitions and privet sector to talk about this issues .

Ministry of Environment, Some Universities, NCARTT, RSCN, and Implemented projects distributed brochures and posters .

The Ministry of Education is disseminating biodiversity information and facilitates students understanding through formal and informal activities. The Ministry has introduced 365 environmental terminologies many are of biodiversity related issues diffused in the curriculum starting from the 5<sup>th</sup> and all through Tawjihia classes.

**Financial resources**

**1-** The Government of Jordan allocate in its annual budget a relatively low amount of money to support the running cost of the activities of Ministries which are involved in the CBD implementation. Mainly MOE, MOA, NCARTT.

The government also allocates in its annual budget a specific amount of money to support NGO's working indifferent fields including biodiversity conservation. Mainly to RSCN.

**2-** GEF, the Small Grants Programme -SGP

The SGP in Jordan was initiated in 1992 by the United Nations Development Programme (UNDP). Up todate, the Programme has supported a total of 101 projects; 12 during the Pilot Phase, 20 during the First Operational Phase, and 69 projects have been supported as part of the current Second Operational Phase. (4%) of the supported projects are planning grants.

Funded Projects in Jordan by GEF since the Inception: Single Country Projects (Jordan) - 6 Projects, Funded Projects in Jordan by GEF since the Inception Regional and Global Projects - 6 Projects

## **Main challenges**

In general, the main challenges for improving plant genetic resources conservation, utilization and benefit sharing can be summaries as follows:

1. Inadequate capacity development for resource mobilization:  
Apart from one or two experienced organizations, most institutions in Jordan lack the technical and practical knowledge for resource mobilization
2. A better policy design is needed for improving extension services and technology transfer in Jordan which takes in consideration providing additional support to biodiversity conservation through improving financial resource mobilization systems and capacity building;
3. Agricultural research should be directed towards real life problems (applied research) and it should be linked with extension services;
4. More involvement of rural women is needed;
5. Farmers' associations is good policy instrument that can be used to improve the value-added from conservation and improving the productivity of landraces in the two areas;
6. Land use policy should be developed as one of the major factors affecting property rights;
7. Traditional knowledge should be respected in designing new policies or reforming current policies and legislations related to the conservation of biodiversity and utilizing neglected species;
8. Additional efforts are still needed to provide funds and develop micro credit systems that focus on biodiversity conservation;

## **Suggested Training Areas & subjects:**

- Survey & Monitoring biological and plant genetic resources diversity
- Data base management & data analysis
- Protected areas & natural habitat management
- Training on regulating, managing risks associated with the use and release of living modified organisms ( LMO)
- Methods & Techniques for sustainable utilization of biological resources by encouraging customer's use of biological resources in accordance with traditional cultural practices.
- Traditional utilization of biological resources (Indigenous knowledge )
- Procedures for Environmental Impact Assessment ( EIA)
- Public awareness, outreach & local community involvement.
- Rehabilitation of degraded areas and Eco-systems.
- Supporting & building the capacity of local communities.
- Biotechnology –molecular breeding
- Plant variety protection procedures.

## **Chapter 6: The state of regional and international collaboration**

Jordan has strong relations mainly with most of the regional and international centers and institutions: FAO, ICARDA, IPIGRI, AOAD, Kew Garden, and TWNSO.

NCARTT has an agreement with the KEW GARDEN (ENGLAND) for cooperation in collection identification and preservation of seeds and herbarium specimen.

ICARDA-NCARTT- in the last ten years we have by lateral agreement between plant Genetic Resource Unit (ICARDA) and Biodiversity and Genetic Resource program (NCARTT) in Joint venture Collection and training our staff in ICARDA headquarter in collection, documentation preservation and database.

ICARDA through its experts and the coordination with other institutions (IPGRI, ACSAD) provided training on different aspects mainly management, technical aspects and monitoring and evaluation,

In 2005, Ministers of Agriculture in Jordan, Syria and Lebanon assigned multilateral cooperation agreement in accesses and benefit sharing of agro-biodiversity, this agreement include exchange of information, technology transfer, training and other issues for the implementation of the CBD.

Cooperation agreement between the Hashemite Kingdom of Jordan and the Popular Democratic Republic of Algeria in 2002: Article 8 of this agreement includes:

**a.** Coordination and cooperation in the field of plant and animal biodiversity, exchange of strategies and cooperation in preparing policies relevant to environmental balance

**b.** Cooperation in the field of protecting and increasing the populations of endangered species as well as benefiting from service centers in both countries with the aim of protecting the environment

Cooperation agreement between the Hashemite Kingdom of Jordan and the Government of Kuwait in 2004: Article 2 of this agreement states that the fields of cooperation between the two countries include management of nature reserves and the management of coastal and marine areas. Article 5 states that the two countries will exchange experts in accordance with a designated work plan.

### **International Agreements**

The Government of Jordan has ratified the following conventions: The Convention on Biological Diversity (CBD) in 1993, the Convention to Combat Desertification (UNCCD) in 1996, the Ramsar Convention in 1977, the Cartagena Protocol in the 2000, the KYOTO protocol in the year 2000, the Plant Genetic Resources for Food and Agriculture (PGRFA) in 2001, the Convention on Persistent Organic Pollutants (POPs) in 2002

## **Chapter 7 : Access to Plant Genetic Resources and sharing of benefits derived from their use, and farmers rights**

Jordan representative by NCARTT has subscribed international agreements relevant to access to plant genetic resources and sharing of benefits with KEW Garden in 2000. In 2001 Jordan assigned the International Treaty for Plant Genetic Resources for Food and Agriculture and Convention on Biological Diversity (CBD). In addition to that the Ministry of Agriculture has signed the Plant Variety Protection Agreement (UPOV).

Except the by law for the transfer of plant genetics resources materials, legislations and policies related to the access to plant genetic resources and sharing of benefits are under developing.

The issue of benefits sharing and access to genetic resources is not adequately regulated through a package of re-enforcing modern policies and legislations to ensure smooth access and balancing right to access and intellectual property rights. This issue needs also technical capacity development and institutional networking.

The Law for Protection of New Plant Species for the year 2000 gives property rights to those who create new and original plant species. In Theme 5 of the NBSAP 2003, it is suggested to develop bylaws and regulations on biodiversity-related issues, including intellectual property rights, which until now do not address the issue of new plant species.

During the implementation of the Agro-biodiversity project this issue was taking a big consideration, the project introduce this issue to the local community in the four countries (Jordan, Syria, Lebanon and the Palestinian Authority) through conducting 2 national and one regional workshops on accesses, benefit sharing and farmers wrights.

In the future measures will be taken according to the obligations of the PGRFA treaty and in consistence with the international SMTA which is Adopted by the Governing body of the PGRFA treaty on Madrid meeting on June -2006 which is start to be active January, 2007.

According to the regional multilateral agreement between Jordan, Lebanon, Syria and the Palestinian Authority, each country should develop a national legislation on accesses, benefit sharing and Farmers rights on PGRFA. Syria already develops the legislation and it will be used by the other countries as an example of the area and modified to suite its local legal environment. Jordan will start working in this legislation as soon as the new reformed national genetic resource committee resumes its duty.

The National Biodiversity Strategy and Action Plan of 2003 identified Strategic and Operational Objectives for the Economic Valuation of Biodiversity such as to “assess economic and social opportunities arising from the actual and potential use of Jordan’s biological resources” and to “demonstrate the economic and financial advantages of biodiversity conservation”.

## **Chapter 8: The Contribution of Plant Genetic Resources to food security and sustainable development**

PGRFA are as the most important component of biological diversity dealing directly with food security and agricultural development and consequently with human food, medicine, shelter, energy basic needs and requirements. The Government of Jordan has carried out many activities focusing on major crops important for food security, in particular, wheat, barley and food legumes. Participatory research activities with local farmers were conducted with the objective of evaluating and screening best performing wheat materials for grain yield and other agronomical characteristics. Recently research is being targeted toward the improvement of varieties adapted to local environments, the identification of best yielding entries through multi-locational trials, and the maintenance of seed and genetic purity. Current research regarding food legumes aims at (i) producing (selecting or improving?) high-yielding varieties of chickpea and lentil; (ii) introducing varieties with the desirable characteristics (large seed, tall, erect, and early maturity) and tolerance to biotic and abiotic stresses, such as Sitona weevil and drought in lentil.

Genetic resources needed for further crop improvement and future insurance against developing environmental challenges (desertification, climatic change etc....) with great inter-dependence between countries. The Sustainability of farmers livelihoods mainly living under harsh conditions depends on the PGRFA presented in their eco-systems. These valuable genetic resources were used in the breeding programs at national and international levels to overcome major future challenges. In addition to that it is known for there

ecological benefits through greenhouse gas regulation, reduction of chemical pollution; socio-cultural benefits in the form of social coherence and sustainability empowerment of local communities in biodiversity rich areas and recreational value. The national program in Jordan recognizes the above benefits and launched many projects aiming at:

- Investigation of potential uses of wild relatives as food by training farmers on food processing such as Jam, pickling, roasted wheat and other traditional food The Royal Society for Conservation of Nature (RSCN ).
- Use PGRAF for promoting eco-tourism in biodiversity rich areas (Ministry of Environment.)
- Train farmers on the sustainable cultivation of medicinal and herbal plants and development of home gardens Conservation of Medicinal and Herbal Plants Project;
- Demonstration of the benefits of improvement and train local community on sustainable management of range and forest eco-systems (Ministry of Agriculture).
- Linking farmers with market through establishing permanent agro-biodiversity markets and shops and training local community on packaging of local products NCARTT and Agro-Biodiversity project).
- Utilizing the wild plant species by local community to establish small enterprises such as fruit trees nurseries, this is considered as one of the successful cases in Jordan (supported by agro-biodiversity project) and in the table below you will see the annual revenue from one of these nurseries.( Table 11.). Taking in consideration that the total in-kind incentive for establishing this nursery is 1000USD only.

**Table 11: The Revenue from Dina Fraihat nursery for the wild plant species**

<b>Year</b>	<b>Production</b>	<b>Annual revenue( USD)</b>
<b>2002</b>	<b>500 seedlings+ 100 trays of annual plants</b>	<b>750</b>
<b>2003</b>	<b>3000 seedlings</b>	<b>1800</b>
<b>2004</b>	<b>10000 +3000 seedlings of medicinal plants</b>	<b>3000</b>
<b>2005</b>	<b>10000 +3000 seedlings of medicinal plants</b>	<b>3000</b>

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