



The Hashemite Kingdom of Jordan

**The General Corporation for the Environment Protection**

# **CONSERVATION AND SUSTAINABLE USE OF BIOLOGICAL DIVERSITY IN JORDAN**

**First National Report  
of The Hashemite Kingdom of Jordan on the Implementation of Article  
6 of the Convention on Biological Diversity**

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Compiled and Edited by Dr. Abdel-Muti M. Tellawi  
Project Coordinator, Biodiversity Strategy and Action Plan

## **List of Contributors (Participating Agencies and Organizations)**

### **Project Team:**

**Dr. Abdelmuti M. Tellawi:** Project Coordinator, Biodiversity Strategy and Action Plan Project.

**Mr. Jaquas Prescott:** International Consultant and Drafter

**Dr. Odeh Jayyosi/ JES:** National Consultant Water Use

**Eng. Mohammed Ayesh/JES:** National Consultant Environmental Education and Awareness

**Dr. Ayed Omari/ Moutah Univ.:** National Consultant Forestry

**Dr. Kamal Tadrus/ Private Sector:** National Consultant Range Management.

**Dr. Nabeel Helat/ Science and Tech. Univ.:** National Consultant Animal Production and Marine.

**Eng. Yanal Abeda/Industrial Chamber of Amman:** National Consultant Industry and Energy.

**Dr. Ahmed Oqlah/ Yarmuk Univ.:** National Consultant Flora.

**Dr. Sameer Masoud/ Moutah Univ.:** National Consultant Microbiology and Biotechnology

**Eng. Qasim Omari/ Private Sector:** National Consultant Mineralogy.

**Dr. Hani Soub/ Jordanian Univ.:** National Consultant Agriculture (Plant Production)

**Royal Society for the Conservation of Nature:** National Consultant Wild life.

**Royal Society for the Conservation of Nature:** National Consultant Eco-tourism.

**Royal Society for the Conservation of Nature:** National Consultant Wild life Reserves

**Royal Society for the Conservation of Nature:** National Consultant Endangered Biological Species.

**Mrs. Rabab Al-Tal/Private Sector:** National Consultant Environmental Legislation.

**Dr. Abdelmuti M. Tellawi:** National Consultant Land Use.

**Dr. Aamer Jabbareen/ Jordanian Univ.:** National Consultant Biodiversity Economy.

### **Project Management Team:**

**Dr. Abdelmuti M. Tellawi:** Project Coordinator, Biodiversity Strategy and Action Plan Project.

**Dr. Iyad Abumoghli:** UNDP.

**Engineer Khalaf Alokla:** GCEP.

**Engineer Nadia Juhari:** Ministry of Planning.

**Engineer Raed Bani-Hani:** GCEP.

**Eng. Rania Al-Nimer:** Adminst. Support /Secretary.

**Mr. Bashar Rawashdeh:** Adminst. Support /Accountant.

### **Project Steering Committee:**

**Engineer Faris Al-Junaidi:** General Director of GCEP, Head of the Steering Committee

**Dr. Iyad Abumoghli:** UNDP

**Engineer Khalaf Alokla:** GCEP-Directorate of Nature and Land Conservation

**Engineer Nadia Juhari:** Ministry of Planning.

**Dr. Abdelmuti M. Tellawi:** Project Coordinator, Biodiversity Strategy and Action Plan.

***Dr. Saeed Damhouryeh:*** University of Jordan  
***Engineer Rania Abedelkhaleq:*** Ministry of Water & Irrigation  
***Mr. Nawzat Abedah:*** Ministry of Tourism  
***Mr. Essa Mahadeen:*** Radio and Television Corporation  
***Engineer Khaled Irani:*** Royal Society for Conservation of Nature  
***Mr. Yahia Shihadeh:*** Royal Society for the Conservation of Nature  
***Dr. Mohammed Alajloni:*** Project Coordinator – Agro-biodiversity Project  
***Engineer Subhieh Soaefan:*** Ministry of Agriculture (NCARTT)  
***Engineer Suliman Alabbadi:*** Ministry of Agriculture  
***Engineer Ahmad Alme fleh:*** Royal Jordanian Geographic Center  
***Engineer Esam Qararaeh :*** Jordanian Cooperative Corporation  
***Dr. Sami Alsunnaa:*** Private Sector  
***Mrs. Ghadah Alabdullat:*** National Women Committee Gathering  
***Engineer Raed Bani-Hani:*** GCEP- Biodiversity Unit  
***Mr. Amjad Alghubari:***GCEP- Environmental Legislation

## Abbreviations

**ASEZA:** Aqaba Special Economic Zone Authorities.  
**CBD:** Convention on Biological Diversity  
**CNM:** Contingent Valuation Method.  
**COP:** Countries Of Parties  
**CPC:** Cleaner Production Center.  
**DOS:** Department Of Static.  
**EIA:** Environmental Impact Assessment.  
**FAO:** Food And Agriculture Organization.  
**GCEP:** General Corporation for Environment Protection  
**GEF:** Global Environmental Facility  
**GIS:** Geographic Information System.  
**GNP:** Gross National Product.  
**GOJ:** Governmental Of Jordan.  
**GRU:** Genetic Resources Unit.  
**GTZ:** German Technical Cooperation.  
**ICARDA:** International Center For Agriculture Recherche In Dry Areas.  
**IUCN:** International Union For The Conservation Of Nature  
**JBD:** Jordan Biodiversity Data Base.  
**JES:** Jordan Environment Society  
**JSDCBD:** Jordanian Society For Desertification Control And Badia Development.  
**JUST:** Jordanian University Of Science And Technology.  
**JVA:** Jordan Valley Authority.  
**LMO:** Living Modified Organisms.  
**MOA:** Ministry Of Planning.  
**MOTA:** Ministry Of Tourism Antiquities.  
**MWI:** Ministry Of Water And Irrigation.  
**NBSAP:** National Biodiversity Strategy And Action Plan.  
**NCARTT:** National Center For Agriculture Research And Technology Transfer  
**NCPC:** National Cleaner Production Center.  
**NEAP:** National Environment Action Plan  
**NES:** National Environment Strategy  
**NEWS:** National Environmental and Wildlife Society.  
**NGO:** Non- Governmental Organization.  
**NRA:** Natural Resources Authority .  
**NUB:** National Unit For Biodiversity  
**RJSED:** Royal Jordanian Society For Ecological Diving .  
**RSCN:** Royal Society For The Conservation Of Nature  
**RSS:** Royal Scientific Society.  
**SAP:** Strategic Action Plan.  
**SMES:** Small and Medium Enterprises.  
**SSSI:** Sites Of Special Scientific Interest.  
**UNCED:** United Nations Conference On The Environmental Development  
**UNDP:** United Nations Development Programme  
**UNEP:** United Nations Environment Programme  
**UNESCO:** United Nations for Education , Science and Culture Organization  
**USAID:** United State Agency For The International Development  
**WWF:** World Wildlife Fund

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## ***EXECUTIVE SUMMARY***

Jordan is characterized by a wide range of physical conditions and by a rich variety of flora and fauna. Its location at the crossroads of climatic and botanic regions endows the country with a rich variety of plant and animal life including some 152 families of vascular plants recorded in Jordan, including more than 2,500 plant species, plus several hundreds species of non-vascular cryptograms. Several taxa of these have agro-ecological value and are regarded as of great regional and global use.

The Rift Valley is a major migration route that raptors and other birds use to migrate between Africa and Europe in spring and autumn. On the other hand, the Eastern Desert which covers more than 75% of the total surface area of the country is a place where several species are present especially reptiles and small mammals that are used to the dry and harsh conditions of these habitats.

The variation in ecosystems and habitats has led to a wide biodiversity. A total of 77 species of mammals belonging to seven orders have been recorded so far. The Jordanian herpetofauna consists of 102 species. The majority of it, is not critically endangered even though about 14 species are relatively rare, 2-4 species might be already extinct and a few species are probably critically endangered.

The 411 bird species recorded in Jordan belong to 58 families. The Avifauna of Jordan is one of the best-studied groups due to Jordan's location on the migration route for birds. The invertebrate faunas of Jordan are unique in many aspects since its composition is a mixture of several faunal origins but due to lack of comprehensive research on invertebrates in Jordan, the exact number of species is unknown. A total of 13 orders and 116 families were only recorded in Jordan so far.

Nature protection in Jordan has been a constant concern of both the Royalty and Government always realising the fragile nature of ecosystems owing to the socio-economic, physiogeographic and climatic conditions of the country. In modern times, this environmental concern has been manifested nationally and internationally in several occasions. In 1980, Jordan was among the original 30 countries to declare support for the World Conservation Strategy. Another milestone in this effort is the "National Environment Strategy" for Jordan (NES), a resource book of information and guidelines for action, compiled by a team of 180 Jordanian specialists with support from the IUCN and USAID. In October 1995, the new Jordanian Environmental Law was passed to achieve the principal objectives mentioned in the NES, and the National Environmental Action Plan (NEAP) was prepared emphasizing the need for a national biodiversity inventory. In September of 1996, the national Agenda-21 project was launched to lay the ground for sustainable resource development and environmentally sound management in the country. The country study on biodiversity in Jordan being completed by the National Unit for Biodiversity (NUB) under the guidance of the GCEP, with financial support from the GEF through UNEP implementation. At the regional and international levels, the Government of Jordan has ratified the following conventions: the Convention on

Biological Diversity (CBD) in 1993, the Convention to Combat Desertification, the Ramsar Convention, the World Heritage Convention and the Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment. Jordan is also party to the IUCN and UNESCO Man and Biosphere Program through a national committee. In 2000, Jordan was host to the Second World Conservation Congress.

**- The Convention on Biological Diversity:**

The Convention on Biological Diversity is dedicated to three objectives: to conserve biological diversity, to use its components sustainably, and to share fairly and equitably the benefits arising from the utilization of genetic resources. The Convention does not view biological diversity in terms of the extinction of species or disappearance of ecosystems alone. It views conservation of biological diversity as an integral part of the development process, aimed at satisfying the essential needs of both present and future generations. In addition to their ecological value, a greater diversity of species means a better potential for significant medical and agricultural developments, as well as possible solutions to such environmental problems as climate change, water pollution and treatment of hazardous materials. In light of significant reductions in biological diversity worldwide, it is vital to anticipate, prevent and tackle the causes of this loss.

The Biological Diversity Convention is the first global convention which relates to all aspects of biological diversity: genetic resources, species and ecosystems. It declares that conservation of biological diversity is a common concern of humankind and an integral part of sustainable development. By joining the Convention, states obligate themselves to preserve the biological diversity of their countries. In addition, the provisions of the Convention have ramifications on the world market and on Jordan in terms of international agreements on trade and bio-technologies, access to genetic resources and gene banks, development of agricultural products, use of natural resources and rehabilitation of ecological systems.

The global and integrated approach which underlies the Convention on Biological Diversity marks a milestone in the world community's movement toward sustainable development. Since humankind is dependent on biological diversity for its very existence, it is now up to the Contracting Parties, including Jordan, to undertake the necessary steps toward integrating the provisions of this all-important Convention in their development policies.

**- Jordan's Role in Implementing the Convention:**

Jordan ratified the Convention on Biological Diversity (CBD) in 1993 but, as stated previously, the country's rich tradition of nature conservation is by no means a recent development. Since Jordan is a developed country, in terms of both its scientific and technological development and its nature conservation and environmental experience (including law enforcement, management and research), it expects to take an active part in the implementation of the Convention.

The Kingdom's commitment to environmental protection has been demonstrated by a number of significant legal measures to prevent pollution, habitat damage and to protect

wildlife. That include: the adoption of a “National Environment Strategy” in 1991, the adoption of the “Jordanian Environmental Protection Law” in October 1995, the creation of the “General Corporation for Environment Protection” in 1996, and the preparation of the creation of the “Ministry of Environment” in the near future. The Government of Jordan has also ratified several other international conventions related to the environment including: the “Convention to Combat Desertification”, the “Ramsar Convention”, the “World Heritage Convention” and the “Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment”.

The recently adopted National Biodiversity Strategy and Action Plan constitutes a major contribution to the country's development plan. Land, water, pasture, terrestrial and marine ecosystems as well as wildlife and aquatic resources in particular are central to agriculture, fisheries and tourism development. Habitat protection, natural resource conservation and sustainable use options offer significant opportunities for demonstrating that conservation of biodiversity represents a vital investment in future sustainability of Jordan's economic and social development.

The ministry responsible for the implementation of the Biodiversity Convention is the Ministry of Municipality, Rural Affairs and the Environment. The General Corporation for the Environment Protection, acting under the Minister of the Municipality, Rural Affairs and Environment, is the scientific advisory body for Jordan to the Convention. An inter-ministerial committee (Steering Committee) for conservation of biodiversity was appointed in December. of 2000. It includes 18 representatives from the Ministries and NGO's of : Ministry of Planning , Ministry of Agriculture Ministry of Tourism, Ministry of Information ( TV & Radio Corporation), Ministry of Water an Irrigation, Ministry of Municipality and Rural affairs and Environment, National Center for Agricultural Research and Technology Transfer, Royal Geographical Center, Royal Society for the Conservation of Nature, United Nations Development Programme, Women Gathering Committee, Farmers Union, Jordanian Cooperative Corporation, University of Jordan, Project Coordinator of Agro-biodiversity Project, Project Coordinator of Biodiversity Strategy and Action Plan, General Director of the General Corporation for Environmental Protection, Director of Nature and Land Conservation Directorate, Head of Biodiversity Unit, Legal Consultant, Environmental expert/ Private sector. The Steering Committee is taking part in the preparations for the formulation and implementation of Jordan's Biodiversity Strategy.

## **LEGAL AND POLICY BACKGROUND:**

In view of its commitment to the Convention on Biological Diversity, the Government of Jordan is taking serious steps for implementing conservation programs and for applying concepts of awareness raising for the sound use and conservation of biodiversity resources. This commitment has been reflected in Jordan's interest to conserve its natural and biological heritage at sites like the Azraq and Dana Natural Reserves. Jordan has also supported the national institutional structure and mechanism for the sound use and conservation of biodiversity resources through the establishment of agencies like the General Corporation for Environment Protection (GCEP) and many other related

agencies.

Soon after the CBD was ratified, the General Corporation for Environment Protection was designated as the key agency responsible for the development of a National Biodiversity Strategy and Action Plan to determine the measures required to meet the obligations of the convention, and to enhance co-ordination of national efforts aimed at the conservation of biodiversity and the sustainable use of biological resources.

The primary responsibility for conserving biodiversity and ensuring the sustainable use of biological resources is shared among GCEP and other sectoral departments such as the Ministry of Agriculture, Ministry of Planning, Ministry of Water and Irrigation, Ministry of Information, Ministry of Tourism. As these and most other ministries have an integral role to play in the processes needed to implement the articles of the CBD, an intergovernmental Biodiversity Steering Committee with representation from each of these departments was therefore established to develop the Jordan National Biodiversity Strategy and Action Plan. The Royal Society for Conservation of Nature, the Jordan Farmers Union, the Jordanian Co-operative Corporation, the National Centre for Agriculture Research and Technology Transfer, the University of Jordan, the Royal Jordanian Geographical Centre, the General Corporation for Broadcasting and Television and the National Jordanian Group for Women Committees also participate to the steering committee work.

Regional and urban districts, private property owners, businesses, local and indigenous communities, international conservation organizations, university and research institutions and other groups also play an essential role in conserving biodiversity and sustainably using biological resources. Several of these stakeholders were consulted in the course of the preparation of the Strategy and action plan.

The Strategy clearly recognizes that government cannot act alone to ensure the conservation of biodiversity and the sustainable use of biological resources. It invites and encourages all Jordanians to take action in its support and recognizes that Jordan has an important role to play in co-operating with other countries, especially neighbour countries, to implement the Convention.

Conserving biodiversity and sustainably using biological resources are fundamental to achieving sustainable development. They are an echo to the teachings and beliefs of Islam on the obligation for man to maintain balanced relations with the other elements of creation.

The Kingdom's commitment to environmental protection has been demonstrated by a number of significant legal measures to prevent pollution, habitat damage and to protect wildlife. That including: the adoption of a "National Environment Strategy" in 1991, the adoption of the "Jordanian Environmental Protection Law" in October 1995, and the creation of the "General Corporation for Environment Protection" in 1996. The Government of Jordan has also ratified several international conventions related to the environment including: the "Convention on Biological Diversity (CBD)" in 1993, the

“Convention to Combat Desertification”, the “Ramsar Convention”, the “World Heritage Convention” and the “Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment”.

This National Biodiversity Strategy and Action Plan constitutes a major contribution to the country's development plan. Land, water, pasture, terrestrial and marine ecosystems as well as wildlife and aquatic resources in particular are central to agriculture, fisheries and tourism development. Habitat protection, natural resource conservation and sustainable use options offer significant opportunities for demonstrating that conservation of biodiversity represents a vital investment in future sustainability of Jordan's economic and social development.

### **OBJECTIVES OF JORDAN’S BIODIVERSITY STRATEGY:**

Jordan’s National Biodiversity Strategy is based on a national vision whereby society appreciates and respects all life forms and sustainably uses natural resources while preserving and conserving the country’s rich biological diversity for the benefit of future generations. Jordan has an important role to play in conservation and sustainable use of biological resources to improve quality of life and economic prosperity locally and globally, that agree with the teachings and beliefs of Islam on the obligation for man to maintain balanced relations with the other elements of creation.

In order to fulfill this national vision, Jordan has formulated several targets aimed at protecting, assessing, utilizing and benefiting from biodiversity and its components.

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

Every effort is being made to identify organizational frameworks capable of implementing the program and to strengthen the role of non-governmental organizations. In addition, new or amended legislation is being developed in order to strengthen natural resource conservation, to accord protection from exotic species and to prohibit commerce in indigenous species. High priority will be accorded to integrating the principles of biodiversity in educational programs on all levels.

On the technical level, initiatives will be launched to incorporate ecosystems which are not currently represented in the national network of protected areas, marine reserves and population inventories and surveys. Recommendations for conserving and using different biotic resources will be formulated, and plans for research and management of isolated populations for the purpose of their preservation will be drafted.

On the research front, it will be necessary to strengthen taxonomic and systematic research and to monitor global impacts and ozone depletion. An economic assessment of indigenous genetic resources, genetic engineering and use of popular knowledge of these resources is planned as well.

The Strategy provides a framework for actions at all levels that will enhance our ability to insure the productivity, diversity and integrity of our natural systems and, as a result, our

ability to develop sustainability. It promotes the conservation of biodiversity and the sustainable use of our biological resources, and describes how we will contribute to international efforts to implement the convention.

**\* Main Strategic Goals:**

The Strategy's five goals 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 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;

\*Managing 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, developing 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; and

\*Work with other countries to conserve biodiversity, use biological resources in a sustainable manner and share equitably the benefits that arise from the utilization of genetic resources.

The Strategy recognizes that the conservation of biodiversity and the sustainable use of biological resources are fundamental to Jordan's local communities. It describes mechanisms through which these communities will be able to develop their own understanding of, and response to, the Convention.

**IMPLEMENTATION OF JORDAN'S BIODIVERSITY STRATEGY:**

In a country as small as Jordan, with a high rate of activities and urbanization, nature reserves are important to help secure the biodiversity of the natural environment.

Proposed mechanisms for implementing the National Biodiversity Strategy and Action Plan include:

\*The production of an annual national report on policies, activities and plans aimed at implementing the Strategy;

\*Building institutional capacity for GCEP to implement the Strategy,

\*Coordinating the implementation of national and international elements of the Strategy

through a permanent Interdepartmental Biodiversity Steering Committee and National Unit for Biodiversity;

\*Measures to allow and encourage non-government participation in the implementation of the Strategy;

\*Regular reporting on the status of biodiversity; and,

\*Revision of the Strategy after an initial implementation phase of five years.

Successful implementation of the Strategy will be determined, in large measure, by the degree to which all parts of society adopt its vision and principles and contribute to achieving its goals. Ultimately, the conservation of biodiversity and the sustainable use of biological resources will require the support and participation of individual citizens, local communities, urban and regional governorates, conservation groups, business and industry, and educational and research institutions. The implementation of the actions listed in the Action Plan will be decentralized and under the responsibility of each participating ministry, agency or non governmental organization.

#### **Action Plan:**

Recognition of the worldwide impact of the decline of biodiversity inspired the global community to negotiate the United Nations Convention on Biological Diversity. The Jordanian delegation participated actively in these negotiations. The Hashemite Kingdom of Jordan ratified the Convention on Biological Diversity (CBD) in 1993.

A steering committee on biodiversity composed of 16 government department and agencies representing the primary managers of Jordan's biological resources and land base was formed to devise the convention implementation Strategy as well as an action plan. A Biodiversity Unit largely assisted the committee in this task. The draft Strategy was submitted to public consultation before being adopted as the Government's official Strategy.

The Jordan Biodiversity Action Plan, part of the Strategy development process, includes 60 proposed projects related to the measures identified in Jordan's Convention on Biological Diversity implementation Strategy. It specifies the role of the department or government agency concerned and defines a five-year implementation timetable. Nearly one-third of the actions contained in this document are already under way or will be improved by the departments concerned, while the remaining two third consist of newly defined courses of action.

Implementation of the present Action Plan will be monitored annually by the National Steering Committee on Biodiversity. This will be done with the understanding that the main objectives targeted by the Convention on Biological Diversity, i.e. the conservation of biodiversity, the sustainable use of biological resources, and the fair and equitable sharing of benefits resulting from the use of genetic resources, are echoing the three dimensions of sustainable development. Part of the mandate of the steering committee

related to sustainable development will be to assess the performance of adopted measures with respect to biodiversity at the end of the first five-year implementation period.

Effective, efficient and harmonious implementation of Jordan's Biodiversity Strategy requires sustained co-operation and consultation among the Government's agencies managers to ensure that the natural environment's productive capacity and ecological potential are respected. Furthermore, the Jordan government is encouraging all Jordanians to help safeguard our biological diversity. All individuals and organizations, including the municipalities, are invited to contribute to the annual progress reports by informing the National Steering Committee on Biodiversity of the activities they carry out. These activities are numerous and of great importance to the maintenance of Jordan's biological diversity.

The Action Plan will take effect in December 2001, signaling the true implementation and enabling the first results of Jordan's Convention on Biological Diversity implementation Strategy.

**Priority Actions:**

The National Strategy and Action Plan proposes a series of priority actions and projects that are presented according to the following themes involving most sectors of society:

**Theme 1. Protection of biological resources**

Endangered species

Protected areas and ex situ conservation

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

Wild plants

Forests

Terrestrial and freshwater wild fauna

Marine life and fisheries

Microorganisms

Agriculture resources:

-Plant production

-Animal production

-Rangeland production

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

Mining

Industry and factory production

Biotechnology and biosafety

Eco-tourism.

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

Land tenure and land use planning

Water resources

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

Economic valuation of biodiversity

Legislation, and institutional structure

Public awareness and participation

## **MONITORING AND REPORTING ON IMPLEMENTATION:**

The National Biodiversity Unit, under the guidance of the National Steering Committee and with the support of the Technical Advisory Group shall monitor and report on NBSAP implementation. The monitoring itself should extensively involve national stakeholders in gathering, compiling and analyzing relevant information. It should be based on performance indicators developed for each NBSAP sectoral objective.

Reports on this monitoring should be prepared annually. They should be credible and objective, concise and easily understood by a broad national audience, and widely disseminated among national stakeholders. Reports should focus on the main policies, activities and on-going programs contributing to the goals of the Convention and to the sectoral objectives of the National Strategy and Action Plan. The reports should take the form of a printed or electronic document. From time to time, videos could be produced on certain topics deemed relevant for broader public distribution.

### **. The Need for Biodiversity Indicators:**

The goal of monitoring the national biodiversity Strategy in Jordan will be to measure changes induced by the efforts of different national stakeholders and programs. This sort of induced change can be difficult to distinguish from a normal range of variation. Monitoring of indicators should start from the earliest stages of implementing the biodiversity strategy and action plan and continue long enough to help observers distinguish natural variability from the actual results and effects of their programs.

### **. Involvement of National Stakeholders:**

Working in close collaboration with the main stakeholders, the National Biodiversity Strategy Unit should also clearly identify the monitoring roles of each of the partners involved, government agencies, private sector organizations, NGOs, etc. Ensuring national stakeholders are fully involved in the planning and implementation of the reporting will help reinforce their ongoing participation in the national dialogue on sustainable development.

The National Biodiversity Strategy Unit will need to establish focal points in all major stakeholder organizations. These focal points, known as the Technical Advisory Group, will in turn be instrumental in ensuring that their organizations will contribute effectively to monitoring the implementation of the national biodiversity Strategy and action plan.

The National Biodiversity Strategy Unit should also make use of other national experts to support this monitoring when necessary. The Office may find it useful to hire a local specialist for a certain period each year to help collect, collate, analyze and synthesize the information of various types made available by various stakeholders over the year.

# **THEME 1: INTRODUCTION TO BIODIVERSITY IN JORDAN**

## **1.1. Historical Roots of Conservation in Jordan:**

Jordan's commitment to nature conservation is by no means a recent development. Concern for all living things coupled with prohibitions against environmental degradation may be traced back to the period 6000-7000 BC., where human life started around the water springs in the Jordan Valley area and (Ain Ghazal) area near Amman. The inhabitants, at that time, lived on hunting and collecting wild plants' seeds including wheat and barley (Al-Shakhatrih 1981).

Studies indicate that wide areas of Jordan specially the mountainous heights were covered with forests and rich vegetation cover, and that the vegetative cover in many Jordanian territories was terminated since the third and second century before Christ until now, due to transforming forest lands into other land use, continuous over- grazing, hard environmental conditions, long excessive exploitation of natural resources, and movement of armies invading the region or passing through it. This destruction was so comprehensive that it left just only some scattered pockets of forest remnants.

### **\* Historical review:**

#### **A. The BC period:**

The establishment of residential centers, living on agriculture under irrigation, occurred between 6000-5000 BC. Irrigation systems, and channel construction were developed, several species of trees and plants were cultivated in Jordan Valley, specially wheat, barley, grapes and the date palm. Wells were dug to store rain water in 4000 BC. But floods, torrents and the resulting damages resulted there, caused a part of these inhibitors, to move to mountain cliffs and cultivate the area (Al- Shehabi 1965)

During the Bronze age (3000-1200 BC), agriculture expanded in Jordan to include the southern areas of Jordan Valley, and more irrigation channels were constructed to utilize rain and river' water. Archaeological researches showed that several village ruins related to that period were found such as Tapqat Fahel. During (1200-586 BC.) the Arab Canaanite people started to establish residential centers on mountains, fertile plains, and adjacent spring. Agriculture flourished and exceeded the inhabitants' needs. The olive oil processing were constructed as well as alcohol factories, to extract wine from grapes and date palm. The inhabitants started to protected the land and conserve soil by building terraces and stone walls(Goor1963). In the period (586-63 BC.) the Babylonians, Persians and Greeks invested wide areas for agriculture, and many of them owned wide agricultural areas (Al-Shehabi 1965).

#### **B. The period (63BC.-330AD)**

In the Roman period the lands were invested excellently, where the agricultural land expanded, agriculture methods developed, dams were constructed, irrigation systems were developed, manure were used to increase the crop productivity, terraces were constructed on mountain cliffs and measures were taken to control land deterioration.

In the Bezantian period (330-640 AD), agriculture widely developed, accompanied by an

architectural development whose remnants still exist until now. Taxes on agriculture products increased and reached 50% of the agricultural products. The continuation of agricultural expansion at that period indicates the benefits of agriculture despite the high taxes .(Al-Shakhatrih 1981).

### **C- The period (640-1250 AD).**

This period includes the Islamic, the Crusaders', and the Mameluke era, in which agriculture was ignored, the vegetative cover started to deteriorate, the dominant land use changed completely, and the soil conservation terraces disappeared, but this did not last too long, as palaces and gardens were constructed in the Jordanian desert during the Ommiads era.(Al-Refaae 1973).

Wheat, barley and some vegetables such as onion and garlic as well as figs, olive, grapes, and thick forests were known in Jordan since ancient eras. Jordanian forests were described in the Ommiads era as Al-Maqdisi says: ( "Terebinth was well known on the Jordan River banks, while mountains of Ajloun and Balqa were known by their abundant forests" (Al- Balathri). The historian Al-Thaalibi confirms: ("Syria is abundant in olive. Olive was also planted in the extreme South of Syria in Al-Humaima, and Wadi Musa, while Mu'ab, specially Karak, was famous of pomegranate, as well as Sult") (Al-Hamawi).

Gardens and palaces flourished during the Abbasi era for entertainment and hunting centers, as the palaces of Amra, and Al- Hallabat. and Al-Harranah that still lucid evident to that. During the Mameluke era (1250-1517), the major part of the vegetative cover was destroyed due to over grazing(Al-Dori 1950).

### **D- The Ottoman era (1517-1917):**

In the Ottoman era (1517-1917) the lands were leased to village councils or to feudal lords for a considerable amount of money, forcing the tenet to exploit the land randomly without taking into consideration its carrying capacity, to gain an utmost income, even if this destroyed its future productivity. Land- reform operations, stone walls construction and fertilizer applications had all seized. Trees located in these lands were cut, or sold to be used as fuel wood or in construction, and over grazing continued as well (Al-Refaae 1973).

In 1858 the Ottoman government issued the agricultural reform act, which allowed the farmers to register the land they cultivate or bought as private property in their names. The Ottoman State aimed to deal directly with the farmers without the mediation of the sheikh or the tax collector, in order to improve and activate agriculture, thus gaining more money for the bankrupt Ottoman State treasury, but the farmers feared the state blundering through the taxes imposed on them, so they registered them in the names of other persons such as the local sheikh and those with strong influence to protect them from state. This situation allowed the local sheikhs, and the people with strong influence to own large areas of lands. The government also allowed foreigners to own land (Al-Tahir1950).

Oil fruits and those of industrial use such as sesame, wheat, corn and tobacco were the most important crops. The agriculture deteriorated at the end of the Ottoman era.(Al-Tahir1950). The situation deteriorated badly in 1914 as the First World War started and forests become military training centers and the chopped trees used in building Hijaz Railway and as trains fuel.(Al-Tahir 1950).

### **1.1.2- Forests and vegetation cover in the last 100 years:**

Jordan was covered with wide areas of forests that were estimated to cover more than one and a half million dunums 100 years ago ( Tellawi 1994). The travelers who visited Jordan 100 years ago described the various aspects of agriculture life, the fertile lands, virgin and rich in vegetation cover. Traveler Dr. Selah Merrill (1875) said: “(I don’t know which surprised me more, the over fertility in East Jordan or the marvelous antiquities scattered here and there”).

#### **A. Northern and middle area of Jordan:**

The north region was distinguished by thick forest of oak trees, specially the western part of it. The whole area covered by thick forests of Christ thorn (ziziphus) in Jordan Valley and oak trees in the slopes and top mountain, the forests contain wild almond, styrax, carob, terebinth and olive trees. Olive trees, grapes, and other fruit trees were planted in Sult and Ajloun, Selah Merrill(1875) described the city of Sult: “( The town of Sult is located in a narrow valley, old olive trees cover one third of its area, residents consume cold, fresh water from an abundant spring”), he also said( “In Ajloun mountain and around Sult, the most delicious types of grape fruits are produced”). He described the huge number of bee hives in Halawa village, the wild pigs in Al-Mukheiba village, palm date, retame and phragmites in Al-Adaseyeh, different wild animals in Ajloun and Um-Qeis including gazelle, wolves, foxes, and wild birds living in the forests, he added: “( we left Wadi Al-Yapis to Zerqa River, we passed through wide wheat farms, crossed Ajloun wadi and Rajib wadi through large water streams, the tents of the Bedouins and their livestock specially the camels covered area, in Rajib wadi we saw interested ruins and huge natural tunnel passing through the hills”). (Selah Merrill 1875).

High percentage of Irbid area were was covered by forests, another part cultivated by wheat or covered with orchards, Selah Merrill (1875) said:” (Around Irbid there are forests of oak trees, the birds are numerous in addition to the green fields of wheat)”...he added in 1877: “(Ajloun Valley is more beautiful than Wadi Alyabis because it is wider and full of springs and view from the village of Ain Jenna makes it the most beautiful valley in whole Syria, here you can see orchard full of fruit trees including figs, olive, peach, quince, apricot, lemon, apple and pomegranate. The Valley includes several mills as I have seen 12 of them”)... (“This is Amman the city of water, to the west of Amman there are fertile agricultural lands with few springs, and the graze-lands are full of grass...and in some parts of the western mound there are thick forests”).(Selah Merrill1881)

Traveler Gotlib Schumacher (1885) described the north region as such:( “This region is distinguished by thick forests of oak trees. From Um-Quis in the East to Houran, and from the border of Wadi Al-Arab and along Wadi Al-ghafer in the South to Soum and

Tebna and from there westward until Al-Ghor, you can see the whole area covered by thick forests of Christ thorn (*Ziziphus*) and oak trees...) ( Al- Kfarat area is fertile and covered by oak trees”), he described the historic oak trees (*Quercus aegilops*) called the Qinousi Tree:( “I have seen, to the north of that inhabitants don’t touch its leaves or branches because they believed of its holiness”.(Schumacher 1885).

### **B. The Southern area:**

The Southern area was rich in vegetation cover more than now. Cultivation, specially field crops and orchards, was more widespread. Traveler Dr. Selah Merrill (1875) described Maeen and Hisban area in Madaba district and Kerak areas: “(we passed through Maeen, we saw three huge herds of camels covered the fertile plain, in each herd several thousands of sheep’s and goats in their way to Jerusalem and other Palestinian towns,..Kerak area is famous with original Arabian horses”). He added “(The Bedouins in the south are usually interested in their lands, but the cultivation is done by other farmers from the neighboring villages) (Selah Merrill 1875)

Traveler Robinson Lees (1890) described that in the southern part of Jordan, that number of trees in the area was limited, but cultivation by the farmers in the villages was intensive, even by Bedouins. There were intensive trading in livestock among the local people in town and villages, while the Bedouins living in deep desert depend mainly on camel raising. He added that Houran in the North and Kerak in the South were linked in by wide fertile cultivated plains.(Robinson Lees 1890)

### **\* The Emirate era (1922-1939)**

The Emirates inherited a retarded agriculture from the Ottoman era for many reasons, the most important of which is lack of security, the farmers were at the mercy of some groups who invade the agricultural areas and plunder what farmers produced, as well as their cattle and crops, and forced them to pay (tributes). Farmers were poor and miserable, lived for by their day and could not settle in certain lands. The joint ownership of land contributed in agricultural retardation and farmers refrained to care for a certain lands or to plant it them with fruit trees.(Al-Tahir1950).

The Ministry of Agriculture was established for the first time in East Jordan Emirate on 8 August 1939, the number of technicians at that time was less than hand fingers, and the ministry worked hard to develop the agriculture sector despite its limited capabilities. The first unit to reserve forests was established since the establishment of East Jordan Emirate in 1922, and the first forest act was issued in 1923, followed by the general forest act in 1927 which is the basic law on which recent forest law was based. The efforts of that unit succeeded in preserving the natural-forests until the beginning of the thirties.

Most of the forest lands had been surveyed and partitioned during ( 1932 and 1938), but the outbreak of World War II in 1939 drove people to break the forest lands, and chop the available trees, to use the land for field crops to avoid famine similar to that occurred in World War I, thus eliminating thousands of hectares of forests during that period.

## **1.2. Biological Diversity in Jordan:**

Jordan is characterized by a wide range of physical conditions and a rich variety of flora and fauna. Along its 400-kilometer length, Jordan embraces landscapes that are normally separated by thousands of kilometers in other countries. The Northern Highland represent Mediterranean fauna and flora, while the Gulf of Aqaba in the south, harbors spectacular coral reefs and colorful fish that represent the tropical zones. Lying between these two extremes are arid desert areas, lush oases, green Mediterranean woods and forests, and the lowest point on earth -the Dead Sea.

Jordan is rich in biodiversity. Its location at the crossroads of climatic and botanic regions endows the country with a rich variety of plant and animal life including some 2500 plant species (of which 100 species (2.5%) are listed as endemic), 411 bird species, 77 mammal species, 97 reptile species and 5 amphibian species were recorded (Jordan Country Study On Biological Diversity,1998). The number of invertebrate species is difficult to estimate. The scarcity of wetlands is reflected in the dearth of amphibians as opposed to the wealth of reptiles. Within the small land area of Jordan, two opposing climatic regimes are found -Mediterranean in the north west and desert in the east south. The steppe part of the country is a transition area between these two biogeographical regions where desert biota is gradually replaced by Mediterranean biota. Species widely distributed over the entire Mediterranean climate region reach their southern limits of distribution in Jordan while Saharan or Asian desert species reach their northern most limits in this country.

The decline of biodiversity is largely a result of accelerated development, population increase and the resulting destruction of habitats. While about 4 percent of Jordan's land area is preserved within declared nature reserves, most of them (90 percent) are located in the desert areas of Jordan. Only about 1 percent of the Mediterranean region is currently protected in nature reserves. The main problem facing nature conservation in the Mediterranean region is habitat fragmentation and urbanization.

Protection of many animal populations (e.g., bats, sand dwelling reptiles, large predators like wolves, and other mammals such as gazelles) is impossible to achieve within the reserve system, while outside the reserves, development, habitat degradation and conflicts with agriculture and other human activities, make it difficult to preserve the small Jordanian populations. Cooperation and coordination in research, management and development plans are sorely needed to secure nature conservation in this region.

In the south of the country, the unique desert ecosystem is also endangered, mainly by pressure from development plans. Further scientific research is required to understand the desert ecosystems, explain the mechanisms involved, and thereafter prescribe the correct balance of livestock grazing, reintroduction of extinct wildlife, proper road construction and tourist accommodation.

## **1.3 Role, Importance and Value of Biodiversity**

One problem facing ecology and economics today is how to measure the value of

environmental goods whose destruction (associated with the ever-increasing scale of the human enterprise) generates vast externalities. A prime example of one of those goods is biodiversity - the variety of genetically distinct populations and species of plants, animals, and microorganisms with which *Homo sapiens* share Earth, and the variety of ecosystems of which they are functioning parts.

Economists and ecologists agree that biodiversity has value to humanity, although whether it has value independent of human needs is less clear. Both groups also agree that the value of biodiversity to humanity has both use and non-use components.

### **1.3.1 Direct Values:**

Natural ecosystems provide people with food and innumerable materials of all sorts, from honey and truffles to teak. Most notably, a crucial portion of the protein in our diets comes straight from nature in the form of fish and other animals harvested from the seas. This service is provided by oceans in conjunction with coastal and wetland habitats, which serve as irreplaceable nurseries for marine life that is either harvested directly or used as a food supply by the sea life that we eat.

The active ingredients in at least a third of the prescription drugs used by civilization come directly from or were derived from chemical compounds found in wild plants, fungi, or other organisms, especially in tropical forests - digitalis, morphine, quinine, and antibiotics being among the most familiar.

Natural ecosystems maintain a vast genetic library from which *Homo sapiens* has already drawn the very basis of civilization and which promises untold future benefits. That library of millions of different species and billions of genetically distinct populations is what biologists are referring to when they speak of biotic diversity, or biodiversity.

The potential for biodiversity to supply new and vitally needed foods and medicines alone is enormous. Wild plants and animals could be sources of new foods to augment the human food supply, which in the last generation or two has seen shrinkage in the variety of foodstuffs entering the economy as agricultural systems have shifted to the big three (wheat, rice and maize) and other widely grown and improved crops at the expense of many traditional varieties and species. The narrowing of the genetic base of major crops is a serious concern that has been addressed (although how adequately is questioned by many agronomists and geneticists). But the neglect of potential food plants that have never been domesticated and of many traditional foods in tropical regions is also a serious matter, especially as tropical forests, the prime potential source of new foods, drugs, and other useful materials, vanish at accelerating rates.

### **Biotechnology and Pharmaceutical Industries:**

Most if not all pharmaceutical industries in Jordan rely upon readily imported raw materials. The potential of producing such materials is there, what is needed is a real drive toward exploitation of the available resources from natural products. Microbial secondary metabolites that include organic substances, food additives, bio-pesticides

enzymes, etc. are just a few examples of what we should invest in both economically and scientifically.

### **Food and Beverage Industries:**

In Jordan, improving product quality and increasing the production of microorganisms is lagging behind the industrial world. In developed industrial countries, superior microbial species have been carefully selected and improved over centuries to suit local conditions and special circumstances. Priority in Jordan should concentrate upon microbiological control of insects, genetic characterization of strains of *Rhizobia*, and ectomycorrhizal fungi, which are important for soil rehabilitation and reforestation. Also extra-cellular enzyme producing microorganisms are worthy of investigation, and specially those thermostable varieties which are important in fermentation and food technology and industries. All the above-mentioned lies in utilizing the great diversity of microorganisms in nature. It is this variation that results in the often-superior capabilities of microorganisms together with their novel capacities of bio-transformations, tolerance to environmental stress and variety of biochemical pathways that support the productivity.

### **Economic Value of Plants:**

Few studies related to the economic and medicinal value of plant biodiversity in Jordan were carried out. Extensive studies are thus needed to investigate the economic value of Jordanian plants in terms of their potential use in agriculture, forestry horticulture, medicine, genetics, or biotechnology.

### **Economic Importance of Coral Reef Communities:**

The Gulf of Aqaba could play a major role as a revenue earner for Jordan. Important as the only marine outlet for Jordan, the Gulf of Aqaba holds valuable economic resources for pharmaceutical, recreational and tourist use, and for fisheries.

### **Tourism:**

Tourism is now the leading revenue earner in many countries. The Florida reefs are considered to be worth US\$1.6 billion in recreational earnings. Recreational divers from the US alone spend US\$286 million each year in the Caribbean and Hawaii. The economic value of reef tourism has only been partially determined in the developed countries. The Gulf of Aqaba, if managed properly, has several key elements, which can make it one of the most important contributors to Jordan's economy. These points can be summarized as follows:

- a) The Gulf of Aqaba is the nearest tropical sea to Europe, which can attract many tourists due to the low traveling costs. In addition, accommodation in Jordan is relatively not expensive.
- b) The Gulf embraces one of the most unique, fascinating and highly diverse coral reef communities. About 1000 species of fish, 150 species of reef building corals, 120 species of soft corals and 1000 species of mollusks are found in the Gulf of Aqaba. Coral species in the Gulf represent about 40 % of the maximum number of coral species found in any area of the Indo-Pacific.
- c) The warm, clear and calm waters of the Gulf make it suitable for many aquatic sports, such as snorkeling, diving, water-skiing, wind surfing, boating etc.

### **Pharmaceutical Applications:**

As a result of the recent scientific development, there is growing interest in reef species as a source of compounds for drug industry. Many species, sea fans, sponges, fishes, corals and nudibranchs, living in the Gulf of Aqaba contain pharmacologically active substances. Recently, small pieces of corals have been used as bone graft substitutes. In addition, the UV-light absorbing pigments in coral tissues have been investigated as a source of a new ingredient for sunscreens.

### **Aquarium Trade:**

Many reef species, including fish, shrimps, mollusks and corals, have been taken for the aquarium trade. However, there is no information about the economic value of this sector and its effect on the marine environment of the Gulf of Aqaba.

### **1.3.2 Indirect Values**

Humanity, of course, is dependent for its very existence on other organisms, but in ways that are rarely recognized in formal economic analyses. It must be emphasized that it is not just preserving samples of the world's genetic diversity (as might conceivably, but not practically, be done through a vast network of seed banks, botanic gardens, and zoos) that is important. Other organisms, in all their extraordinary variety, are part and parcel of a global life-support system that benefits them and humanity as well. We not only sprang from other life ourselves, we are completely dependent on it to maintain the habitability of this planet.

Perhaps the most basic dependence of humanity on other organisms is through the process of photosynthesis. That is the process by which green plants, algae, and some microorganisms bind solar energy into chemical bonds of carbohydrate molecules (sugars, starches, cellulose). That chemical energy can be used to drive the life processes of organisms, mostly by combining it with oxygen in a slow burning process known as cellular respiration (or just respiration). The vast majority of non photosynthesizers - human beings and other animals, fungi, and many microorganisms - must obtain their energy from photosynthesizers, either by eating them or by eating other animals that do.

The ravaging of biodiversity is the most serious single environmental peril facing civilization. Biodiversity is a resource for which there is absolutely no substitute; its loss is irreversible on any time-scale of interest to society. The loss can be viewed as one if not the most single serious externality associated with human economic activity. But it is an externality so vast and pervasive that finding ways to evaluate (let alone internalize it) will be difficult.

### **1.3.3 Global Importance of Jordanian Biodiversity**

The global importance of Jordan's biodiversity lies within its geographical location, climate and geology. Its unique geographical features provide for a tremendous diversity of habitats, including some of the oddest distribution of species, communities and coral reefs.

As the global conservation community becomes increasingly concerned with dry land biodiversity and the consequence of its conservation and management, Jordan, situated at the center of this unique biota, offers a window into the biodiversity of dry lands, which in their own are transitional zones between biologically rich areas.

Jordan is among the few countries that have maintained and continue to maintain species related to different biota in a small, relatively semi land-locked space. These species include: the Arabian oryx (*Oryx leucoryx*), Syrian ostrich (*Struthio camelus*), Syrian bear (*Ursus arctos syriacus*), Cheetah (*Acinonyx jubatus*), Syrian wild ass (*Equus hemionus*), Arabian leopard (*Panthera pardus nimr*), fennec (*Fennecus zerda*), sand cat (*Felis margarita*), common otter (*Lutra lutra*), Persian squirrel (*Sciurus anomalus*), sand gazelle (*Gazella gazella*), Eurasian badger (*Meles meles*), African honey badger (*Mellivora capensis*), rock hyrax (*Procapra capensis*), spiny-tailed lizard (*Uromastix aegyptius*), desert monitor (*Varanus gresius*), brown fish-owl (*Ketupa zeylonensis*), Greek tortoise (*Testudo graeca terrestris*) and many other endangered species.

Jordan's territorial water in the Gulf of Aqaba are home to many globally important marine species such as the marine turtle (*Chelonia mydas*), whale shark, 300 species of coral fish and 250 species of corals, many of which are globally endangered and protected by several international conventions and treaties.

In its fresh water sources Jordan maintains two endemic species of fish: Serhani fish (*Aphanius serhani*) and the Dead Sea garra (*Gara ghorensis*). Jordan's biodiversity is yet to be fully uncovered, in fact many species are being discovered every year, and some are first-time recordings in science.

In 1977, IUCN-WWF defined 12 different areas of conservation importance, which encompasses the majority of Jordan's biological diversity. These 12 areas make up the network of Jordan's protected areas.

In 1995, Birdlife International in cooperation with RSCN defined and globally declared 27 areas in Jordan as important bird areas, and 13 areas as valuable wetlands in the Middle East.

These special habitats have further global consequences because they attract endangered birds such as the black and white stork, herons and many water fowl of Eastern Europe, on their annual migration routes from Europe to Africa.

Other special habitats of Jordan are its forests. The juniper forests are the world's most northerly distribution of this species, and the pine forests are considered the most southerly distribution of that kind of forests. Such habitats are of significant economic value to Jordanian society if properly conserved and managed as they could generate revenue from eco-tourism and forest management.

### Why care about biodiversity?

The value of biodiversity includes the economic worth of its different components such

as microorganisms and animals used in pharmaceutical and food products, medicinal and edible plants, natural products used in handicraft production, scenic ecosystems and marine life important to eco-tourism. It includes, as well, investments made through local and international agencies for monitoring and sustaining biodiversity. Biodiversity also bears essential scientific, cultural, social and ecological values.

**Protection, sound management and sustainable use of biological resources contribute to:**

- Maintain adequate and diversified food supply
- Provide sustainable supply of basic products (wood, fibers, medical supplies, etc.)
- Improve air and water quality
- Improve health conditions
- Opportunities for economical growth (eco-tourism, fisheries, hunting, agriculture and livestock production, forestry, biotechnology, etc.)
- Alleviate poverty
- Provide sustainable income for rural communities
- Improve quality of life
- To alleviate poverty and improve quality of life.

**1-4 ECOSYSTEMS:**

**Desert Ecosystem:**

This ecosystem comprises the eastern three quarters of the country and is continues with the Arabian Desert of Syria, Iraq and Saudi Arabia. It is a gently undulating plateau with an elevation of 500 to 900 m. Four broad habitats –types can be distinguished in these ecosystem:

- Hammada; smooth, gravel/chert plains, which stretches from Ras An-Naqab to the Iraqi border in the north-east.
- Harrat; black boulder-fields of basalt rocks, which extends from south Syria, through north-east Jordan, and onwards into Saudi Arabia.
- Extensive sand dune desert that occurs in the southernmost part of the country such as Wadi Rum and Wadi Araba areas.
- Clay pans lying at the bottom of closed drainage basins in the desert can become flooded after heavy rains, with the water persisting for several months rather than draining away. The best known such areas are Qa' al Azraq and Qa' Al Jafer , very occasionally forming a huge temporary lakes.

This largely treeless ecosystem is dominated on its fringe, adjoining the Highlands ecosystem by Irano Turanian species of small shrub and bush such as *Artemisia*, *Retama*, *Anabasis* and *Ziziphus*. The majority of the ecosystem to the east of this highland fringe, has even poorer plant cover dominated by *Artemisia*, *Phlomis*, *Stipa*, *Astragalus* and *Trigonella*. Deserts in Jordan are mainly defined as Badia.

The Badia is the main range-land of Jordan. But the range quality is deteriorating due to very heavy grazing and widespread of ploughing for rainfed cultivation barley, which has led to loss of plant cover and accelerated soil erosion and degradation through wind and

water erosion.

**\*Scarp and highland ecosystems:**

This ecosystem consists of escarpments and mountains, hills and undulating plateaus which extends mainly from Irbid in the North to Ras Al-Naqab in the South, and from the Rift Valley region in the West to the Badia region in the East.

The mountains in the southern half of its region are higher on average, and some range between 1,200 and 1,600 m high. Numerous broad, shallow, gravelly wadis drain the eastern and western flanks of this region. There is also an isolated tract of high mountains between Ras Al-Naqab and the Saudi border, including the highest peaks in Jordan Jabal Um Ishrin, at 1750 m.

The largest remaining areas of natural woodland occur in the highlands between Amman and Irbid, and are dominated by *Pinus halepensis* above 700 m, whilst mixed evergreen/deciduous oak woodland of *Quercus calliprinos* and *Quercus aegilops* dominates at lower elevations where the original pine-dominated woodland has been degraded.

Cultivation of rain-fed wheat is widespread on the plateau between Madaba and Irbid, and olive groves cover a large part of the north-western mountains above 700 m. More than 80% of the Kingdom's cities and villages occur within this region.

**\*Sub-tropical Ecosystem:**

This ecosystem extends in the Rift Valley from Dier Alla area and down until Aqaba areas. It is so called sub-tropical due to the Sudanian penetration in this region. The Dead Sea rift follows the line of a gigantic fault which extends 370 km from the meeting point of the Yarmouk river with the Jordan River in the north to the Gulf of Aqaba, and is part of the great African Rift Valley.

In the northern Ghor, lying north of the Dead Sea, the country's main river, the Jordan, flows south to the Dead Sea. The northern Ghor is the main agricultural area in Jordan; the principle crops are intensively cultivated fruit and vegetables, irrigated from canals which divert water from the Yarmouk, Zarqa and other rivers. Wadi Araba is mainly composed of stony and gravelly out wash plains and mobile dune desert, with some sabkhas (saline mudflats).

The natural vegetation of the valley plain and lower scarp slopes has been greatly modified by cultivation and grazing in the Jordan Valley, but is more intact in the stonier Wadi Araba: Tropical Sudanian species of tree and dwarf-shrub are prominent in the sparse and very open vegetation, including *Accacia*, *Balanites*, *Tamarix*, *Calotropis*, *Maerua*, *Salvadora*, *Orhradenus* and *Panicum*.

Three eco-zones in Jordan are of global importance: The Dead Sea Basin, the Jordan River and the Gulf of Aqaba.

### **\*Dead Sea Basin:**

The shores of the Dead Sea and the oasis in its vicinity preserve a rare blend of desert biota and biogeographic relics which have survived in the isolation of the surrounding desert. Several species have been separated from their species' gene pool long enough to evolve into subspecies, and even local endemic species. The presence of the latter is especially significant.

One species of endemic fish and dragon fly (*Caloptryx syriaca*) are known to occur in the Dead Sea area. The Mujib basin, where in relation to the Dead Sea, has been identified as an important bird and wetlands area for the Middle East. Here, evidence of breeding activity for the globally threatened Griffin vulture, lesser kestrel and the Egyptian vulture has recently been discovered.

Endemic birds are *Onychognathus tristrami*, *Passer moabiticus* and *Corvus rhioudo*. Many vertebrates such as the leopard, hyenas, Nubian ibex, rock hyrax, the jungle cat, Blanford fox, Egyptian mongoose, caracal and other globally and regionally endangered species inhabit the basin.

### **\*The Jordan River Basin:**

The Jordan River and its tributaries that flow east-west on its east bank are considered biologically important. As in the case of the Dead Sea, many endemic forms have evolved over the millennium to create many special habitats and communities. In dry and arid areas wetlands become important ecosystems for the survival of species thus creating the chance opportunities for species and habitat diversity.

The Jordan River is also an important wetlands area in the Middle East because it maintains many globally valuable species such as the brown fish owl, the common otter, Arabian leopard, rock hyrax, fresh water turtle, several endemic fresh water fish, fresh water snake and many other endangered species.

The river lies on a globally important migratory route for birds. It is estimated that about one billion birds migrate annually through this narrow corridor, thus making the basin an important migratory route of global avifauna, such as the black and white stork, dalmatian and common pelican, kingfisher, herons, shovelers, sandpipers, shanks, francolins and other globally threatened water fowl. In addition, the Jordan River represents a high economic value in terms of its forestry, agriculture, fishing, and religious and recreational tourism.

### **\*The Gulf of Aqaba:**

The coastline of Jordan extends for 27 Km along the northeastern section of the Gulf of Aqaba, a long, narrow and very deep arm of the Red Sea. It consists of a series of embayments. In each, a comparatively similar and wide range of communities is present, including: rocky shore, reef flat, reef face, fore reef, sandy shore, sandy bottom and sea grass ecosystems.

There is a discontinuous series of fringing coral reefs and reef flats, never more than 150

m wide, over a length of 13 km. These are found mainly around headlands, and are separated by bays, usually sea grass beds, which correspond to the mouth of dry wadis. The coastal plain is very limited, with alluvial fans spreading from inland mountains to the shore.

The Gulf of Aqaba's global importance stems from its geographical location. It is the only inland connection between Africa and Eurasia. It is still the bridge where many floral and faunal species are naturally transferred between east and west, north and south.

The marine environment maintains around 1000 marine fish, 5% of which are endemic. Many of these species, especially the migratory, are of high economic value, such as the tuna and sardine that enter the Red Sea and reach the Gulf of Aqaba. The gulf sustains about 250 different species of coral and other invertebrates, some of which are globally endangered, such as the red and black corals.

#### **Freshwater ecosystems(Wetlands):**

Apart from the famous Azraq Oasis ( Ramsar site) there is no major large wetland in Jordan, nevertheless there are smaller wetland areas that are important for the migrating or over wintering waterfowl. These occur in five main areas, which are : 1) North Jordan Valley 2) Middle Jordan Valley 3) South Jordan Valley 4) Seasonal marshes and mud flats of the eastern desert such as Disi area, Qaa Khana, Qaa Burqu (permanent pond ) and Jafer., 5) Gulf of Aqaba.

Jordan lies on the major migrating route of north palearctic waterfowl. Although in the past few years the majority of migrating waterfowl has shifted from Azraq area to the Jordan Valley, due to the dryness of Azraq Qaa caused by over extraction of underground water, migrating waterfowl nowadays disperse to different water bodies all over the Jordan Valley which gives it a crucial importance.

The hydrofaunal diversity of the above mentioned wetland areas are not thoroughly surveyed yet, certain floral and faunal key species are known up-to-date. Floral species such as *Phragmites communis.*, *Juncus maritimus.* And *Nerium oleandor*, and faunal wetland species such as *Rana ridibunda*, *Hyla arborea*, *Lutra lutra*. *Tilapia spp.*, *Natrix tessellata*, *Barbus spp.*, *Aphanius spp.*, *Gara rufa*, *Claris lazera* and many reptiles are known to inhabit these areas.

Jordan's wetlands vary from salt marshes to marine ecotypes, from to estuaries and permanent small water bodies to man-made water reservoirs and sewage treatment plants. Any water body in such semi arid areas is of significant importance for the survival of migrating waterfowl. However, all water bodies in Jordan are looked upon as a source of exploitation for urban, agricultural or industrial uses. Many water bodies are affected by increasing salinity, pollution and eutrophication due to intensive agricultural practices. Many aquatic species are at the edge of extinction if not already so. Seasonal marshes in Disi and Jafr areas are deteriorating due to seasonal cultivation of barley and wheat. The mentioned areas are also divided into different wetland types varying from man made water reservoirs to natural small ponds and permanent or seasonal springs in wadis.

## **1-5 THREATS FACING BIODIVERSITY:**

Biodiversity in Jordan was exposed to several threats and these have led to sharp decline in most of the Jordanian flora and fauna and extinction of several species, these threats can be summarized in the following.

### **\*Lack of information:**

This is the basic threat to all forms of wildlife including terrestrial fauna. This threat leads to less of knowledge about the biology, status and distribution of wildlife and human-animal interaction that consequently leads to inefficient measures to conserve these species. The different efforts in this field should be interpreted into practical steps toward a better understanding of Jordan's wildlife simply by coordination between the different sectors and stakeholders involved.

### **\*Habitat Degradation and Destruction:**

Activities causing this threat have led to loss of natural habitats including terrestrial and aquatic habitats that resulted in affecting the faunal composition of these areas.

Uncontrolled urban expansion in the form of deforestation and transforming forests into agricultural and urbanized areas, in addition to the increase in Jordan's population and industrial development have caused the urban expansion made at the expense of natural habitats. Overgrazing and extensive woodcutting in addition to the intensive agricultural practices have caused a major threat to wildlife in Jordan through destroying natural habitats and caused led to soil erosion in some parts leading to more habitat destruction. Despite of the economic importance of mining for in Jordan, unplanned mining and quarrying can lead to destructive results to the wildlife in general by destroying habitats

Uncontrolled vehicle movement has led to destruction of most of the habitats and has caused disturbance to mating areas and migratory species which decreases the number of successful breeding occasions and the number of migratory birds visiting Jordan.

Unbalanced water use and unplanned water extraction from surface and underground water resources are threatening many parts of Jordan and consequently affecting the habitats and micro ecosystems of both animals and plants. On the other hand pollution of surface and underground water resources and aquifers due to agro-chemicals, sewage discharge and solid waste disposal caused more threat on the presence and ability of reproduction of many faunal species.

### **\*Persecution of Wildlife, Trading and Spreading of Diseases through Wildlife:**

Illegal hunting was one of the main reasons for the extinction of several species from Jordan's wildlife, and is considered as one of the main factors threatening the faunal biodiversity in the country. The impact of this threat has greatly increased after using the modern hunting techniques.

The illegal trade of native species which directly affects the population of faunal species in the country in addition to the illegal dissemination of non-native species have caused a

severe stress on some species in their habitats and threatened the presence of the native species.

Little is known about the status of some diseases and the role of wild animals in transmitting them. The increased contact with wildlife has led to the transmission of some diseases from livestock to wild animals and vice-versa through direct contact or predation. On the other hand, several wild animals in Jordan are thought to be vectors or reservoirs for some diseases. Some of these diseases affect both humans and wild fauna and is a real threat to the distribution and relative abundance of certain species.

**\*Invasion of Alien and Exotic Species:**

Introduction of alien species is one of the major threats to the native animal species. They can also become pests by causing destruction to natural habitats and agricultural areas. On the other hand, feral species, which invaded the country long time ago, might affect their wild relatives through competition and interbreeding. Invasive exotic species are usually capable to adapt to habitat changes. Some of these species might have the same effect as alien species in that they destroy natural habitats and agricultural areas.

**\*Weak enforcement of laws:**

Weak enforcement of laws is a perennial issue, although there has been a great improvement in the six designated protected areas in recent years as a result of capacity building within the RSCN. The problem of enforcement, however, remains exacerbated by the lack of by-laws and other legal deficiencies referred to above. There is, for example, no law at present authorizing protected area management agencies to control grazing levels of domestic livestock, yet they remain one of the most serious threats to the ecology of these areas. Enforcement staff still need to rely on interpretations of the Agricultural Laws or the influence of sympathetic district governors.

## **THEME 2.**

### **ENVIRONMENTAL LEGISLATIONS, INSTITUTIONS AND PUBLIC AWARENESS IN THE FIELD OF BIODIVERSITY**

#### **2.1 LEGISLATIONS:**

##### **Current Status:**

The recent social, economic, commercial and industrial development, in addition to the increase in population; have been resulted in high demand for energy, natural resources, food, expansion of rural areas on the expense of agricultural land; which had great implications on the local environment and in particular on biodiversity and the natural habitat of flora and fauna.

Furthermore, the marine environment had been tremendously affected by the development of Aqaba Region, mainly by the establishment of the energy generating plant, the expansion of tourists area, building hotels and tourist facilities, and the increase in maritime and land transport. These factors had formed major challenges facing the environmental sector, that need legislation's as one of the most important mechanism to face these challenges.

The Government of Jordan (GOJ) has recognized the threats to environment and has taken many initiatives to overcome these challenges and protect its environment since the establishment of the Kingdom in 1946. The GOJ has also realized that an essential input to the protection of environment is the issuance and enforcement of environment related laws.

In February 1976, Jordan issued by-law (Nizam) no. 57/76 which renamed the Ministry of Municipal and Rural Affairs, the Ministry of Municipal, Rural affairs and the Environment (MMRAE). In accordance with section 4 (b) of the Nizam, the Council of Ministers established the Department of Environment within the MMRAE.

In 1989, the government of Jordan in cooperation with IUCN, issued the National Strategy on the Environment. The Strategy was officially adopted in May 1991 and thus Jordan became the first Asian country to adopt a clearly defined national Strategy for environmental protection.

In the Jordanian laws and rules, which are in force, legal texts were mentioned relating to management and protection of the environment. Throughout a long term of period, started from the beginning of the fifties up to date, these texts have been continuously amended or other items have been added to them, which made them unstable and scattered among different laws and rules and hence referring to them became difficult and impractical.

The Jordanian constitution is considered the highest level of the legislation rank, followed by law which is issued by the legislation authority (parliament); that forms of a

group of general basis to regulate the people habits, these basis must be respected and committed by the people. The system (by-law) is followed the law that includes the detailed instructions to apply the law, the by-law is issued by the executive authority (the cabinet), then the regulations that issued by the minister, which include the detailed instructions and explanations for the contents of laws and by-laws. The main purpose of environment related legislation is to guarantee the legal rights of property, persons, environment, and others.

Existing legislation concerning deals with biodiversity is generally inadequate in Jordan: in the Jordanian laws and rules, which are currently in force, legal texts are found relating to management and protection of the environment. But from the beginning of the nineteen fifties up to now, these texts have been continuously amended or other items have been added to them, and referring to them became more and more difficult and impractical. Moreover important areas related to environment and resources are not adequately covered (e.g. land use, pastures, forests, endangered species, bio-safety, intellectual property, etc.). By-laws and regulations related to the 1995 Environment Law are being prepared and are not yet adopted. There is a strong need to inform the public and the different stakeholders on the existence of the Environment Law. National, regional and international actions related to conservation and resource uses have to be closely integrated and complemented.

The Government has recently developed guidelines for environmental impact assessment through the National Agenda 21 and other initiatives. According to these guidelines, major projects are required to do an Environmental Impact Assessment (EIA) to evaluate the extent of damage to the environment and provide measures for preventing and/or mitigating such damage. The EIAs are submitted to the GCEP for approval. Implementing these guidelines proves to be limited because of the lack of training from GCEP staff in this field as well as general lack of awareness from decision makers and promoters on the opportunities that this approach is offering for sustainable development.

In Jordan, several acts and regulations include provisions on environmental protection, however, these laws and regulations are enforced through different governmental agencies. These include the following laws and by-laws:

**Laws:**

- Organization of Cities, Villages and Buildings Law no. 79 of 1966 and regulations.
- Agriculture Law no. 20 of 1973.
- Municipalities Law no. 29 of 1955.
- Organization of Natural Resources Affairs Law no. 17 of 1974.
- Punishments Law no. 16 of 1960.
- Civil Defense Law no. 12 of 1959
- Environment Protection Law no. 12 of 1995.
- Aqaba Special Economical Zone Law no. 32 of 2000.
- Organization of Natural Resources Affairs Law no. 37 of 1966.
- Public Electricity Law no. 13 of 1991
- Patent Rights Law no. 32 of 1999.

- Crafts and Industries Law no. 16 of 1953 and related regulations.
- Housing Establishment Law no. 27 of 1968.
- Public Health Law no. 21 of 1971.
- Quarries Law no. 8 of 1971.
- Antiquities Law no. 12 of 1976.
- Jordan Authority Law no. 18 of 1977.
- Traffic Law no. 14 of 1984.
- Nuclear Energy & Radiation Protection Law no. 14 of 1987.

**By-Laws:**

- Quarries By-Law no. 7 of 1971.

By-Law of the Protection of Birds and Wildlife and the Regulation of Hunting no. 113 of 1971.

By-Law of the Environmental Protection of Aqaba Special Economical Region no. 21 of 2001.

Legislation and regulations pertaining to the environment have been adopted and enacted by the Government of Jordan since the 1950's (Crafts and Industries Law no. 16 of 1953 and related regulations). Present legislation and regulations include more than 250 articles related to environmental issues. For example, the Public Health Act of 1971 deals with health hazards, the Agriculture Act of 1973 deals with the protection and conservation of soil, forestry, pastures, birds and wild animals, the Water Authority Act of 1988 deals with the protection and conservation of water resources and the sustainable use of water, the Natural Resources Act of 1968 deals with exploitation of mineral resources and land reclamation, the Mining by-law (Nizam) act of 1966 deals with occupational hazards in mines, to mention only a few.

The General Corporation for Environment Protection is now charged with enforcing with the recently issued law of Environment Protection for 1995. The Law of Environment Protection no. 12 enacted in October 1995, was to overcome all general weaknesses in other laws concerning environmental issues and help improve the quality of life of the citizens of Jordan, by protecting the environment and achieving economic and social development.

**• Organization of Cities, Villages and Buildings Law no. 79 of 1966 and regulations:**

The law is regulating all forms of land use and buildings according to the community benefits, several articles of the law have the biodiversity field. Article no. 40 of this law include the forming of local and regional committee to protect trees, parks, and forest lands in cooperation with Ministry of Agriculture. The committee can issue orders to protect trees, flowers, forest lands, plantations and parks. The order includes: Prohibition of cutting or removing trees or flowers before getting the approval of the concerned committee, the committee can issue the license for cutting the trees under certain conditions.

The order of replanting whole or part of the forest land that had been cut through license. This order is not applying on the died dead or damaged trees or if the tree existence

forming dangerous for the population. A fine of 5-100 Jordanian Dinar, and in case of continuing offense will punish any one acting against the regulations of this order, additional fine will be not less than 3 J.D per day after the claim of the judgement.

Article no 14 of this law include states that before the starting of layout plan, a basic topographical layout plan of the region must be prepared, including the current status, public benefits, recreation sites, and natural and biological resources.

Article no 15 of this law include states that the basic regional layout plan which include the local skeleton layout must include the public benefits, recreation sites, agriculture land, orchards, forest areas and the natural conservation sites.

Article no 48 of this law include states that there is no need to compensate the owner of the land in case of refusing to give him license for the rehabilitation of his land if the rehabilitation of the land can cause destruction or negatively affected natural recreation sites or the ruins and antiquities material or negatively affected the conservation of these sites.

### **Agriculture Law No. 20 for the year 1973:**

Chapter 3 Protection of birds and wild animals and their hunting regulations

According to Article 144, it is prohibited to hunt birds and wild animals without a license issued by the Ministry. (The Minister of Agriculture had given the authority to RSCN to issue the hunting license)

Article 145 A- It is prohibited to hunt, or kill, or capture by any means the beneficial birds for agriculture, also it is prohibited to own or transport or sell or display for sale alive or dead.

B- It is prohibited to hunt raptor birds or carnivorous animals or capturing by any means or its poisoning without a permission issued by the minister.

C- The Minister specifies bird species of which the regulations of this article are applicable and indicating the terms for issuing a hunting license for scientific purposes.

Article 146: It is prohibited to destroy dens, nests or burrows of wild animals or picking or destroying their eggs or harming their young's.

Article 147: It is for the Minister to specify areas and hunting seasons, and bird's species and wild animals that are allowed to be hunted.

Article 148: A- It is prohibited to use mechanical vehicles or spotlights or automatic guns in hunting birds and wild animals.

B- it is prohibited to use military rifle in hunting wild animals, with the exception of animals designated by the Minster.

Article 149: It is prohibited for foreigners residing outside the kingdom to hunt birds and wild animals without a license from the ministry.

Article 150: It is prohibited to enforce cruelty on animals.

The Minister issues decisions to specify certain animals that are encompassed within this prohibition.

Article 151: A- It is prohibited to import sticky materials (used for capturing birds) or selling, owing or using.

B- It is prohibited to use any form of traps for bird capturing.

C- It is prohibited to hunt birds by using any camouflage devices (Colored flags, animals skin, and calling device)

D- It is prohibited to use anaesthetizing drugs in hunting birds and wild animals.

E- Aquatic birds specified by the Minister are exempt from the regulations of these paragraphs.

Article 152: The Minister forms a committee known as “(The hunting committee””, responsible to specify hunting grounds and hunting seasons for birds and wild animals that are allowed and all matters concerned with it.

Article 153 Any one who hunts differently against these issued regulations of this section will be punished by a fine not less than:

A- 100 Jordanian Dinar for each desert or mountain gazelle or an ibex.

B- 25 Jordanian Dinar for each Hubra bustard

C- 10 Jordanian Dinar for each animal or bird with the exception of the wild boar.

Article 154 A- In case of using a mechanical vehicles during hunting against to the regulations of article No. 148 of this law or the issued regulations, the vehicle driver will be punished by a fine not less than 10 Jordanian Dinar, and the owner of the vehicle will be punished similarly if the offense was to his knowledge in addition to the punishment stated in article 153 of this law, and in case of continuing offense, the fine will be doubled and the hunting license will be withdrawn for one year.

B- In case the continuing offense within one year the punishment is doubled and the weapon or the devised used in hunting will be confiscated

C- In addition to punishments stated in articles 153 and 154, the weapon used in hunting will be confiscated for the following offenses:

1. Hunting with an expired hunting license.
2. Hunting in prohibited areas.
3. Hunting out of hunting season.

Article 155 Ministry of agriculture personnel, public security, Armed forces and individuals not employed by the ministry entrusted by the Minster are responsible to arrest any offender against the regulations of this chapter and deliver them to the nearest police station along with a report.

## **2.2 INSTITUTIONS:**

Addressing environmental and biodiversity issues is a complex endeavor that require the concerted efforts of most if not all government bodies including GCEP, Ministry of Agriculture, Ministry of Finance, Ministry of the Interior, Ministry of Commerce and Industry, Ministry of Energy, Ministry of Education, etc. and the Royal Society for the Conservation of Nature. These ministries and NGO must also work closely with the university, museums, and technical institutes as well as the private sector. As it is the case within most governments around the world, their collective action often suffers from jurisdiction overlap, fragmentation and inadequate co-ordination.

### **Governmental Institutions:**

An annual budget is allocated by the Ministry of Finance to several ministries and Governmental Organizations to be spent on the establishment and management of sites, research and monitoring for biodiversity of Jordan. These organizations are:

### **Ministry of Agriculture/ Department of Forestry:**

In a dry country like Jordan, the environment faces serious impacts that threaten biodiversity through deterioration of soil, lack of ground and underground water, and impacts from desertification. Therefore, as one of its measures for the conservation of Jordan's biodiversity, the Forestry and Soil Conservation Department is seriously trying to compensate the loss of the forests and range-lands, through re-forestation, management of forests, and range lands, law enforcement and other activities.

The Forestry Department is maintaining several forests and range-lands in addition to its re-forestation schemes of roadsides and highways. The Forestry Department is heavily involved in research and surveys of national forests and range-lands including production of seedlings for re-forestation purposes.

Other management activities include management of sites, recreational areas, protected areas, and range-land reserves. These activities included: Establishment of new protected areas, fencing highly endangered forests and range-lands, and management of watersheds.

More than three-quarters of the area of Jordan is considered arid land type (desert), and most of forests have been degraded over the last 50 years due to encroachment of urban areas on forests and range-lands.

Law enforcement is crucial matter to survival of this type of biodiversity. The forestry department emphasizes the role of law enforcement in protecting Jordan's natural forests, and allocates part of its budget to this effort.

### **General Corporation for the Environment Protection:**

In 1994, the General Corporation for Environmental Protection signed an agreement with United Nations Environment programs to prepare the Jordan Country Biodiversity Study. The long-term objective of the country study is to ensure the protection and conservation of the broadest possible range of global biodiversity and its rational use. The short-term objectives of the study are:

To enhance the capacity of the General Corporation for the Environmental Protection in the context of conservation and management of biological diversity in Jordan.

To review the status of biodiversity in Jordan.

To identify, on the country level, in light of social, economic, environmental and other objectives, the basic needs for effective conservation and rational use of national biodiversity at a desired level.

To identify the needed supportive measures and costs to meet those needs.

To investigate the benefits associated with the implementation of these measures.

To assist Jordan in arriving at a realistic assessment of total costs and unmet financial needs of global biological diversity and rational use.

To lay the foundation for the preparation and implementation of a national biodiversity Strategy and Action Plan.

### **The Higher Council for Science and Technology (HCST):**

The Higher Council for Science and Technology (HCST) in cooperation with The Jordan Badia Research and Development Program, University of Jordan, Jordan University of Science and Technology, University of Yarmouk and University of Mu'tah have initiated a biodiversity research program in the eastern desert of Jordan and other arid areas. The project included research and survey of flora and fauna of these parts of Jordan.

The projects included:

#### **a) Floral Diversity**

Objectives: Surveys of the wild plants in Jordan have been made (Flora of Jordan) with particular concentration on collection, identification and classification of medicinal plants to be presented in a book. The project studied these plants' chemical constituents and their effect on the activity of microorganisms and the physiology of the peripheral nervous system. In addition, the physiology and anatomy of some desert plants will be studied in relation to their adaptation to xeric conditions.

#### **b) Faunal diversity**

Objectives: Surveys of the wild vertebrates and invertebrates, identification and classification, numbering, tabulation and spotting their geographical distribution on maps.

#### **c) Micro-floral diversity**

Objectives: Surveys of the microorganisms and mycorrhizae in different habitats in Jordan. Isolation of antibiotic-producing bacteria that can be used in biological control of insects as well as the isolation of mycorrhizae. Characterization of the effectiveness of the antibiotic-producing isolates in combating larvae of important agricultural insects, flies, virus vectors, mycoplasma and effect of mycorrhizae on wheat and barley crops.

### **Biodiversity conservation in the Badia Research and Development Area:**

This project was executed jointly between the Royal Society for the Conservation of Nature, Badia Research and Development Program, University of Jordan, Jordan University of Science and Technology and Durham University in the United Kingdom. The project's main objectives are:

Build up capacity in biodiversity management and conservation for local ecologists.

Update information on the biodiversity of the eastern desert and Badia program area.

Establish a management plan for the conservation of the area.

Strengthen coordination and cooperation between national and international conservation and research institutions.

Promote sustainable development projects in the area such as: eco-tourism, socio-economic, organic and sustainable farming.

### **Non-governmental Organizations:**

Mandated by the Jordanian government to conserve and manage biodiversity; RSCN is the major contributor to conservation of Jordanian biodiversity as a non-governmental organization. RSCN depends mainly on membership, hunting license fees, national and international donations for expenditures on its projects.

An annual budget is allocated every year for establishment and management of reserves, reintroduction programs, law enforcement and research and monitoring. The Royal Society for the Conservation of Nature is rehabilitating additional four sites as eco-tourism sites. These sites are within the network of the wildlife reserves managed by RSCN: Shaumari, Azraq, Mujeb and Zubia wildlife reserves.

### **International Donors Community IDC**

Several international agencies have contributed to the conservation and management of Jordan's biodiversity. These agencies are:

### **Global Environmental Facility (GEF)**

GEF has been involved in several biodiversity projects in Jordan. These projects are:

#### **Conservation of Dana Wild Lands**

The main objective of this project was to build up national capacity in conservation and management of biodiversity in Jordan through the establishment of the Dana Wild Life Reserve to promote sustainable development projects such as eco-tourism and organic farming, and build a solid bridge between nature conservation needs and the socioeconomic needs of local community. The first management plan for a wildlife reserve in Jordan was established.

The project was successfully executed, and the new know-how is being transferred to another network of protected areas and institutions. The budget of the first phase of the project was \$3.3 million. Due to change in political situation in the Middle East, the Global Environmental Facility has extended the project with an additional budget of \$1.8 million to extend the Dana Reserve up to the border of Israel and transfer the new concept of conservation to network of reserves such as: Azraq wetlands, Zubia, Mujib, Shaumari, and others. The extension of the project was included comprehensive ecological surveys, establishment of management plans, promotion of sustainable development and review of status of protected areas to establish a new master plan for the network of wildlife reserves in Jordan.

#### **Rehabilitation of Azraq Oasis**

The main objectives of the project were to rehabilitate Azraq Oasis, an internationally recognized as a Ramsar site, through the execution of comprehensive ecological surveys, establishment of management plans, environmental assessment for impacts affecting the Azraq basin and promotion of sustainable development in the basin towards sectors such as agriculture, urban development, tourism, industry, and water extraction. The total budget of the project was around \$3.3 million. The project was successfully executed, a management plan for the reserve was established, and an assessment for the impacts affecting the environmental resources of the area was made. The project managed to reduce the extraction of water and recycle the reduction into the ponds and marshes which resulted in the revival of the biodiversity of the area including the migratory waterfowl.

### **Aqaba marine coastal management and the establishment of Aqaba Marine Park.**

This project started in 1995 in cooperation with the Aqaba Regional Authority, Global Environmental Facility and the EU. Main objectives of the project: To promote conservation of the marine biodiversity, establish a coastal management plan as well as build up environmental capacity of the Aqaba Regional Authority. Outputs of the project has resulted in the creation of the first Marine Reserve, a Coastal Management Master Plan for the Aqaba Coast and the establishment of an Environmental Unit at the Aqaba Regional Authority.

### **Small GEF Grants**

The Small GEF Grant was initiated in 1992-93. The Small GEF Grant is a successful program in Jordan from which and several local NGOs and grass roots organizations benefited from this initiative.

### **National Agenda-21 for Jordan**

The project had the following main objectives:

To prepare a national agenda 21 for Jordan through a participatory process involving all parties concerned.

To raise the level of awareness in the country about environment protection and sustainable development.

To provide training/assistance to selected nationals.

To lay the basic groundwork for preparing an environment impact assessment (EIA) system

Effective liaison with Aqaba Environmental Action Plan Projects

The National Agenda 21 for Jordan was completed and formally adopted in the fall of 2001.

## **2.3 EVALUATION OF ENVIRONMENTAL LEGISLATION AND INSTITUTIONS**

### **Obstacles:**

The main obstacles that face the Government in enforcing environment-related laws are:

-Lack of awareness among citizens on the importance of environment protection and its impact on the quality of life.

-Some laws were issued many years ago thus, the penalties and punishments stated in those laws are inappropriate in current times.

-Current judicial procedures are too complicated and lengthy.

-Lack of clarity, and inadequacy and unexhaustive of certain articles within the laws lead to failure in proper enforcement of the law

-Favouritism.

-The Employees of the General Corporation for Environment Protection can not act as judicial police.

-Duality and overlap in existing legislation.

-Lack of implementation of environmental strategies.

The main weaknesses in other legislation with respect to environmental issues can be

summarized as follows:

- Duality and overlapping of existing laws and regulations, which cause confusion in enforcement.
- Lack of an adequate punitive deterrence system.
- Most articles to the laws are mainly concerned with the protection of humans and private property, and are only indirectly related to the environment.
- Present laws and regulations are outdated and do not address current crucial environmental matters.
- Overlapping of jurisdiction exists in some areas, such as water management, where numerous governmental departments and agencies compete for jurisdiction on over high profile issues; or conversely use this overlapping to shun responsibility where such a course would be.

Current enforcement of environment related legislation is still weak in Jordan. At present time, environmental violations are reported by persons, Environmental NGOs representatives (authenticated by the Government of Jordan), or if environmental accidents occur.

Once, an environmental violation is reported, the violator will be taken to court. Unfortunately, the current judicial procedures are too complicated and lengthy. As a result, punishment and remedies take effect after a long time.

Most of the text did not directed to protect environment, other texts talked about protecting parts of the environment according to a narrow imagination, which makes these texts not enough and not appropriate to the needs of the current development from the point of the factors that affect on the environment and the required protection against them.

These text did not include referable scientific standards to indicate the environment related violations and when a substance of a wrong practice violates or harm the environment and when it is not, and when a certain property is environmentally acceptable and when it is not. This was negatively reflected on applying these texts, were it made, in most cases, difficult to apply such text in the law fulfilling the permanent legal principle, which says that no crime and no punishment but only by a text in the law.

The absence of the referable scientific standard may leave applying of the legal text to the personal efforts the thing which takes the legal text away from its purposes and makes any measured or decision, which may be issued according to the text, a point contesting, and hence the prosecution time may elongate or the time required to take a certain measure may also elongate.

In addition there are some important aspects related to the environment, which texts that are currently in force did not deal with them entirely, which means that there is a legislative gap in providing the legal treatment and the obligatory legal support to protect the environment and managing it in these aspect.

The duplication in the texts mentioned in more than one rule or law to treat one of the

aspects related to the environment, and the duplication in the job of the environment related corporations and what comes out from applying different measures, imposing different punishments and conflicting of the authorities have in force. Since the texts were non suitable and deficient, then the technical and industrial development and what accompanied them, from the point of practices and processes that seriously damage the environment, needed to look again into the environment related legislation and to fix it to agree with the required level of protecting the environment.

**Institutional Structure:**

Key issues facing current institutional structures include: Responsibilities overlap between agencies; lack of co-ordination between central and regional ministerial offices; lack of inter-ministerial co-ordination on issues such as land use planning; Government is in the process of creating a Ministry of Environment; necessity to establish an effective high level coordination office for the implementation of the Convention on Biological Diversity and national Strategy and Action Plan.

The impact continuation of the present situation continuation will lead to the aggravation of environmental problems, destruction of natural resources, social unrest, and poverty increase.

Buildup of the environmental problems because of the legislation deficiency:

In most cases the legislation which took care of the environment did not deal directly with the environment, its constituting elements and with protecting them as an issue, but in most cases they were legislation related, in a way or another, to the environment and the issues related to it. Many important environments related issues were not direct issues for the legislation, and hence such issues were sometimes left without legislative treatment or they were treated in a superficial and nonessential way, which is sometimes not enough. All of this was reflected on our environment resembling in discharging of dust in the crushing plants and the quarries, wide lands with no green color, water which pollutes the plants, fruits for the interval between spraying them with pesticides and their presenting to be consumed is unknown, empty cans and bottles, exhausted tires, car scrap along the road sides, unburied wastes, canals in which the chemical and organic materials and exhausted oil flow from factories, workshops and houses, different smells coming out from chemical industries, treatment stations, a soil which its salinity is subjected to be concentrated because of the scarcity of the rain and water and because of misusing it which harms its properties.

Ground water which is exposed to the concentration of its salinity because of the irregular pumping out of it, pasture lands which are converting day after day to desert, construction expansion on the expense of the green land and many other problems, which if they were blockaded then our environment will be cleaner and more suitable for the human and other living creatures life, but if they were expanded then the life becomes at least difficult and dangerously threatened if such problems will buildup more.

Conflicting of the authorities and the punishments variation as a result of duplication:-

The duplication in the legislation and in the parties and corporations, which undertake the

supervision, management and execution, create other problems related to conflicting of the authorities and the punishment variation, in addition to what may result from giving the same authority to more than one party to use different instruments to accomplish the same work, which wasted energies and abilities without a justification, and sometimes oversteps the essential authorities.

### **Protection against Fires**

#### **Lack in the Legislation Related to Protection against Fires:**

This issue was treated in the agriculture law, by preventing setting on fires in the forests; in a text in the municipalities law, that gives the municipal council the authority to take the precautions to prevent fires and to monitor fuels; in a text in the rule of regulating and managing Ministry of Energy, which gave the Ministry of Energy the authority to investigate the transport means, distributing and storing of the petroleum products and their safety, and in a text in the punishment law including punishments for who caused in setting of fires on purpose or because of his negligence.

Although fires are of the important caused in polluting and affecting the environment especially if the vegetation cover was burned. The oil fires can cause environmental destruction and affect on the climate, air and the atmosphere pollution and many other effects.

Although the industrial development created many different reasons and circumstances to cause fires, and despite all of this, no legislation included texts which necessitates to take the required precautions for the protection against fires and clarifying of such precautions. These issues were left to the administrative decisions and measures, which may not have a clear support by the law, which leave no way to cancel or contest these issues.

### **Solid wastes**

#### **Lack in the legislation related to solid wastes:**

Many researches treated with the solid wastes, the way to dispose them, waste disposal sites and environmental and health problems which they evoke; and if we know that such wastes are disposed by burning them in most cases. The specialists in the field say that burning was incomplete because of the humidity existed in the domestic wastes then this will produce fine air dust, gaseous hydrocarbons, poisonous carbon monoxide (CO), nitrogen oxides, and sulfur oxides.

Although of these and other hazards, of which the environment scientists are aware, but this issue did not have the care of the legislator and it was not mentioned to regulate some aspects of this situation, nothing but only six texts, two of them in the public health law, which were restricted to prevent wastes disposal in the streets in considering such wasted disposal as making a health adversity. Other two articles in the rule of preventing the adversities, which also regard waste unless obtaining the municipality chief concurrence. And other tow articles in the law of regulating cities and villages, according to which the local regulating committee was given the authority to send an executing notification to anyone, who leaves a car engine, ruins, scrap or wood in the unfenced lands, to remove

such stuffs and also it was given the authority to send a notification to the owner of a house, a factory or barn or other properties, if it was obvious that their wastes disposal results in a health adversity. In this notification the committee will order him to remove the adversity.

### **Desertification**

#### **Lack in the Legislative Texts Related to Desertification**

Five articles related to the above titled issue were mentioned in the agriculture law and all of them deal with regulating grazing and to the relevant authorities of the minister of agriculture. Although these texts are related to vegetation cover protection in the grazing areas, but they were basically aiming to provide grazing for the longest period of time throughout the year, (Article –128- of the agriculture law).

Although desert crawling requires taking measures such as planting of a green belt of appropriate trees, which will help in preventing this crawling, making some projects elated to irrigation nets to treat the scarcity of the rainfall, as well as by making rain to fall, providing transport nets in addition to other relevant measures. But there are important aspects in which the legislation can participates

### **2-4 NATIONAL PROTECTED AREAS POLICY:**

Jordan does not, as yet, have an officially endorsed policy on protected areas. There is, however, a draft policy framework produced under the auspices of the Ministry of Planning in 1996. This framework was prepared with technical guidance and financial support from USAID. Its preparation involved a number of workshops with relevant Jordanian organizations, both government and non-government, in order to secure consensus on key policy issues and priorities. The suggested policy framework, together with the findings of the workshops, were published in July 1996 in a report entitled “Jordan Parks Policy Project”. The policies of most relevance to this review are the so-called ‘Fundamental Policies’ and these presented verbatim as follows:

#### **Fundamental Jordan Protected Area policies:**

JPAs will conserve the natural, cultural, archaeological, and scenic resources of the kingdom, while leaving them unimpaired for use and enjoyment by future generations. Visitor use, scientific study, education, and public enjoyment should be encouraged, but only in such a manner that will not adversely affect the resource.

JPAs will be designated through a process of evaluation using the “Selecting Areas for a JPA system Criteria.” An approved set of formal criteria will be applied during the designation process to assess significance. Additions to the JPA system will be strategic, and the system will expand in conjunction with the availability of the staff and financial resources to meet protection and operating requirements.

The system should represent a full spectrum of significant Jordan flora and fauna, ecosystems and natural habitats as well as sites of important archaeological and cultural interest, and artifacts from important events in history. Proper selection of areas

designated as JPAs will produce a nation wide system of representative sites, with priority given to the finest example of the nation's natural resources, outstanding archaeological artifacts and sites illustrating or commemorating the most significant events in Jordan's history.

JPAs will normally be established through an agreed-upon national strategy based on approved criteria, incorporating where possible existing protected areas, whether public or private. Where this is not the case, existing expropriation laws may apply. In cases in which where public land ownership is not imperative, a variety of compensation tools are available. For new JPA areas, displacement of resident inhabitants is an option only in cases involving extreme resource degradation.

In general terms, the current legal, policy and planning framework for protected areas is inadequate, although there have been some positive developments in recent years.

One such development was the Law for Protection of the Environment 1995 which gives separate legal status to protected areas and offers the prospect of improved safeguards and management. As such, it represents a major national achievement.

Of the agencies listed, RSCN has played the leading role in the establishment and management of protected areas and its continuing prominence is largely due to a general acceptance by government of its expertise and effectiveness. RSCN, however, despite its national remit, does not have a clearly stated mandate from the Government officially confirming its role and authority.

The final report of the Jordan Parks Policy Project (July 1996) examines the issue of the multiplicity of agencies involved in protected areas and presents options for creating new organizational structures and systems to rationalize and improve the situation. In most of these options the case is made for a single agency to oversee the management and administration of all protected areas. The ideas for this agency vary from a new government unit to a private, non-profit trust.

## **2.5 PUBLIC AWARENESS AND PARTICIPATION**

Jordan is currently facing serious environmental problems including over-pumping from water basins, erosion and land degradation, air, water and soil pollution, degradation of coastal areas, historical and antiquities sites, irregular urban extension, loss of natural habitats and extinction of wildlife species. The misuse of natural resources is an important factor affecting the environment. People start to understand the need to protect their environment when they realize the spoiling and disappearance of the natural resources supporting the quality of their own life. Public awareness is crucial for the conservation and sustainable use of natural resources as it refers to communication and training activities aimed at raising people's knowledge and understanding of the fact that conserving and sustainably using biodiversity resources may reduce poverty and facilitate the development of rural areas.

Several national governmental organizations are currently involved in public awareness programs on environmental protection; especially on pollution prevention, nature conservation, and wildlife protection. The 1995 Law of Environment Protection No. 12 has established the General Corporation for Environment Protection as the main agency responsible for environmental protection including public awareness activities. The Ministry of Agriculture is involved in extension and forestry conservation activities, the National Center for Agricultural Research and Technology Transfer is engaged in application of environmental sound technologies, and the Ministry of Education is seeking up to include environmental issues in curriculum development. Ministry of Water and Irrigation is delivering irrigation advisory services and promoting environmental protection; the Ministry of Media in raising up environmental issues and the Ministry of Antiquities and Tourism is concerned with antiquities and tourist sites conservation. The Aqaba Regional Authority is supporting marine life conservation, the Amman Greater Municipality is involved in the development of gardens and green spaces and the National Information Center is displaying environmental information.

A number of non-governmental organizations specialized in wildlife and environment protection are very active in public awareness activities that are generally more effective than government initiatives. These include the Royal Society for Conservation of Nature (RSCN), Jordan Environment Society (JES), Jordanian Society for Desertification Control and Badia Development (JSDCBD), Friends of Environment Society, Royal Jordanian Society for Ecological Diving (RJSED), Petra National Trust, Jordanian Society for Animal Protection, Human Center for the Welfare of Animals, National Environmental and Wildlife Society (NEWS) and Jordanian Wild Plant Society.

Several women organizations undertake environment-related activities like the Jordanian Women Federation and the Women's Committee of the Arab Women Organization. Developmental organizations involved in environmental activities include the Jordan River Foundation, Noor Al Hussein Foundation and Jordanian Hashemia Fund for Human Development. Educational organizations including the Cultural Society for Youth and the Childhood Science and Technology Club are also promoting environmental awareness.

Some universities offer a BSc. and/or MSc. degree in environmental science and also have environmental centers conducting research and studies on environmental issues. The Higher Council for Science and Technology is implementing through the Badia Research and Development Program a research project aimed at surveying biodiversity in the Badia areas. Engineering Associations are active in environmental awareness through committee action especially within the Agricultural Engineering Association. The private sector is also engaged through the Amman Chamber of Industry pollution prevention activities and by providing financial support to NGOs.

The promotion of environmental awareness is strongly supported in Jordan by international donations. For example, the Global Environment Facility (GEF)/Small Grant Program for NGOs is helping local communities to protect the environment through community action projects. GEF funds projects in the field of biodiversity,

climate change, international water and land degradation. GEF funded so far more than 50 projects, about 40 of them related to biodiversity conservation including 8 projects on public awareness.

Despite all these efforts, public awareness programs still suffer from the lack of necessary attention from governmental and academic organizations. There is a great need for administrative, legal, and technical support as well as of funding and trained human resources. Public awareness programs need better coordination at the national level even if the Sustainable Development Networking program is expected to improve this situation.

Inadequate legal and administrative framework may affect public participation. For example, the Jordan Valley Authority has studied the possibility to delegate irrigation water management to water user associations in the Jordan Valley, while the law clearly states that irrigation water management is under the responsibility of the Jordan Valley Authority. The creation of new NGO is also made difficult by the fact that this process is currently under the umbrella of several government agencies (Ministry of Interior, Ministry of Social Development, Ministry of Youth, Ministry of Education) while the Cooperative Foundation, a non-governmental organization, is responsible for the establishment of the cooperative societies especially in rural areas.

Comprehensive public awareness programs based on community participation may contribute to overcome these vital problems. The major goal of such programs should be to encourage the people of Jordan to contribute and participate effectively in efforts leading to biodiversity conservation. Jordanians should be encouraged to participate in non-governmental organizations at the local community level to conserve air, water, land, wildlife and other natural resources. Experiences show that involvement and participation of local communities and concerned stakeholders is a prerequisite for successful conservation of natural resources. The participation and involvement of the private sector should also be encouraged through fiscal and other incentive measures.

## **THEME 3**

# **ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION**

### **3.1 PROTECTED AREAS**

Many conservation initiatives have taken place in the last 50 years. Protected areas are one of the ways of conserving what is left of the terrestrial fauna and their natural habitats. Protected areas in Jordan currently include 23 forest or range-land reserves, 6 wildlife reserves (and 12 proposed sites), one marine reserve in the Gulf of Aqaba and 8 national parks. These protected areas represent different ecosystems and habitats of Jordan and include some archeological or historical sites. Forest and range-land reserves fall under the authority of the Ministry of Agriculture/Forestry Department, the management of the wildlife reserves has been delegated to the Royal Society for the Conservation of Nature (RSCN), and the national parks are owned and managed by the Ministry of Tourism and Antiquities, local authorities, municipalities and the private sector.

Protected Areas in Jordan are divided into the following according to the biodiversity country study:

- 1-Wildlife reserves (Terrestrial & Marine)
- 2-Forests reserves
- 3-Range-land reserves
- 4-National Parks
- 5-Cooperative organization grazing reserves.

There are other sites, which are identified as potential protected areas:

- 1-Important Bird Areas (IBAs).
- 2-Wetlands (Azraq Wetland, Mujib Wildlife Reserve)

In the year 2000, a total of 27 areas were identified as important bird areas covering a total area of 7600 km<sup>2</sup>, representing about 8.5 % of the total area of Jordan. Seven of these sites are already protected areas and the other twenty are proposed; on the other hand, thirteen important wetland areas were identified to help protecting nationally and internationally important waterfowl and other threatened birds.

Several research programs and baseline surveys have been conducted inside and, to lesser extent, outside protected areas. In wildlife reserves, research activities were mainly promoted by the RSCN to meet its principal objective, which is conserving representative sites and their wild species through shaping and improving management plans for these sites, other research activities have been undertaken by academic institutions and NGOs.

In general terms, the legal, policy and planning framework for protected areas is inadequate and confusing, although there have been some positive developments in recent years. One such development is the 1995 Law for the Protection of the Environment, which gives a distinctive legal status to protected areas and offers the

prospect of improved safeguards and management. As such, it represents a major national achievement. However, the Law itself has many deficiencies, the least of which being its failure to recognize the need for comprehensive, integrated legislation for the protection of the natural environment. The two brief articles on protected areas are the only ones providing some protection to Jordan's ecosystems and biological diversity. All other articles in the law only touch on these aspects in the context of pollution control. There are no general articles, for example, related to habitat and species protection or promoting conservation measures through land use practices. This deficiency is highlighted by the fact that species protection legislation, which is highly related to the role of protected areas, was left vested and unchanged in the Agricultural Law under the responsibility of a completely different ministry.

Defenders of the Environment Protection Act may argue that it was prepared as a 'framework' legislation and allows for other legal measures to be drafted as by-laws, which are easier to process through the government legislative machinery. However, this offers no compensation for inadequacies in the framework itself and it is well known that by-laws can take a long time to be prepared and approved. The protected area by-laws, for example, took three years to draft and are still a long way from ratification; without these by-laws, protected areas remain highly vulnerable since there is technically no legal basis to enforce the required protective measures.

Another problematical aspect of the "new" protected area law is its position in the hierarchy of national legislation. It is not clear which of the laws affecting land use takes precedence over the other. This issue was exemplified in the Mujib Nature Reserve, which was seriously threatened by a major water extraction scheme. Consultants engaged to conduct an environmental impact assessment of the scheme were confused about the legal status of the reserve in relation to the laws governing the rights of the Ministry of Water.

Weak enforcement of laws is a perennial issue, although there has been a great improvement in the six designated protected areas in recent years as a result of capacity building within the RSCN. The problem of enforcement, however, remains exacerbated by the lack of by-laws and other legal deficiencies referred to above. There is, for example, no law at present authorizing protected area management agencies to control grazing levels of domestic livestock, yet this constitutes one of the most serious threats to the ecology of these areas. Enforcement staffs still need to rely on interpretations of the Agricultural Laws or on the influence of sympathetic district governors.

Violations of international agreements and conventions have been another significant issue in Jordan. One notorious case was the failure to uphold agreements on water extraction rates from the Azraq Oasis, leading to the degradation of one of the world's great wetlands. In the same area, the failure to prevent damaging land use changes in the Ramsar site led to its degradation as an international site for migrating birds. Serious problems were also experienced further south in the Dana Nature Reserve, where attempts were made to break World Bank agreements limiting copper extraction in the core area of the reserve. Once again, in all these situations, the lack of clear and effective

laws governing protected areas has made it difficult to prevent the contravention of these agreements.

At the policy level, the situation is not much brighter. The initiatives taken by the Ministry of Planning to prepare Protected area policies have not been followed through and the policy document prepared in 1996, which represents a great deal of thoughtful discussions, is still awaiting finalization and adoption.

Among the main factors inhibiting the effective development and implementation of protected area laws, policies and planning strategies has been the number of agencies involved and the lack of clearly defined roles, coupled with poor coordination and inadequate technical and managerial capacity. There are currently at least 8 agencies influencing the establishment and management of protected areas: GCEP, Ministry of Planning, Ministry of Tourism and Antiquities, Ministry of Agriculture, Natural Resources Authority, Jordan Valley Authority, Aqaba Regional Authority, Higher Council for Science and Technology (Badia Project) and the Royal Society for the Conservation of Nature. Clearly, with so many players and inadequately defined laws for protected areas, there is confusion over roles and authorities and duplication of effort.

Of all the agencies listed, RSCN has played the leading role in the establishment and management of protected areas and its continuing prominence is largely due to a general acceptance by government of its expertise and effectiveness. RSCN, however, despite its national remit, does not have a clearly stated mandate from the Government officially confirming its role and authority.

The final report of the Jordan Protected Areas Policy Project (July 1996) examines the issue of the multiplicity of agencies involved in protected areas and presents options for creating new organizational structures and systems to rationalize and improve the situation. In most of these options, the case is made for a single agency to oversee the management and administration of all protected areas. The ideas for this agency vary from a new government unit to a private, non-profit trust. The document also makes it clear, however, that the role of organizations like RSCN, which have a good track record for protected area management should not be “diluted” or “shifted”.

Main problems facing forests and range-land reserves- Several problems, the main ones being the lack of financial and human resources, and the fact that the management is not based on proper scientific data, boundary definitions, zonation plans and land use policies, affect the management of these reserves. For most of these reserves on-site management is aimed at protecting vegetation cover, without properly taking into consideration human, fauna and cultural issues. Only a few reserves are working on sustainable development and watershed management plans within their sites.

Some of the major threats to such reserves are overgrazing, woodcutting, plant collection and illegal hunting resulting from poor on-site legal enforcement. Scientific research and ecological data gathering is infrequent and inadequate due to poor funding and lack of human resources. Overall, these reserves were not established on the basis of

international standards, nor national priorities, and are not considered as integrated ecological units of national or regional importance, although they globally contribute to maintain important wildlife species.

Main problems facing wildlife reserves- Despite huge efforts by RSCN since 1966 in the field of nature conservation, and the GEF/World Bank projects which started in 1994 and led to site management plans based on sound scientific research and monitoring, the wildlife reserves still face serious problems and obstacles.

Lacks of effective legislation and law enforcement represent major problems for wildlife reserves. Since these sites are managed by RSCN (an NGO), with limited budget allocation, enforcing hunting laws and other agricultural and environmental laws is difficult without proper manpower and equipment. RSCN recently associated with the Police to improve law enforcement regarding illegal hunting and wild species illegal trade. An on-going cooperation with the Ministry of Agriculture started a long time ago to conserve forests and enforce the Agricultural law regulations related to hunting, grazing, wood cutting and wild plant collection. The GCEP 1995 Environmental Law No. 12, and the 1999-2000 reviewed Agricultural Law represent a good step towards better law enforcement but still need to be implemented.

Limited manpower is another issue as RSCN is currently managing 5 reserves and helping to manage the sixth (Wadi Rum) with Aqaba Regional Authority. Even if the total number of staff exceeds 140 individuals, they are overloaded and unable to properly cover all sites. RSCN does not have enough financial resources to recruit more staff.

#### **Main problems facing National Parks-**

Most national parks in Jordan (Petra, Rum, etc.) are effectively managed according to management plans based on scientific research, but recreational and municipal parks are lacking proper zonation schemes and plans to minimize and control negative impacts from tourism activities. Most sites are not properly monitored and available data is outdated.

#### **Main problems facing the Marine Reserve-**

Although the first marine reserve was established and conservation activities were started in Aqaba, the reserve's management plan is not yet finalized and capacity building is needed for the staff and local communities. Legislation here causes a main problem because the laws are not clear nor properly enforced to ensure the conservation of coastal areas and especially the coral reefs. Another important problem is inadequate public awareness and support. A lot of efforts will have to be conducted to gain a wider public support for the reserve.

### **3.2 SPECIES AT RISK**

During the last 120 years, many native Jordanian species have been lost, thus becoming nationally extinct, including some species that were once widespread and common. Some species are now considered to be on the verge of national extinction. This is the result of

many threats including the destruction of natural habitats and ecosystems, the introduction of invasive species, the modernization of transportation and the improved hunting techniques. About nine macro-mammals and at least five plants are extinct from the wild (GCEP, 1998). Further studies are likely to reveal more extinct organisms, especially invertebrates and plants.

Many wild species in Jordan are considered globally threatened and a total of 49 different species and subspecies are listed in the IUCN 2000 Red Data List. The proportion of threatened species to the total number of species is very high, especially in mammals, where 24 out of 77 mammals (31.16 %) are considered globally threatened. In birds, 18 out of 411 total species (4.38 %) are considered globally threatened.

The existence of some species in Jordan is uncertain. The species of most concern are those that are known to be declining in range and numbers or those that are confined to a few sites or to vulnerable habitats. Major declines might have occurred in animals that are usually considered well known such as mammals and birds but the status of most species is unknown at the national level because of the lack of systematic research and the lack of agreed methodology. The decline in Jordan's wildlife is mainly affecting large mammal populations as well as other taxonomic groups. About 46 mammal, 11 bird, 4 reptile, 6 freshwater fish, 2 marine invertebrate and 4 marine vertebrate species are nationally threatened in Jordan.

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 and trading of species, and intensive use of agro-chemicals.

Protected areas are playing a major role in safeguarding biodiversity, particularly for the species and habitats of global importance. In 1979, a report was produced on key habitats specifying their geological, ecological, hydro-biological characteristics and biodiversity. The report recommended the establishment of a network of 12 wildlife reserves to be managed by RSCN. Of these, six are now established and managed by RSCN.

RSCN recently identified six other sites of conservation importance bringing to 18 the total number of protected areas in this network including the six already established protected areas.

RSCN also identified a number other sites of significant conservation importance due to their great diversity of species and habitats. They consist of 27 important bird areas, 13 important wetland areas, as well as marginal areas at national borders (protected by the

army) and wildlife corridors. A total of areas were identified as important bird areas in Jordan.

While the importance of in-situ conservation cannot be overemphasized, ex-situ conservation (conserving biodiversity outside of the original habitats) in zoos, aquaria, botanic gardens and germplasm banks may contribute to species at risk conservation by maintaining viable populations of species threatened in the wild, providing educational and public awareness services, and serving as sites for basic and applied research.

Several captive breeding programs were established by the Royal Society for the Conservation of Nature to breed and reintroduce some of the nationally extinct animals including Arabian oryx (*Oryx leucoryx*), roe deer (*Capreolus capreolus*), blue-necked ostrich (*Struthio camelus molybdophanes*) - the closest subspecies to the globally extinct Syrian ostrich (*Struthio camelus syricus*) -, Asian wild ass (*Equus hemionus onager*) - the closest subspecies to the globally extinct Syrian wild ass (*Equus hemionus hemippus*).

The Forestry Seed Center was established in 1992 within the Department of Afforestation and Forests with assistance provided by the German Technical Cooperation (GTZ). The main objective of this center is to secure high quality forest seeds through selection, collection, processing, certification and handing these seeds

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 proposal supported by the United States Agency for International Development (USAID).

The conventions and legislation for environmental protection are playing a major role in protecting species at risk. Eighteen acts and eight regulations were issued in Jordan, including provisions for the protection of the environment. Most of these acts are being implemented through different government agencies. The 1995 Environmental Law no. 12 and the 1973 Agricultural Law no.20 have articles dealing with animal protection that would help in decreasing pressures on species at risk.

The Ministry of Agriculture has delegated the implementation of wildlife protection (1973 Agricultural Law no. 20) to the RSCN, recognizing it as one of the agencies aiding in the enforcement of hunting laws. Other agencies that share in this task include the Forestry Department rangers, the army and the police. Still, many seem to believe that enforcement is the only responsibility of the RSCN. The RSCN is currently the leading organization in implementing this law, but this NGO, with its five rangers, cannot enforce the law all over Jordan. To overcome this misunderstanding and improve the law enforcement, networks were established between the RSCN and the police and between the RSCN and the Ministry of Agriculture. These networks will hopefully enhance law enforcement within the country. Public awareness programs were also carried out to promote enforcement of agricultural law.

### **3.3 Land Tenure and land use planning**

A working definition of land use planning is the process of determining the location of discrete areas for different land use activities. In land use planning, land use areas are locked out for specific uses within the context of higher order planning criteria and the directives and/or requirements of integrated national, regional, or urban planning.

The age of settlements in rural Jordan goes back to the Neolithic period. For the past 10,000 years people lived in tents, encampments, in villages, towns and cities, in rural estates, and in single farmhouses.

Those settlements and the percentage of population living in them reflect the changing pattern of social structure and political stability. The landscape is rich with archaeological sites which often were home to several human settlements built on top of the other. Some of these sites are still inhabited. The villages of Um El Jimal and Um Qais are two examples of settlements which have been continuously inhabited since the historic period. The Greek-Roman planning tradition is today visible in many parts of these settlements.

#### **Current System**

With the introduction of modern infrastructure, roads, and services into the countryside during the 1950's and 1960's, villages have increased in numbers. In fact, the majority of currently ingested villages are those built in this period. These villages were of a mixed character, combining the traditional and more recent buildings. With the introduction of municipal plans, several villages became officially planned according to zoning regulations. A comprehensive land use scheme is lacking on the national, regional and local levels. As a prerequisite for nearly all decisions, e. g., in the water sector for the location and design of waste water treatment facilities, in the transportation sector for design and construction of roads, for agriculture, industrial facilities, mining, and the protection of nature reserves, lack of land use planning creates serious threats for the environment as well as for public health. Examples of problems caused by deficiency of land use planning are the City of Amman's westward expansion that has encroached on some of Jordan's finest agricultural land while the eastern sites receive less attention.

Expanding human requirements and economic activities are placing ever increasing pressure on land resources in Jordan, creating competition and conflicts and resulting in non-optimal use of both land and land resources. These increasing pressures on land resources create environmental problems such as land degradation and contamination.

Land resources in Jordan are used for a variety of purposes, which interact and may compete with one another. It is desirable to plan and manage all uses in an integrated manner.

Jordan agricultural potential is limited. The rainfed agricultural sub-sector is limited by scarce and irregular rainfall and by the topography of the land in the higher rainfall zone: only 235,000 ha of Jordan area receive adequate rainfall for rainfed agriculture (greater

than 350 mm), of which only about 155,000 ha have a slope below 25%. Jordan has a low potential for livestock production due to its meager range-land resources and its inability to economically produce feed for fattening and milk production. Overgrazing, a succession of droughts and the appropriation of the better lands for rainfed crops have decreased considerably the fodder availability without decreasing the number of livestock.

The severe limitation of agricultural land has been further aggravated by the loss of the best agricultural land to urbanization and industrial uses. The fallow system, together with land speculation, further reduces land available for agriculture. Most of the Badia have the traditional right of communally utilizing the land. Without settling the ownership and utilization rights of this Badia land, development programs, particularly by the private sector, could be greatly constrained.

Overall, land use in Jordan is unbalanced and suffers from conflicts between the major land uses. Land use planning, supported by appropriate legislation, has become a necessity for achieving the balanced exploitation of natural resources.

Range-lands, defined as the areas receiving less than 200 mm of average annual precipitation, cover more than 90% of the total land area of Jordan. The present condition of range-lands in Jordan is generally poor to very poor. They urgently need demarcation, re-organization, management plans, strategies and action programs for their proper scientific management. Grazing is the optimal way of utilizing these areas, of converting native plants not usable by man to animal products suitable for human consumption. In most cases, present production does not exceed one-third to one-sixth of the potential productivity. The cause of this low productivity is overgrazing of the range-lands, resulting from a higher demand for animal products by a fast increasing population. Overgrazing inhibits several plant species from producing enough seeds to maintain suitable vegetation cover. Consequently, several important species have disappeared, and less palatable species have dominated and taken their place.

Jordan's natural forest area totals 40,594 hectares, constituting only 0.44% of the country's total area. These are fragmented, mostly undemarcated, unmapped, degraded forests of poor density, with practically no natural regeneration. Forest cover has been increased by 35,361 ha of man-made forests. Thus, the total forest area in the country became 75,955 ha, representing only 0.84% of the total area; while the rest of the declared forest of 150,862 ha is mostly hilly, steep, stony or rocky, with small patches of shallow soils and without any forest cover. Moreover, large areas of forests are still threatened by uncontrolled degradation, pests, misuse and pressures resulting from energy shortages in rural areas. To remove the deficit in forest cover and prevent further destruction of forests, joint efforts are needed to awaken public awareness and encourage public participation in the conservation activities.

Urban environmental problems tend to be increasing in Jordan and may become a predominant obstacle to environmental sustainability. Unacceptable interaction between major industries and urban areas has occurred because of the lack of proper urban

planning. Industries are concentrated in and around urban areas especially in Amman, Zarqa and Aqaba. The absence of mass transit system leads to degradation of air quality due to vehicular emissions, especially in Downtown Amman.

### **Main Issues Concerning Land Use in Jordan:**

In the recently completed National Environmental Action Plan for Jordan report, three main environmental issues related to the land use to land were identified:

Land degradation.

Land contamination.

Coastal zone degradation.

These issues are considered a threat to the land resources and land cover of Jordan, especially because the country is mostly arid and semi-arid. Almost 90% of the land area receives less than 200 mm of rainfall annually as reflected in its soils, its land cover of range grasses and forests, and in the way Jordanians use their land.

The remaining lands are suitable for more intensive uses, such as irrigated and non-irrigated agriculture, forestry, tourism, recreation, and urban and industrial development. Most of the country's economic activities take place on 10% of its land.

### **Institutions Related to Land Use Planning**

Ministry of Agriculture (MOA): The Agriculture Law No. 20 of 1973, gives the MOA some authority over land use.

Aqaba Region Authority (ARA): The development institutions of the Aqaba region were established in 1960 when the government formed a committee to organize the city and develop its land use patterns. The Aqaba Region Authority was established in 1984 and amended in 1987 to have a nominal entity and financial and administrative autonomy over the region.

The Jordan Valley Authority (JVA): According to the Jordan Valley Development Law No. 19, 1988, Article 3, the JVA is also responsible for "The development of towns and villages, the selection of their sites, and the delineation of their boundaries. In addition the JVA is charged with the preparation of skeletal and detailed plans of the cities and villages shown on these plans.

### **Policy, Legal and Institutional Issues**

Definition

There is no common working definition of sustainable land use and planning.

Environmental Issues

The absence of land use planning has aggravated the degradation of natural and cultural resources of Jordan.

Absence of EIA for urban planning

Imbalance population growth and pressure on the land.

Encroachment of urban and rural development on prime agricultural lands, green areas,

open spaces, and forests.

### **Legislative Issues**

The lack of a clear legal mechanism for enforcing the use of integrated regional/urban land use planning/zoning as a part of comprehensive national development planning.

The lack of a clearly defined prioritization mechanism use in land use planning.

Weakness of existing laws and inadequate enforcement of laws, codes, and regulations.

Existing legislation related to land requires strengthening, updating, and development.

Existence of ambiguous land tenure systems.

Inappropriate pricing and taxation (urban land speculation, property tax, transfer tax, vacant land tax, profit tax).

lack of comprehensiveness of existing legislation.

### **Institutional Issues**

There are a multiplicity of institutions responsible for land use planning. Overlapping authorities which believe they control the use of land.

Lack of integrated planning.

Lack of communication and coordination among agencies.

Absence of nationally agreed upon land use plans/ buffer zones.

Decentralization of operations to the local level.

### **Management Issues**

Availability, accessibility, co-ordination, and proper use of land information.

Lack of a system of monitoring and evaluating the land use situation.

Lack of funds for land use planning and management.

Lack of stakeholders' awareness and participation in land use planning process.

### **Key Issues:**

Expansion of development projects at the expense of cultivable land and natural habitats.

Lack of effective land use planning

High population growth rate and consumption patterns.

Litter and waste generated as a result of high consumption levels and bad management.

Problems of disposing of liquid and solid waste in urban areas.

## THME 4 BIODIVERSITY RESOURCES IN JORDAN

### 4.1 FLORA

Jordan is located on east side of the Mediterranean Sea and its variable in its plant communities, such as mountainous, desert, subtropical communities, this variability in part accounts to relatively high species richness.

The total number of plant species recorded in Jordan exceeds (2500) species of which 100 species are endemic, 250 species are rare, 125 species are very rare, 150 species are endangered and currently about 75 species are considered extinct. These species represent 152 families and about 700 genera. Because Jordan communities are mainly Mediterranean in their vegetation characteristic, many species are adapted to tolerating human impact and they are ornamental or medicinal in their nature. The flowering plants are the dominated group of species that give the country its seasonally which make Jordan an excellent place to visit during the spring, this is the season where most of the species are found to be in the following stage and where human impact in maximum.

The flora of Jordan was indirectly studied in earlier works related to the area such as Flora Orientals, (Boissier, 1867-1883); Flora of Syria, Palestine & Sinai (Post, 1932-1933), Flora Palestina (Zohary & Feinbrun, 1966-1986). Extensive work was carried out during the past three decades from which plant collection and deposition was made. About 60,000 specimens are deposited at the Herbarium, Department of Biological Sciences, University of Jordan. Another collection of around 10,000 specimens is deposited at the Herbarium, Department of Biological Sciences, Yarmouk University. A third small collection comprising one of the old collections of Meyer and Dinsmor is deposited at the Ministry of Agriculture, National Center of Agricultural Research and Technology Transfer.

Many floristic studies were published during the same period (e.g. Boulos et al., 1977; Al-Eisawi, 1983, 1986 and 1988; El-Oqlah, 1976; El-Oqlah et al., 1988; Lahham, 1975; Oran, 1984; Oran et al., 1985).

Few taxonomic revisions and serious treatments were made during the past two decades. Some of these studies were related to the following plant families: (*Umbelliferae*, *Resedaceae*, *Cruciferae*, *Euphorbiaceae*, *Ranunculaceae*), as given by (Al-Eisawi, 1977; Lahham, 1976; and Jallad, 1976).

#### \* Vegetation Classification

Several studies related to the vegetation of Jordan in particular or as part of the Middle East region have been carried out (Zohary, 1973; Long, 1957; Kasapligil, 1956 and Al-Eisawi, 1985). Endemic species: *Crocus*, *Colchicum*, *Iris*, and *Verbascum*. Rare Species: *Orchis*, *Romulea*, *Biarum* and *Globularia*. Thirteen vegetation types were recognized by Al-Eisawi (1985) as follows:

1. Pine forest.

2. Evergreen oak forest.
3. Deciduous oak forest.
4. Juniper forest.
5. Mediterranean non forest region.
6. Steppe vegetation.
7. Halophytic.
8. Sandy dunes.
9. Hammada.
10. Tropical.
11. Acacia and rocky vegetation.
12. Hydrophytic.
13. Mud flats.

### **\* Flowering Plants**

Although, Jordan is a small country, its flora is rich and highly diverse compared to the total number of recorded vascular plant species on earth - 250,000-. Jordan, with a total area of not more than 90,000 km<sup>2</sup> has a vascular flora of 2,500 species, included within 152 families and 700 genera. This means that this little country has 1/100 of the total world flora. In addition to that, Jordan has four major phyto-geographical regions. The recorded plant species are well adapted to xeric conditions.

Serious studies related to the identification of endemic, rare and endangered species have not been carried out in Jordan. Nevertheless, an estimated 100 species of endemic plants comprising about 2.5% of the total flora are recognized. Many species are known to be rare or endangered such as Orchid species, ornamental bulbous plants, some rare edible and medicinal plants, but still the status of many species is unknown. Therefore, the following are suggested studies related to the status of endemic, rare and endangered species that should be carried out.

### **\* Gymnosperms**

Although, the total number of gymnosperms does not exceed three species, they confirm some of the most important forest ecosystems in Jordan, especially the Aleppo pine forest (*Pinus halepensis*) in Northern Jordan and the Phoenician Juniper (*Juniperus phoenica*) in the South. The Juniper and *Cupressus* species are considered threatened species due to the human impact on their natural habitat.

### **\* Pteridophyta**

The total number of ferns in Jordan is estimated to range from 5-10 species. The status and distribution of these species is not well known.

### **\* Bryophytes**

Few studies were made on the bryophytes of Jordan. About 150 species have been recorded so far. Information related to their distribution is not well known.

### **\* Lichens**

An estimated number of about 150 species of lichen have been recorded. Complete and

extensive surveys and specific studies have not been carried out so far.

**\* Flagship Species**

Plant flagship would include *Iris petrana*, *I. negranesis*, *Moringa peregrina*, *Salvadora persicum*, *Cyclamen persicum*, *Aloe vera*, *Pinus halepensis*, *Juniperus phoenicia*, *Acacia arabica*, *Pistacia palestina* and others.

The flora of Jordan constitutes a very important component of Jordan's biological diversity. Conservation of such a national resource to ensure sustainability and development is listed high on the priorities of Jordan to conserve such a valuable resource.

**\* Major Threats to Vegetation in Jordan:**

The flora of Jordan is facing, like many areas of the Mediterranean region, a continues is facing continued deterioration because of one or more of the following factors:

- Cultivation: replacing the natural vegetation cover with cultivated crops utilizing modern agriculture machinery.
- Grazing: The carrying capacity of many of the vegetated areas is way below the actual number of grazing animals mainly goats and sheep many of the plant species that live in Jordan coevolved with grazing animals. In several areas, illegal grazing as well as overgrazing led to serious vegetation destruction, .Goat grazing which can lead to serious damage to plant growing points as well as high seedling mortality.
- Cutting Tree: This is mainly in the forested areas of the Badia area are particularly stricken by tree harvesting for firewood and charcoal production. that resulted from usage of plants for fire-wood and tree cutting in the forested areas. It is estimated that we loose around 1000 trees are lost annually, most of, which are old trees, which have a very significant contribution to genetic diversity.
- Urbanization: The spread of land use age for building houses, and opening highways and roads as well as encroachment of people on public and state owned land gradually led to a decrease of forested areas. Jordan is facing a population boom in which there leads to an increasing is demand for food and housing areas. Many cities, towns or villages have extended over their normal range and many agricultural zones are being shifted to become under city organized zones for further development residential zonest.
- Off-road driving: Trampling of vegetation in transitional and fragile ecosystems by having most by off-road vehicles which is leading to the destruction of vegetation cover and soil erosion.
- Collecting: several plant species are threatened by unregulated collection. These include medicinal and ornamental plants of the genus *Tulipa*, *Narcissus*, *Lupinus* and *Cyclamen*. This practice target several plant species that put them under the threatened or endangered list because of specific needs, many species like Tulipa and Narcissuss as well as *Lupinus* and *Cyclamen* are collected for various reasons. Many Medicinal plants are collected for medicinal usage.

- Natural Disasters: Water stress, heavy rain, snow and flash flood rains are among the environmental factors that can lead to the destruction of plant species and tree death these occurring happen once during a certain period of time but can lead to serious changes in the plant communities.

- Pests and pathogens: The effect of these biological factors is insignificant compared to other factors, as no epidemics were reported in Jordan for the past 50 years.

- Pollution: This factor is one with of the least gathered scientifically documented. knowledge we had about, in certain areas, for example near the Cement factories or the refinery in the Al-Hashemiah area, where we have permanent source of pollution, monitoring vegetation monitoring is of high priority. like near the Cement factories or the Refinery in Al-Hashemia area. It is a high research priority that need to be done soon. Many of the areas outside the above mentioned areas do not suffer from any serious air pollution but other forms of pollution can be of existence and information needs to be gathered about them.

The causes of natural deforestation are many, and some of those can be blamed mainly on human development, such as inappropriate land tenure systems and incentives, expansion of agriculture areas, increasing forest product demand and lack of information and understanding on the value of forests.

### **Legislation:**

It is well known that there can be no serious protection of nature biological diversity without series and effective laws to that effect. Protection and conservation can not be left to personal choice. Efforts to conserve forests, wild flowers, rare and endangered plants, orchids, cacti or animal life without serious efforts at various governmental and non-governmental levels seldom succeeds.

In Jordan, there are hundreds of specimens illegally smuggled yearly in the form of either living or dry herbarium specimens. Many rare, endemic or new species to the flora of Jordan have been collected and taken to herbaria of various nations, especially European countries, without leaving duplicate specimens in Jordan or giving information about the place of their deposition or even a list of their names, numbers and locations. Such activities, should be treated as criminal acts of smuggling because they were perpetrated irresponsibly and without official permits.

### **Conservation:**

Two ways can be used to conserve: In Situ conservation and Ex Situ conservation.

#### **In Situ conservation:**

In Situ conservation involves the following activities :

a- Conservation of forest ecosystems such as conservation of the Phoenician Juniper forest in Southern Jordan, as in the case of Dana Reserve.

b- Conserving certain types of ecosystems of highly threatened types such as the desert ecosystem, as in the case of Shaumari Reserve.

- c- Conserving habitats of threatened, endangered or rare plants such as orchids, by conserving their forest ecosystem.
- d- Conserving certain population of rare and endangered plants such as those in hot-spring areas, especially in the Dead Sea area and Zara where Jordan has limited population distribution which are highly threatened.
- e- Initiation of botanical gardens that can act as rescue sites for rare and endangered species as well as genetic resources.

**Ex- Situ conservation :**

Ex- Situ conservation can be achieved by:

- 1- Collecting seeds from natural habitats of occurrence and germinating them in special laboratories using modern methods of propagation and returning them to their natural habits to increase their numbers.
- 2- Collecting plant propagules and propagating them in specialized laboratories.
- 3- When unsuccessful in the use of classical methods, modern aspects of biotechnology such as tissue culture or others should be applied to propagate rare and endangered plants.
- 4- Seed banks and gene banks should be established in different parts of the country to conserve biodiversity and genetic resources.

**Herbarium Information:**

Many Herbaria exist in Jordan that they have major collections the biggest being at Yarmouk University in which about 20,000 specimens are present deposited at the Herbarium of the Jordan Natural History Museum and about 12,000 specimens at the Department of Biological Sciences Herbarium. The University Of Jordan Herbarium has about 40,000 specimens and the Ministry of Agriculture about of (6,000).

Replace this text with the paragraph on herbaria already prepared in theme 2.1 Wild plants (of the Strategy final draft)

## **4.2 FORESTS**

Jordan has limited forest resources with only 1.5 % of the country being classified as forest including natural and man-made forests as well as bare lands considered having a forest production potential. Of this forestland, only 26 % have forest cover with a canopy density of 10 % or more and the rest is mostly composed of land sparsely covered with vegetation.

The forests in Jordan, especially natural forests, are fragmented, open in density, slow growing, of degraded conditions and, thus, of low commercial value. Commercial forests are only expected in areas receiving more than 400 mm of precipitation annually. Such lands constitute only 9 % of the total forestlands. Afforestation activities can be implemented in areas receiving more than 250 mm / year which constitute 8.3 % of the total forestland.

Jordan does not possess (please correct this word in the Strategy Draft) a forest industry as such with the exception of a limited secondary industry producing furniture and fruit

boxes. Most of Jordan's requirements in forest products are imported.

Because of their limited commercial value, the forests in Jordan are mostly valued for their contribution to soil conservation, watershed management, aesthetic purposes, biodiversity conservation and limited supply of firewood and animal feed. The ecological and social functions of forest are thus of great importance in Jordan and take precedence over wood production and other products. Forest environment provides a habitat for a great diversity of plant and animal species and represents the largest single store of biodiversity.

The forest vegetation in Jordan can be divided into the following categories:

Natural forests that are composed of evergreen shrubs, pine and juniper forest as well as broadleaf forests.

Artificial or man-made forests, areas that are afforested artificially by the Department of Forest since the 1950s. The afforested areas are found in all registered forest land in Jordan. They are planted mostly with *Pinus halepensis* and *Acacia saligna*. The survival rate varies from 0 to 75 %.

Bare forest lands, areas registered as forest land in the name of the government treasury but being presently bare of forest cover. They are characterized by rough topography, poor site conditions, soil erosion hazards, over grazing or over harvesting.

Unsettled forest areas, areas covered completely or partially by forest trees, but still unsurveyed or unregistered. The total area of unregistered forest area is estimated at 12,200 ha. These areas are in principle governmental land at the disposition of the forestry administration.

Roadside plantations covering about 1000 km of roadsides. Trees planted along the roads belong to the government and are managed by the Department of Forest.

All these are government forests, either registered in the name of the Jordan government Treasury as forestland or declared as forestland according to the 1973 Agricultural Law no. 20 and to the 1974 Government property owned management Law no. 17.

Private Forests are registered in the name of their private owners and are found mostly in the northern part of Jordan where higher rainfall is prevailing. They include natural forest vegetation and tree plantations on farms, in the form of windbreaks and shelter-belts. Private forests account for less than 4 % of the total declared forestland. These forests consist of small-scattered parcels, partially covered by broad leaf species, which are typically of low timber value and only used for fuel wood and charcoal. The owners view their forests as obstacles to the maximum yield of their land and therefore they tend to cut down these trees or replace them with fruit trees. The Department of Forest acknowledges their ownership and rights to use their lands for other agricultural production.

There are four forest natural reserves currently established or under preparation. These reserves are managed and directed through the Forestry Department and the Royal Society for the Conservation of Nature. They cover an area of 107 200 ha.

There are 13 permanent tree nurseries distributed in the different climatic and geographical zones of Jordan. They are equipped with irrigation and watering facilities, and managed by trained personnel. The production of these nurseries is used directly in afforestation programs that are implemented and supervised by the Forestry Department or distributed to the public or to the military for their annual plantation programs. Even though the annual production of these nurseries is about 9 million seedlings, there is a need for improvement.

The current policy of the forest administration is to protect and improve existing forest and cover bare forest lands through afforestation in order to improve the semiarid conditions, achieve soil conservation, and green the landscape. Afforestation has been one of the main programs of the Forestry Department in Jordan. Most of the plantations are intended for protective and environmental purposes rather than for productive and economic outputs. Native and exotic plant species are used with a preference for *Pinus halepensis*. The quality and survival rates of such plantations are variable and should be closely evaluated at the country level. Afforestation activities on degraded land have sometimes caused serious conflicts with local people who previously used such areas as free grazing land.

The objectives of afforestation programs in Jordan can be stated as follows:

- Bringing an adequate proportion of all lands, at least in the better rainfall areas, and irrigated areas under permanent vegetation cover.
- Establishing plantation of suitable tree species in the better rainfall areas and manage their productive and protection functions.
- Establishing protective plantations of trees, such as windbreaks or shelter-belts and roadside avenues in cultivated areas and land put to other uses.
- Re-establishing a forest cover over all degraded forest areas.

Jordan has enacted a few forest laws including the 1927 Wood and Forest Law, with amendments until 1951, the Compulsory Tree Planting Law of 1953, the Law prohibiting the grazing of goats in forests of 1952, the 1973 Agriculture Law. These laws served the country well but they need revisions to account for biodiversity and land use in order to conserve and sustain what is left of forest and agricultural lands for future generations.

In Jordan, the problems facing forests are similar to other Mediterranean and neighbor countries. These include overgrazing, over exploitation and clearing activities causing inter linked problems, notably soil erosion, watershed destabilization and microclimate changes. There is a permanent threat to sustainable soil and water management for agriculture due to the environmental degradation of upper watersheds. In several areas, fuel-wood is being harvested at a faster rate than natural regeneration can support. Inadequate management and fire control accentuate this problem.

### **4.3 TERRESTRIAL AND FRESHWATER WILD FAUNA**

The location of the country between three old continents has made it a special “meeting” place for species from various origins. The Rift Valley is a major migration route that raptors and other birds use to migrate between Africa and Europe in spring and autumn. On the other hand, the Eastern Desert which covers more than 75 % of the total surface area of the country is a place where several species are present especially reptiles and small mammals that are used to the dry and harsh conditions of these habitats.

The variation in ecosystems and habitats has led to a wide biodiversity. A total of 77 species of mammals belonging to seven orders have been recorded so far. The Jordanian herpetofauna consists of 102 species. The majority of it is not critically endangered even though about 14 species are relatively rare, 2-4 species might be already extinct and a few species are probably critically endangered.

The 411 bird species recorded in Jordan belong to 58 families. The avifauna of Jordan is one of the best-studied groups due to Jordan’s location on the migration route for birds. The invertebrate fauna of Jordan is unique in many aspects since its composition is a mixture of several faunal origins, but due to lack of comprehensive research, the exact number of invertebrate species is unknown. A total of 13 orders and 116 families were recorded so far in Jordan.

Many conservation initiatives have taken place in the last 50 years. Protected areas are one of the ways of conserving what is left of the terrestrial fauna in their habitats. Protected areas in Jordan are managed by the Royal Society for the Conservation of Nature by delegation of the government. The current protected area network consists of 6 adopted and several other proposed sites. Special attention was directed to other zones outside protected areas. These zones have significant conservation importance due to their great diversity of species and habitats. They consist of important bird areas, important wetland areas, marginal areas at national borders (protected by the army) and wildlife corridors.

Major threats to wildlife in Jordan- Biodiversity in Jordan is exposed to several threats that have led to sharp decline in most of the Jordanian fauna and to the extinction of several species. These threats can be summarized in the following.

Lack of information is the basic threat to all forms of wildlife including terrestrial fauna. Insufficient knowledge about the biology, status and distribution of wildlife and human-animal interaction consequently leads to inefficient measures to conserve these species. The different efforts in this field should be interpreted into practical steps toward better understanding of Jordan’s wildlife simply by coordination between the different sectors and stakeholders involved.

Habitat degradation and destruction from human activities have led to the loss of natural habitats including terrestrial and aquatic habitats that affected the faunal composition of these areas

Uncontrolled urban expansion in the form of deforestation and transforming forests into agricultural and urbanized areas in addition to the increase in Jordan's population and industrial development have caused the destruction of natural habitats.

Overgrazing and extensive woodcutting in addition to intensive agricultural practices have caused a major threat to wildlife in Jordan through natural habitat destruction and soil erosion.

Unplanned mining and quarrying can lead to destructive results for wildlife by destroying habitats.

Uncontrolled off-road driving has led to the destruction of several habitats and is causing disturbances to breeding areas of migratory bird species.

Unbalanced water use and unplanned water extraction from surface and underground water resources are threatening many parts of Jordan and consequently affecting the habitats and micro ecosystems of both animals and plants. On the other hand, pollution of surface and underground water resources and aquifers due to agro-chemicals, sewage discharge and solid waste disposal causes a definite threat to the reproduction capacity of many animal species.

Illegal hunting was one of the main reasons for the extinction of several species from Jordan's wildlife and is still considered as one of the main threatening factors for fauna biodiversity in the country. The impact of this threat has greatly increased with the wide spread use of modern hunting techniques.

The illegal trade of native species which directly affects the population of faunal species in the country in addition to the illegal dissemination of non-native species has caused a severe stress on some species in their habitats and threatened the survival of native species.

Little is known about the status of some diseases affecting livestock and the role of wild animals in transmitting them. The increased contact with wildlife has led to transmitting of some diseases from livestock to wild animals and vice-versa through direct contact or predation. On the other hand, several wild animals in Jordan are thought to be vectors or reservoirs for some diseases. Some of these diseases affect both humans and wild fauna and are a real threat to the distribution and relative abundance of certain species.

Introduction of alien species is one of the major threats to native animal species. They can also become pests by causing destruction to natural habitats and agricultural areas. On the other hand, feral species, which invaded the country long time ago, might affect their wild relatives through competition and interbreeding. Invasive exotic species are usually capable to adapt to habitat change. Some of these species might have the same effect as alien species in that they destroy natural habitats and agricultural areas.

#### **4.4 MARINE LIFE AND FISHERIES**

The only maritime region in Jordan, with the exception of the Dead Sea, is the Gulf of Aqaba. The Jordanian coastline covers about 27 km at the northern tip of the Gulf, which extends for about 180 km from the Jordanian shore in the north to the sills of the Strait of Tiran in the south. It has an average width of 20 km and an average depth of 800 m. The Gulf of Aqaba, which is the only fish resource of Jordan, is unique because of its clear waters, low algae productivity and colorful biological diversity inhabiting the coral reefs.

More than 161 species of fishes were reported in the Gulf of Aqaba. Many of these species, especially the migratory, are of high economic value such as the tuna and sardine that enter the Red Sea and reach the Gulf of Aqaba. The Gulf also sustains about 270 different species of corals and more than 1000 species of other invertebrates. The marine resources of the Gulf are of great economic value in terms of tourism and the Gulf itself, as Jordan's only outlet to the sea, is important for transport and industry. Coral reefs and sea grass beds are recognized to be of particular importance as nursery areas and as a source of food for a rich and specialized fauna including turtles, fish and numerous invertebrates. The development of shipping, industry and urban centers along the coast threatens to degrade significantly the environment in which these ecosystems thrive. With the deterioration of many corals, fish populations, which rely upon the reef for both protection and food, are expected to decline rapidly.

The marine environment in Jordan has not received much scientific attention in the past decades. Although, some scientific studies have begun, the situation in the Gulf has been changing rapidly as intense commercial and industrial development takes place along the coast. Furthermore, these studies were mostly limited to coastal and shallow water. No study, to the best of our knowledge, was conducted on the deeper sections of the Jordanian side of the Gulf. In addition, a good part of the recorded species is subject to discussion on the basis of their taxonomic validity.

In the past 10 years, fish production increased from 370 tons in 1991 to 1075 tons in 2000. That same year, Jordan also produced about 1075 tons of fish while it imported about 12834 tons of fish. The average consumption per person was 2.7 kg in 2000 compared to 5 kg in the world. The self-sufficiency is not more than 8 % for the year 2000. There are no recent numbers regarding annual fish catchments and fish stocks in the Gulf of Aqaba because of the lack of adequate management. Various fishing gear being used in Jordan include: cast nets, gill nets, hand nets, occasionally explosives and traps. An estimated number of 216 fishermen and 136 fishing boats operate in the Gulf.

Major threats to marine life and fisheries in the Gulf of Aqaba include:

Pollution by chemicals: According to the report submitted by the delegation of the European Community in 1993 and a study published by Mergner in 1981, the clean water in the Gulf of Aqaba is affected mainly as a result of pollution with nutrients. The major pollution impact on the Gulf of Aqaba is due to the spill of raw phosphate. High phosphate concentrations were reported in the vicinity of the phosphate-loading berth.

Enrichment of phosphate in the Gulf stimulates algae growth. The second potential source of pollution comes from the handling of fertilizers and the spill of rice and grain in port areas. Such spills, particularly raw phosphate, will decrease the transparency of water and gradually lead to the eutrophication of the water, thus harming marine life by reducing light intensity.

Urban and industrial development: The short coastline of Aqaba is very busy not only because of port activities but also because of significant constructions, hotels and other industrial buildings. The discharge from these buildings and ships is automatically flowing into the Gulf water. New constructions destroy the sea beds and have a negative effect on the biotope in which the animals survive. Moreover, humans residing or working in the buildings near the shore dump large amounts of litter. Such scenes are often witnessed on the shoreline near the Marine Science Station.

Sewage infiltration and direct discharge into the gulf waters are also affecting both water quality and animal life as stated by the 1993 European Community Delegation report on the coastal resources and environmental management in Aqaba.

Other threats to marine life and fisheries include:

- Oil spills;
- Over-fishing of high value marine and coastal resources;
- Destruction of coral reefs and shallow water habitat through inadequate anchoring practices;
- Coastal erosion and depletion of mangroves;
- By-catch of non targeted or protected species;
- Use of illegal fishing gears and fishing out of season;
- Introduction of alien fish species.

Do not include table 1,2 and 3 in this report.

**Table 1: Freshwater Fishes Reported From Jordan**

<i>Family</i>	<i>Species</i>
<i>Cyprinidae</i>	<i>Acanthobrama terraesanctae halensis</i> , <i>A. lissneri</i> , <i>Barbus canis</i> , <i>B. longiceps</i> , <i>Capoeta damascina</i> , <i>Garra rufa</i> , <i>G. ghorensis</i> , <i>Hemigrammocapoeta nana</i> , <i>Pseudophoxinus drusensis</i> .
<i>Cobitidae</i>	<i>Nemacheilus insignis</i> , <i>N. galilaeus</i> , <i>N. leontinae</i>
<i>Clariidae</i>	<i>Clarias gariepinus</i>
<i>Cyprinodontidae</i>	<i>Aphanius dispar</i> , <i>A. richardsoni</i> , <i>A. sirhani</i>
<i>Cichlidae</i>	<i>Astatotilapia flauijosephi</i> , <i>Oreochromis aureus</i> , <i>Sarotherodon galilaeus</i> , <i>Tilapia Zilli</i> , <i>Tristramella sacra</i> , <i>T. simonis</i>
<i>Bleenniidae</i>	<i>Blennius fluviatilis</i>
<i>Mugilidae</i>	<i>Mugil cephalus</i>
<i>Anguillidae</i>	<i>Anguilla spp.</i>

**Table 2: Commercial Fishes from the Gulf Of Aqaba**

<b>Family</b>	<b>Species</b>
<i>Lamnidae</i>	<i>Isurus oxyrinchus</i>
<i>Fistularidae</i>	<i>Fistularia petimba</i>
<i>Priacanthidae</i>	<i>Priacanthus hamrur</i>
<i>Apogonidae</i>	<i>Cheilodopetrus lineatus</i>
<i>Carangidae</i>	<i>Seriola dumerili</i>
<i>Caesionidae</i>	<i>Caesio caeruleus</i> <i>Caesio lunaris</i>
<i>Lutjanidae</i>	<i>Lutjanus bohar</i> <i>Lutjanus kasmira</i> <i>Pristipomoides typus</i>
<i>Gerreidae</i>	<i>Gerres oeyena</i>
<i>Pomadasyidae</i>	<i>Plectorhynchus gaterinus</i>
<i>Sparidae</i>	<i>Acanthopagrus bifasciatus</i> <i>Diplodus noct</i>
<i>Mullidae</i>	<i>Malloidichthys flavolineatus</i> <i>Parupeneus barberinus</i> <i>Parupeneus cyclostomus</i> <i>Parupeneus macronema</i>
<i>Labridae</i>	<i>Xephocellus robustus</i> <i>Scarus ferrugineus</i>
<i>Hypotyichidae</i>	<i>Hyporhamphus dussumeri</i>
<i>Siganidae</i>	<i>Siganus luridus</i> <i>Siganus rivulatus</i> <i>Siganus rostratus</i>
<i>Scombridae</i>	<i>Euthynnus affinis</i>
<i>Soleidae</i>	<i>Pardachinus marmoratus</i>
<i>Serranidae</i>	<i>Aethaloperca rogae</i>
<i>Sphyraenidae</i>	<i>Variola louti</i> <i>Pterotropomus maculatus</i> <i>Epinephelua tauvina</i> <i>Einephelus microdon</i> <i>Sphyraena fosteri</i>

**Table 3: Status of freshwater fishes in Jordan**

<i>Species</i>	<i>Distribution</i>	<i>Status</i>
<i>Acanthobrama lissneri</i>	Widely distributed in Jordan River drainage and in some dams	Common
<i>A. terraesanctae</i>	Lake Tiberias	Common
<i>A. hulensis</i>	Not defined	Not defined
<i>B. longiceps</i>	Dams and Jordan River	Common
<i>Barbus canis</i>	Dams and Jordan River	Common
<i>Capoeta damascina</i>	Jordan River tributaries and Yarmouk River and Mujib	Common
<i>Garra rufa</i>	Jordan River and tributaries towards north of Jordan	Vulnerable
<i>Garra ghorensis</i>	Restricted to springs in Dead Sea area (southern part of Jordan)	Vulnerable Endemic
<i>Hemigrammocapoeta nana</i>	River Jordan and River Yarmouk	Not very common
<i>Pseudophoxinus drusensis</i>	Northern part of Jordan River basin near Jabal Druz	Vulnerable
<i>Nemacheilus insignis</i>	Jordan River tributaries	Vulnerable
<i>N. galilaeus</i>	Lake tiberias	
<i>N. leontinea</i>	Jordan River	Rare
<i>A. sirhani</i>	Azraq Oasis	Endangered
<i>Aphanius dispar</i>	Restricted to the steams in	Valnerable
<i>Aphanius richardsoni</i>	The Dead sea area	
<i>Clarias gariepin us</i>	Jordan river & azraq oasis	Common
<i>Astatotilapia flavijosephi</i>	Jordan river	Not defined
<i>Oreochromis aureaus</i>	Jordan river, and Azraq oasis, dams	Common
<i>Sartherodon galilaeus</i>	Jordan River, dams	Common
<i>Tilapia-zilli</i>	Jordan River, dams	Common
<i>Tristramella sacra</i>	Reported in lake Tiberias	
<i>T. simonis</i>	Reported in lake Tiberias	
<i>BleNNius fluvitalis</i>	Lake Tiberias	Occasional
<i>Mugil cephalus</i>	Jordan River	Occasional
<i>Anguilla sp.</i>	Jordan River	Occasional

#### **4.5 BIODIVERSITY OF GENETIC RESOURCES IN JORDAN PLANT GENETIC RESOURCES:**

Variation in climate and topography in Jordan has led to a wide diversity in ecological habitat and flora. The Flora of Jordan comprises approximately 2500 species ecologically adapted to local conditions. Most of these species are even adapted to the dryer parts such as the desert of Jordan. Therefore, the species growing in this vast area are of extreme importance as the primary vegetation element and hence their uses as edible for human, grazing for animals, medicinal, soil fixing, nitrogen fixing, parent of cultivated, disease, drought and saline resistant plants. Important ornamental plants such as *Iris*, *Tulip*, *Allium*, *Crocus*, *Colchicum* and others also exist.

The collection missions were organized in cooperation with ICARDA and using the

ICARDA manual for taking eco-biogeographical data. Descriptors of IPGRI are used for evaluation purposes, and conservation of seed material was at ICARDA gene bank. A total of 4024 accessions of Jordan germplasm stored at ICARDA gene bank represents the following genera: *Aegilops*, *Anthyllis*, *Astragalus*, *Biserulla*, *Bromus*, *Cicer*, *Coronilla*, *Dactylis*, *Festuca*, *Hippocrepis*, *Hordeum*, *Hymenocarpos*, *Lathyrus*, *Lens*, *Lolium*, *Lotus*, *Medicago*, *Mililotus*, *Onobrychus*, *Ononis*, *Phalaris*, *Pisum*, *Poa*, *Scorpiurus*, *Securigera*, *Tetragonolobus*, *Triolium*, *Trigonella*, *Triticum*, and *Vicia*. These genera include rare, forage, wild progenitors species, and land races of the Plant Genetic Resources Unit.

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 proposal supported by the United States Agency for International Development (USAID). The project budget was 43.100 JD for two years, 1993-1995. The objectives of this Unit are:

Collection of plant genetic resources from Jordan.

Evaluation, documentation and conservation of plant genetic resources in accordance with international rules.

Promotion of the exchange of plant genetic resources material and information.

Coordination of crop genetic resources activities so as to become the national center for plant genetic resources in Jordan as was recommended by the workshop on genetic resources held at NCARTT in 1994.

The first genetic resources workshop in Jordan was held in cooperation with WANA\IPGRI and USAID during August 1994. Seventeen discussion papers were presented and more than 30 scientists from international and local institutions participated in the workshop. The major recommendations of this workshop can be summarized as follows: Plant genetic resources of Jordan, are a national and international heritage; these resources should be conserved and utilized for the benefit of humanity. In the past, individual efforts led to the collection, conservation, evaluation and utilization of a sizable part of these resources. However, these efforts should be brought under one national umbrella in order to efficiently utilize the available resources.

Literature indicated that Jordan still harbors a vast diversity of land races, old cultivars, wild forms and wild relatives of wheat and barley. For example, there are cultivated durum *Triticum durum*, bread wheat *Triticum aestivum*, wheat and other wild wheat forms such as *Triticum monoccocum*, *T. beoticum*, *T. turgidum*, *T. dicoccoides*, *Agliops spp.*, cultivated two and six-row barley landraces, old and improved cultivars; *Hordeum vulgare*, and the wild barley; *Hordeum spontaneum*.

ICARDA-GRU evaluations on *T. dicoccoides* confirmed resistance to drought and diseases of *Septoria* blotch, common bunt, yellow rust, stem rust and barley yellow dwarf virus. Protein content of *T. dicoccoides* was found to be higher than cultivated wheat varieties ranging from 13%-27%. *T. dicoccoides* collected from Jordan was subjected to a comprehensive evaluation study. The results indicated that accessions of *T. dicoecum* represent important genetic characters such as; earliness, short stem, high number of fertile tillers, long spikes, kernel weight per spike, protein content and drought tolerance.

The wild relatives of fruit trees are found in Jordan in the highland from north to the south and to west such as *Ceratonia siliqua*, *Ziziphus lotus*, *Ziziphus spina-christi*,

*Caratagus aronia*, *Prunus mahaleb*, *Pistacia*, *Ficus* and *Olea*. Ten accessions of *Prunus* were collected by NCARTT, IPGRI, in 1994. These species and genera have adapted to harsh conditions that include extremes in temperatures coupled with extended drought and low soil fertility. They are excellent resources for future research after identification of rootstocks like dwarfism, drought and calcareous soil tolerance. Unfortunately little information is available regarding this field, and a major interest in Jordan would be the use of a number of genera in the *Pomidaceae* as rootstocks. Pome and stone fruit production is mainly dependent on imported rootstocks, which are often un-adapted to the local environment, and require further investigation. *Amygdalus dulcis* are local rootstocks that are used in the country. The use of this species as a rootstock instead of the imported ones could increase fruit production

The medicinal plants identified either include herbs, shrubs, or and trees. Medicinal plants r are distributed all over the country. With a wide range of distribution from the eastern desert and other parts of the country, those plants are massively used by Bedouins or local people in folk medicine as hot or cold drinks, or chewed raw materials, fresh or dry.

Many local people and plant shop owners are affecting the biodiversity of these species since they pick them so as to be used as dry ornamental plants or fresh, as decorations. These are:

Trees like *Retama reaem*, *Ceratonia siliqua*.

Bushes like: *Astragalus*, *Cistus*, and *Salvia*.

Bulbs like: *Tulip*, *Orchis*, *Iris*, and *Colchicum*.

Corm like: *Cyclamen* and *Scorzonera*.

Many plants are under collection pressure and used often for many purposes; some examples are *Artemisia*, *Achilla*, *Salvia*, *Paronychia*, *Ecballium*, *Ephedra*, *Ajuga*, *Marrubium*, *Origanum*, *Alcea*, *Thymus*, *Sarcopoterium*, *Hyoscyamus* and many others. Either by collecting these plants for domestic use, grazing or housing and industrial projects established in the areas which are known for their beauty and richness of flora. The projects that depend mainly on wild plant especially medicinal plants in order to be packed and marketed are causing serious threats to natural habitats. Many of these plants are endemic like *Iris petrana*, *Cousinia dayia*, *Plantago maris-mortui*, *Crucianella transjordanica*, *Scrophularia nababeorum*, *Silene hussonii* and *Tamarix arvensis*.

Rare species are as followsinclude: *Colchicum tunicatum*, *Euclidium syriacum*, *Lathyrus gloeospermus*, *Brunnera orientalis*, *Hetrocaryum szovitsianum* *Onosma roussaei*, *Campanula heirosoymtana*, *Legousia falcata*, *Silene hussonii*, *Chardinia orientalis*, *Centaurea procurrens*, *Cnicus benedicuts*, *Convolvulus schimprei* (New to Jordan) *Aethionema carneum*, *Matthiola arabica*, *Cupressus semprevirens*, *Equisetum ramosissimum*, *Aegilops bicornis*, *A. cylindrica*, *A. ovata*, *A. seasii*, *A. distachyos*, *Asthenatherum forsskalii*, *Cutandia maritima* and *C. philistaea* (both new to Jordan) *Festuca arundinaceae*, *Hyparrhenia hirta*, *Pinnisetum asperifolium*, *P. ciliare*, *P. divisum*, *taenitherum crinitum*, *Terapogon villosus*, *Ajuga iva*, *Teucrium leucocladum*, *astragalus annularis*, *A. sanctus*, *Hippocripis bicontorta*, *Midicago litoralis*, *Teragonolobus requienii*, *Trigonella maritima*, *Plantago marismortui*.

Many wild plants in Jordan are used as ornamentals. These are:

Trees like; *Retama reaem*, *Ceratonia siliqua*.

Bushes like: *Astragalus*, *Cistus*, and *Salvia*.

Bulbs like: *Tulip*, *Orchis*, *Iris*, and *Colchicum*.

Corm like: *Cyclamen* and *Scorzonera*.

Many local people and plant shop owners are affecting the biodiversity of these species since they pick them so as to be used as dry ornamental plants or fresh, as decorations.

Recently a national project to conserve and evaluate genetic resources of herbal and medicinal plants of Jordan has been launched at NCARTT with the support of the World Bank.

#### **4.6 MICROORGANISMS:**

Microorganisms include all living organisms other than plants and animals and are mostly microscopic cellular organisms that include bacteria, mycoplasmas, protozoa, fungi and some algae. The non-cellular replicative agents such as viruses and viroids are metabolically inactive but genetically active and usually included in microbial studies.

Microorganisms were used in food processing thousands of years ago and their importance was better recognized with the advancement of science. The nineteenth century witnessed great advances in microbiology and its practical applications including taxonomy of microorganisms, manipulating microorganisms in food processing and preservation, and finally understanding the role and some control of microorganisms in infectious diseases to human, animals and plants. Microorganisms are still intensively used by humans in different fields and are considered as a biological resource. The Convention on Biological Diversity (1992) has recognized that the biological resources include “genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value to humanity”. They are used in food processing such as production of cheese, bakery, pickles, preserved meats and fermented drinks. They are also utilized in biodegradation and recycling of organic matters, pollutants and toxins in several applications including water purification, treatment of industrial and urban wastes, composting and recycling of agricultural byproducts. Microorganisms are also used in energy production such as biogases and alcohol.

The Convention on Biological Diversity has defined an ecosystem as “a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit”. The diverse physiological activities of living microorganisms are very important components for the chemical and biological balance of all natural and agricultural ecosystems. Microorganisms are referred to collectively as functional groups in ecosystems, based on their physiological rather than their taxonomic relatedness. Microorganisms are very rich in their diversity and count with very complex interactions. The specific role of each microorganism species in a given functional group or the connecting flows of matter and energy is not fully

understood. But, the endogenous microorganism diversity presumably is the base for the survival of natural or agricultural ecosystems despite that the functional groups mainly receive the attention in most ecological studies. Loss of endogenous microorganism diversity or replacement with exotic populations will directly affect ecosystem processes and consequently biodiversity.

According to the 1998 National Country Study on Biological Diversity, 68 bacteria, 134 fungi and 56 virus species have been found so far in Jordan. Many microorganisms included in this list cause diseases in human, plants or animals or have direct economical applications including medical, food processing and agricultural.

There is no registered culture collection, which is a very important aspect for in vitro conservation and characterization of microorganism biodiversity in Jordan. Limited non-registered culture collections are available in Jordan mainly for confined teaching and research purposes.

Medical and agriculture microbiology in Jordan is advancing at a faster rate compared to environmental microbiology. Diagnosis of human pathogenic organisms is regularly performed in public and private laboratories using biochemical and immunological techniques or genetic fingerprinting. Similar techniques are used to diagnose some plant and animal pathogens. But some specialized governmental and private laboratories are regularly testing for biological contamination of water and food.

It is usually not easy to recognize new invasive microorganism other than those pathogenic to large organisms. There are continuous new outbreaks of diseases in wildlife and agriculture systems. Some of these animal diseases also attack humans. Contributing factors in these epidemics are the connected geographical zones and the strong human associations and trading within and between Jordan and other countries. Current agricultural quarantine laws are sometimes not practical to enforce. There is some direct import of microorganisms that are used in research, dairy processing, bakery, fermentation and other food processing or in agriculture such as microbial bio-pesticides (e.g. *Bacillus* endospores and the fungus *Trichoderma* spp). One local private company is also commercially producing alternatives to chemical pesticides using the fungus *Trichoderma* spp. There is some concern regarding the possible impacts to the environment and human health from importing genetically engineered microorganisms to be released in agriculture ecosystems or natural ecosystems. Jordan has signed the Cartagena Protocol on Bio-safety and is going toward regulating such products. Microorganisms are also indirectly used in biodegradation for some environmental applications. Natural microorganism activities are enhanced during treating sewage or organic gases from some industrial processes. In addition, natural microorganisms are used at a limited experimental scale to produce bio-gas from urban solid waste that are high in organic matters.

**Key Issues and Impacts-** There is a general lack of biodiversity studies in Jordan including plants and animals, but microorganisms received even less attention for their higher technical demands and smaller sizes. Taxonomy of microorganisms requires

highly qualified experts and laboratory studies. There is a need for comprehensive national biodiversity studies coupled by ex situ storage of the collected isolates. Lack of such surveys in part could be attributed to lack of expertise, interests or resources. Most available resources and interests in research programs are directed toward some applications with health importance or potential rapid economical return such as infectious diseases or some biotechnological applications.

Lack of information regarding the current situation of microorganism diversity is also combined to lack of research programs related to their role in ecosystem functions. The combined effects result in under-utilizing practical monitoring systems. Such systems would provide information about environmental functions or ecosystem changes. It is difficult to detect early changes in ecosystems without proper techniques. One example is drinking water testing for microbial contamination.

Capacity to monitor alien microorganisms is also needed in Jordan for environment risk assessment related to genetically modified organisms. This monitoring is important and is suggested in the Cartagena Protocol on Biosafety. Furthermore, there is still some concern in Jordan from introducing pathogenic microorganisms to humans, animals or plants.

Ex situ preservation of some microorganisms is important for future studies, detection of genetic changes in population or finally possible utilization by human. Initiating ex situ preservation is important because most of microorganisms isolated from Jordan and used in earlier studies are not currently available for further characterization or comparison. The available small culture collections in Jordan are usually produced by initiatives of single or few researchers or lecturers and are not considered as a national program. These collections were initiated with limited funds and suffer from a lack of resources.

There is still a very limited utilization of endogenous microorganisms in food production and agriculture applications in Jordan. Using local biological resources has great advantages including minimizing the possible introduction of invasive organisms. Microorganisms used in industries in Jordan are imported from other countries. Jordan imports several microorganisms for some applications including research, bio-fertilizers, food industry, bio-pesticides, and other biological control. Lack of endogenous utilization of biological resources could be in part due to lack of research in screening and identification of potential superior isolates. This area and all related aspects such as biotechnological applications and regulation should be strengthened in Jordan. Adapting some biotechnological application has great potential for the human well-being and conserving biodiversity. Regulation level of restricting the import of these microorganisms and other microorganism is controversial and need reevaluation.

## **THEME 5**

### **THE IMPACT OF HUMAN ACTIVITIES ON BIODIVERSITY**

#### **5.1 AGRICULTURE:**

In general, six agricultural practices form the backbone of modern agriculture: intensive tillage, mono-culture, irrigation, application of inorganic fertilizer, chemical pest control, and genetic manipulation of crop plants. These practices form a system in which each depends on the others and reinforces the necessity of using the others. The effect of these activities on the environment can be summarized as follows:

Degradation of soil quality: symptoms of degradation are include: reduction of organic matter, soil compaction, reduction of soil fertility, salting, water-logging, contamination by pesticides and inorganic fertilizers, degrading soil structure, increasing the rate of soil erosion by water and wind.

Waste and overuse of water: Fresh water is becoming increasingly scarce in many parts of the world as industry, expanding cities and agriculture compete for limited supplies. Jordan is considered one of the ten countries in the world that have shortage in water supply. Agriculture uses so much water in part because it uses water wastefully. A great deal of wastage could be eliminated if agricultural practices were oriented toward conservation of water rather than maximization of production.

Pollution of the environment: Pesticides and herbicides applied in large quantities kill the plant enemies and increase the production, however, this practice has a negative impact on the environment. Some pests develop their own immunization system, some secondary pests will be changed into major pests (unbalanced system), beneficial insects and microorganisms will be killed, and plants are directly effect impacted on plants by herbicide applications. In addition to this, pesticides pollute the water streams, rivers, lakes and oceans which might cause deleterious effects on aquatic ecosystems. Also, They can also reach ground water, where they contaminate drinking water supplies. Fertilizers leached from fields is are less directly toxic than pesticides, but its their effect can be equally damaging ecologically. In aquatic and marine ecosystems i they promotes the overgrowth of algae, causing eutrophication and death of many types of organisms. Nitrates from fertilizers are also a major contaminant of drinking water. The increase in the application of chemical fertilizers especially nitrogen fertilizers reduce soil capability of developing and producing nitrogen from the organic sources available in the soil due to the reduction of soil organisms that fix the atmospheric nitrogen. Rounding out the list of pollutants from agriculture are salts and sediments which in many areas locals have degraded streams, helped destroy fisheries, and rendered wetlands unfit for bird life.

It is clear that conventional agricultural practices are degrading the environment globally, leading to declines in biodiversity, upsetting the balance of natural ecosystems and ultimately compromising the natural resources base on which humans and agriculture depend.

The agricultural sector in Jordan has developed quickly in the past twenty five years. This development was characterized by introduction of new varieties, new crops, utilization of chemical fertilizers, utilization of pesticides and herbicides, growing crops under irrigation in the dry lands. All these activities were aiming to increase productivity and profitability, without thinking of the impact on the environment. There was no management or monitoring for the effect of these practices on environment and in particular on biodiversity. Therefore, a great loss of biodiversity (flora and fauna) occurred, however, unfortunately there is no data on the amount of losses or the degree of deterioration. The highest impact was clear in the Jordan Rift Valley, which was rich with indigenous relict and even endemic flora, fauna, water and mineral resources.

Studies show that the concentration of DDT is especially high in the Jordan Rift Valley, and residues of chlorine pesticides were found in fish specimens from the Jordan River. Also, it is well known that high concentrations of DDT affect the shells of bird eggs which contributing to the decrease in the local bird population, as evidenced in the case of the relict population of the brown fish owl (*Ketupa zeylonensis*), which inhabited the Jordan river and its tributaries and feeds mainly on fish of the area. Thallium-sulfate and Fluoraictamid, used in Jordan, have accumulated in secondary consumers and has been transferred to carnivores. As a result of this, many breeding and migratory bird species such as *Falco biarmicus* and *Falco naumani* have been affected.

#### **Problems:**

Spread of agro-chemicals (pesticides, herbicides and fertilizers).

Agro-chemicals are essential to increase production of agricultural crops. Without these chemicals, pests will attack the crop and destroy it, however, the unwise use of these chemicals starts to create problems. Farmers rely on these chemicals for maximum production, therefore, more chemicals are introduced, higher rates were added, without any no control over the use of these materials and their effect on the harvested crop, or on the environment. Pollution (air, water, and soil) start to show up as a negative impact of such uncontrolled practices; wild animal and plant populations start to decrease; destroying the natural vegetation; beneficial organisms such as bees and N- fixing bacteria also were negatively affected. The continuous use of these chemicals without control will end up with losing diversity of animals and plants that might be considered as a national heritage of Jordan.

#### **Over use of water for irrigation.**

The agricultural sector in Jordan suffers from the limited availability of water and declining water quality. Generally speaking, the improper use of water as a result of lack of knowledge about scheduling of water, crop water requirements, using crops that consume large amounts of water and the improper irrigation methods were as the main reasons behind the deterioration in water quantity and quality. Many water resources were affected by salinity or reduced, due to over extraction from ground water, or due to digging unauthorized wells. If these practices continue, water resources will be reduced in both quantity and quality to the degree that will prevent agricultural production, especially in the Highlands. Plants and animals that live near water resources (riverbanks,

or waterways) will be affected as a result of the reduction in water quantity and quality. On the long run, all kinds of living organisms will be negatively affected.

### **Soil deterioration, plowing, and land reclamation in the dry areas.**

Cultivation is essential for crop production because it aerates the soil, kills disease causing agents found in the soil, kills weeds, consequently increasing production. However, too frequent use of these machines and summer plowing, or fallowing, will lead to soil erosion, soil compaction, and soil deterioration. Over use of inorganic fertilizers and other agro-chemicals especially in the irrigated lands, is one of the major causes of soil deterioration. Another factor that should be taken care of is the agricultural practices in the dry areas. These areas are not suitable for growing crops, however, due to the possibility of using water for irrigation, these areas were cultivated and used for plant production. This means, using heavy machines for seedbed preparation without considering the fact that soils in these areas are fragile. Therefore, natural vegetation cover was removed, soils became bare and exposed to erosion, consequently desertification risk increased. Biodiversity (fauna and flora) will be negatively affected as a result of removing natural vegetation and soil deterioration.

### **Land fragmentation in rainfed areas.**

This problem is clearly shown in the rainfed areas, because these areas fall in the vicinity of municipals and villages councils. This put a pressure on land utilization in the rainfed areas, therefore land was fragmented into small pieces to be used for building purposes. As a result of higher prices for the fragmented land when compared to agricultural land, in addition to low production capacities of most of these lands, there was a shift in land utilization towards land fragmentation. This has a negative effect on the agricultural production in the rainfed areas, and moreover, biodiversity was reduced to the extent of losing large numbers of wild species.

It is clear that agricultural resources in Jordan are scarce and facing a big problem. Therefore, the agricultural sector is facing a big challenge, to increase agricultural production to meet the increasing population needs and at the same time preserving the limited resources. Environmental issues must be considered in any agricultural project, because without conserving the environment there will be no production in the future. The concept of sustainable agriculture can be the answer for this hard and difficult situation- to produce enough food without damaging the environment. The idea is to keep agricultural resources capable of producing for a long period of time.

## **5.2 ANIMAL PRODUCTION:**

Jordan has a diverse range of domesticated animal species: sheep, goats, cattle, camels, horses, donkeys, mules, pet animals (cats and dogs), and poultry. The contribution of the agriculture sector (animals and plants) in the total Gross National Product (GNP) is about 3 % of which 58 % is animal production. Five hundred fifty million JD is invested in this sector. Jordan produces about 61.4 % and 44 % of its needs in milk and red meat respectively. The red meat mainly comes from small ruminants. Jordan is able to produce 22.3 million chicks for meat production per two-month period. Jordan also produces

815.9 million eggs annually.

As Jordan's population has increased substantially in the past 25 years and it is expected to do so in the next 25 years, paralleled with an improvement of the standards of living, there will be increasing demands on the quality and the quantity of meat, milk, wool and their by-products.

The general trends for small ruminants' population are decreasing while the population of cattle almost did not change over the last 10 years. The number of local, and hybrid cattle, Shami and local goats is decreasing substantially. The number of camels is also believed to have decreased substantially although camel meat production is stable. Although there is no reliable data regarding horses, mules, donkeys, it appears that their numbers are also decreasing. These animals are used mainly as working and draught animals in the hilly mountainous and in the tourist areas. They participate in securing acceptable income for some poor families. The number of expensive pure breed Arabian horses has increased in recent years due to an heightened interest in raising these breeds for racing and riding and recording their pedigree. In addition to their social and cultural value, some local animal breeds have unique attributes for adaptation to local conditions, disease resistance, specific uses, and should therefore be preserved as they are being threatened by the introduction of exotic breeds.

The number of local chicken breeds has significantly decreased as exotic breeds and commercial poultry lines are replacing them. This is accompanied by an increase in the number and production capacity of the poultry and egg farms. Jordan presently meets most of its national demands in eggs and poultry white meat. Turkeys, ducks, geese, pigeons and rabbits are also raised in Jordan but their number is small and their meat is not widely used. This is mainly due to the wide availability of poultry at affordable prices.

The animal agriculture sector has a fundamental role to play on the political stability and food security of the country. About six percent of the Jordanian work force is working in the agriculture sector of which animal production is a major element. More than 45 000 families, composed of six members on average, are working directly or indirectly with sheep and goats. Four Faculties of Agriculture and one Faculty of Veterinary Medicine are involved in agriculture education, research and training. An estimated 8000 agriculture engineer and 1000 veterinarians in addition to many governmental and non-governmental organizations are working in this sector. An important proportion of farmers and animal breeders, especially in the Badia region, are under-educated and could hardly do anything else for a living. Any reduction in the capacity to raise animals could force them to migrate in the cities thus increasing pressures on urban development.

In recent years, animal production has been negatively affected by shortages in feed and water. Disease outbreaks have been more severe and, in some farms, sheep and goat populations have decreased between 50 % and 70 %. A number of farmers have sold all their animals because of increasing costs of animal raising. Camel populations have also been severely affected, leaving many people in the Badia without jobs and sufficient

income.

Existing slaughterhouses, dairy plants and pharmaceutical plants are not appropriate for proper meat, milk and veterinary drug preparation and processing. This situation is likely to negatively affect the import and export of animal products especially after Jordan's adhesion to the World Trade Organization. Pollution from the expanding use of plastic bags, the improper use of pesticides and from other toxic chemicals is affecting animal production negatively and induces economical losses. High density cattle farming, as it is the case in the Al-Dhuleil area where 60 % of cattle population is found, also leads to a higher transmission rate of animal diseases and to negative impacts on the local environment.

Shortages in animal feed and water and animal diseases are the major constraints for sustainable animal production and diversity. Limited veterinary services, inappropriate marketing and insufficient application of health and safety measures are also important obstacles. Desertification is also largely affecting animal biodiversity and production.

### **5.3 RANGELAND PRODUCTION:**

Range-lands are defined as lands receiving less than 200 mm average annual rainfall. They cover about 91 % of the country and include Badia, steppes and parts of Ghor and Wadi Araba. Range-lands play an important role in providing native feed at no or very cheap cost; grazing being a way of life and source of income for a large sector of the people inhabiting these areas. Traditional grazing cycles were originally based on a transhumance system that allowed for the natural regeneration of forage. Nowadays this situation no longer exists, as traditional grazing rights are mostly ignored. Range-lands are being severely degraded because of overgrazing, uprooting of range plants, off-road driving, inadequate cultivation patterns and urbanization. This degradation is confirmed by the following observations:

- Decreasing numbers of some important range plants,
- Expansion of poisonous and noxious plants,
- Retrogression of large areas of perennial ranges to annual ranges,
- Soil erosion and loss of soil fertility,
- Loss of rainfall water through runoff,
- Salinity and low underground water levels,
- Frequent occurrence of wind storms,
- Disappearance of wildlife.

If suitable correction measures are not taken readily, the trend of degradation will increase and will reach in many parts of these range-lands an irreversible stage that may lead to desertification, and will affect biodiversity of range species, forage production for grazing animals and environment balance.

The government has recognized for many years the importance of range-lands and the need for their development. The first range reserves were established in the early 1940's,

to protect, improve, and manage range-lands through research and development activities. Currently there are 27 governmental range reserves covering a total area of about 0.8 million hectares and 9 cooperative range reserves covering a total area of about 0.11 million hectares. Even if these reserves contribute to the sustainable development of range-land their surface is very limited compared to the vast areas of actually degraded range-lands, and their actual management is questionable.

The Ministry of Agriculture is currently developing a comprehensive range-land Strategy.

The protection and sustainable use of range-land is facing the following challenges:

Lack of clear long-term range policy based on the carrying capacity of this ecosystem.

Lack of strong technical body and staff able to put and implement range-land development strategies and actions.

Unclear leadership over the protection, development and use of these lands.

Weak awareness of range users of the importance of range-land development.

Encroachment on governmental range-lands and ownership claims leading to destruction of vegetation cover.

Legislation deficiency and lack of enforcement of existing legislation.

Lack of attention given to fodder production in the high rainfall and irrigated areas to provide animal feed and release pressure on range-lands.

#### **5.4 MINING:**

Mining activities in Jordan can be dated back to prehistoric times. Wadi Araba is a unique place to follow-up and study copper mining and smelting through history for a period of more than 3000 years. In mediaeval times, iron ore was already mined from the north part of Jordan. Systematic mining activities started in the 1930's with phosphate. Mining of other mineral commodities eventually followed.

Mineral resources in Jordan are currently mined and exploited to meet the needs of the construction sector, mining industries sector, and for export. They play an important role in the economy of Jordan. Their contribution in the national income reached 10.5 % in 1999. Earnings from mining mineral commodities and mining industries reached 558 million JD for the same year and their share from the total export was 37.7 % in 1999.

Small or large-scale mining activities may have a significant impact on environment and biological diversity. Exploration, mining and manufacturing mineral commodities can cause environmental pollution, destroy landscape, affect wildlife and surface vegetation. Tailing and seepage coming out of benefaction plants, processing plants and factories may create hazards to surface and underground water reservoirs.

The inadequate consideration of environmental protection measures in mining activities may be explained by several factors including:

Improper consideration of biodiversity protection in existing mining codes and legislation;

Inadequate mining procedures especially in quarries and small mines;  
Issuing exploration permits, exploitation licenses and mining rights without a proper mining plan;  
Deficient control of mining activities by government authorities;  
Absence of environment and biodiversity culture among mining employees and workers and government staff.

## **5.5 INDUSTRY AND FACTORY PRODUCTION:**

Industry in Jordan has grown from about 800 factories (mostly primitive and craft workshops) employing about 2000 workers in the 1950's, into about 25 000 establishments in 1998 including a wide range of chemical, food, textiles, and other types of industry employing about 150 000 workers. The industrial sector is currently contributing to about 22 % of the Gross National Product, for a total value of about 3 billions JD. This growth was paralleled by the services sector including energy production and transportation. During the same period of time, electricity production increased from about 15 million kw/hr reaching 10 000 inhabitants to about 5.9 billion kw/hr produced by two power stations located in Zarqa and Aqaba and servicing more than 99 % of the population.

This rapid growth of the industrial sector is causing severe environmental problems including water and air pollution and hazardous waste. In some areas, the quality of ambient air as well as the emissions have exceeded the World Health Organization standards. One of these areas is Al-Hashemiya where the Petroleum Refinery as well as the Al-Hussein Energy Station are located. The emission of Sulfur Dioxide from the refinery reaches 40 tons per day. Other areas include the Aqaba Port where phosphate export as well other activities in the port contribute significantly to air and water pollution in the area.

Jordan's energy supply is mainly dependent on the importation of high sulphur oil from Iraq. As the demand for energy resources is increasing by almost 5 % annually, air pollution levels are expected to increase accordingly. Air pollution is also caused by the 500 000 vehicles in operation in the country. Most of these vehicles use leaded gasoline containing high levels of sulphur. Recently, sulphur dioxide and carbon monoxide as well as suspended solids exceeded the standards of the World Health Organization in the Amman downtown area.

Solid and liquid wastes including hazardous wastes are produced and disposed by industry with limited protective treatment. The total amount of hazardous waste produced in Jordan in 1993 was about 43 000 tons. It is expected to reach about 26 200 tons in the year 2015. Due to the absence of hazardous waste collection and treatment, it is mainly stored within the grounds of the factories putting at risk workers as well as local environment.

Industrial pollution, because of its extent and the variety of the pollutants involved, has a tremendous impact on biodiversity and therefore should be prevented. To cope with these

issues, the industrial sector can count on management and planning tools including environmental management processing, environmental certification, and environmental impact assessment. Environmental management processing is mainly defined as “ the continuous implementation of cleaner production through the auditing of the life cycle of the product and making the necessary changes to prevent or minimize pollution.” It has been proven around the world that such technique is very useful in waste minimization as well as economically beneficial. It should be noted that a Cleaner Production Center aimed at promoting cleaner production and pollution prevention is being established in Jordan under the initiative of an NGO (Friends of the Environment in Jordan Society) with the collaboration of the Amman Chamber of Commerce, RSCN and others.

The ISO 14001 certificate is considered the main environmental quality certificate around the world. Considered as a good marketing tool, it adds a competitive value in the global market. The certification for an ISO 14001 system depends mainly on the implementation of an environmental management system based on an environmental audit. The ISO 14000 environmental management program includes continuous monitoring to ensure compliance to such system. The Jordan Cement Company has been the first ISO 14000 certified enterprise in Jordan in 1998, followed by the Phosphate Company in 1999. Nowadays, the number of certified companies exceeds 40.

Environmental impact assessment (EIA) is another tool to prevent pollution from industrial activities. It is seen as “a combination of activities to specify and define the potential environmental, social, and economical impacts of new projects; analyze these impacts; and define mitigation measures to prevent or minimize its impacts.” The Environmental Protection Law no.12 of 1995 provides the umbrella for such technique where its is mentioned in article 15 that: “It is the responsibility of the General Corporation for Environmental Protection (GCEP) to set and provide the basis for EIA to assure environmental protection”. Based on that regulation, new projects are required to apply to GCEP for approval.

## **5.6 BIOTECHNOLOGY AND BIOSAFETY:**

Biotechnology is defined by the Convention on Biological Diversity (1992) as “any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use”. The roots of modern biotechnology lie in using microorganisms in fermentation of foods and drinks that have evolved over several centuries. Major advances in selecting, improving, upgrading and expanding the range of biological agents are now being used in the biotechnology industry. Biotechnology includes many applications that have the potential to influence the environment either positively or negatively and consequently affect biological diversity. The Convention of Biological Diversity require that contracting parties, particularly developing countries, effectively participate in biotechnology development and take advantages of its benefits while considering the need for safety regulations.

Modern biotechnological techniques could be directly used in studying, maintaining or protecting biodiversity. For example, DNA genetic fingerprinting is being used in

taxonomic and phylogenic studies and for measuring and monitoring the extent of biodiversity. In addition, biotechnology may contribute to long-term in vitro storage of genes, genomes, cells, tissues, organs or whole organisms.

Biotechnology is usually safer and more sustainable than alternative industries using chemical or physical methods. It uses renewable resources and its by-products are less toxic to humans and other living organisms. Biotechnology has several practical applications including energy production, production of pharmaceuticals and raw materials, water purification, biodegradation, treatment and recycling of industrial wastes, toxins, urban wastes and agricultural residues. In addition, genetic engineering is being used to improve the efficiency of natural organisms by producing more effective biological agents who are called Living Modified Organisms (LMOs). LMOs could be released in the environment for a specific goal such as treating environment contaminants or some agricultural applications. Traditional and modern biotechnology could be also used to produce alternatives to agriculture chemicals such as pesticides and fertilizers or to produce genetically modified (transgenic) plants to improve quality and quantity of products or enhancing resistance to pests, pathogens and physiological stresses such as drought and salinity.

**Current Status of Biotechnology in Jordan-** Similarly to most other developing countries, biotechnology in Jordan attracts high attention but is still in early development stages and behind the developed countries. There are some efforts in Jordan to catch up in this rapidly developing area, especially in the fields of medicine and agriculture. Several universities have recently established graduate and undergraduate programs in biotechnology or genetic engineering. Research program in universities or biotechnology centers are using basic biotechnology, immunology, and molecular biology techniques. There is also high research interest for and a limited production of immunological diagnostic kits and animal vaccines. Traditional biotechnology is being used in Jordan for the production of food, drink and yeast. Some work was conducted in the area of screening for organisms that have a potential biotechnological application. Also, most major cities in Jordan treat sewage to minimize their hazards to human health and to the environment. A new company in Amman is currently running a small-scale plant for urban-solid waste treatment and biogas production.

Plant tissue culture has attracted high attention from public and private sectors. Several university, governmental and private research programs were conducted to optimize micro-propagation of plant tissues. Tissue culture has been used for in vitro conservation and cryo-preservation, production of disease-free plants, plant propagation, selection of biotic and abiotic tolerant stocks and production of secondary metabolites. Private and governmental laboratories commercially produce regenerated plants such as ornamental and cut flowers, date palm, potatoes and banana. Animal and human cell culture is mainly centered around medical and veterinary applications such as in vitro fertilization and embryo culture.

Another commercial production of biotechnology in Jordan includes agricultural input particularly for plant protection. One private company has initiated production of

alternatives to chemical pesticides by commercializing bio-pesticides for the control of plant diseases and pests using natural enemies such as the fungus *Trichoderma spp.* In addition, several companies import from other countries and market in Jordan similar and other bio-pesticides.

Most biotechnological interests using molecular biology techniques are directed toward pharmaceutical production or diagnosis and genetic characterization of causal agents of infectious diseases affecting humans, animals and plants. Genetic fingerprinting is being used in the forensic laboratory and several medical and hospital laboratories. Jordan also imports some biotechnology products for medical applications such as diagnostic kits, pharmaceuticals and recombinant vaccines. Few studies were conducted to characterize diversity of farm animals or economically important crops such as cultivated cereals and vegetables.

Biotechnology and genetic engineering being a relatively new field with rapid and continuous developments, Jordan has not produced specific laws that regulate biotechnology either for its intellectual property rights or its bio-safety. However, active steps in this direction are underway. Jordan has signed the newly adopted international Cartagena Protocol on Bio-safety. Furthermore, in response to public concerns of importing food and feed containing genetically modified organisms, a national safety committee was established. The committee has proposed some recommendations in this area as well as on the introduction and releasing of genetically modified organisms. There are currently no research or field trials of LMOs including transgenic plants with enhanced resistance to diseases and pests.

There is an increasing public interest in Jordan for biotechnological advances, their socio-economical implications and possible impacts to biodiversity and human health. There is however some confusion about the nature of these advances and how they were produced. Genetic engineering is often confused with biotechnology and some people inaccurately refer to new advances using traditional breeding programs as LMOs. Most of the public in Jordan wouldn't accept direct human applications of the new developments other than the anticipated human gene therapy and the already used in vitro fertilization. Applications in plants and animal may raise fewer objections even though the general public considers these products as non-natural and inappropriate to human consumption. But LMO products are already present in the international marketing channels and most likely are consumed in some imported food or present in some feed. Research initiatives were started to survey the prevalence of such food and feed in Jordan markets but none related to their safety.

The wide field of biotechnology is not yet properly recognized in Jordan as an alternative to current practices that are negatively affecting the environment. The slow development of biotechnology can be attributed to a number of interacting factors. One of the most important being the absence of a national strategy to promote biotechnology. Lack of long-term research commitment also restricts biotechnology development whereas the lack of public awareness prevents investing, adapting and utilizing such alternatives.

Regulating biotechnology including the area of intellectual property right and bio-safety during development, production and transport of LMOs is clearly needed. Lack of such biotechnology regulation could complicate importing or local production of such products. In compliance with the Cartagena Protocol on Bio-safety (2000), Jordan needs to regulate biotechnology in terms of reducing risks to biodiversity and human health. Such regulations could promote biotechnology by increasing public acceptance of new developments, allowing for direct financial support from international organizations and increasing the interests of local and international organizations and companies to invest in the field of biotechnology in Jordan.

## **5.7 ECO-TOURISM**

Tourism is a major business in Jordan. The country is blessed with abundant, world-class, archaeological sites and spectacular natural scenery that attracted nearly 1.4 million visitors in the year 2000. The tourism sector has maintained a consistently high growth rate over the last ten years, despite political tensions in the region. Tourism is now the largest generator of foreign exchange, exceeding that of all exported products, and providing direct employment for around 20 000 people. The extent of growth is further emphasized by the increase in hotel construction, whose number has more than doubled since 1989. In order to support tourism growth, Jordan has invested heavily in infrastructure, especially roads and water supplies. This has led to the fast and largely unplanned development of hotels and other facilities in some areas, with significant environmental impacts. It also threatens the sustainability of the industry as a whole, since the natural environment is the fundamental resource of Jordan's tourism.

Eco-tourism is defined as tourism that “has a low-level impact on the environment and local cultural values and which is used to help sustain local economies and the conservation of the natural and built heritage”.

If this definition is applied rigorously in Jordan, there is only one in-situ tourism operation that is currently applying its embodied principles: the Dana Nature Reserve. Some other sites are being developed along the ‘Dana lines’ but these have some way to go before they can justify the epithet of “eco-tourism”. While at present there are few good examples of eco-tourism in Jordan, the country clearly has enormous potential to develop this market niche further.

Replication of the Dana approach- Building on the success of the Dana pilot program, RSCN has been transferring the lessons learned to other protected areas under its jurisdiction. Most progress has been made in the Azraq Wetland Reserve in the eastern desert, another site of global significance for biodiversity. With financial assistance from the Global Environment Facility (GEF), this reserve now has a range of purpose built facilities, including a visitor center, bird hides and boardwalks through the marshland. It has been developing outreach and education programs with local communities and recently established a number of reserve-based socio-economic activities, most of which are related to tourism. Like the Dana Reserve, all of its staff have been recruited locally and have received training in different aspects of tourism management.

Eco-tourism principles in mass tourism sites- Jordan's Ministry of Tourism and the Aqaba Special Economic Zone Authority (ASEZA), in cooperation with RSCN, have been introducing some of the principles of eco-tourism into Petra and Wadi Rum, both of which are among the top three most visited sites in the Kingdom. In Petra, a management plan was drafted during 2000, with the help of the US National Parks Service, making provision for safeguarding the natural assets of the site, including wildlife. In Wadi Rum, a conservation-oriented management plan is being prepared based on the involvement of local communities and improved benefit sharing. The implementation of these plans, however, will be the main challenge because both sites have a long history of use and of conflicts with local communities; and in many areas, especially in Wadi Rum, environmental degradation is severe.

Impacts of tourism on biodiversity- Weak planning and development control is the main cause of biodiversity loss from tourism. Jordan does not, as yet, have an effective land use planning system, and tourism development is usually based on discrete projects, without reference to agreed national criteria or guidelines. Biodiversity issues are only considered if they are raised in the context of the project itself – usually by donors – rather than as a routine procedure of the planning process. For large development projects, Jordan is obliged under Environmental Law No 12 to conduct Environmental Impact Assessments (EIAs) but this is not yet enforced. In Wadi Rum, for example, a new access road due to be constructed in 2001 within a relatively pristine part of the protected area, was not required to undergo an EIA. To date, very few tourist sites in Jordan have management plans at all and only rarely do they incorporate biodiversity conservation measures. The absence of such measures is not surprising in itself, since they constitute a new approach that will take time to be implemented.

In relation to tourism operations, carrying capacity can be defined as the number of visitors and level of development a site can absorb without causing unacceptable changes to the natural, social and cultural environment and without negatively affecting visitor's enjoyment. In Jordan, the present carrying capacity of some sites is clearly being exceeded. One is Wadi Rum where vehicles are causing serious erosion of the fragile desert vegetation. Another is Petra, when at certain times the siq is so crowded that it is impossible to enjoy the grandeur of the scenery. Establishing user limits for sites like these, however, is fraught with difficulties because so many factors need to be considered, apart from ecological sensitivities, such as accommodation capacity, infrastructure and services capacity and daily visitor use patterns. Imposing limits and controls on visitor distribution is much more difficult when sites have a history of unregulated tourism use, as they do in most of Jordan. The Dana situation is not typical because it received virtually no visitors before it was developed for tourism, so imposing daily use limits has been relatively straightforward.

However, the concept of carrying capacity remains a very valid one and, in terms of protecting biodiversity, it is an important tool for minimizing damage and disturbance to habitats, species and ecological processes.

The tourism industry is familiar with standards. They are, nowadays, a fundamental part of virtually all tourism services. Environmental standards, however, have not been widely introduced into Jordan's tourism industry and, where they exist, they are not rigorously applied. The standards that are of most concern to biodiversity conservation are those governing the location of buildings and infrastructure (to avoid, for example, damaging important habitats), water and waste treatment (to minimize and ensure effective, safe disposal) and general site operations (like site cleanliness). Appropriate standards are also required for tour operators and guides, since they have a great influence over the behavior of visitors.

Most aspects of tourism development at the site level are regulated under the 'Tourism Law'; a law which concentrates on the protection of antiquities, since this is what most tourism sites in Jordan are renowned for. Although this law gives the Ministry of Tourism and Antiquities (MOTA) considerable license to control tourism activities, it does not facilitate the protection of important natural features like habitats and species. With the wide variety of management agencies, there is some confusion as to which organization has, or should have, responsibility for setting and enforcing environmental regulations and standards on the ground, especially as several laws, emanating from different ministries, apply to the same site. In the future, the situation is likely to become more confusing as new sets of bylaws take effect. Clarification of responsibilities, roles and the legal powers of site staff are vitally important if the quality and consistency of environmental management in tourism sites are to be improved

In general, there is a low level of awareness, both within and outside the tourism industry, of the environmental impacts of tourism and of alternative approaches like eco-tourism. At the visitor level, signs of this lack of awareness are evident in every tourist site, such as littering, graffiti and noisy behavior. At the institutional level, tourism development generally proceed with little public consultation or stakeholder involvement and there have been very few national initiatives to raise awareness. One of these was a modest campaign by the Jordan Royal Ecological Diving Society during 1999 - 2000 to highlight the need for responsible treatment of coral reefs by tourists. In order to improve the level of awareness and to promote the benefits of eco-tourism to all stakeholders, concerted effort is needed at both the site and national levels.

Applying the principles of eco-tourism- The negative impacts of tourism on biodiversity could be greatly reduced if the basic principles of eco-tourism – protection of the resource, support for local communities, support for conservation – were adopted for all tourism developments, whether big or small. They could be embodied in most of the mechanisms and procedures described above, such as policies, regulations, standards, management plans and site procedures. Adoption through such mechanisms would not only help protect biodiversity but would also help to make the tourism industry more sustainable. Apart from this, the embryonic eco-tourism market in Jordan could be developed and promoted as a tool for supporting biodiversity conservation in a more proactive way. It could become the means of safeguarding natural areas and of supporting conservation initiatives. Presently, however, there is no clear vision for this market sector or the capacity to ensure that it is developed correctly.

## **THEME 6**

### **OBJECTIVES OF JORDAN'S BIODIVERSITY STRATEGY**

#### **6.1 A NATIONAL BIODIVERSITY STRATEGY FOR JORDAN**

##### **Our Vision:**

*“Jordan has an important role to play in conservation and sustainable use of biological resources to improve quality of life and economic prosperity locally and globally, that agree with the teachings and beliefs of Islam on the obligation for man to maintain balanced relations with the other elements of creation”.*

The Jordan National Biodiversity Strategy provides a framework for actions at all levels that will enhance our ability to ensure the productivity, diversity and integrity of our natural systems and, as a result, our ability to develop sustainably. It promotes the conservation of biodiversity and the sustainable use of our biological resources in order to alleviate poverty in rural areas and improve the health conditions and quality of life of the population. The Strategy also describes how we will contribute to international efforts to implement the Convention.

##### **Our Five Strategic Goals:**

\*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 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, developing 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;

\*Work with other countries to conserve biodiversity, use biological resources in a sustainable manner and share equitably the benefits that arise from the utilization of genetic resources.

### **Our Guiding Principles:**

- \*Biodiversity has ecological, economic, social, cultural and intrinsic values.
- \*Islam teaches us that all life forms, including humans, are ultimately connected to all other life forms.
- \*The people of Jordan depend on biodiversity and have a responsibility to contribute to biodiversity conservation and to use biological resources in a sustainable manner.
- \*All Jordanians should be encouraged to understand and appreciate the value of biodiversity and to participate in decisions involving the use of our air, water, land and other resources.
- \*An ecological approach to resource management is central to conserving biodiversity and using our biological resources in a sustainable manner.
- \*Development decisions must reflect ecological, economic, social, cultural and spiritual values.
- \*Healthy, evolving ecosystems and the maintenance of natural processes are prerequisites for the in situ conservation of biodiversity and the sustainable use of biological resources.
- \*Ex situ measures may be required to support the conservation of some species and populations and are essential to ensuring the sustainable use of many agricultural, forest and aquatic resources.
- \*The knowledge, innovations and practices of pastoral and local communities should be respected, and their use and maintenance carried out with the support and involvement of these communities.
- \*The conservation of biodiversity and the sustainable use of biological resources should be carried out using the best knowledge available and approaches refined as new knowledge is gained.
- \*The conservation of biodiversity and the sustainable use of biological resources require local, national and global co-operation and a sharing of knowledge, costs and benefits.

### **Our Priority Objectives and Actions:**

The National Biodiversity Strategy proposes a series of priority objectives and actions that are presented according to five themes involving most sectors of society. Alongside each theme are listed the number-one priority actions identified in the National Biodiversity Action Plan:

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 network.

## 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.

Marine life and fisheries: Establishment of a Fisheries and Marine Life Institution.

Microorganisms: Comprehensive survey and ex situ conservation of microorganisms.

Agriculture resources:

Plant production: Establishing a specialized center for plant biodiversity.

Animal production: Developing alternate animal feed sources in the Badia region.

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 and participation: Establishment of a comprehensive database on Jordan's biodiversity.

### **Four Crosscutting Issues:**

Underlying these different sectors and thematic areas, four crosscutting issues are evidenced:

\*The need for well-documented biodiversity data

\*The need for an integrated land-use planning mechanism

\*The necessity to improve capacity-building and technical training

\*The importance of public awareness initiatives

## **6.2 PREPARATORY PROCESS:**

The Jordan NBSAP was prepared by a small management team appointed by the GCEP, in coordination with the Ministry of Planning and in consultation with UNDP. The project was assisted by a National Steering Committee representing members from different acting agencies and stakeholder groups. The Committee conducted monthly meetings to discuss and approve the project workplan, strategy framework, project activities and assess progress.

An international consultant was recruited to facilitate the development of technical working groups, provide guidance for reports and document, assist in the biodiversity planning process, draft and finalize the biodiversity strategy and action plan. The selection of this consultant has been done under IUCN guidance.

National consultants were appointed to undertake studies and sectoral analyses, collect pertinent information and synthesize them into working papers for each selected topic. These consultants were selected according to their expertise and experience in the different subjects.

A series of consultative sectoral and cross-sectoral meetings were held during the preparation of the strategy documents. Participants from different sectors were invited to meet with the project consultants to discuss biodiversity issues, local perceptions and alternative solutions for sustainable use and conservation of biodiversity resources.

An Awareness Team was appointed to develop and implement an awareness campaign including a series of public and broad media coverage aiming at increasing the awareness and understanding of the general public on the Convention for biological diversity and its relation to people's everyday life.

Three workshops were conducted to synthesize the inputs from the consultants. The first workshop was conducted in Amman and targeted mass media staff. Two provincial workshops were held in Irbid (North) and Aqaba (South) for the identification and analysis of options to meet the objectives of the Convention.

Two national conferences were held in Amman whereby targeting representatives from different government entities and non-government agencies including the private sector. The objectives of the first conference were to present data from stocktaking, to explain the objectives of the project and the process involved, and to brainstorm on the possible options in the management of biodiversity. The objectives of the second conference were to validate the final objectives of the strategy, prioritize the actions proposed in the action plan and discuss the next steps involved in the implementation of the National

Biodiversity Strategy and Action Plan.

### **6.3 ACTION PLAN:**

Recognition of the worldwide impact of the decline of biodiversity inspired the global community to negotiate the United Nations Convention on Biological Diversity. The Jordanian delegation participated actively in these negotiations. The Hashemite Kingdom of Jordan ratified the Convention on Biological Diversity (CBD) in 1993.

A steering committee on biodiversity composed of 16 government department and agencies representing the primary managers of Jordan's biological resources and land base was formed to devise the convention implementation Strategy as well as an action plan. A Biodiversity Unit largely assisted the committee in this task. The draft Strategy was submitted to public consultation before being adopted as the Government's official Strategy.

The Jordan Biodiversity Action Plan, part of the Strategy development process, includes 60 proposed projects related to the measures identified in Jordan's Convention on Biological Diversity implementation Strategy. It specifies the role of the department or government agency concerned and defines a five-year implementation timetable. Nearly one-third of the actions contained in this document are already under way or will be improved by the departments concerned, while the remaining two third consist of newly defined courses of action.

Implementation of the present Action Plan will be monitored annually by the National Steering Committee on Biodiversity. This will be done with the understanding that the main objectives targeted by the Convention on Biological Diversity, i.e. the conservation of biodiversity, the sustainable use of biological resources, and the fair and equitable sharing of benefits resulting from the use of genetic resources, are echoing the three dimensions of sustainable development. Part of the mandate of the steering committee related to sustainable development will be to assess the performance of adopted measures with respect to biodiversity at the end of the first five-year implementation period.

Effective, efficient and harmonious implementation of Jordan's Biodiversity Strategy requires sustained co-operation and consultation among the Government's agencies managers to ensure that the natural environment's productive capacity and ecological potential are respected. Furthermore, the Jordan government is encouraging all Jordanians to help safeguard our biological diversity. All individuals and organizations, including the municipalities, are invited to contribute to the annual progress reports by informing the National Steering Committee on Biodiversity of the activities they carry out. These activities are numerous and of great importance to the maintenance of Jordan's biological diversity.

The Action Plan will take effect in December 2001, signaling the true implementation and enabling the first results of Jordan's Convention on Biological Diversity implementation Strategy.

### **Implementation of the Strategy and Action Plan:**

The proposed mechanism for implementing the National Biodiversity Strategy and Action Plan include:

Co-coordinating the implementation of national and international elements of the Strategy through a permanent National Biodiversity Steering Committee, Technical Advisory Group and National Unit for Biodiversity;

Building institutional capacity for GCEP to implement the strategy;

Measures to facilitate non-government participation in the implementation of the Strategy;

Coordinating and building synergies with other national teams involved in the planning of environment related activities and other biodiversity related conventions;

The production of an annual national report on policies, programs and activities aimed at implementing the Strategy;

Regular reporting on the status of biodiversity; and,

Revision of the Strategy after an initial implementation phase of five years.

Successful implementation of the Strategy will be determined, in a large measure, by the degree to which all parts of society adopt its vision and principles and contribute to achieving its goals. Ultimately, the conservation of biodiversity and the sustainable use of biological resources will require the support and participation of individual citizens, local communities, urban and regional administrations, conservation groups, business and industry, and educational and research institutions. The implementation of the actions listed in the Action Plan will be decentralized and under the responsibility of each participating ministry, agency or non-governmental organization.

## **6.4 PROPOSED IMPLEMENTATION PROCESS**

### **Step 1. Reinforcing the National Biodiversity Unit (NBU)**

The NBU established under GCEP is currently staffed with one coordinator acting as national focal point for the UN Convention on Biological Diversity (CBD). The unit will be reinforced with the addition of one full-time technical assistant and one full-time secretary. NBU may from time to time turn to the services of national or international consultants. The main role of the NBU will consist of:

Preparing country positions in collaboration with the National Biodiversity Steering Committee and Technical Advisory Group, and representing the country at the Convention on Biological Diversity's meetings;

Disseminating pertinent information to members of the National Biodiversity Steering Committee and Technical Advisory Group and other relevant national or international organizations;

Overall management of NBSAP implementation;

Supporting steering committee's contribution to NBSAP implementation process;

Preparing country reports to the CBD and annual reports on NBSAP implementation;

Coordinate and build synergies with other national teams involved in environment-related planning efforts and implementation of biodiversity-related conventions (Agenda 21, Range-land management, Land use planning, Combating desertification, Climate change,

CITES, Ramsar, etc.).

GCEP authorities shall see that adequate funding and technical support is allowed to the NBU for capacity building activities related to NBSAP implementation and reporting.

### **Step 2. Establishing National Biodiversity Steering Committee**

A high-level steering committee composed of representatives at managerial level from relevant NGO, government agencies and institutions will be established and chaired by the Minister responsible for the Environment. It meets at least once a year. Its main responsibilities include the following:

Providing high-level guidance and orientation for the Strategy and action plan implementation and for the country participation to CBD meetings;

Raising the level of awareness of the importance of the national biodiversity Strategy within high-level bodies of government;

Ensuring that all measures are taken to maximize the probability that the biodiversity Strategy and action plan will be implemented;

Acting as an umbrella unit for the development and coordination of biodiversity related projects;

Mobilizing funding for biodiversity projects through the development and implementation of a biodiversity funding Strategy;

Facilitating the work of the National Biodiversity Unit and ensuring access to archives and information held by their respective institutions.

### **Committee Membership**

The core membership of the National Biodiversity Steering Committee shall be composed of high-level representatives at managerial level from the following organizations:

General Corporation for the Environment Protection:

Ministry of Agriculture

Ministry of Planning

Ministry of Industry: Standards and Specifications Department

Ministry of Water and Irrigation

Ministry of Tourism

Ministry of Finance: Land and Survey Department

Municipality of Amman

General Corporation for Broadcasting and Television

Royal Society for Conservation of Nature

Jordan Environment Society

Jordan Phosphate / Cement Factory

National Center for Agriculture Research and Technology Transfer

University of Jordan: Dept. of Biological Science, Faculty of Sciences, Faculty of Agriculture.

Ministry of Energy and Mining: Natural Resource Department;

Higher Council for Science and Technology;

Royal Science Society;

Jordan Farmers Union;

Jordanian Cooperative Corporation;  
Amman Chamber of Industry;  
Royal Jordanian Geographical Center;  
National Jordanian Group for Women;  
Other relevant NGOs and private sector organizations

This core or executive membership shall be completed with representatives from the following or other institutions, when deemed necessary:

### **Step 3. Establishing a Technical Advisory Group**

The Technical Advisory Group is composed of technical advisors or focal points appointed by each participating ministries and institutions. It is chaired by the coordinator of the National Biodiversity Unit and meets at least twice a year. Its main role consists of:  
Participating in the implementation of the Strategy and action plan;  
Contributing to the formulation of priority projects and funding requests;  
Participating to the preparation of annual reports and to the development of indicators;  
Advising the steering committee and the national biodiversity unit on relevant issues related to the CBD;  
Serving as biodiversity focal points within their respective ministries and institutions.

### **Step 4. Development of a funding Strategy for NBSAP implementation**

The National Biodiversity Unit, under the guidance of the National Steering Committee and with the support of the Technical Advisory Group shall prepare a funding Strategy for NBSAP implementation.

Elements of this funding Strategy shall include:

Identification of potential funding mechanisms for priority biodiversity projects;  
Identification of potential funding agencies (multilateral, bilateral, governmental and private sources of funding);  
Distribution of NBSAP to potential donors and organization of a donors' workshop in order to disseminate the NBSAP and secure donors' interest for specific projects;  
Private presentations of NBSAP to targeted donors;  
Integration of financial requests for biodiversity projects in the budgets of participating ministries and institutions.

### **Step 5. Preparation of funding requests for priority projects**

With the guidance and help of the National Biodiversity Unit, the National Steering Committee and Technical Advisory Group, the organizations identified as the main implementation agency for the different priority actions listed in the action plan shall prepare a funding request for each priority projects. This funding request shall build on the previous experience of the implementation agencies and on the guidelines provided by targeted funding agencies.

## **Step 6. Monitoring and reporting on National Biodiversity Strategy and Action Plan implementation**

The National Biodiversity Unit, under the guidance of the National Steering Committee and with the support of the Technical Advisory Group shall monitor and report on NBSAP implementation. The monitoring itself should extensively involve national stakeholders in gathering, compiling and analyzing relevant information. It should be based on performance indicators developed for each NBSAP sectoral objective.

Reports on this monitoring should be prepared annually. They should be credible and objective, concise and easily understood by a broad national audience, and widely disseminated among national stakeholders. Reports should focus on the main policies, activities and on-going programs contributing to the goals of the Convention and to the sectoral objectives of the National Strategy and Action Plan. The reports should take the form of a printed or electronic document. From time to time, videos could be produced on certain topics deemed relevant for broader public distribution.

## **Step 7. Monitoring and reporting on the status of biodiversity**

### **A. Type of Monitoring and Reporting Needed:**

Reports on this monitoring should be prepared annually. They should be credible and objective, concise and easily understood by a broad national audience, and widely disseminated among national stakeholders.

The monitoring itself should extensively involve national stakeholders in gathering, compiling and analyzing relevant information, much of which will be made available. Longer-term results and effects will be looked for when monitoring the implementation of the biodiversity action plan.

The monitoring process will inevitably require specific information gathering to fill in gaps. Both stakeholders and the National Biodiversity Unit can do this. A range of different types of information should be sought to provide an accurate state of the progress made towards sustainable development. More subjective instruments such as case studies and interviews / questionnaires should be combined with systematic monitoring of key indicators to provide a balanced picture of the evolving situation.

### **B. Way of Monitoring and Reporting:**

The monitoring approaches should be as simple as possible, both to understand and to carry out. The system developed to report on this monitoring would need to avoid being too standardized or too complicated, and avoid putting unrealistic demands on those responsible for the monitoring and reporting. Avoiding systems which are too demanding, too complicated or too standardized will go a long ways towards ensuring that first, the monitoring and reporting will actually be done and second, people will read the reports. The National Biodiversity Strategy Unit will have to clearly define what type of information is needed to properly monitor the implementation of the biodiversity strategy and action plan. This will involve assessing what types of monitoring are

required to track progress on issues, and what types of information are of greatest interest and value to national stakeholders. The National Biodiversity Strategy Unit will need to clearly indicate how different types of monitoring information will be obtained, analyzed, and summarized (and who will do what).

Monitoring the implementation of the biodiversity strategy and action plan should involve three types of information gathering.

1. Gathering readily available information from national stakeholders:

The National Biodiversity Strategy Unit should be able to obtain a certain amount of monitoring information from regular reports and studies of national partners such as government agencies (and their major projects and programs), universities, regional and municipal governments, NGOs and private firms.

2. Gathering of necessary supplementary information by national stakeholders:

Different stakeholders from the public and private sectors and NGOs can be asked to take responsibility for specific dimensions of the monitoring. For example, public and private organizations and NGOs may agree to each monitor one key indicator of results in their areas of interest (e.g. water resource management, industry, agriculture, land use planning, mining or energy management).

3. Gathering of necessary supplementary primary information by the National Biodiversity Strategy Office:

Each year the National Biodiversity Strategy Unit will probably have to gather a certain amount of supplementary information to complete an annual report on the implementation of the biodiversity strategy and action plan. The Unit may wish to contract national specialists to carry out a series of short term monitoring assignments, such as interviews and / or questionnaires to measure changes in attitudes and knowledge about sustainable development issues among different groups of Jordanians. Case studies could also be developed to assess the effectiveness of different types of economic instruments being used to promote more sustainable behavior among Jordanians.

**Reporting:**

The National Biodiversity Strategy Unit will necessarily take the lead in reporting through synthetic reports compiling the main achievements. The Unit will also ensure that these reports are broadly distributed among national stakeholders and that the reports provide information which is interesting and useful for these stakeholders.

National communication specialists may be contracted to prepare short videos documenting the development and implementation of the national biodiversity strategy and action plan and describing to a Jordanian audience the different problems solved and lessons learned. Local or national television networks could be asked to air these video.

### **The need for biodiversity indicators:**

The main goal of the National Biodiversity Strategy and Action is to induce positive changes on the status of biodiversity in Jordan through the efforts of the different national stakeholders and programs. This sort of induced change can be difficult to distinguish from a normal range of variation. Identification and monitoring of biodiversity indicators should start from the earliest stages of implementing the biodiversity Strategy and action plan and continue long enough to help observers distinguish natural variability from the actual results and effects of their programs.

### **Start with a few simple indicators**

National stakeholders in collaboration with the National Biodiversity Strategy Office should select appropriate indicators. When selecting indicators, national stakeholders and the Biodiversity Strategy Office will need to reconcile conflicting imperatives. On one hand, it will be desirable to have all important environmental, economic and social results and effects of the national biodiversity Strategy and action plan captured by monitoring. On the other hand, it will be most desirable to start by monitoring only a few key simple indicators (for example, one indicator for each sub theme of the NBSAP) since resources available for monitoring are likely to be limited. Monitoring reports, if they are to be widely read by national stakeholders (and the international community) should be concise and uncomplicated.

Environmental indicators should constitute the core of biodiversity monitoring and reporting. Examples of environmental indicators include various chemical and biological parameters measuring water quality, land area devoted to forests and range-lands, various parameters measuring the quality of these lands and their bio-mass, diversity of species, percentage of citizens receiving some form of environmental education or training, etc.

Economic indicators like per capita area of land, and income derived from biodiversity products could also contribute to effectively monitor the implementation of the biodiversity Strategy office and action plan.

### **Involvement of National Stakeholders**

Working in close collaboration with the main stakeholders, the National Biodiversity Strategy Office should also clearly identify the monitoring roles of each of the partners involved, government agencies, private sector organizations, NGOs, etc. Ensuring national stakeholders are fully involved in the planning and implementation of the reporting will help reinforce their ongoing participation in the national dialogue on sustainable development.

The National Biodiversity Strategy Office will need to establish focal points in all major stakeholder organizations (Technical Advisory Group). These focal points will in turn be instrumental in ensuring that their organizations will contribute effectively to monitoring the implementation of the national biodiversity Strategy and action plan.

The National Biodiversity Strategy Office should also make use of other national experts to support this monitoring when necessary. The Office may find it useful to hire a local

specialist for a certain period each year to help collect, collate, analyze and synthesize the information of various types made available by various stakeholders over the year

### **6.5. Criteria for Setting Priorities for Ecosystem Conservation**

An essential part of any national Strategy for the conservation of biodiversity is the setting of priorities for action. In Jordan, the following criteria have been set for selecting ecosystems for preservation:

- wealth of biodiversity;
- high level of endemism;
- representative value;
- undisturbed status;
- presence of important species;
- critical ecological value (path of migration, nesting, food, hydrological significance to the ecosystem.)

The following criteria have been set for selecting species for preservation:

- genetic importance;
- ecological importance;
- economic and social importance;
- level of risk and damage.

**THEME 7**  
**A BIODIVERSITY STRATEGY AND ACTION PLAN IN JORDAN**

**\*STRATEGIC AND OPERATIONAL OBJECTIVES:**

**PROTECTION OF BIOLOGICAL RESOURCES**

**7.1 SPECIES AT RISK**

**Strategic Objectives:**

Reduce the decline and prevent the extinction of fauna and flora species in Jordan.

**Operational Objectives:**

- \*Establish the status and distribution of species at risk.
- \*Conserve key important habitats for species at risk.
- \*Establish a national species in-situ conservation programs outside protected areas.
- \*Effectively control and manage the hunting and the trading of species at risk.
- \*Effectively manage and control the introduction of invasive species.

**Priority Actions:**

National Red Data List for flora and fauna species at risk.  
Endangered species conservation program.  
National strategy for the management and control of invasive species

**7.2 PROTECTED AREAS**

**Strategic Objectives:**

Ensure the representation of major and key ecosystems in the national protected area network.

Minimize habitat degradation within protected areas.

**Operational Objectives:**

- \*Finalize and adopt the Jordan Protected Area Policy Project
- \*Finalize protected area review.
- \*Ratify protected area bylaws and establish all proposed protected areas including Important Bird Areas and areas with conservation significance.
- \*Clarify institutional management responsibility, facilitate interagency coordination and set consistent management approaches for protected areas.
- \*Allocate adequate financial resources and implement a well-designed technical capacity program within management institutions.
- \*Develop public awareness on the role and importance of protected areas.
- \*Provide alternatives for livelihood to the local communities living in and around protected areas.
- \*Develop and implement clear management plans for all sites.

### **Priority Actions:**

Completing the protected area network

Consistent integrated management planning for protected areas.

Rationalizing institutional arrangements among institutions working in the field of protected areas.

Maintaining effective management for existing wildlife reserves.

## **SUSTAINABLE USE OF BIOLOGICAL RESOURCES**

### **7.3 WILD PLANTS**

#### **Strategic Objectives:**

\*Secure the multiple roles of flora and their habitats by strengthening national institutions and capabilities to formulate and implement effective policies, plans, programs and projects relevant to wild plants and vegetation issues.

Better utilize and recognize the social, economic and ecological values of trees, forests and forest lands and ensure their sustainable management in a manner consistent with land use, environmental considerations and development needs.

#### **Operational Objectives:**

\*Conduct field studies to determine biotic or abiotic factors affecting plant biodiversity.

\*Apply modern techniques like remote sensing and geographical information systems in vegetation studies.

\*Train people in order to carry on any applied duties of conservation needed in the various regions of Jordan.

\*Establish a plant data bank and link it to regional as well as international sites concerned with conservation.

#### **Priority Actions:**

Establishment of a national botanical garden.

Establishment of a national herbarium.

### **7.4 FORESTS**

#### **Strategic Objectives:**

Recognize the social, economic and ecological values of forests and ensure their conservation and sustainable management.

#### **Operational Objectives:**

\*Promote afforestation in forestland and reforestation of open natural forest.

\*Enforce the prohibition of illegal cutting.

\*Prevent forest fires and increase readiness for forest fire fighting measures.

\*Promote environmentally friendly forestry practices.

\*Improve the quality and quantity of forest seedling production with the aim of increasing their survival rate in afforestation projects.

\*Monitor the status and trend of natural forest and afforestation activities.

**Priority Actions:**

Establishment of a green belt to combat desertification.

Development of tree nurseries.

Development of forest fire protection.

Forest inventory in Southern Jordan.

Study of the survival rate and performance of afforested areas.

## **7.5 TERRESTRIAL AND FRESHWATER WILD FAUNA**

**Strategic Objectives:**

Effectively conserve and manage terrestrial fauna species and their key habitats.

**Operational Objectives:**

\*Collect comprehensive information on the biology, status and distribution of Jordan's terrestrial fauna.

\*Conserve key natural habitats and ecosystems.

\*Control and monitor persecution of wild animals.

\*Control trading and spreading of diseases through wildlife.

\*Control and monitor invasion of alien species through the country.

**Priority Actions:**

Enforcement of legislation and conventions concerning the protection of wildlife.

National database on information regarding biology, status and distribution of terrestrial fauna.

National census for game species.

## **7.6 MARINE LIFE AND FISHERIES**

**Strategic Objectives:**

Ensure the conservation of marine and coastal life and the sustainable harvesting of commercial fish.

**Operational Objectives:**

\*Promote the use of environmentally sound fishing techniques.

\*Ensure the protection of coral reefs and coastal zones in general.

\*Monitor the status of marine species and habitats and the negative impacts threatening their survival.

**Priority Actions:**

Establishment of a Fisheries and Marine Life Institution.

Improvement of commercial and artisanal fisheries.

Fish farming development.

## 7.7 MICROORGANISMS

### **Strategic Objectives:**

Increase information related to microorganism diversity particularly on those playing a role in ecosystem sustainability.

Preserve endogenous biodiversity from the invasion of alien microorganisms.

Conserve endogenous microorganism diversity both in situ and ex situ.

### **Operational Objectives:**

- \*Develop national capacity building in environmental microbiology.
- \*Establish a comprehensive database of Jordan microorganism diversity.
- \*Create and maintain a registered ex situ culture collection of microorganisms.
- \*Initiate research programs on the ecological importance and population dynamics of selected microorganisms.
- \*Develop the use of microorganisms or their products in environmental monitoring systems and in pollution studies.
- \*Evaluate existing regulations on introducing exotic and invasive microorganisms.
- \*Promote environmentally sound utilization of microorganisms in agriculture and biotechnology.
- \*Encourage the use of immunological and molecular diagnostic techniques in the detection of pathogenic microorganisms.
- \*Emphasize the environmental role and importance of microorganism diversity in school and university curricula.
- \*Increase public awareness in considering microorganism diversity as a natural resource.

### **Priority Actions:**

Comprehensive survey of environmental microorganism diversity in Jordan.

Establishing ex situ conservation of microorganisms in Jordan.

Ecological and population studies of selected environmental microorganisms.

Adapting the use of microorganisms in ecosystem monitoring to express environmental changes in Jordan.

## 7.8 AGRICULTURE RESOURCES

### **Strategic Objectives:**

Manage and utilize available agricultural resources, in particular water, land, capital and labor, in an economically efficient manner, while preserving the environment and ensuring the sustainability of agricultural production.

Promote alternative and modified land use practices through community-based farm habitat and species management for the sustainable use and conservation of agrobiodiversity of the wild relatives and landraces of crops through education and capacity-building measures.

### **Operational Objectives:**

- \*Reduce chemical pesticide and fertilizer use through proper training, alternate biological means (integrated pest management-IPM, organic farming and soil-less cultivation), and enforcement of laws related to the misuse of agro-chemicals.
- \*Protect, improve and properly utilize the local resources of plant biodiversity.
- \*Promote the optimal utilization of water resources for irrigation.
- \*Safeguard soil and water from contamination due to drainage water carrying undesirable chemical residues and from misuse of fertilizers and pesticides.
- \*Define crop-water requirements in the various agro-climate zones to rationalize the use of irrigation water.
- \*Protect agricultural land in rainfed areas from fragmentation and urban encroachment.

### **Priority Actions:**

Establishing a specialized center for plant biodiversity.

Farmer's participation in biodiversity conservation.

Evaluation, characterization and utilization of cereal accessions conserved in NCARTT gene bank.

Utilization of *Amygdalus arabica* plant genetic resources as promising rootstock for stone fruit production and the rehabilitation of dry lands.

Organic farming pilot project.

Hydroponics culture project.

## **7.9 ANIMAL PRODUCTION:**

### **Strategic Objectives:**

Efficiently manage and promote animal agriculture production in order to meet the increasing demand for animal products, using recent knowledge and applied technology.

Promote the production of safe and healthy food and pharmaceutical products and prevent the transmission of diseases through education, training and capacity building measures, and maintaining good processing standards.

### **Operational Objectives:**

- \*Protect animals and humans from animal diseases through appropriate animal vaccinations and preventive health programs
- \*Ensure the maximum production capacity of local species and breeds by providing appropriate selection, management, nutrition and health programs.
- \*Ensure technology transfer and provide adequate information to farmers, veterinarians, decision-makers and technical staff.
- \*Identify and develop alternative feed sources and feed management in order to reduce the use of expensive imported feed.
- \*Reduce environmental contamination risks from animal waste products and pharmaceuticals used in animal husbandry.
- \*Develop graduate and undergraduate training and extension programs emphasizing animal health, herd management, genetic selection and breeding performance.
- \*Draw up breed preservation plans, semen and embryo collection and storage, farm-

based conservation of indigenous stock or in situ preservation.

\*Select indigenous animal population on the basis of genetic uniqueness.

**Priority Actions:**

Developing alternate animal feed sources in the Badia region.

Monitoring the impacts of diseases on animal productivity.

Development of embryo transfer and artificial insemination techniques.

Study on the effects of plastic wastes on animal production and biodiversity.

**7.10 RANGELAND PRODUCTION:**

**Strategic Objectives:**

Ensure the conservation and sustainable use of range-lands.

**Operational Objectives:**

\*Monitor the status and trends of range-land resources.

\*Reduce range-land degradation.

\*Improve the quality and production of range-land vegetation cover.

\*Develop the capability to manage range-lands on a sustainable basis respecting the carrying capacity of the ecosystem.

**Priority Actions:**

Training and capacity building for range-land management.

Survey of range resources.

Protection of rangelands.

Improvement of rangelands.

Management of rangelands and grazing systems.

**REDUCING THE IMPACT OF INDUSTRY ON BIODIVERSITY**

**7.11 MINING**

**Strategic Objectives:**

Minimize the negative impacts of mining activities on environment and biodiversity.

**Operational Objectives:**

\*Promote the implementation of eco-efficient mining procedures.

\*Modernize the mining law and mining codes to meet the needs of the latest development in mining activities and to include articles for the protection of biodiversity.

\*Strengthen the control on mining activities by concerned government authorities.

\*Prevent mining in forested areas.

**Priority Actions:**

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

Study mine dumping sites, seepage and tailings.

Restoration of building stones quarry sites.

Monitoring the environmental impacts of mining operations.  
Monitoring the environmental impacts of quarry operations.

## **7.12 INDUSTRY AND FACTORY PRODUCTION**

### **Strategic Objectives:**

Prevent industrial pollution and reduce environmental impacts of energy consumption.

### **Operational Objectives:**

\*Promote the use of environmentally friendly and cleaner production processes based on their economical and ecological benefits.

\*Promote the use of environmental management systems such as ISO 14001.

\*Ensure that new industrial and energy projects are submitted to environmental impact assessment or due diligence procedures.

### **Priority Actions:**

Studying the impacts of Phosphate Company gypsum dump on marine life in Aqaba.

Capacity building for the staff and stakeholders of the National Cleaner Production Center.

Review and analysis of national environmental legislation to accommodate global trade requirements, cleaner production and environmental management systems.

Creation of a Website for the National Cleaner Production Center.

Biodiversity impact analysis of Al-Akaider landfill in Northern Jordan.

## **7.13 BIOTECHNOLOGY AND BIOSAFETY**

### **Strategic Objectives:**

Promote the development of bio-technologies that contribute to the protection and sustainable use of biodiversity.

Prevent the risks associated with the use of bio-technologies.

### **Operational Objectives:**

\*Adopt biosafety regulations in agreement with the Cartagena Biosafety Protocol signed by the Government of Jordan.

\*Encourage private investment in environmentally friendly applications of biotechnology.

\*Initiate field demonstrations of new biotechnology applications in agriculture and industry.

\*Develop biotechnology training and research programs.

\*Increase public awareness and appreciation for environmentally safe biotechnology developments.

\*Encourage fruitful international cooperation in research and development of environmentally safe biotechnological applications.

**Priority Actions:**

Establishment of a National Council for the Promotion and Regulation of Biotechnology in Jordan.

Biotechnology Capacity Building Program.

Elaboration of a National Bio-safety Framework.

Establishment of an Applied Environmental Biotechnology Center.

**7.14 ECO-TOURISM**

**Strategic Objectives:**

Minimize the impact of tourism activities on biodiversity and natural habitats in and around tourism areas through the implementation of eco-tourism principles.

Promote the understanding and implementation of eco-tourism principles.

**Operational Objectives:**

\*Develop and implement environmental guidelines and standards for tourism projects based on the carrying capacity of the sites.

\*Support eco-tourism projects.

**Priority Actions:**

National environmental standards and guidelines for tourism projects.

Institutional management plans for tourism sites.

Eco-tourism development in protected areas.

**PROMOTING INTEGRATED LAND USE PLANNING AND WATER RESOURCES DEVELOPMENT**

**7.15 LAND TENURE AND LAND USE PLANNING**

**Strategic Objectives:**

Ensure strict protection of biodiversity rich lands in land use planning schemes.

**Operational Objectives:**

\*Take full account of environmental considerations in the socio-economic planning process and in the identification of alternatives and priorities.

\*Establish active and effective planning units within concerned government agencies and municipalities

\*Enhance, improve and strengthen planning, management and evaluation systems for land use and land resources.

\*Review and develop policies to support the optimal use and the sustainable management of land.

\*Strengthen institutions related to land use and management and improve coordination among them.

\*Maintain and generate a database and information system aimed at facilitating integrated land use planning and management.

**Priority Actions:**

Preservation of biodiversity rich areas through urban planning.  
Limiting urban expansion on agricultural and forestlands, and promoting green spaces through landscape planning.

**7.16 WATER RESOURCES DEVELOPMENT**

**Strategic Objectives:**

Utilize and manage water resources in Jordan in a sustainable manner to preserve biodiversity.

**Operational Objectives:**

- \*Protect and monitor water bodies and ecosystems to ensure the conservation of biological and genetic resources.
- \*Disseminate and share the benefits derived from the sustainable development and use of water-bodies and ecosystems.
- \*Apply environmental impact assessment to water development projects in biodiversity rich areas like Mujib, Wala, and Jordan River.
- \*Involve the local community in the protection and conservation of water bodies and biodiversity.

**Priority Actions:**

Assessment and monitoring of water bodies and ecosystems.  
Protecting wadi Mujib catchment's area.  
Impact assessment of water projects on biodiversity.  
Assessing the impacts of treated wastewater on biodiversity in the Zarqa River.  
Monitoring Jordan River water flow and quality and its impact on biodiversity.

**7.17 TOWARDS A BIODIVERSITY-ORIENTED SOCIETY  
ECONOMIC VALUATION OF BIODIVERSITY**

**Strategic Objectives:**

Assess economic and social opportunities arising from the actual and potential use of Jordan's biological resources.

Demonstrate the economic and financial advantages of biodiversity conservation.

**Operational Objectives:**

- \*Expand and improve training related to the incorporation of economic analysis in biodiversity conservation practices.
- \*Establish a comprehensive national database on the economic value of biological resources.
- \*Identify and describe analytical techniques (economic instruments) and needed economic data that should be used to estimate the economic values of biodiversity resources.

**Priority Actions:**

Capacity-building and training material on economic valuation of biodiversity resources in Jordan.

**7.18 LEGISLATION AND INSTITUTIONAL STRUCTURE**

**Strategic Objectives:**

Ensure the protection and sustainable use of biodiversity and other natural resources through adequate and efficient legislation and management standards.

Enhance interdepartmental and intergovernmental co-ordination for the protection, conservation and management of resources.

Confirm and strengthen the Kingdom's commitment to its role, rights and obligations for biodiversity conservation in the regional and international communities

**Operational Objectives:**

\*Strengthen the process of environmental impact assessment, environmental consultation and project scrutiny, including that of compliance with permit conditions, for all new development projects.

\*Adopt bylaws and regulations of the Environment Law related to biodiversity issues, namely national parks and reserves, species at risk, biosafety, water protection, pesticide control, and EIA.

\*Establish a permanent National Biodiversity Unit, a multi-stakeholder Steering Committee and Technical Advisory Group with the mandate of coordinating NBSAP implementation.

\*Strengthen environmental control and monitoring institutions (within GCEP).

\*Review and develop environmental legislation to cover the designation of small sites of importance to biodiversity as Sites of Special Scientific Interest (SSSI) and raise penalties to a sufficient level.

\*Promote the application of integrated program planning where the projects will be inter-sectorally, intrasectorally and regionally integrated.

\*Promote and participate in the establishment of lines of co-operation and co-ordination with neighbor countries.

**Priority Actions:**

Reviewing existing environmental legislation.

Environmental legislation training center.

**7.19 PUBLIC AWARENESS AND PARTICIPATION**

**Strategic Objectives:**

Encourage and support the participation of individuals, local community, private sector and other stakeholders in efforts leading to conservation and sustainable use of biodiversity.

**Operational Objectives:**

\*Raise individuals and local community awareness on the importance of public participation in non-governmental organization activities.

\*Implement legal, administrative and economical incentive measures to promote participation of individuals and local communities in the conservation and sustainable use of biodiversity.

\*Develop technical training programs on skills and practices supporting individual and local community participation in the development of biodiversity related projects.

\*Improve knowledge on the status and trends of biodiversity in Jordan.

\*Develop socio-economic projects at the local community level for the sustainable use of biological resources.

**Priority Actions:**

Establishment of a comprehensive database on Jordan's biodiversity.

Institutional capacity building program on biodiversity.

Public awareness program on biodiversity issues

fauna and flora habitat conservation

agro-biodiversity

natural areas

water and marine ecosystems

pollution prevention

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## *Glossary (Key Terms)*

- **Biodiversity Indicators**- indicators or measures that allow us to determine the degree of biological or environmental changes within ecosystems, populations or groups of organisms over time and space.
- **Biodiversity or Biological Diversity**-the variability among living organisms from all sources including, interalia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
- **Biological Resources**- includes genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.
- **Biosafety**- protection of ecological balance against foreign organisms.
- **Biotechnology**- the application of science and engineering in the direct or indirect use of living organisms, or parts or products of living organisms, in the natural or modified forms.
- **Conservation of Biodiversity** managing human uses of the Earth's resources in order to maintain ecosystem, species and genetic diversity and the evolutionary and other process that shaped them. Conservation includes the option to use resources.
- **Conservation**- the maintenance or sustainable use of the Earth's resources in a manner that maintains ecosystem, species and genetic diversity and the evolutionary and other processes that shaped them. Conservation may or may not involve the use of resources; that is, certain areas, species or populations may be excluded from human use as part of an overall landscape/waterscape conservation approach.
- **Corridors**- measures that are taken to ensure the natural immigration and emigration of populations and species. This may be a physical corridor, such as a terrestrial or marine migration route, a flyway, or it may refer to a particular management practice that allows species and populations to continue patterns of movement.
- **Degraded ecosystem**- ecosystem whose balance has declined or whose productivity is reduced.
- **Ecological Management**- the management of human activities so that ecosystems, their structure, function composition, and the physical, chemical, and biological process that shaped them, continue at appropriate temporal and spatial scales. Ecological management is sometimes called ecosystem management or an ecological approach to management.
- **Ecological Services**- services that humans derive from ecological functions such as photosynthesis, oxygen production, water purification and so on.
- **Ecosystem**- a dynamic complex of plants, animals and microorganisms and their non-living environment interacting as a functional unit. The term ecosystem can describe small-scale units, such as the biosphere.
- **Ecosystem diversity**- Complex of habitats situated within a given territory, including the ecological processes specific to those habitats.
- **Endangered species**- species that are threatened with immediate extinction or extirpation if the factors threatening them continue to operate. Included area level or

whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

- **Endemic species**- species which exist in only one specific area, or ecological zone.
- **Ex situ Conservation**- the conservation of components of biological diversity outside their natural habitats, often in such institutions as zoos, museums, botanical gardens, aquariums and gene banks.
- **Genetic diversity**- all genetic variation within all population of given species. Genetic diversity determines the evolutionary capacity of living species.
- **Genetic engineering**- the technique involving the transfer of specific genetic information from one organism to another.
- **Genetic resources**- genetic material of actual or potential value.
- **Genetically modified organism**- an organism whose genetic information has been altered by any technique including natural processes, mutagenesis or genetic engineering.
- **Germplasm**- genetic material (with a defined chemical and molecular constitution) that forms the physical basis of inherited qualities and is transmitted from generation to generation by the germ cells.
- **Habitat**- the place or type of site where an organism or population naturally occurs. Species may require different habitats for different uses throughout their lifecycle.
- **Harmful Alien Organism**-organisms that enter an ecosystem in which they are not naturally known to exist –through deliberate or inadvertent action by humans—and thereby pose a threat to native species.
- **In situ Conditions**- conditions where genetic resources exist within ecosystems and natural habitats and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.
- **In situ Conservation** – the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and in the case of domesticated or cultivated species in the surrounding where they have developed their distinctive characteristics.
- **Integrated Pest Management (IPM)**- a holistic or integrated approach to controlling the risks and damage associated with natural predators, diseases and pests. It involves using site-specific information to determine the most effective combination of physical, chemical, biological, or cultural practices to reduce damage, while reducing impacts on the environment, biological diversity and human health.
- **Landscape ecology**- science, which ensures inclusion of the configuration and dynamic of the different type of land making up ecosystems that interact with each other.
- **Landscapes**- complexes of terrestrial ecosystems in geographically defined areas.
- **Living Modified Organisms**- organisms that have been genetically modified through the application of biotechnology, including organisms that have been modified by novel recombinant DNA techniques as well as mutagenesis or classical breeding and selection techniques.

- **Microorganism-** any organism that can be seen only with the aid of microscope.
- **Mutagenesis-** a process whereby the genetic information of an organism is changed in a stable, heritable manner, either in nature or induced experimentally via the use of chemicals or radiation. In agriculture, these genetic changes are used to improve agronomically useful traits.
- **Natural biological diversity-**biological diversity that has not been modified by humans.
- **Natural Resources Accounting-** accounting for the state and quality of the environment and the natural resources base by deducting from the gross domestic product various aspects of environmental degradation, such as the value of pollution abatement and control expenditures, the cost of environmental damage, and the depletion of natural resources.
- **Non-renewable Resources-** resources such as mineral. Materials, natural gas and oil, whose reserves are depleted by their use.
- **Protected Area-** geographically defined areas that are designed or regulated and managed to achieve specific conservation objectives.
- **Rare Species-** small population of species that are not currently endangered or vulnerable, but are at risk. These species are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range. Rarity can be defined locally, regionally, provincially/territorially, nationally or globally.
- **Rehabilitation-** the return of a species, population or ecosystem to a healthy, functioning state.
- **Resource Harvesting-** the harvesting of biological resources for the purposes of subsistence or economic gain, include both aquatic and terrestrial resources.
- **Restoration-** the return of a species, population or ecosystem to its state prior to disturbance.
- **Species or native diversity-** all sub-species, species, genera, families, etc. of all living organisms found within a given territory (animals, plant, fungi, and microorganisms).
- **Speculation** – the evolutionary process of species formation.
- **Sustainable Development-** development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- **Sustainable use** – the use of components of biodiversity in a way and at a rate that does not lead to their long-term decline thereby maintaining the potential for future generations to meet their needs and aspirations. Sustainable use in this Strategy refers to consumptive uses of biological resources.
- **Threatened Species-** species that are likely to become endangered if the natural or human pressures causing them to be vulnerable are not reversed.
- **Traditional Knowledge-** knowledge gained from generations of living and working within a family, community or culture.