



Forestry Department

Food and Agriculture Organization of the United Nations

Planted Forests and Trees Working Papers

**THE NETHERLANDS TRUST FUND SUPPORT TO SUSTAINABLE
FOREST MANAGEMENT IN LOW FOREST COVER COUNTRIES**

***ROLE OF PLANTED FORESTS AND TREES OUTSIDE
FORESTS IN SUSTAINABLE FOREST MANAGEMENT:***

***SULTANATE OF OMAN
COUNTRY CASE STUDY***

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with the assistance of

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Comments and feedback are welcome.

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Foreword

People of developing countries facing desertification and severe land degradation, particularly in arid and semi-arid areas, can experience extreme food insecurity and abject poverty. In most countries, their relationships with forests and trees are inseparably interlinked and interdependent. Poor people recognize that forests and trees protect soil, water and biological diversity, provide shelter and shade for their villages as well as havens for cultural customs and help to combat desertification. To meet their basic food, fuel-wood, fodder, medicine and construction materials from the meagre resources available, they adopt survival attitudes, overexploit forests and rangelands, and provoke alarming rates of deforestation and forest degradation, which further erode their livelihoods.

Decentralized, participatory, intersectoral and multidisciplinary approaches to policy, planning, implementation and monitoring are new to many developing low forest cover countries. They require new institutional frameworks as well as training and skills in forest planning and management. The voice of the forestry sector, which has generally been marginalized, needs to be mainstreamed in intersectoral planning committees and working groups to derive national development priorities and national forest development strategies. In so doing, it should examine the real value and potential roles of natural forests, planted forests and trees outside forests in supporting landscape restoration and sustainable livelihoods in urban and rural landscapes.

It is critical to integrate planted trees and forests in more holistic approaches to provide environmental services, biodiversity benefits and meet people's short and long-term needs. It is also necessary to make modern technology and traditional knowledge available in more people oriented approaches to be shared through national and international networks, and sound extension and technical support systems and demonstrations.

This case study was carried out under the FAO-Netherlands Partnership Programme to support Sustainable Forest Management in Low Forest Cover Countries in the Near East and African Regions. It is one in a series of six carried out in Iran, Oman, and Tunisia in the Near-East Region to form the basis of the Teheran Workshop, 28-31 October 2002 and Mali, Ethiopia and Namibia in the African Region to form the basis for the Nairobi Workshop 26-29 November 2002.

The case studies, chosen to represent the uniquely different ecological, social, cultural, environmental and economic conditions prevailing in the regions, were conducted to evaluate the role of planted forests and trees outside forests in supporting sustainable forest management and landscape restoration in low forest cover countries. Natural forests, rangelands, woodland resources, trees outside forests, agroforestry, urban and peri-urban forestry all play important roles in supporting the social, cultural, environmental and economic landscapes, particularly in low forest cover countries.

This case study focuses on the major issues, the policy/legal/institutional contexts, status of forests and rangelands, constraints, opportunities, gaps in knowledge, lessons learned and the proposed actions for the way forward. This is a first step in translating policies and proposed actions towards implementation.

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I would like to thank regional officials and local people for their hospitality and say my sincere gratefulness to FAO and the Government of the Sultanate for making it possible for me to visit the beautiful and hospitable Oman, capture its main environmental development issues, and participate to the formulation of some possible solutions.

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List of Acronyms

AU	Animal Unit
CBD	Convention on Biodiversity
CILSS	Comité Inter-états de Lutte Contre la Sécheresse au Sahel
DGAAWF	Directorate General of Agriculture, Animal Wealth and Fisheries
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
FAOR	Food and Agriculture Organization Representation
FRA 2000	Forest Resources Assessment (FAO)
FU	Forage Unit
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographical Information System
GPS	Global Positioning System
ICRAF	International Centre for Agroforestry Research
IGADD	Intergovernmental Authority on Drought and Development
ITCZ	Intertropical Convergence Zone
IUCN	The World Conservation Union
LFCCs	Low Forest Cover Countries
MAF	Ministry of Agriculture and Fisheries
Mm³	Million Cubic Meters
MRME	Ministry of Regional Municipalities and Environment
MRMEWR	Ministry of Regional Municipalities, Environment and Water Resources
MT	Million Tons
Mt	Metric Tons
NCS	National Conservation Strategy
NE	North East
NEAP	National Environmental Action Plan.
NGO	Non Governmental Organization
NPACD	National Plan of Action to Combat Desertification
NW	North West
NWFPS	Non-Wood Forest Products
OMA	Oman
OMR	Omani Rials
PhD	Doctor of Philosophy
RRD	Rangeland Resources' Department (MAF)
SE	South East
TCP	Technical Cooperation Programme
TOFs	Trees Outside Forests
TSE	Treated Sewage Effluents
UN	United Nations
UNCCD	United Nations' Convention to Combat Desertification
UNCED	United Nations Conference on the Environment Development
UNDP	United Nations Development Programme
UNEP	United Nations' Environmental Programme
UNESC	United Nations Economic and Social Commission
UNESCWA	United Nations Economic and Social Commission for Western Asia
US \$	United States' Dollar

Executive Summary

Preamble

According to FRA¹ 2000, over seventy, for the most developing countries, possess a forest cover of less than 10 % of their land area. The international expert meeting held in Teheran (1999), on needs and requirements of developing countries with low forest cover, agreed to prepare proposals to secure international support to sustainable forest management in LFCCs. The Netherlands approved to support targeted outputs and activities of the “Teheran Process”, one of which, aims at preparing country studies for Africa and the Near-East regions, that outline the causes and effects of deforestation and forest degradation as well as the lessons learned and the priority needs to enhance the role of planted trees. The present report, which constitutes the case study for the Sultanate of Oman, has highlighted the following:

- i) Despite an arid climate prevailing over most of its territory, Oman is a country of comparably high plant and animal biodiversity. Forestry, in the sense of a sector aiming at the production of forest resources, mainly wood products, is for all practicality, inexistent in Oman. Forests exist only in the form of small galleries and groves, the main bulk of tree vegetation being constituted of extensive woodlands and shrub-land or bush intimately mixed with herbs and forbs, the combination of, which makes up the natural rangelands of Oman.
- ii) Shifts in vegetation cover and land use ensuing woodland/rangeland degradation are believed to be considerable even though they are hardly assessable in terms of area loss and environmental impact, given the absence of national survey and monitoring capacity. They are due to mismanagement subsequent to land nationalization, and woodland and rangeland allocation to urban and agricultural development of the country in its modernization phase.
- iii) Seven government institutions, among which the Ministries of Agriculture and Fisheries and of Regional Municipalities and Environment, have major responsibilities in environmental protection expressing the authorities’ high concern for the safeguard of the remaining natural resources. The institution in charge of administrating the woodlands and rangelands estate is the newly established Rangeland Resources Department, within the Directorate of Animal Wealth of the MAF. Operated by two graduates, the department is too weakly staffed and skilled to actually achieve the assignments it is vested with, which go from planning to implementation of range/woodland surveys, protection and sustainable management, to afforestation activities, enforcement of the Range and Forestry Law etc.

Lessons learned

The lessons learned include:

- The country’s valuable woodland and shrub-land natural stands are increasingly recognized to be under threat;

¹ Forest Resources’ Assessment.

- The MAF has focused priorities to increasing animal wealth but less so to the sustainability of the natural resources base on which it depends; it has moreover placed undue emphasis on livestock reduction alone, rather than a comprehensive approach addressing the rangeland degradation in a more holistic manner;
- Animal production in the past ignored the importance and urgency of sustaining the natural pastures, rangelands and woodlands; the policy regarding their management and development remains unclear and inconsistent, while their related legal and regulatory frameworks are ineffective and unenforceable;
- The Government institutions have so far, failed to address the legitimate goals and needs of the traditional woodlands and rangelands users, but there is some recognition of the necessity to adopt participatory approaches to understand those of livestock and rangeland dwellers;
- There is a confusion of institutional responsibilities at the national level with regard to conserving, managing and developing the woodland/rangeland natural resource and at the same time, insufficient funds and investments have been allocated to its management and development, while the numbers and quality of trained senior and field staff of RRD/MAF in forestry, rangeland management and desertification control remains very insufficient.

Conclusions

Some of the major conclusions drawn may be summarized as follows:

- Rural development programmes initiated so far in Oman have been of little assistance in improving the conservation and sustainable management of woodlands and rangelands;
- Development policies need to consider giving more attention to safeguarding the remaining misused woodland/rangeland estate;
- Dhofar has been the focus of the few efforts undertaken to preserve and manage rangelands and woodlands;
- The land use and tenure policy related to rangelands and woodlands discourages local dwellers from investing and participating in their protection and management;
- Institutions entrusted with woodland and rangeland resources' management are characterized by their weak capacity, their lack of effectiveness, their excessively centralized planning and decision-making procedures, all of which perpetuate natural resources' degradation;
- The national woodland and rangeland estate is more important than openly acknowledged in terms of biodiversity significance, area covered, socio-economic importance, environmental influence etc.
- Rangelands and woodlands constitute multipurpose resources providing soil protection, wood and non-wood products, water seepage from monsoon mist, space for agriculture expansion etc.
- The inefficient, uneconomical and unsustainable livestock management and breeding programmes negatively impact on natural woodland and rangeland resources;
- The role of planted urban and crop (fruit) trees, has long been recognized as important, while that of planted forests and natural woodlands and rangelands is gradually gaining recognition.

Recommendations

To address the present issues and create the capacity to sustain, improve and enlarge the woodland and rangeland estate, a number of recommendations are put forward, among which:

- The need to assess and monitor urgently and over the entire country, the structure, state and importance of the natural woodland and rangeland estate to allow for future wise development planning;
- The development of an appropriate and well-coordinated institutional framework with clear mandates, responsibilities and resources to support more efficiently and durably, the initiation and implementation of carefully decentralized rangeland, woodland, and watershed management, environmental protection, desertification control, and rural development programmes;
- The preparation and adoption of a comprehensive Forest and Range Law to be well coordinated with the existing environmental laws;
- The formulation and approval of a land use system that grants enough tenure security and motivation to invest and actively participate in the conservation and development of woodlands and rangelands;
- The need for enhancing greatly, making use of all training and cooperation opportunities, the MAF's Rangeland Department's human resource base' capacity;
- The necessity to upgrade in a mid-term perspective, the Rangeland Department to the level of General Directorate of Forestry, Range and Desertification Control within the MAF, with decentralized departments distributed over the main regions of the country;
- Calling in for FAO's cooperation and backstopping in developing training programmes, and strengthening the MAF's capacity in the fields of woodland, and rangeland rehabilitation, protection and management, watershed management and desertification control, and in promoting sustainable rural development, by developing woodland and rangeland sustainable participatory management approaches and models;
- Giving high priority to the safeguard, the regeneration and the sustainable use, management and development of the natural woodlands and rangelands;
- Promoting durable employment and revenue opportunities among those of the forest and rangeland dwellers that constitute the "poor of the poor" of rural Oman;
- Developing, woodland and rangeland extension training programme and promoting popular participation;
- Carefully scrutinizing urban and peri-urban tree-planting operations with respect to their own impact on water consumption, particularly considering that irrigation may be of permanent nature;
- Promoting trees outside forests, in agroforestry and silvo-pastoral land-uses;
- Setting up sustained planting and seeding operations, under all possible favourable conditions and approving the proposed five-year, 1 250 ha fodder species' planting programme for the Dhofar region etc.

Introduction

Initiated as a result of the Netherlands' support to achieving the targeted outputs and activities of the Teheran Process, this mission, mounted by FAO was approved by the Omani Government. It involves preparing a case study over Oman featuring the low forest cover countries of the region, in readiness for the LFCC Workshop, to be held in October 2002 in Teheran. The mission's terms of reference are detailed in annex 1. In spite of the limited information available, the report attempts to outline the causes and effects of deforestation and forest degradation and to underline some lessons learned and priorities to enhance the role of planted forests, and trees outside forests etc.

Following a briefing session at the FAO Headquarters in Rome², the consultant arrived at Muscat³ on 25/3/02. He departed to Salalah on 26/3/02.

The organization of the mission proved to be arduous. The international consultant briefed the Head Manager of the General Directorate of Animal Wealth Resources at the MAF on 6/4/02. A short programme of visit (7-10/4/02) arranged for the northern regions of Oman was carried out successfully (see annex 2). It proved to be useful in recognizing the importance of woodlands and rangelands in Oman. Following his insistent request, assurances were given to the international consultant, regarding the imminent designation and recruitment of a national counterpart, to accompany and assist him in his task, as per TORs. The detail of the persons met is given in annex 3, while some FAO forestry definitions used in the text are presented in annex 5.

From 11-20/4/02 the international consultant collected all woodlands/rangelands related information and data available in Salalah. The task proved strenuous for several reasons: i) notes related to rangeland and woodland estates and management are limited and published mostly in Arabic; ii) data published in English is scarce; iii) no national consultant was designated to assist in securing data and information and in preparing and reviewing the draft report. A last minute set of useful handwritten notes prepared by two Sudanese expatriates⁴ stationed at Salalah, was provided to the international consultant prior to his departure to Muscat on 21/4/02. The debriefing took place at the Ministry of Agriculture and Fisheries on 22/4/02. The international consultant departed Muscat for Teheran on 23/4/02.

Considering the difficulties encountered, the international consultant has tried to prepare a report as comprehensive as possible under the circumstances. Much relevant information and data is absent. However, the lessons learned and some of the conclusions and recommendations had been examined with Mr. Mohamed Al Masheikhi⁵ and two Sudanese expatriates⁴ and formulated with their assistance to reflect the country's viewpoint.

² There is no FAO Representation in Muscat.

³ After ending his mission in Tunisia.

⁴ Mr. Salah Eldin A.M. Ageib, forest specialist and Mr.El Hag Bakhit Ahmed Koll, expert in range management.

⁵ Head of the Rangeland Resources Department at the Ministry of Agriculture.

1. General setting

1.1 Context

1.1.1 Brief geographical and historical description ⁶

One of the Gulf countries, Oman (see map in annex 6) occupies a strategic position, with a foothold on the Musandam Peninsula, which controls the Strait of Hormuz, a vital transit zone for world crude oil. It is bordered by the Arabian Sea to the east, the Gulf of Oman and the Persian Gulf to the north, Yemen to the south and the United Arab Emirates and Saudi Arabia to the west. The coastline and the land boundaries are respectively 2 092 km and 1 374 km long. Oman's borders with Saudi Arabia, UAE and Yemen are in that order 676 km, 410 km and 288 km long. The total land area is 212 460 km² of, which two-thirds is desert land running from the Dahran to Dhahira in the north, down through the Jiddat Al Harasis as far south as Dhofar. Oman is devoid of any significant water body.

From the 7th to the 15th century, Oman's maritime trade flourished, as Omani ships regularly called at ports in Persia, India and South East Asia. In 1507 a Portuguese fleet ransacked Muscat and Oman remained under Portuguese occupation until 1650. From 1804 to 1856, the country reached its zenith as a regional power with possessions on both sides of the Gulf and in East Africa. Zanzibar especially was the jewel of the crown, producing cloves, sugar, and cinnamon, while from Mombassa came ivory. Afterwards, Oman remained largely isolated until 1970, when Sultan Qaboos came to power, opening a new era of development, prosperity and social and economic progress.

1.1.2 Economic and demographic characteristics

Since 1970, when Oman's Sultan Qaboos Ibn Al-Said assumed power, the sultanate has moved from a poor underdeveloped country, towards a modern nation state.

Economy

Indexes of development measuring per capita gross national product, infant mortality, literacy rates and availability of social services validate the positive change brought about by the government's policies⁷. With a GDP per capita of US \$ 9 500, Oman is nowadays considered a wealthy country, whose economy has been transformed by the export of oil since 1967. Traditional exports were, dates, limes and fish. Prior to 1970 imports were limited to basic foodstuffs and simple goods.

In 1987 an industrial estate was established at Raysut, the port of Salalah, in the Dhofar region. The government is pushing the economic development of the country, and in addition to major domestic funded projects, is keen to attract foreign investment.

Tourism

Tourism in Oman is in the early stages of development. The private sector is encouraged to take the initiative in developing tourism. Progress has been achieved in increasing the

⁶ Source: <http://www.salalah.com/body.htm>.

⁷ Source: Internet site: [http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCIC+om0018\)](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCIC+om0018)) Data of Jan. 1993.

country's lodging capacity, which rose from 32 to 50 hotels, motels and rest houses between 1991 and 1996. The present target is to have 10 000 rooms by the year 2005.

1.1.3 Government and administrative set-up and organization ⁸

Government institutions include the Council of Ministers and two other bodies: the National Defence Council and the National Development Council. Headed by His Majesty Sultan Qaboos, the Council of Ministers includes a Special Representative of His Majesty the Sultan and a cabinet composed of 27 Ministerial Departments⁹ including the Deputy Prime Minister¹⁰. Sultan Qaboos Ibn Said who holds concurrently the functions of Prime Minister, Minister of Foreign Affairs and Minister of Defence, controls all ministerial appointments and cabinet reshuffles. Policy formulation remains largely the product of person-to-person negotiations between the Sultan and individual ministers. The National Development Council manages national development planning; all projects involving more than a given minimum expenditure require its review.

Seven government institutions have major responsibilities in matters of environmental protection and natural resources' development¹¹. They are: i) The Ministry of Agriculture and Fisheries; ii) the Ministry of Regional Municipalities and Environment; iii) the Council on Conservation of the Environment and Water Resources; iv) the Office of the Adviser on Conservation of the Environment; v) the Planning Committee for Development and Environment in the Southern Region; vi) the Ministry of Housing; and vii) the Ministry of Commerce and Industry.

The country's administrative division consists in:

- Five regions or *Mintaqas*, which are: Ad Dakhiliya, Al Batinah, Al Wasta, Ash-Sharqia, and Ad-Dhahira;
- Three governorates or *Muhafadats*, which are Musandam, Dhofar and Muscat;
- Fifty-nine *Wilayates*.

1.1.4 Political and legislative framework ¹²

Oman is an absolute monarchy with no formal constitution. All laws are issued by Royal Decree of the Sultan with assistance of the Council of Ministers. On 6 November 1996, Sultan Qaboos issued a royal decree promulgating a new basic law, which among other things, clarifies the royal succession, provides for a prime minister, establishes a bicameral¹³ legislature, which includes the Consultative Council or *Majlis Ash-Shura* (83 elected members) and an upper chamber, the *Majlis Ad-Dawla* (48 appointed members) or State Council, and guarantees basic civil liberties for Omani citizens.

⁸ Source: Internet site: [http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCIC+om0018\)](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCIC+om0018)) Data of Jan. 1993.

⁹ The Sultan occupies the sensitive posts of Prime Minister, Minister of Defence, Minister of Foreign Affairs and Minister of Finance.

¹⁰ Last update 7/20/01.

¹¹ Source: http://www.fao.org/forestry/fo/country/is.jsp?geo_id=95&lang_id=1&page_id=62.

¹² Source: http://www.fao.org/forestry/fo/country/is.jsp?geo_id=95&lang_id=1&page_id=62.

¹³ *Adj (legislature)* having two chambers.

The legal system subscribes to the Islamic Law, Sharia, which is both state and religious.

1.1.5 Planning procedures

Planning and decision-making are highly centralized, many decisions being taken by Royal Decree or by the government, which is headed by the Sultan. Some level of decentralization exists at governorate level, where specific programmes and projects for the governorate are formulated, operated and managed by the local authorities.

1.2 Environmental characteristics

1.2.1 Geology¹⁴

The geological formation in Oman ranges from pre-Permian to recent age, with rock types including volcanic formations and sediments. The predominant formations, which are of interest from the point of view of water resources' collecting, belong to the post-nappe autochthonous and autochthonous units.

Oman consists basically of two geological regions: i) the Oman mountains and their adjacent areas in the north; and ii) the desert area and the southern mountains.

1.2.2 Landscapes and soils

The very diverse¹⁵ country landscapes include the following:

- The Musandam Peninsula at the extreme north is a deeply fissured fjord-like landscape;
- Northern Oman is bounded by the rugged Hajar Mountains that run NW-SE over 600 km along the northern coast. The western Hajar section (peak at 3 009 m situated in the Jabal Akhdar) achieves higher elevations than the eastern segment of the Hajar chain. Owing to the limestone sediment structure of the mountains, water flows regularly in the deeply cut ravines of the wadis;
- The Batinah coast referred to as the garden of the Sultanate is a fertile plain extending 400 km long and 10-50 km wide, between the western Hajar Mountains and the Gulf of Oman. The soils of North and South Batinah are of alluvial types. They comprise yermosols of silt and fine sand, which represent the most suitable soils for agricultural activities. Some of the gravel covered soils of the inter-fluvial plains are used for agricultural production despite their low suitability;
- The Ja'alan region located south of the eastern Hajar Mountains is home to the Wahibah sands, which extend 200 km to the Indian Ocean shoreline. The soils here are, formed mainly by alluvial and aeolian processes. Yermosols constitute here also

¹⁴ Source: United Nations Economic and Social Commission for Western Asia, UNEP Regional Office for West Asia, FAO – National Plan of Action to Combat Desertification in the Sultanate of Oman: April 1993.

¹⁵ Source : <http://www.oman.de/geoe1.htm> .

the most suitable agricultural lands. Interfluvial plains with arenosols are considered to have the highest potential for agricultural production (Jicca, 1990);

- The vast, environmentally hostile flat wasteland plains of Central Oman extend 800 km from the Hajjar to the Dhofar Mountains; the Rub Al-Khali desert covers the western part of the region. Alluvial soils in the north bear yermosols derived from limestone range and represent the agricultural lands of the regions. Flood water bring weathered materials to the plains and forms fine textures soils;
- Home to the frankincense trees and to the most lush woodlands and rangelands of Oman, the region of Dhofar covers 100 000 km² of diverse landscapes comprising the high dunes of the Rub Al-Khali, the dry plateau, the steep mountain escarpments, the foothills and the coastal plains. The Salalah plains with their yermosols derived from the northern Jabal, represent the most important agricultural lands in the southern region. In the Jabal, soils are well structured and are of clay and silt type. Yermosols are also the main soils in the Nejd desert.

1.2.3 Climate ¹⁶

The Sultanate can be divided roughly into three climatic zones:

- Sub-tropical climate within the coastal area of the north, in Muscat. The summers are very hot and humid. Winter is characterized by its mild temperatures (around 25⁰ C) and the heavy downpours that may occur and lead to dangerous flooding that affect the mountain areas, the hydrographic network and the infrastructures;
- Dry climate (scare rainfall, high temperatures) dominates in the deserts and gravel plains of central Oman;
- Tropical climate under the influence of the light southwest monsoon that brings cool winds, rainfall and dense clouds and fog from the Indian Ocean to the southern Dhofar region (see Box), during the “kharif” season from June to early September. The rest of the year, the temperatures remain mild and occasional heavy downpours occur, bringing floods that affect the watersheds and the coastal plain.

With the exception of Dhofar region (see details on Dhofar climate in annex 9), the climate of Oman is typical of deserts of mid latitudes. It is extremely hot and dry most of the year. Summer begins in mid-April and lasts until October. The highest temperatures (54⁰ C) are recorded in the interior. On the Al Batinah plain, temperatures seldom exceed 46⁰ C, however, because of the low elevations prevailing, relative humidity may be as high as 90%. The mean summer temperature in Muscat is 33⁰ C, but the strong western winds (gharbi) that blow from the Rub Al Khali desert, can raise temperatures in the Gulf of Oman by 6-10⁰C. Winter temperatures are mild and pleasant, ranging between 15-23⁰ C.

Precipitation along the coast and on the interior plains ranges from 20-150 mm a year, occurring during mid and late winter. Rainfall in the mountains, particularly over Djabal Al Akhdar, is much more significant as it may reach 700 mm/year. In spite of this, vegetation, which might be expected to be lush, is rather meagre as the Djabal Al Akhdar plateau consists of porous limestone that allows rainfall to seep swiftly to the underground. This explains the

¹⁶ Source: Internet site: [http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCIC+om0018\)](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCIC+om0018)) Data of Jan.1993.

existence of a massive water reservoir under the plateau, which provides numerous springs and underground water for the low-lying areas.

1.2.4 Biological resources ^{17/18}

Despite an arid climate, over most of its territory, Oman is a country of comparatively high biodiversity, particularly in regions with relatively higher precipitation regimes. Rangelands and woodlands harbour a whole array of diverse plants; 1 208 species, of which 78 are endemic, have been identified.

Southern Dhofar exhibits a Sudano-Deccanian floristic affinity, with Africa, Yemen and southern India elements. Affinities of northern Dhofar and of the edge of the Empty Quarter are Saharo-Sindian, with Saharan and northwest Indian elements. Northern Oman has affinities with Iran's Irano-Turanian region of Iran at low altitudes and the western Himalayas at high altitudes (Davis *et al.*, 1986; Mandeville, 1977). Sea-grass beds, mangrove and coral reefs, as well as important planktonic and benthic algal resources characterize the sub-littoral region (Daly, *in lit.* 1982). In the Salalah region, more than 200 algae, 200 mollusc, and 120 crustacean species have been recorded (UNEP/IUCN, 1985).

The mammalian fauna, which numbers 70 species, includes Arabian gazelles, wolves, striped hyenas, Arabian leopard, ibex, Masirah hare, Arabian tahr, desert fox, and caracal. Some 461 species of birds have been identified, some of which are residents, while others stop in Oman while migrating from Africa, Asia, Europe and the Mediterranean. There are 75 species of reptiles and thousands of invertebrate species. This terrestrial variety is complemented by the rich marine diversity, made up of a wide variety of vertebrates and invertebrates, 20 species/subspecies of whales and dolphins. Five species of marine turtles, of which 4 nest along the coasts of Oman, with the green turtle nestling population estimated at 13 000 units in the Ras Al Hadalone.

There are 5 regionally and 1 nationally endemic mammal species, 6 nationally endemic reptiles and amphibians, and 26 species and subspecies of scorpions and possibly two spider species, several of which are currently at risk.

1.2.5 Land resources - Types, distribution and occupation of lands ¹⁹

According to a soils survey (MAF, 1990), the total suitable for agricultural activities in Oman is 2 223 million hectares (10,35 % of the country's surface area), of which 791 651 ha highly suitable for agriculture and 1 431 406 moderately suitable, therefore having limitations, which in aggregate are severe enough for sustained agricultural use. However, according to the study (JICA, 1990) based on analyses of the 1982 Landsat MSS data, the land area suitable for crop growing activities amounts only to 269 000 ha. Despite the surveys and studies carried out, the status of cultivable lands in Oman is not clear. The differences may be due to several factors, the most important of which would be the differences in definition of agricultural lands.

¹⁷ Source: Sultanate of Oman – MRMEWR, UNDP/GEF, IUCN: National Biodiversity Strategy and Action Plan.

¹⁸ Source: http://www.fao.org/forestry/fo/country/is.jsp?geo_id=95&lang_id=1&page_id=62.

¹⁹ Source: UNESCO for Western Asia, UNEP Regional Office for West Asia, FAO – National Plan of Action to Combat Desertification in the Sultanate of Oman: April 1993.

The Al-Batinah coastal plain accounts for about two-fifths of the land area under cultivation; it is the most concentrated farming area in the country. Annual rainfall along the coast is minimal, but precipitation on the mountains percolates through permeable strata to the coastal strip, providing a source of underground water only about 2 m below the surface.

1.2.6 Water resources²⁰

1.2.6.1 Surface water and drainage systems

Rainfall being on the whole unreliable, so is surface water flow. It is mostly confined to short periods (a few hours and at best of a few days), following substantial and usually heavy rainstorms. This runoff flows as a general rule towards the sea in the form of intermittent watercourses. Spate flows are however of major importance for the recharge of aquifers in the coastal as well as in the interior plains.

Wadi Dayqa, (70 km) south of Muscat is the only perennial surface flow, taking place over some 30 km. Some perennial springs originating from the limestone structure of the northern Hajar Mountains and southern Dhofar Jabals persist occasionally as surface flow over substantial distances (MMDI, 1991).

1.2.6.2 Occurrence and characteristics of groundwater

Estimates of groundwater resources in Oman were made by the JICA (1990), which reported 1 239,8 Mm³ of groundwater recharge available each year. Water abstraction as estimated by the MMDI for the year 1990 amounts to 850 Mm³. Opportunities to increase groundwater abstraction seem very limited. According to the estimates made by the MMDI (1991), the planned schemes for enhanced groundwater abstraction for the period 1991-1995 amounted to 12 Mm³. At the same time, JICA, 1990, estimated the water loss through floods to amount to a substantial 230,5 Mm³/year. This indicates that there is a possibility to improve the country's annual water resources availability through densification of the water-harvesting network of the country.

1.2.6.3 Desalinated water

Major desalination plants have been established in Muscat, Salalah and the Kuria-Muria Islands. Small-scale plants have been installed in some rural areas. The total annual capacity for water desalination was of the range of 41 Mm³, representing about 4,5% of the total annual water consumption of the Sultanate for 1991 (910 Mm³ as estimated by MMDI). Sea and brackish water offer an unlimited but very expensive desalination water source potential, which limits its use to potable water.

²⁰ Source: UNESCO for Western Asia, UNEP Regional Office for West Asia, FAO – National Plan of Action to Combat Desertification in the Sultanate of Oman: April 1993.

1.2.6.4 Treated wastewater effluent

Treated sewage effluents (TSE) represent a renewable source of water when properly managed. In 1993, TSE amounted to about 70 000 m³/day, representing 25,6 Mm³/year, of which, 30 000 m³ (11 Mm³/year) were used daily by the municipality of the capital area for irrigating the ornamental plants of its urban and peri-urban plantations. This amount has no doubt drastically increased since then, given that ornamental plants are irrigated on a permanent basis here, and that the number of trees planted since 1993 is quite substantial.

The increase in both generated and consumed amounts of TSE is expected to expand significantly, when the sewage systems and the wastewater treatment plants of such major cities as Salalah are completed in the very near future. Research findings of Al-Shuriani (1991) revealed that the tertiary TSE of the sewage treatment plant of Muscat was as safe as well water when used for irrigation of sunflower oil crop. This suggests that the standards set for the application of TSE may be reviewed to include besides irrigation of ornamental plants, watering of multipurpose indigenous fodder and fruit trees. These could be introduced in urban and peri-urban plantations, road plantations etc. to accommodate for greenery, embellishment and shade, and serve a production purpose with regard to non-wood forest products.

1.2.6.5 Water demand and balance

Agriculture is the main water user in Oman with about 94% of the water consumption in the country. Most of it pumped from groundwater was consumed (JICA 1990) to irrigate 54 400 ha cultivated to date palms (44%), vegetable crops (23%), alfalfa (16%), fruit trees (15%) and other crops (2%). Thirty two thousand ha were irrigated by wells, 12 410 ha by aflaj, 121 ha by springs, 2 782 ha by more than one of the above and 478 ha by rain. Farmers tend to over-irrigate to control the build up of salt concentration in the soil within the root zone. In Dhofar alone, the irrigated production of Rhodes grass consumes 50 million m³ of water annually.

The per capita water for Oman is 150,l/day, which is quite high. This figure does not however reflect the actual utilisation of water for domestic purposes as most of the water goes to irrigated agriculture.

The assessment of the water balance in Oman carried out by MMDI (1991) revealed that the water deficit for 1990 was equal to 286 Mm³. The highest water deficit amounted to 245 Mm³ for the Al-Batinah and the Capital area. Potential new resources from additional recharge dams, TSE and new wadi catchments, were expected to provide 82 Mm³/year, reducing the deficit to 203 Mm³/year.

1.3 Human factor: socio-economic characteristics

1.3.1 Population demography²¹

The total population of Oman was estimated to amount to 2 264 590 inhabitants (July 1997) and the overall density to be of 10,65 persons/km². The population is mainly Arab, but

²¹ Source: Oman Infoworld – About – The Omani People. <http://www.inforamp.net/~emous/oman/people.htm>. And <http://www.salalah.com/body.htm>.

significant minorities of Indians, Pakistanis, and East Africans are found in large cities. The Khoja community in Matrah, of Indian origin, is perhaps the richest and best-educated group in Oman. Baluchis from Iran and Pakistan are concentrated in Muscat and the Al Batinah coast; they play a significant role in the armed forces. Ex African slaves and Zanzibari Omanis of African descent are well represented in the police force and the professions. The presence of Omanis of Indian descent in Muscat reflects the historical commercial ties between the Sultanate and the Indian sub-continent. The majority of the population is Ibadi Muslim (75%). The other religious groups are the Sunni Muslims who are second in importance, the Shi'a Muslims and the Hindu. Besides Arabic, which is the official language, the other spoken and/or written tongues are English, Baluchi, Urdu and Indian.

1.3.1.1 *Population parameters*

The main population parameters (1997 estimates) are as follows:

- Age structure: The 0-14 years old represent 46% of the population (female 507 849; male 527 091); the 25-65 years old constitute 51% of the population (female 535 149; male 632 647) and the 65 years and over, are 3%, (female 33 880; male 27 974);
- Population growth rate: 3,49%;
- Birth rate: 37,85 births/1 000 souls;
- Infant mortality: 26,4 deaths/1 000 live births;
- Life expectancy at birth: total population = 70,8 years (male 68,84 years; female 72,85 years);
- Total fertility rate: 6,02 children born per woman;
- Death rate: 4,39 deaths/1 000 population;
- Sex ratio at birth: 1,05 male/female.

1.3.1.2 *Spatial and temporal mobility of populations*

Opportunities in urban centres stimulated the rural-urban shift, reducing the number of individuals engaged in agricultural labour. The net migration rate is estimated at 1,42 migrants/1 000 inhabitants.

1.3.1.3 *The gender issue*

Women play a more active and visible role in Oman than in most of the Arabian Peninsula. Omani women have received government support and encouragement, which provide schooling and university education for girls on a par with that of boys. The government has also decreed that women should be given career opportunities and equal pay. In Muscat, many women now have jobs, especially with the government. In the rural world, women have always played an active role in the agricultural communities. For the most part, the Omani women are not veiled, although in some tribes, they still wear the “burqa” or facemask and black cloak, the “abaya”.

1.3.1.4 *Employment*

The total labour force was estimated at 430 000 (1995), 40% of which have an agricultural occupation. Because of the small indigenous population, the government has called upon foreigners. In 1992, about 60% of the labour force was foreign. The high percentage of foreigners in the working labour force has contributed to an informal caste system, with nationals clearly ranked highest in the hierarchy, followed by westerners, with non-western foreigners at the bottom. It has also prompted the government to introduce an indigenisation programme, whereby nationals gradually replace foreigners.

A high proportion of the Omani population works in either their traditional activities of agriculture, livestock and fisheries, or are employed by the government. They also work in the wholesale and retail sector and in “other services” sector. Expatriate jobs have been created in the construction sector as well as in non-traditional activities. However, significant expatriate participation occurs in the wholesale/retail sectors and in other services as well as in agriculture.

1.3.1.5 *The tribal nature of the Omani society past and present*

The tribal past of the Gulf society in general and of the Omani people in particular is undeniable. Tribal leadership was based on the concept of “the first among equals”, suggesting a collective leadership in which one among a number of leaders was recognized as the most authoritative. This principal leader continued to consult with his lesser colleagues, ruling by consensus.

An extension of this pattern of leadership is the notion of leading families within the tribe. Although tribalism tended to discourage inherited authority, tradition of leadership, were nevertheless passed down, and tribes expected certain families to provide them with leaders. The existence of these ruling families is, perhaps still one of the most obvious manifestation of tribalism nowadays. Economic development has resulted in social transformation, decreasing the importance of the tribal element.

1.3.2 **Economic overview**²²

1.3.2.1 *Economic performance*

It is closely tied to the fortunes of the oil industry. Petroleum accounts for 75% of export earnings and government revenues and for roughly 40% of the GDP. Oman has 4 billion barrels of proved oil reserves, equivalent to 20 years’ supply at the current rate of extraction.

The 1997 budget was based on US \$ 5,3 billion revenues and US\$ 6 billion expenditures. The GDP was estimated in 1996 at US \$ 20,8 billion and the GDP real growth rate equal to 6,5%. The 1996 GDP per capita was equal to US \$ 9 500. The inflation rate in the same year was of 0,5%. The GDP composition by sector for the year 1994 was as follows:

²² Source: <http://www.salalah.com/body.htm>.

- Agriculture 3%;
- Industry 55%;
- Services 42%.

1.3.2.2 Oil industry and economic diversification

The national industries are based on crude oil extraction and refining as well as natural gas production. The government is encouraging private investment, both domestic and foreign, as a prime force for further economic development and diversification.

The exports amounted in 1996, to a total value of US \$ 7,2 billion. Petroleum was first, representing 75% of the total export value. Other resources exported were: fish, processed copper, textiles etc. The total value of imports in 1996 was US \$ 5,5 billion. Imports concerned machinery, transportation equipment, manufactured goods, food, livestock, lubricants etc.

Since the development of the country's infrastructure in the 1970s, national development plans have given priority to reducing dependency on oil exports and encouraging income-generating projects in non-oil sectors, promoting private sector investment and effecting a wider geographical distribution of investments to correct regional imbalances. Constraints in implementing economic diversification include the limited growth potential of alternative sectors, such as agriculture and fisheries. Constraints include also the low-skilled labour force, the limited water resources etc.

1.3.2.3 Main agricultural production systems

Although agricultural activities are carried out by private farmers and enterprises, land distribution for agricultural purposes (and other activities) is controlled by the Ministry of Housing. 1970-1988 some 27 436 ha were distributed to farmers and enterprises to be used for agricultural purposes. About 57% of the 100 000 h cultivated agricultural land is concentrated in Al-Batinah, 46% in the Northern Region, and 4% in the Southern Region. These Al-Batinah and Al-Sharquiya agricultural lands were often lands originally occupied by natural woodland stands, particularly of the species *Prosopis cineraria*, which make up good agricultural lands.

The widely accepted figure for irrigated land area in Oman is in the range of 55-60 000 ha. The area under cultivation is believed to have increased by almost 18% from 1985 to 1990. Fruits were grown over 36 990 ha, i.e. 64% of the cultivated area in crop year 1989-1990. With over 10 million date palms planted in the country, dates accounted for 45% of the total cultivated area, or 70% of the area under fruit cultivation. Grains such as barley, wheat, and corn accounted for 19,2% of the total area under cultivation (11 092 ha), and vegetables accounted for 16,8% of the total area cultivated, i.e. 9 732 ha.²³

During the period 1985-1990, the overall agricultural production increased by 3% to 669 000 tons. Field crops, largely alfalfa accounted for more than half the total agricultural production, or 354 300 tons, a 40% increase in the five-year period. Fruit production (including dates and

²³ Source: [http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+om0042\)](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+om0042)).

limes) was 182 400 tons, up from 154 500 tons. Vegetable production totalled 162 300 tons, an increase of almost 50%.

Projection from a 1982 survey showed that the livestock population could be estimated at just over 1 million heads comprising (Source: Statistical Yearbook 1989):

- 831 000 goats and sheep;
- 126 000 cattle, mainly in Dhofar;
- 126 000 camels (mainly concentrated in the Dhofar region).

1.3.2.4 Status of agricultural sector in the national economy²⁴

Agriculture is carried on at a subsistence level and the general population depends on imported food. Agricultural products include dates, limes, bananas, alfalfa, vegetables, livestock, and an annual fish catch of 100 000 MT.

While the participation of agriculture and fisheries to the GDP has risen in absolute value from 14,3 OMR in 1967 to 117,1 OMR in 1989, its share expressed in percentage of the GDP has declined from 34,6-3,6% in the same period. The mean annual growth rate (calculated over eight years) of the sector was equal to 9,6% is an indication of the ambitious development of the sector (JICA, 1990). Although agriculture and fisheries contribute little to the GDP, they are given high priority by the government, which intends to encourage further their development, to improve the county's food security and limit the rural-urban potential migration movements. Maintaining the present rate of agricultural development has its limits however, as water constitutes a serious limiting factor to its expansion.

1.4 Food security and consumption trends in Oman

1.4.1 Agricultural production and self-sufficiency

Self-sufficiency in agricultural food products in 1988 ranged between 0% for rice, beans, sugar and plant oil, to 64% for vegetables, 105% for dates and 408% for some fruit. Projections were made to improve self-sufficiency in agricultural products, partly by increasing the cultivated area, particularly for the production of red meat, which would require an increase of cultivated area from 10 174 ha in 1988, to 14 412 ha in 2000. This however depends on the capacity to mobilize new water sources which, as indicated earlier, are very limited.

Animal products in Oman are subject to a large deficit as self-sufficiency was only 26,0% in 1988. This was variable according to the product: It was 28,6% and 29,9% respectively for meat and milk products. It was lower for eggs and poultry, respectively 18,8% and 6%. It was projected to achieve here 100% self-sufficiency by year 2000. Increase in self-sufficiency for red meat was projected, as it was to reach 46,6% in 2000. Local milk products will remain deficient and would satisfy only 22,4% of the country's demand in 2000. The projected 92 000 MT demand for meat in 2010 is far beyond the capacity of the natural woodlands and rangelands of Oman.

²⁴ Source: UNESCO for Western Asia, UNEP Regional Office for West Asia, FAO – National Plan of Action to Combat Desertification in the Sultanate of Oman: April 1993

1.4.2 Firewood and charcoal consumption

Firewood is barely used in the country, since the introduction of natural gas energy, which is available in the most remote areas and at reasonable prices. As for charcoal, most of it imported from Indonesia, Somalia etc. even though there subsists some local but insignificant production.

2. Forest and range resources: current status and management

2.1 Forestry and range survey information

2.1.1 Forestry and range data and information systems

Insufficient funds have been allocated for the acquisition of reliable and timely geo-spatial data and information. Thematic maps are scarce, often outdated and the development of digital geo-spatial databases is proceeding slowly. The MRME possesses a Geographical Information System (GIS) but has not yet developed the capacity for comprehensive periodic national/regional surveys. This is in part explained by shortages in equipment and training opportunities (for geo-spatial data management). For the most, however, this is due to a lack of reliable field data collection capacity. With the exception of a few and often outdated qualitative descriptions of the country's natural resource base, such basic data as surface area occupied by existing woodlands and rangelands, estimated available biomass, wood volume stocks etc. is severely lacking. The important shift in vegetation cover and in land occupation following deforestation, rangeland degradation and woodland/rangeland distribution for urban/rural settlements and agricultural development is impossible to be assessed in terms of area loss and of environmental impact. The existing basic authoritative studies/documents published following project implementation and special expeditions are difficult to trace, due to feeble archiving systems in the public administrations.

2.1.2 Forest and range surveys

Except for descriptive investigations carried in As-Sharqia²⁵ and Dhofar²⁶ regions, there has been no comprehensive survey of the woodlands/rangelands estate in the country. However, following the sketching of a vegetation map²⁷ for Dhofar, an approximation of the area covered by natural vegetation has been attempted, which indicates that:

- The total rangeland and woodland area for the Dhofar region would be about 500 000 ha;

²⁵ Investigation by the Royal Geographical Society's Wahiba Sands Project, which identified over 130 plant species

²⁶ By Anthony G. Miller and Miranda Morris.

²⁷ Produced by A.M. Agieb.

- The rangeland area would be approximately 400 000 ha;
- The woodland and forest area amounts to some 100 000 ha.

The stocking of the Dhofar woodlands is greatly variable: (i) in the escarpments and at the foothills, it ranges from 1 000-1 500 trees/ha; (ii) in the wadi valleys, it amounts to 150-300 trees/ha; (iii) in the short-grass plateau, stocking is low, between 10-25 trees/ha; (iv) in the naturally protected tall-grass plateau, there are 1 000-1 500 trees/ha; (v) in the desert area, the stands of *Boswellia sacra* found in the north draining valleys display variable stocking rates of 10-200 trees/ha.

2.2 Features of country's woodlands/rangelands

Oman's arid/semi-arid vegetation types can hardly be differentiated into "single purpose use" groups. Indeed, it is difficult to distinguish between woodland, bush or shrub-land, grassland etc. because trees, shrubs, herbs and forbs tend to be closely intermixed and ecologically interdependent. This intimate, mutually supporting relationship between various vegetation forms is typified by the fact that herbaceous plants, whose vegetation period becomes shorter as aridity increases, owe their occurrence, growth and regeneration ability to the shelter they find under tree cover. Under such harsh ecological conditions, vegetation cover is open, ranging from wood stands composed of more or less continuous cover of trees and shrubs, to scattered and sometimes isolated trees and shrubs sheltering meagre grass.

Such vegetation cover forms are predominant in Oman. Though they may be rather dense at times, they remain principally seen and used as a source of forage and browse as well as a source of energy and construction wood. This clarifies the overlapping system of land use they belong to, namely woodland and simultaneously rangeland. Although the country has no forests in the accepted meaning of the word, there are however a number of extensive dense woodland communities. Throughout this report, however, reference may occasionally be made to woodlands or to rangelands, but the understanding remains that in Oman, woodlands and rangelands constitute one major vegetation form.

2.2.1 Ownership status, structure and distribution of natural woodlands and rangelands

2.2.1.1 Ownership status

Woodlands and rangelands are legally owned by the government, but actually still managed and controlled by tribes, despite the fact that traditional customs have been officially abolished. Rangelands and woodlands are demarcated into segregated territories exploited by their traditional users. This is particularly true of the frankincense lands, which are, for all practicality, still under possession of local people claiming to have old ownership documents. In general and as of today, the tribes control all the incense production (Source: Salah Eldin Abdallah Mohamed Agieb, Salalah, April 2002).

2.2.1.2 Structure and distribution

It still often claimed that except for a narrow strip of significant woodland and grassland in the southern Dhofar Mountains, Oman does not possess any natural woodland. Considering FAO's definition of woodland, it may be asserted that the country has possessed and still accommodates extensive, though often degraded woodland areas of such major species as *Acacia tortilis*, *Prosopis cineraria* in the Ash-Sharqiya, Al-Batinah etc. regions. Others, such as the Juniper woodland (*Juniperus macropoda*) of the central range of the Western Hajar Mountains, are important.

According to El Hag Bakhit Ahmed Koll (2002), tree cover that can be classified as forest/woodland in Oman is found in the: (i) Jabal Akhdar in the form of *Reptonia-Olea europea* woodland; (ii) Ravines, at the higher altitudes of Jabal Aswad; (iii) Wahiba Sands desert, which supports degraded *Calligonum comosum* cover and extensive *Prosopis cineraria* stands; (iv) Al-Batinah coastal sands and further inland where open woodlands of *Acacia tortilis*, *Prosopis cineraria* and *Salvadora persica* with ground cover of *Suaeda* spp. and *Mareua crassifolia* constitute a very important, but excessively browsed vegetation of dwarf bushes and or more exceptionally of trees. The saline coastal wetlands of Al-Batinah and Mahawt island support groves of *Avicennia marina*; (v) Western Hajjar Mountains' Juniper woodland and; (vi) the middle slopes of the Dhofar mountain range, and to a lesser extent the upper plateaux, where woodland/forest belts dominated by *Ficus sycomorus*, *Ficus vasta*, *Ficus lutea*, *Tamarindu indica*, *Anogeissus dhofarica*, *Ziziphus spina-christi*, *Acacia nilotica* etc. Sparser tree cover is also found at the foothills of Jabal Dhofar, with occasional dense groves in the wadis. Some *Avicennia marina* mangroves still exist in the coastal area of Dhofar.

According to A.M. Ageib, the woody vegetation cover of Oman can be schematically divided up into the following three categories²⁸:

1) Desert vegetation: In this category, thorny trees are found in watercourses and low lands. They include *Prosopis cineraria*, *Ziziphus spina-christi*, *Ziziphus leucodermis*, *Acacia tortilis*, *A. laeta*, *Maerua crassifolia*, *Leptadenia pyrotechnica*, *Tamarix* spp. *Boswellia sacra*, *Nonorthops* spp. etc.

2) Coastal vegetation: The coastal areas covering the eastern part of the country are subdivided into:

- The extensive coastal plains, which are characterised by the presence of such plant species as *Ipomea pes-caprae*, *Heliotropium fartakense*, *Limonium axilare*, *Cyperus conglomeratus* and the grass *Urachondora serulata*. The main tree species is *Acacia tortilis*. The plains bear a number of xerophyte shrubs, such as *Cadaba baccarinii*, *Cadaba farinosa*, *Caesalpina erianthra*, *Commiphora* spp., *Adenium obesum*, *Euphorbia* spp., *Aloe* spp., *Tamarix aphylla* etc. Extensive, sometimes very dense stands of *Acacia tortilis* and *Prosopis cineraria* are found respectively on the gravelly plains and on the sandy areas of Ash-Sharqiya and Al-Batinah regions.
- The coastal lagoons and sea tongues, which bear some relicts of *Avicennia marina* mangrove stands.

²⁸ Source: Report on Forest in Oman, by: Salah Eldin A.M. Ageib, forestry specialist, Dept. of Range and Forestry, Salalah – Oman.

3) Mountainous vegetation: Vegetation varies in kind and density within the same mountain range. The main differentiation factor is topography, which determines the vegetation types of the foothills, the escarpments and the plateaus. Tree vegetation cover and density are more significant in the Dhofar mountain chain, which is highly affected by the summer monsoon rains. The Hajar Mountains, which are subject to a winter rainfall regime, bear less vegetation cover, mainly because of the limestone nature of the soils, which allow for deep-water infiltration.

Collectively, the vegetation cover in both areas includes among others the following tree and shrub species: *Ficus spp.*, *Olea spp.*, *Dodonea spp.*, *Ziziphus spp.*, *Acacia spp.*, *Lania spp.*, *Sterculia spp.*, *Blepharispermum sp.*, *Cadaba spp.*, *Moringa spp.*, *Dracena spp.*, *Euphorbia spp.*, *Croton sp.*, *Euclea sp.* etc.

The assertion that Oman is devoid of woodland formations is in all probability attributable to the fact that these are assimilated to, and confounded with rangelands, given their major past and present utilization and significant contribution to fodder production and livestock breeding. This may explain why the FAO Forest Resource Assessment for 2000 states that “there is very little forest or woodland in Oman. The date palm (*Phaenix dactylifera*) is the country’s most important tree with almost 10 million palms grown along the northern Batinah coastal strip”.

2.2.2 Natural woodland and rangeland global estate and shift in vegetation cover

2.2.2.1 Woodland and rangeland area

Based on the examination of inventory reports made available to it, FRA 2000 stated the following: (i) no historical data are available for the country; (ii) “There is no natural forest cover in Oman. The woody cover present in the country is being planted by the government”; (iii) Oman’s total forest cover amounts to 920 ha of man-made forests.

It is clear from the previous paragraphs, particularly 2.1.2, that this statement is erroneous. It is obvious at this stage that there is a lack of statistical data on the Sultanate’s woodlands and rangelands global estate. This would explain that no official figure has been proposed to FRA 2000.

2.2.2.2 Woodland and rangeland degradation

Woodlands and rangelands are degenerating at an alarming rate. Some Dhofar mountain range areas that were once covered with dense woodlands have now only scattered trees. In northern Oman woodlands and rangelands have degraded and lost much of their vegetation cover as well as a number of palatable species. All are displaying poor regeneration ability.

Because no inventory or monitoring activities have been carried out, the levels and extent of degradation phenomena are not known. However, on account of visual descriptions, degradation must affect more or less intensely, all the woodlands and rangelands of the country.

2.2.2.3 *Shift in vegetation cover following deforestation & rangeland devastation*

According to FRA 2000, the forest cover change for the period 1990-2000 amounts to a mean annual increase of 37 ha. As disclosed earlier, this figure does not take into consideration the substantial changes that affect natural woodlands, which have neither been inventoried nor monitored.

In actual fact, the forest cover change is likely to be negative, considering that woodland and rangeland allocation for agricultural and urban development still takes place. It is indeed a common scene to encounter, particularly in Al-Batinah, boundary landmarks of recently distributed plots within natural woodland, rangeland and scrubland stands. Moreover, degradation processes taking place in most of the woodland and rangeland estates of the country add to the surface area lost every year.

It may be said that the structure of some important woodlands and rangelands in the country is relatively well documented but not updated, while the magnitude of the estate is unknown, as is the relative importance of the various types of woodlands and rangelands. It is, however a common belief here, that the woodlands and rangelands of the Dhofar Region are by far, the most important of the country.

Regarding the products and services available from woodlands and rangelands, little is known except for the fact that they contribute very substantially to the fodder needs of the animal population of Oman. The revenues and employment secured from natural rangelands and woodlands are likewise not documented, though undoubtedly very important.

2.2.3 **Structure and magnitude of man-made forests**

According to a report (anonymous)²⁹ forest plantations began in the Sultanate of Oman in the mid seventies. They were mainly associated with the greening of cities and later evolved to include the rehabilitation of areas affected by overgrazing and desertification. Even though some introduced species are used in such operations, tree planting mainly focuses on native species. Several institutions (MAF, MRME, Dhofar and Muscat Municipalities etc.) carry out afforestation activities. “By year 1999, the planted area in the country amounted to 1 172 ha, including a total number of 548 133 trees and shrubs planted at 4mx4m distance”. According to FRA 2000 the total area planted (including forest plantations) until year 2000, was equal to 920 ha. Considering a mean annual increase of 37 ha, the area planted should therefore equal 994 ha in 2002.

The only precise indications we have with regard to “man-made forests” or plantations meant to be established and to be treated as government-owned forest stands are those for the Dhofar region. The statistics provided by Mr. Salah Eldin A.M. Ageib, expatriate forestry specialist in Salalah, indicate:

1. 2 000 ha of rangeland rehabilitation (Jabali grazing enclosures) by planting and enhancing natural regeneration of tree species);

²⁹ The report is termed as anonymous, because only a part of it was handed over to the consultant, the date of publication, name of the author and report title were not given.

2. 178,6 ha of reforestation (175 000 trees) in degraded forest areas within:
- The plains and foothills of Dhofar Mountain. The species used were: *Acacia Senegal*, *A. nilotica*, *Boswellia sacra*, *Zyziphus spina-christi*, *Anogeissus dhofarica*, *Tamarindus indica*, *Phytocellobium dulce*, *Zyziphus jojoba*, *Azadirachta indica* etc.
 - The wet and dry plateaus of Dhofar Mountain. The species used were: *Acacia Senegal*, *Zyziphus spina-christi*, *Anogeissus dhofarica*, *Ficus sycomorus*, *F. vasta*, *Cordia purpurina*, *Olea europea*, *Tamarindus indica*, *Lawsoniana inermis*, *Woodfordia longiflora* etc.

The contribution of these forest plantations to the extension of the national forest or vegetation cover is not known and if any, would be very insignificant. The contribution of these plantations to fodder, wood, charcoal, and non-wood forest products, is nil, seen that they are under integral protection.

2.2.4 Structure and importance of trees outside forests

Trees outside forests in Oman include fruit tree plantations, urban ornamental plantations and roadside plantations.

2.2.4.1 Orchard plantations

Fruit orchards covered 36 990 ha in 1989-90 (about 64 % of the country's total agricultural area). Date palm plantations occupied 26 000 ha, representing 70 % of the fruit orchard area. It is estimated that 10 million date palm trees have been planted up to year 2002.

2.2.4.2 Urban and peri-urban forest and ornamental tree plantations

There are no global statistics relative to the urban man-made forests and ornamental plantations, which surely constitute most tree plantings in the country (line tree-plantings, parks, gardens etc.). The MRME is in charge of the country's urban planting programmes, with the exception of the Dhofar, Sohar and Muscat governorates, where they depend on the municipalities. These have developed ambitious long-term urban forestry programmes, relying on the increasing availability of treated wastewater effluent to satisfy their irrigation needs. A project has been initiated by the MRME to identify the priority zones for its future urban and peri-urban programmes.

Common characteristics of these urban tree plantations are: (i) their very high cost; (ii) their large and permanent dependence on irrigation water and; (iii) their strong reliance on expatriate labour force. Their future expansion and preservation are tightly correlated to the amount of irrigation water that will remain available to them. Treated wastewater effluents may soon be exclusively destined to crop irrigation, in which case, urban forests would rely upon selecting drought-resistant species that would reduce or even suppress the need for tree irrigation.

2.2.4.3 Road plantations

Road plantations, often composed of water-demanding exotic species, exist over hundreds of kilometres throughout the country. Irrigation is carried out on a permanent basis, once a week at doses ranging from 60-120 l/tree. While in large peri-urban areas, roadside plantations are irrigated with treated wastewater effluent, more inland they depend exclusively on pumped underground water transported by tanker. These plantings are not only very expensive they also consume large amounts of “clean water” more needed for the satisfaction of domestic requirements or crop cultivation. In Dhofar, the municipality has established about 200 ha of road plantations and natural parks (eight).

2.3 Woodland/rangeland environmental significance

2.3.1 Biodiversity conservation

With their 1200 plant species, woodlands and rangelands contribute significantly to the national biodiversity. They constitute also vital habitats to large animal communities. Their importance with regard to biodiversity is reflected by the precedence the National Biodiversity Strategy sets upon protecting all forms of natural vegetation.

2.3.2 Other protective functions of woodlands, rangelands & TOFs

As elsewhere, woodlands, rangelands and trees outside forests in Oman have numerous protective functions, among which those of: (i) protecting animal and plant life by providing salutary shade; (ii) soil and water conservation; (iii) bestowing habitat for multiple life forms and; (iv) protection against winds, enhancing soil fertility, reducing pollution etc. Other intangible protective benefits comprise enhancing groundwater recharge; improving local climatic conditions; providing shelter to agricultural crops, controlling desertification etc.

2.4 Economic and social significance of woodlands and rangelands

2.4.1 Populations depending on range and woodland estate³⁰

The populations depending on the range/woodland estate are chiefly pastoral nomadic communities. Estimated at 70 000 persons (3% of the total population of Oman), they occupy over 80 % of the country’s landmass. These pastoralists who hold most of the country’s livestock wealth, are thinly spread over the entire central desert region of Oman as well as in other areas, namely: (i) nearly 10 000 people along Al Batinah, in the Hajjar and Jabal Akhdar valleys, and the Interior Foothills; (ii) some 30 000 Dhofari livestock breeders in the South; (iii) about 30 000 pastoralists in the Central Region.

³⁰ Source: Pastoralists in Oman, By D. Chatty, M. Marzoug and A. Osman (FAO, Rome 1991)

2.4.1.1 Population characteristics³¹

The economic viability of a pastoral household depends upon having enough manpower to manage their mixed herds of camels and goats. Often the manpower requirements of the household exceed that of the nuclear family. The division of labour in a household leaves women fully in charge of smaller domestic animals (goats and sheep), while men are responsible for the larger camels and, in parts of Dhofar, for the cattle.

Increasing numbers of herders have recently recruited foreign labour to tend their cattle, and to a lesser extent their camels and goats. This has been induced by: (i) a rise in the rate of migration of young jabalis³² in search of employment; (ii) an expansion in school attendance by both boys and girls; (iii) new job opportunities available at administrative and Firqat level; (iv) a significant increase in herds' size and in volume of work required to maintain them; (v) a relative advantage induced by additional incomes from migratory family members coupled with the low-cost of foreign labour.

2.4.1.2 Socio-economic benefits derived from woodlands & rangelands

Rangelands and woodlands constitute the most valuable source of nutrition and shelter for animal herds that form the major source of income of rural communities. Although their main use is linked to livestock rearing, they also provide direct and indirect benefits that have yet to be assessed and which include: (i) a variety of wood and non-wood products and range by-products; (ii) soil and water conservation in watershed areas; (iii) mitigation of aridity and desertification; (iv) habitat for wildlife and; (v) environmental protection and recreation.

2.4.1.3 Prevailing socio-economic issues related to woodlands & rangelands use

The prevailing woodland and rangeland socio-economic related issues are due to their steady degradation, reduced productivity and carrying capacity, which strongly impact people's livelihood quality. Also, cheaper imported products compete strongly with the national agricultural commodities, affecting even more deeply the pastoral communities that depend on woodlands and rangelands for their living. Despite the government's variable forms of investments and subsidies, poverty is affecting gradually local herder communities, and migration may become a major national issue in the future.

2.4.2 Production versus consumption

2.4.2.1 Fodder production capacity vs. actual consumption

In most parts of Oman, a significant number of trees and shrubs make up a very reliable and substantial source of animal feed. Despite some destructive interventions (traditional lopping) the density of trees and shrubs is surprisingly remarkable for such arid areas and their significance in terms of grazing and brose sources may be illustrated as follows:

³¹ Source: Pastoralism in Oman By: D. Chatty, M. Zaroug and A. Osman (FAO, Rome 1991).

³² Young people belonging to the herders communities residing in the mountain (jabal) areas.

- In parts of the Wahiba Sands, Al Harasiis, Jeneba, and Beit Kathir areas, sizeable *Prosopis cineraria* woodlands are found, from which seed-pods, considered to be an excellent source of sound feed for the herds, are traditionally collected and supplied to camels and goats particularly;
- In the arid northern and eastern Oman, livestock herds are basically fed with agricultural products. Fodder consumption from rangelands taking place after the rainy season exceeds by far their annual renewable production capacity. In the north, livestock get about 40% of their feed needs from roughages including rangeland resources (forage and browse) and the rest from concentrated animal foodstuff;
- In Dhofar the most nutritious animal diet comes from rangeland/woodland grazing and browse as well as from complementary feed made up essentially of hay, cut grass, concentrated feed etc. It is estimated that the Dhofar Jabal livestock dry matter requirements are met in the following proportions: (i) 75% for rangeland resources (grazing/browse); (ii) 25% agricultural products and concentrated feed.

Rangeland feed resources' contribution in animal diet is shown in table 1. Fodder supply from natural rangelands/woodlands in northern Oman represent 8 % of the total animal requirements of the region, while in southern Oman, natural rangelands/woodlands provide 47 % of total animal requirements.

Table 1: Natural rangeland feed resources budget in the Sultanate of Oman (reference year 2000)

Region	Total Animal Units	Forage/ browse* Available	Forage/ browse Requirements**	Annual forage/browse deficit	
				Mt dry matter	in % ***
Northern Oman ³³	266 800	44 000 Mt	587 000 Mt	543 000 Mt	92 %
Southern Oman	231 400	240 000 Mt	510 000 Mt	270 000 Mt	53 %
Total	498 200	288 000 Mt	1 097 000 Mt	813 000 Mt	74 %

Source: Al Hag Bakhit Ahmed, November 2000. * Forage/browse dry matter available in metric tons (Mt-DM). ** Animal forage/browse requirements in metric tons of dry matter (Mt-DM).

*** In percent of the animal fodder/browse requirements

2.4.2.2 Wood production capacity vs. actual consumption

Information related to the wood production capacity of natural and man-made tree stands and to the volumes of wood harvested from them is totally lacking. According to A.M. Ageib, common utilizations of wood resources are regressing in Dhofar. Wood stakes and thorny branches have been replaced by concrete posts and wire mesh in the construction of animal enclosures and since the advent of fossil energy in rural areas, dead wood is only used for outside cooking during ceremonies and for barbecuing.

2.4.2.3 NWFPs: production capacity vs. actual consumption

NWFPs have been and still are traditionally harvested, processed and utilized. Because they have barely been documented, it is difficult to assess accurately their production capacity and actual consumption. The main categories of NWFPs are:

³³ Including North and South Batinah, Al Dakhiliya, Al Wasta, Al Sharquiya, Al Dhahirah.

- Oleo-gum-resins: The oleo-gum-resins found in *Boswellia* and *Commiphora* species are produced in resin ducts present in the bark. *Boswellia sacra*, the most celebrated plant in Dhofar (see annex 11), has played a vital economic role until recent times and was widely used as a medicinal plant for a whole range of ailments;
- Medicinal plants: According to the most recent review on the subject³⁴ the main NWFPs of Oman are medicinal plants. At least 16 species have important uses in healthcare and in traditional medication (see details in annex 5).
- Dyes and tannins: Commonly used dyestuffs in Oman are extracted from *Catharus tinctorius* used in dyeing and in cosmetics, and from *Indigofera coerulea*. Tannins are extracted from *Pergularia tomentosa*;
- Handicrafts: Until recently, one would rarely encounter a community in a settlement or small town, including Salalah itself, which did not engage in making a variety of traditional handicrafts and rural products. A proportion of the local communities, particularly women, acquired experience in craftsmanship for the production, among other things, of:
 - Palm and Agave leaf fibres for the confection of products as baskets, ropes;
 - Pottery and clay containers;
 - Leather goods as strings for hair-binding, skin bags, containers;
 - Sewing and needle work;
 - Frankincense and dry perfumes etc.

The above products and others were designed and made to meet local communities' requirements. The household used part of these products and the rest was sold in local markets to generate family revenues. However, following society's modernization, people shifted to low-cost imported alternative goods that proved more suitable for modern lifestyles. The subsequent decrease in demand for traditional handicraft products resulted in a reduction of their production. The present concern is to support rural products and traditional handicrafts by improving their quality and presentation and securing a consistent market to maintain their production. The development of tourism might open a new profitable market.

2.4.3 Woodlands & rangelands' economic contribution

Forestry, in the sense of a sector aiming principally at the production of forest resources, mainly wood products, is practically non-existent in Oman. This is due to the fact that forests exist only in the form of small galleries, the main bulk of tree vegetation being constituted of woodland and shrub-land or bush, intimately mixed with herbs and forbs that constitute together the natural rangelands of Oman. Rangelands and woodlands, particularly in Dhofar, make an important contribution to the agricultural economy as they provide for livestock, thus an important source of income for the country.

³⁴ Amal Sabra & Sven Walter – Non-Wood Forest Products in the Near East: A Regional and National Overview.

2.4.4 Contribution to employment, revenue generation and food security

2.4.4.1 Contribution to employment & revenue generation

No information was available regarding woodlands and rangelands' contribution to employment and revenue generation.

2.4.4.2 Contribution of woodlands and rangelands to food security

While it is known that rangelands contribute significantly to food security, by providing fodder and forage, no recent assessment of this contribution has been found by the mission. The contribution of rangelands to livestock rearing, thus to meat production may be important, but it does not meet the consumption needs. In 1987, meat consumption amounted to 46 000 MT while the local production was 7 500 MT (Source: MMDI, 1991).

2.5 Management, conservation and participation tools

2.5.1 Woodland/rangeland management objectives, achievements and perspectives

There is, to all appearances, no management programme of any significance for rangelands and woodlands. The Rangeland Department of the MAF is nevertheless developing management tools by undertaking the following:

With regard to rangelands³⁵, a programme of periodic ecological assessment of rangeland resources has been running since 1995. Thirty-nine permanent sites were established in different ecological zones of the Dhofar Mountain and have been annually measured³⁶ to determine the range conditions and trends. The results so far indicate that 90 % of the total rangeland area in Dhofar is severely degraded. There is a change in vegetation composition, a reduction of species and of range quality and productivity. Many areas have, for all practicality, become completely devoid of any vegetation cover;

With regard to forestry, the following tools have been developed³⁷:

- Creation of a nursery in Salalah (1991), which produces seedlings for reforestation programmes and for distribution to the private sector and to governmental institutions. The annual forest tree seedlings' production has dropped from 80 000 (1991-1995) to 30 000 since then. A forest nursery manual has been prepared;
- The Range Department (Forest Division) has implemented a pilot reforestation programme in 21 fenced plots totalling 178,6 ha selected in different deforested ecological zones of the Dhofar region. The objective is to protect some species by providing them a safe sheltered habitat and to provide information about growth, drought and wind resistance, irrigation requirements etc.
- Establishment of an arboretum of 4 ha, in Salalah, comprising 60 species and 1 220 trees. The objective is to provide seeds for reforestation programmes, carry out

³⁵ Information provided by Mr. El Hag Bakhit Ahmed, range management expatriate, Salalah.

³⁶ The field procedure comprises cover, density, frequency and productivity measurements.

³⁷ Information provided by Mr. Salah Eldin A.M. Ageib, forestry expatriate, Salalah.

phenological studies, and determine the adaptability of species under the arboretum's environmental conditions;

- Production of a vegetation map giving an idea about the relative importance and distribution of rangelands and woodlands in the Dhofar region.

2.5.2 Conservation/extension of woodland/rangeland resources - Tools

The MAF's Range Department has established 3 enclosures in the Dhofar plains and foothills, to determine their effect on the conservation of natural woodlands and rangelands. The comparisons between measures within the enclosures versus those in the adjacent open areas give the following average results:

Table 2: Comparison of forest cover characteristics inside and outside enclosures, 8 years after their establishment

Item	Average stocking: (trees-shrubs/ha)	Average species/ha	Average tree cover/ha	Average grass cover/ha
Fenced plots	215/ha	5	12 %	52 %
Adjacent open areas	50/ha	2	1,3 %	35 %

Source: Salah Eldin A.M. Ageib, Forestry expatriate expert, Salalah, 2002.

A similar trial carried out in the wet plateaus of the Dhofar mountain range indicate that the grass cover in the west region is 98,4 % in the fenced plots and 76,8 % in the open ones. The results were respectively 96,5 % and 88,6 % in the central region, and 96,9 % and 82,6 % in the eastern region. (Source: Aspects of desertification and its causes in Dhofar, By: Salah Eldin A.M. Ageib, 1999)

2.5.3 Promoting participation in woodland/rangeland management

Involving local communities in efforts to manage and conserve for their own benefit natural resources makes good sense, because they know and understand the local environment, observe changes affecting it on a timely basis and are able to respond to any crisis situation without delay. Furthermore, "Activities planned and undertaken by communities guided by local knowledge are certain to be more culturally sensitive and less disruptive than centralized programmes, which tend to operate in terms of highly aggregated and simplified information" (Rappaport, 1993).

There is no capacity built up in the country, for the introduction of an authentic participatory approach to development. In fact, there are no significant conservation, rehabilitation or management programmes, where such an approach could be implemented. There is however a communication process in progress, between the government, represented by the Directorate General of Agriculture, Animal Wealth and Fisheries (DGAAWF) for the Dhofar region and local livestock husbandry communities in Dhofar, in relation to the livestock off-take and numbering programme underway.

3. The forest and range institution

3.1 *Institutional framework of forest and range*

3.1.1 State institutions in charge of woodland, range and desertification control matters

3.1.1.1 Desertification control matters

The Ministry of Regional Municipalities and Environment³⁸ (MRME) has the overall responsibility over environmental control, including some form of control over range and forest resources, whose utilization and eventual conversion require the delivery by the MRME of a “No Environmental Objection” certificate. It also has prime responsibility for desertification control vested in its General Directorate of Environmental Affairs. Other institutions, which claim responsibility for, or are dealing, *de facto* with desertification control are the Ministry of Agriculture and Fisheries (MAF), the Development Council, the Planning Committee for Development and Environment for the Southern Region etc. While concerned, their individual roles in desertification control are not always spelled out in their establishment decree or order. The General Directorate of Agriculture, Livestock and Fisheries of the Governorate of Dhofar is an exception in this respect as it has been and continues to be extensively involved in combating soil and vegetation (natural pastures, woodlands and rangelands) degradation.

3.1.1.2 Woodland and range matters

The MAF has the responsibility for the country’s animal wealth as well as for natural rangelands, which include pastures, wooded rangelands and woodlands.

The General Directorate of Animal Wealth at the MAF is in charge of livestock breeding programmes and woodlands and rangelands. The conservation and management of the latter is vested to the newly established Rangeland Resources Department (RRD), through its Planning, and Rangeland Conservation and Development Sections. A Directorate General of Agriculture, Animal Wealth and Fisheries (DGAAWF) assists the RRD in its task, in each of the Dhofar, Al Batinah, and Al Sharquiya regions.

Dhofar’s DGAAWF comprises an Animal Research Station under which is placed the Forest and Range Resources Section³⁹ itself subdivided into three divisions, respectively for: Natural Rangelands, Range Genetics and Range Research. The Range Research Division deals among other things with the management of frankincense natural stands. It is operated by 3 graduates, (1 national and 2 expatriates specialized respectively in range management and forestry), as well as 4 technical assistants. A new Rangeland Resources’ Department is proposed under Dhofar’s DGAAWF. It is to be headed by a director and would comprise 4 divisions in charge of planning, implementation and supervision of range, forestry and irrigated fodder and forage production activities in the region.

³⁸ Established in 1991, the Ministry of Regional Municipalities and Environment was preceded by the Ministry of Environment created in 1984 and charged with the responsibility of environmental pollution control and water resources.

³⁹ Initially, this ex-Forest and Range Department was the only institution that dealt with forests and rangelands conservation and management. The Rangelands’ Resources Department at the MAF is of recent creation.

3.1.2 Main assignments of the Rangeland Resources Department

Besides the RRD's general assignments, this paragraph details the specific duties of the Planning and Rangeland Conservation and Development Sections as well as the specifications of Dhofar's DGAAWF's Range Section.

3.1.2.1 Main assignments of the RRD

The RRD⁴⁰ main assignments consist of:

- Planning and implementation of range and forest resources' surveys, collection of data and information pertinent to the status and utilization aspects of these resources;
- Protection of the range and forest resources and preparation of necessary plans for their proper use according to their potential and capacity to support livestock and provide other products;
- Planning and implementation of programmes for reforestation, shelterbelts and windbreaks establishment, in collaboration with concerned government bodies and local communities;
- Testing and development of agroforestry and sivicultural practices and treatments suitable for the improvement of native fodder tree species. Screening introduced tree and shrub species and selecting the most suitable ones for use in the implementation of the Department's programme;
- Enforcing and ensuring close observance of the Range and Forestry Law in collaboration with relevant government bodies. Drafting local acts and regulations and submitting them for approval;
- Planning and implementing an extension-education programme to increase awareness about the importance of range and forest resources and the need for their protection;
- Preparing and implementing training programmes, seminars, conferences and other technical meetings in the fields of rangeland management and forestry, with the collaboration of specialists, with the objective of upgrading the human resources' capacities

More specifically, the assignments of the RRD's individual sections are as follows:

3.1.2.2 Assignments of the RRD's Planning Section

It is vested with the following assignments:

- Preparing range conservation plans and programmes;
- Running socio-economic studies relative to rangeland resources' utilization by pastoral societies;
- Preparing programmes aiming at the organization and sustainable management of rangelands;

⁴⁰ The RRD is operated by two graduates.

- Proposing technical prescriptions and administrative and legal regulations to manage the rangelands.

3.1.2.3 Assignments of the RRD's Rangeland Conservation and Development Section

It is in charge of:

- Implementing desertification control, and rangeland rehabilitation and expansion programmes;
- Formulating and implementing deferred grazing⁴¹ programmes;
- Conducting periodic range vegetation surveys and studies to assess the resources available and their carrying capacity;
- Coordinating with the concerned authorities the involvement of livestock breeders in rangeland development and utilization programmes;
- Formulating legal and regulatory instruments for range conservation and management;
- Coordinating with the animal wealth extension bodies, rangeland conservation and management awareness raising programmes aimed at livestock breeders and herdsman;
- Preparing plantation programmes based on selected forest and fodder tree species and varieties.

3.1.2.4 Assignments of the Range Section of Dhofar's DGAAWF

Dhofar's present Forest and Range Section has carried out the essential of the studies as well as some research related to forests and range in Dhofar. It has implemented a number of forestry and rangeland improvement projects. Its main assignments are:

- Conserving and managing rangelands and woodlands;
- Training national staff;
- Implementing extension and education programmes;
- Implementing forestry and range policy;
- Enforcing the Range and Forestry Law and ensuring that it is closely observed;
- Planning and implementing range and forest resources' surveys, collection of data and information pertinent to the status and utilization aspects of these resources;
- Protecting, administering and developing range and forest resources;
- Planning and implementing programmes for reforestation, shelterbelts and windbreaks establishment, in collaboration with concerned government bodies and local communities.

⁴¹ Deferred grazing, grazing exclusions, closing-off rangelands, resting rangelands...

3.1.3 Main assignments of the forest and range research

Fifteen forest and range research project proposals have been included in the country's Sixth Five-Year Development Plan (20012-2005). They focus on topics whose present fundamental state of knowledge is inadequate, as well as on the main problems related to range and livestock.

3.1.3.1 Forest and range research programme

The programme comprises basic studies on:

- Woodland and rangeland resources;
- Range and browse utilization and production systems;
- Livestock husbandry systems;
- Range improvement through agronomic and silvicultural practices as well as soil through moisture harvesting and conservation techniques;
- Rangeland, woodland and livestock management;
- Local feeds and agricultural by-products for supplementary animal feeding;
- Fodder crops and fodder trees and shrubs;
- Irrigated forage production;
- Genetic resources' conservation;
- Utilization of treated sewage effluent, saline water, and moisture harvested from fog etc. for the establishment of fodder tree and shrub plantations, shelterbelts, shade plantations.

3.1.3.2 Forestry experimentation carried out in Dhofar

The following experimental trials have been carried out in order to improve the rate of seedling successful establishment in fodder tree and shrub plantations:

- Testing the effect of pit basin depth⁴² on survival rates of freshly planted seedlings benefiting from one 60 litres irrigation/seedling indicated that (i) the basins did not improve the survival rate of *Anogeissus dhofarica* planted in the Dhofar's moist plateau, but did improve height growth after 51 months; (ii) the basins had beneficial impacts on the survival rates of *Ziziphuz spina-christi* and *Blepharispermum hirtum* planted in the drier Dhofar foothills; (iii) in all cases, planting with limited irrigation is possible, as confirmed by the successful plantation (40 ha) in 1997 of *B.hirtum* in a foothills' fenced plot;
- Trapping fog moisture⁴³ to provide additional water to planted seedlings was tested in 2 sites within Dhofar's dry plateau area using *Ficus vasta* and *Acacia gerardii*

⁴² Control plus 10 cm, 20cm, and 30 cm deep basins.

⁴³ By means of 1 m² mesh grids located within each pit-basin.

seedlings. Results indicated a significant improvement of survival rates of the water-demanding *Ficus vasta*. With the drought-resistant *Acacia gerardii* there was no significant difference between treated and control plots.

3.1.3.3 Rangeland experimentation carried out in Dhofar

Three trials were carried out as follows:

1. Participatory⁴⁴ testing of the khareef resting⁴⁵ effect over 2 400 ha overgrazed, unproductive land. After one resting season, land productivity improved, vegetation cover reached 96 % of mostly palatable species (96 %) and tall grass fresh weight attained 15 Tons/ha, providing feed for 6 months after khareef as compared to 3 months feed in adjacent non enclosed and on managed fields (Source: MAF, Rangeland and Forestry Department (1991): Grazing land restitution experiment at Aqabat Toq, south of Teetam);
2. Range fertilization trials showed that N as urea gave good responses following applications of up to 200 kg/ha to improve range quality/productivity. At higher rates, compound fertilizers out-yielded urea;
3. Weed control: Promising results were achieved in suppressing *Dodonea viscosa* in tall grassland (West Qamr) by repeated cutting and successive applications of kerosene to the stumps. The control of such pernicious weeds as *Solanum in anum*, *Cecus quadrangularis* and *Cassia spp.* was also investigated and good results achieved.

3.1.3.4 Experimentation at Rumais Livestock Research Station (Ash Sharqia)

The Nutrition Division there has initiated a research programme that aims at formulating satisfactory animal feed rations that would include fodders from the indigenous woodland/rangeland tree species. Starting in 1992, a six-year chemical analysis programme covering all animal feeds available in Oman, including various native fodder resources established among other things that *Prosopis cineraria* is rich in protein and energy, particularly in the pods, and that it could be advantageously used in the formulation of animal feeds.

3.2 Legal framework of forest and range

3.2.1 Forestry and rangeland legislation and regulation

A legal forest and range conservation Act is to be published soon. It aims to control woodlands/rangelands utilization patterns (grazing regulations), monitor their impact and assist in the conservation of the woodland/rangeland resources by preventing their abusive

⁴⁴ This management trial was carried out with the full participation of 55 livestock owners, who removed voluntarily their livestock during the Khareef season in return for feed subventions by the government.

⁴⁵ Complete cessation of grazing and browsing during the monsoon season.

utilization and/or conversion to other land use types. The proposed law takes into consideration the traditional “Hema” and “San” protection customs. Consultation with local administrators, technical units, local communities, “Firqat” and police is anticipated during the preparation phase of the law.

The Law would give legal authority and power to local units to supervise, implement and enforce the law by arresting and/or fining offenders. The MAF would not deal with disputes or enforce the law, but would rather participate in assessing and reporting damage, educating and making communities aware about the necessity to abide by the rangeland and forest resources new conservation regulations.

3.2.2 Other environment related legislation and regulation

The legislation for wildlife and nature conservation is largely based on: (i) Decree No. 26/79 (15/5/1979) providing authority to establish national parks and reserves; (ii) Ministerial Decision No. 4 of 6/4/1976 that provides for total prohibition of hunting, shooting, capture and molestation of “all species of birds in all parts of Oman’s shores and islands at all times, etc.

By 1991, the responsibility for nature conservation was passed from the Diwan of Royal Court, to the former Ministry of Environment and Water Resources. With this change, the emphasis has shifted from the conservation of “high profile species” to the development of a National Conservation Strategy (NCS) with emphasis on ecosystems’ preservation and protection (see paragraph 3.5.2).

3.3 Policy and planning for forest and range

3.3.1 Policy framework

The government emphasizes the necessity to protect and manage natural forest and range resources to secure a sustained production for the future. Its guiding principles on range and forest resources management prescribe the following:

- Sustainable management;
- Increasing resources’ availability by way of reseeded, plantations, and sound management; and
- Focus on indigenous plant species;
- Reduction of livestock numbers;
- Participation of local people to achieve sustainable livelihoods;
- Environmental protection;
- Preservation of genetic resources.

With regard to livestock, the previous plans defined priorities, programmes and targets with the objective of achieving maximum self-sufficiency in animal products as well as

overcoming the constraints related to deficits in feed resources. Another major goal is to improve the livelihood conditions of livestock owners and herders by integrating livestock and agriculture husbandry and improving the utilization of rangelands. Moreover, animal production is to be increased by enhancing the development of small-scale poultry farms and encouraging dairy and beef fattening.

3.3.2 Planning framework - Country Vision

The current highly centralized government system limits the ability of regional and local institutions to play a meaningful role in development planning and decision-making, particularly with regard to sustainable management of woodland and rangeland resources and production systems. These institutions are also not in a position to negotiate participatory partnership arrangements with organized stakeholders and local communities depending on natural resources for their livelihood.

The mandates of the monitoring and regulatory authorities and institutions pertaining to the assessment of environmental issues, the formulation of sound solutions and the enforcement of environmental laws are not clarified and coordination mechanisms ill defined.

The 1990 – 2010 macro-economic conditions may be different from the circumstances that prevailed through the late seventies and early eighties, when buoyant oil prices enabled a high rate of development to proceed, raising very high the populations' expectations. In view of the uncertainty of future oil prices, matching these expectations to the available resources and fully and wisely utilizing them will necessitate most careful planning in the next decades. This is very important, given the rapid population growth, which will likely continue to exceed the economic base. To achieve careful planning, it is necessary to assess thoroughly the resources available and to closely monitor their modification.

The long term Country Vision encompasses the following:

3.3.2.1 *National Action Plan to Combat Desertification in the Sultanate of Oman (NAPCD)*

Formulated jointly by FAO, UNESCO and UNEP (April 1993), the NAPCD, in its long-term strategy (1994-2020) identified a number of programmes, among which the following address woodland and rangeland rehabilitation, management and development:

Introduction of improved land use systems in areas affected by, or prone to desertification. The programmes aim at:

- Introducing integrated approaches in land resources' utilization and management;
- Introducing improved rangeland husbandry/management systems;
- Undertaking major afforestation programmes;
- Undertaking a campaign of stabilization of shifting sands – specific project proposals to combat desertification in Al-Batinah, Al-Sharqiyah, and Dhofar priority regions should be adopted and receive due priority.

Setting-up a public participation programme to ensure people's involvement and support, and make use of indigenous technological knowledge and experience to ensure their commitment in planning project preparation and implementation.

The NAPCD has so far received little implementation in part for lack of institutional capacity to carry out the programmes aiming at introducing improved land use systems.

3.3.2.2 *Desertification Control Symposium*

A National Desertification Control Symposium for the Dhofar region was held in Salalah in March 2002. The objective was to: (i) review the desertification process in the governorate, its known causes and impacts, (ii) evaluate the efforts undertaken in combating desertification and appreciate the constraints faced in the process; (iii) formulate new desertification control plans and programmes in the light of the recent scientific and technological innovations and (iv) formulate educational and extension programmes for various target groups, to support combating desertification in Dhofar.

The symposium also focused on such issues as water scarcity and decreasing quality, loss of soil fertility and productivity, multiplication/spreading of plant pests. Its main recommendations aimed at:

1. Implementing the objectives and actions formulated by the NAPCD and the National Strategy for Environmental Protection;
2. Promoting the participation of agricultural and pastoral communities in planning and implementing targeted range management and desertification control projects for Dhofar;
3. Rangeland rehabilitation and grazing pressure reduction;
4. Development of remote sensing and GIS units for: a) environmental assessment and desertification processes' and impacts' evaluation; b) monitoring environmental changes; c) research and studies related to desertification and environmental protection;
5. Development of the necessary infrastructure for the promotion of eco-tourism;
6. Monitoring and evaluation of the approved regional development plans and programmes for Dhofar;
7. Improvement of water availability and use efficiency by implementing the relevant decisions and recommendations, and by promoting the exploitation of fossil water in the Nejd desert area and making the most of treated effluent water for local urban and peri-urban plantations;
8. Preparation of a national plan to disseminate education and extension materials in the fields of desertification control and natural resources conservation;
9. Encouraging the private sector to build an industrial base for the improvement of animal wealth and the processing of animal products;
10. Institution of a Steering Committee to follow-up the implementation of the symposium's recommendations.

These recommendations will need more than a Steering Committee to be translated into action. They require political and financial commitment as well as improved institutional coordination and capacity.

3.4 Environmental protection strategies

3.4.1 National strategy for environmental protection

The National Conservation Strategy was approved by the Council of Ministers in 1996. “It represents a first attempt at co-ordinating environmental actions and priority programmes, beyond the traditional species and ecosystems focus. However, its full implementation has been constrained by institutional, conceptual and financial constraints” (Source: National Biodiversity Strategy and Action Plan). This national strategy, applied to the Dhofar governorate is detailed in Box 1.

3.4.2 National Biodiversity Strategy and Action Plan

Despite their acknowledged importance, the natural ecosystems are degrading and the species and their genetic diversity are reducing at worrying rates due to the impact of growing human and animal populations as well as of increasing resource consumption and development choices. To confront this global decline of biodiversity, the National Biodiversity Strategy has opted for the following goals:

- Safeguarding habitats and productive renewable resources for rational and sustainable exploitation;
- Improving the understanding of ecosystems and increasing resource management capacity;
- Developing a legislation that insures the conservation of biodiversity together with the sustainable use of biological resources;
- Granting incentives that will promote biodiversity conservation;
- Sharing equitably the benefits of renewable resources, including genetic resources, at the local and regional levels.

A permanent inter-ministerial Steering Committee on National Biodiversity is the body proposed to ensure the strategy’s implementation. The National Biodiversity Action Plan proposes a series of priority actions, which do not mention explicitly the need for conservation, sustainable management and development of the national woodland and rangeland resources. The conservation of natural resources as proposed, seems to relate mainly to the protected areas and the endangered species.

Box 1: National Strategy for Improvement and Sustainable Development of Natural Rangelands and Animal Wealth in Dhofar Governorate

The Recent rise in livestock population and its limited off-take, have resulted in severe overgrazing/browsing of Dhofar's significant natural woodland and rangelands as evidenced by the sparse plant cover, growingly bare and compacted soils, larger number of unpalatable grass species, and denudation of the woody stratum.

Aware of the considerable socio-economic and environmental importance of these natural woodlands and rangelands, the Government of Oman has outlined in 2002, a strategy for their improvement and sustainable development. Both the government and the local user communities look upon rangelands and woodlands as multipurpose resources whose management should be multipurpose as well. The strategy's framework is then to maximize the economic, social and environmental returns of the natural rangelands of Dhofar.

The strategy reflects the government's commitment to the development objective aiming to conserve range and woodland resources, develop the livestock sector, reverse the current environmental degradation processes, and restore the original beauty of the unique Dhofar mountain range ecosystem. This calls for the sustainable management and conservation of rangelands and for the re-establishment of a balance between livestock density and range carrying capacity.

The immediate objectives of the strategy aim at achieving the following: 1) range and woodland resources inventory; 2) livestock census; 3) reduction/control of livestock density at grazing capacity; 4) distribution of livestock categories, according to animal adaptability and suitability to the existing environmental zones; 5) improvement of range and fodder resources and watershed management; 6) livestock production improvement; 7) conservation and management of range and biodiversity; 8) participation of range and woodland users to the management and conservation of the resource; 9) expansion of the rangeland and woodland areas through reseeding, afforestation etc. and 10) development of bee-keeping and recreation.

The Plan of Action is based on three major complementary programmes, presented below:

The range and livestock development programme consists in: a) livestock marketing and registration; b) initial rangeland assessment and determination of stocking limits; c) livestock de-stocking; d) Khareef range resting; e) range management and development; f) cattle and camel herds management; g) introduction of cattle breeds of high milk and meat productivity and quality;

The range and livestock extension programme: Channels for communication and information flow that cover proper utilization of range and livestock resources, with development and management options to be opened for the benefit of livestock owners and research and services units.

Range and livestock development research will include applied research to test traditional and modern techniques for a sound development and sustainable utilization of resources. Regarding animal production the most urgent priority will consist in developing adapted animal husbandry for local cattle breeds.

3.5 Outside assistance and cooperation related to forest and range

3.5.1 Multi-lateral international assistance to the forestry/range sector

The only outside international assistance on record has taken place through the “Rangeland Management Programme” project (OMA/87/013), executed by FAO between 1988 and 1990 with the following objectives:

- Woodland and rangeland area demarcation in Dhofar;
- Initiation of ecological studies;
- Training human resources in forestry and range (in-service, in-country organized courses and outside training for technicians and graduates);
- Establishing a functional Range and Forestry Department, within the Directorate General of Agriculture, Animal Wealth and Fisheries in Dhofar.

Interrupted after 2 years, the project was not in a position to implement its objectives.

3.5.2 Adhesion to international conventions

The Sultanate has become a signatory of the Convention on Biodiversity (CBD)⁴⁶, which it ratified by Royal Decree⁴⁷. The MRMEWR is the key Agency in charge of the formulation of the National Biodiversity Strategy and Action Plan NBSAP, to meet the obligations of the Convention. The latter has since been formulated to provide a framework of action that should enhance the country’s ability to ensure productivity, diversity and integrity of the national ecosystems.

Oman has also ratified other U.N. Conventions and International Agreements such as: (i) Convention on Climatic Change, (ii) U.N Convention on Combating Desertification; (iii) Convention on Hazardous Waste; (iv) Law of the Sea; (v) Marine Dumping; (vi) Ozone Layer Protection; (vii) Whaling etc.

4. Causes and effects of deforestation and woodland and rangeland deforestation

In the Sultanate of Oman, degradation affecting natural rangeland and woodland vegetation forms results mostly in desertification, owing to the harsh ecological conditions that prevail throughout the country. While natural causes, particularly the climate are, usually recognized as direct causes for the degradation processes, one must also appreciate the importance of other socio-economic, development, and political factors, which often set them in motion.

⁴⁶ In June 1992 at the Earth Summit Conference (Rio de Janeiro).

⁴⁷ (11/94 I 1994).

4.1 Indirect causes

4.1.1 Land and water tenure and users' rights and incentives

4.1.1.1 Land and water tenure and users' rights

Woodland and range resources are important to the country's rural economy. Tribal rights of usage of these resources and tribal management and protection customs were abolished in 1976. Consequently, the traditional "Hema" systems and their correlated regulations developed to ensure the sustainability of the rangelands' productivity and carrying capacity have been brought to an end. They have yet to be substituted by an environmentally friendly and socially and economically viable government initiated users' rights alternative.

Instead, the government has provided incentives to local herders and multiplied water points and road infrastructures, which facilitated the adoption of sedentary lifestyles, causing excessive pressure that has put the existence of the range resources into jeopardy. The lack of realistic land use and tenure policy coupled with the incentives provided are beyond question the main reasons that discourage herders from committing to and investing in rangeland and woodland protection and improvement. Qardheit Meshida (Dhofar) is a good example of how effective and efficient herders can be in managing productive private rangelands. This needs to be recognized and expanded, in association with herders in other areas with suitable environmental conditions (Source: Range management project 87/013 – Oman, 1990)

4.1.1.2 Incentives in agricultural production

Incentives provided in the 70s to livestock breeders, in the hope they would bring about a decrease in animal population, have as it happens resulted in a drastic rise of livestock numbers. They have been stopped since and despite efforts undertaken since 1984, and revived recently to control the animal population particularly in the Dhofar region, rangelands and woodlands are still confronted with excessive pressure, far superior to their carrying capacity.

Agriculture has been affected by rural-urban migration. Its labour force has been attracted to the higher wages of the industry and government service sectors. It has also fallen victim to the competition from highly subsidized Gulf products. The government has since encouraged farming by distributing land, offering subsidized loans to purchase machinery. The area under cultivation has risen substantially, often at the expense of woodlands, rangelands and water reserves. The use of machinery has exacerbated erosion. Intensive cropping has increased soil and water salinity, and subsequently land abandonment.

4.1.1.3 Incentives in water, woodlands and rangelands exploitation

With the advent of new development programmes resulting in water's increased availability and widespread distribution, better human and animal health services, greater cash-flow and more subsidized goods, both human and animal populations increased, exerting more pressure on resources, including woodlands and rangelands. Many boreholes and associated water supply facilities have been developed in Dhofar and other rangeland areas in Oman, with free access to all. This made rangelands accessible all year long. Combined with the continual

expansion of the livestock population, this has led to levels of fodder and forage uptakes that exceed by far the carrying capacity of rangelands, resulting in further aggravated degradation.

4.1.2 Society transformation as foundation to deforestation & rangeland degradation

4.1.2.1 Unchecked population growth versus limited environmental resource base

Rural human and animal populations have expanded far beyond the absorptive capacity of the agricultural economy and its natural resources. Given the lack of off-farm job and revenue opportunities and despite some rural-to-urban migratory movements, 40% of the indigenous population still depend on subsistence agriculture activities essentially. The large agriculture labour force contributes only 3% to the GDP and accounts for little export, which is indicative of a low level of productivity, particularly in livestock-rearing.

The government's response is to encourage private investment as a prime force for further diversified economic development. It also promotes indigenisation, whereby Omani nationals are to gradually substitute the expatriate labour force. Also, efforts are presently underway to initiate a programme aiming at controlling the animal population depending on natural rangelands and woodlands. These initiatives of long-term nature require time before yielding results, particularly given the absence of a skilled national labour force. Meanwhile, pressure on natural woodlands and rangelands continues unabated all over the national territory, leading to more rangeland degradation and deforestation.

4.1.2.2 Economic situation and investment patterns

In spite of its wealth, and of a high environmental awareness, the Sultanate has not invested adequate efforts and budget to ensure a suitable management and development of the national natural rangeland and woodland estate. This is mainly due to the priority it has given to the development of a modern agriculture and infrastructure. It also results from some serious shortcomings in the long-term policy vision, which tends to be more in support of biodiversity preservation and conservation, overlooking the fact that this can only be achieved by sustaining livelihoods, through durable management and development of the resource. Therefore, the lack of robust interventions in controlling the animal population and in developing sustainable and participatory management systems, has led to a relentlessly excessive level of resource exploitation, far beyond the carrying capacity of rangelands and woodlands. This has been detrimental to their preservation and continues to be highly threatening to their sustainable existence.

4.1.2.3 Social response to modernization

Unlike most developing countries, where independence has resulted in population increase and poverty expansion, in Oman, the Al-Nahda movement has brought about modernization and improved well-being to the people of the Sultanate. Road infrastructures have been developed, opening the rural society to outside influence. Well drillings have increased dramatically, encouraging large livestock concentrations. Opportunities for easy comfortable income sources among herders have promoted animal hoarding and made it possible to maintain non-viable, uneconomic livestock rearing practices, accompanied by a progressive

abandonment of the traditional sustainable and environmental friendly rangeland management systems. This has meant that rangelands and woodlands, in the absence of any adequate legislative and law enforcement framework, have in fact become open rangelands, where excessive animal concentration remains uncontrolled all year around.

4.1.3 Capacity to respond on timely basis to misuse issues leading to degradation

4.1.3.1 Economic and financial context – Degree of dependence on foreign aid

Despite its financial capacity, Oman has not allocated adequate budgets/funds to initiate meaningful rangeland/woodland management and development programmes and/or projects. The national policy aiming to promote private investment in the sector has not yielded any significant progress. Recent assistance from international organizations has targeted mainly environmental conservation programmes developed with UNEP. The absence of FAO and UNDP representations in Oman, may explain that no natural resource rehabilitation, management and development project has been launched since 1987. Clearly, the country could use the collaboration and guidance of qualified U.N. Organizations to initiate such programmes. This would facilitate the search for bilateral and multilateral funding, and would inject competence and experience, through variable forms of technical assistance to the rangeland/woodland sector. Until such programmes are initiated for the most vulnerable of the woodland/rangeland resources, deforestation and rangeland degradation phenomena will develop exponentially.

4.1.3.2 Dependence on external technical assistance

Oman is a young country that has achieved commendable endeavours in education. It has however, not yet developed the skills to take in charge in-country training curricula in resource management. The pressing need for qualified personnel at conception and implementation levels, calls for external technical assistance in various fields and at various levels.

4.1.3.3 Institutional set up and capabilities

Institutional capacity is in dire need for improvement within most of the national institutions entrusted with environmental resources' management and development missions. Yet, there appears to be a trend among institutions towards seeking to take the lion's share in terms of assignments and responsibilities⁴⁸. This is to some extent facilitated by the ambiguity of the mandate texts, which leave much room for contradictory interpretation as to each agency's specific roles and responsibilities. Moreover, the sharing of responsibilities between agencies is not always well specified. Public initiatives to combat desertification, protect the environment, manage the natural vegetation resources etc. are not founded on consistent, comprehensive policies, strategies, legislations, regulations and standards. Responsibilities for policy-making, regulation, planning and implementation are fragmented among highly centralized agencies. Coordination between national agencies involved in environmental protection and development missions is weak. Environmental monitoring and assessment is

⁴⁸ According to the viewpoint of representatives of Ministry of Regional Municipalities, Environment and Water Resources (MRMEWR), this institution would be responsible for woodlands and rangelands conservation, management and research.

feeble and overlapping. Training and awareness raising are insufficiently developed and enforcement procedures of existing legislation are not clear, while their capacity of execution is quasi non-existent.

The current over-centralized nature of the public administration system has, with the exception of Dhofar Region, marginalized regional and local authorities, leading to a reduction of their capacity to plan and implement rural development projects/programmes. Indeed, the modern forms of development and resources' utilization introduced within a few decades in Oman, have progressively removed the responsibility for managing the biological resources from the traditional rural communities who live closest to them and depend most on them. It has transferred it instead to government agencies distant from the resources and often unaware of the dire reality of rural survival lifestyles. These agencies have not yet developed the resource assessment, monitoring and management capacity and the political influence to counteract on a timely basis, the newly introduced technological capacity that often leads to the misuse of the limited natural resources

4.1.3.4 Environmental information and monitoring systems

Information about deforestation, agricultural and rangeland degradation and devastation, soil erosion and desertification is completely inadequate in the Sultanate of Oman. The same applies to information on current potential and actual utilization of natural resources. In addition, because of the absence of adequate archiving procedures and systems, there is barely any historic data on degradation and desertification trends. All of this makes it inconceivable to react on a timely basis to all the destructive processes taking place in the realm of natural resources utilization. Moreover, this limits seriously the country's capacity to undertake reliable and sustainable development programming and planning.

4.1.3.5 Legal, customary and regulatory instruments

Addressing natural resources' conservation issues is a complex endeavour that requires the concerted efforts of all concerned to set up a set of comprehensive legal and regulatory instruments. The biodiversity conservation legislation in force is generally adequate, but important areas related to environment and natural resources such as woodlands and rangelands are not properly covered. The penalties for natural resources' mismanagement and environmental offences are not a sufficient deterrent and not suitably enforced, for lack of enforcement agents in the field.

4.1.3.6 Degree of community involvement

The degree of community commitment, in the sense of participatory involvement in planning and decision-making is non-existent at this stage. Much needs to be achieved in the realm of public awareness raising and capacity building. Concurrently, the MAF's RRD requires a much larger and well-trained workforce to plan, implement and supervise meaningful awareness raising campaigns and introduce the participatory approach to rangeland/woodland management sector.

4.1.3.7 Cultural impact

Cooking taking place under the shade of trees during traditional wedding ceremonies in the Dhofar Jabal for instance, constitutes a fire hazard, particularly during the dry season, when woodlands and rangelands are most vulnerable.

4.1.4 Policy & Development priorities - Significance in terms of deforestation/degradation

4.1.4.1 Policy perception of roles and significance of woodlands and rangelands

As stated earlier the priorities of the country have been set upon developing modern agriculture and infrastructure networks, rather than on safeguarding and sustainably managing the residual, but extremely misused natural woodlands and rangelands⁴⁹. Even though this disproportionate agricultural development is backfiring in major agricultural regions as Al-Batinah, woodlands and rangelands continue to be converted to cropland. Only in Dhofar does there seem to be an awareness of the acute necessity to remedy the present situation.

4.1.4.2 Popular perception of woodlands and rangelands as free public good

Since lands have become national property, and traditional landowners and users have become dependent on the government for access to, and utilization of their once own terrains and resources, there has been a breakdown in the customary systems of community woodland/rangeland management. As state property, woodlands and rangelands are to a large extent used privately and without consideration for sustainability. They are regarded as a public free good to be used on the basis of “first come, first serve”.

4.1.4.3 Degree of State commitment to natural resource management

While the government may be committed to sustain natural woodland and rangelands, it does not have the capacity to supervise and manage the vast areas they encompass. Indeed, the capacity in terms of numbers and qualifications of the RRD (MAF) is negligible. Moreover, the development choices made are not always adequate. In the case of woodland and rangeland conservation, the focus has been so far solely on reducing the number of livestock heads and not sufficiently on protecting and managing rationally the resource.

4.1.4.4 Development priorities

Rural development programmes have so far been of little assistance in improving pasture farming and productivity. They have further brought little progress with regard to the conservation and sustainable management of the natural woodland and rangeland national estate.

⁴⁹ They support over a million of livestock heads and thousands of herder households.

None of the Five-Year Development Plans from 1976 to 1995 ever included desertification and natural resources' degradation control issues among the government's aims and priorities, even though regional and sectoral studies had brought to mind desertification and overgrazing as major issues⁵⁰.

As regards development priorities, efforts to preserve and manage woodlands and rangelands in Oman have long been focused on Dhofar. This is verified on account of the desertification control symposium (Salalah, March 2002), in which Dhofar was, once more, the focal point. While attributing some precedence to the southern region may well be justified, given the importance of its resources, it should not validate the quasi exclusion of the rest of the country's woodlands and rangelands from being the focus of national concern and attention. This is all the more crucial that the situation of several their tree species (*Prosopis cineraria*) have suffered great loss to agricultural and urban development and are presently undergoing various degradation forms that put their survival at stake (see Box 2).

Box 2: Degradation of the *Prosopis cineraria* stands in the Wahiba Sands

Southeast of Al-Kamil, in the Al-Sharqiya region, and penetrating the Wahibah Sands, after crossing the sabkha near Sayr Al-Rams, abundant thickets of more or less dense, but discontinued natural stands of *Prosopis cineraria*, with more or less important voids are found over a stretch of sand 2-5 km wide and 150 km long parallel to the coast. The wooded surface area is not precisely known; it is doubtless very substantial and is closest to what can be termed forest stands in terms of stocking, density of cover and average height.

It would seem that these stands formerly mixed with *Zygophyllum sp.* and *Calligonum comosum*, occupied much larger areas in a yet rather recent past. *C. comosum*'s unreserved exploitation for fuel-wood contributed greatly to its degradation. Presently, overgrazing and excessive pollarding of *P. cineraria* and continued cutting (for firewood) of all species are the main source of physical degradation of these natural forest relicts. This is aggravated by the current common practice of collecting animal droppings, found in the livestock zeribas to be sold as organic fertilizer to local farmers. The danger of this exercise consists in exporting the organic manure that maintains soil fertility at a minimum level, as well as large quantities of valuable seed reserves, without which no natural regeneration is possible. This entire situation is further complicated by the acknowledged presence since 1985 of a parasite that causes severe damage to the *P. cineraria* stands. Numerous trees within apparently healthy and vigorous stands show signs of drying out, before dying. Though the parasite has been identified since 1985 as being *Nadisa acaciae* KLUG, no action has been taken to preserve the species.

It is important to stress here the urgency of action required as well by the MRME as by the MAF.

4.2 Direct causes

4.2.1 Natural causes

4.2.1.1 Climate

Aridity affects most of Oman. Very harsh, the climate is characterized by limited and erratic precipitation, high evapotranspiration and excessively high summer temperatures. All factors,

⁵⁰ Source: National Action Plan to Combat Desertification in the Sultanate of Oman, April 1993.

which contribute to make plants' endurance, growth, regeneration and establishment so restraining, that they can hardly be resilient to any form or degree of misuse.

4.2.1.2 Soils

Large areas are covered with sandy soils, which, when disrupted are to blame for massive sand drifts particularly over the areas adjacent to Wahiba Sands and in the plains and wadis of Al-Dakhiliya, Al-Wasta and Al-Janubia regions. The forward movement of the Wahiba sand dunes is hazardous to roads, and other nearby infrastructure (Warren, 1988). Some villages have been abandoned, while others such as Qaryat Al Haouiya, a date palm oasis, are feeling the pressure of sand encroachment. There is however no information about agricultural and grazing areas affected by sand encroachment.

Vast areas are made up of soils covered with hardpans. During tropical storms, runoff is so important that it triggers very severe flash floods, which affect everything standing on their path, including vegetation, settlements, agricultural fields etc.

4.2.1.3 Topography

Topography plays an important role in soil erosion and flooding in the mountain areas of Oman. Indeed, the mountain ranges cover some 50 000 km² of very rugged and densely populated terrain, particularly in the northern Hajjar Mountains where elevations reach 2 980 m.

4.2.1.4 Natural calamities, floods, pests etc.

Floods are frequent as stated earlier; they are responsible for much land resources and property degradation as well as for human and animal losses. Pest epidemics inflict very serious damage to plant resources, as is the case, since more than a decade with the *Prosopis cineraria* stands affected by a parasite identified by the Wahiba Sands Expedition in 1985-86⁵¹.

4.2.2 Causes linked to human activity

4.2.2.1 Misuse of natural resources

Human activities are behind various forms of natural resources' misuse:

Land use versus carrying capacity

The present human and animal population levels have by far exceeded the carrying capacity of the land. The Southern Region, for instance, has about 4 000 ha of agricultural land, of which it is estimated that 2 000 ha are cropped annually to coconut, banana, vegetables, maize, papayas and forage crops (about 800 ha of Rhodes grass). This has created a serious problem as over-pumping has precipitated seawater intrusion. In the Dhofar Jabal, the problem of overgrazing may be reaching the stage of an ecological disaster. Animals are being sustained by the purchase of forages and concentrates. This, coupled with the difficulty

⁵¹ Royal Geographical Society's Wahiba Sands Expedition in 1985-86.

of marketing the expensive⁵² local livestock and meat, maintains artificially high the number of animals in the natural rangelands.

Misuse of woodland and rangeland resources

“Overgrazing has become the general trend everywhere in Oman. This is true for the low carrying capacity rangelands in Wahiba Sands and for the forests of Dhofar Mountains, in the southern region, where two-thirds of Oman’s cattle graze” (NPACD).

With regard to the Dhofar region, the NPACD explains that desertification is due to one or more of the following: (i) Heavy overstocking; and (ii) Little application of rangeland management practices. As a result, there is significant deterioration in rangeland quality and productivity. The NPACD summarizes as follows the misuse woodlands and rangelands have been subjected to in the Dhofar region:

- The coastal plain has suffered severe damage to its vegetation, as a result of overgrazing, off-road vehicles, construction and tourism activities;
- The foothills zone, which used to be heavily wooded has been subjected to heavy pressure by people and livestock and is now severely overgrazed, degraded and dominated by xerophytic shrubs;
- The escarpments, a zone of woodland and tall grasses (1,5 m) is also under severe pressure and degradation; in some areas, the removal of trees has triggered soil erosion;
- The dry plateau, a zone of short grass with thin tree cover is severely overgrazed as a result of overstocking; it suffers extensive degradation;
- In the north draining valleys, which bear sparse tree vegetation, degradation affects vegetation (much of which has become unpalatable) in quantitative and qualitative terms;
- The Desert or Nejd area, known for its famous frankincense trees is mostly devoid of any other vegetation. This explains the consequently excessive browsing pressure exerted by camels and goats, on *Boswellia sacra* stands that have been severely degraded and have suffered heavy damage.

Misuse of water resources

A striking example of water resources misuse is embodied by the situation in Al-Batinah Plain, main agricultural region of the country. The steady rise of water demanding crop cultivation results in excessive groundwater abstraction ensued by seawater intrusion, and groundwater and soil salinization. Desertification is observed at various degrees in horticultural farms, along the whole strip of land between the main highway and the coast. “The reduction of soil and aquifer potential as a result of the present levels of salinization is now widely obvious in the agriculturally important Batinah soils. Concern among the Government circles is growing about this form of desertification, because Al-Batinah coast is

⁵² The local livestock and meat are not competitive with the livestock and meat imported from such countries as Somalia, and therefore find no purchaser. Animals are therefore artificially maintained on natural rangelands.

the most important agricultural area in Oman as it produces 60 % of the country's agricultural production" (The National Plan of Action to Combat Desertification: Part Two)

Inadequate agricultural practices

The most common inadequate agricultural practices responsible for degradation are: (i) the unrestrained and often groundless use of unsuited agricultural machinery; and (ii) the intense irrigation, inefficient drainage and excessive groundwater abstraction.

4.2.2.2 Agricultural land affectation

Extensive and disorderly deforestation and range clearing since 1972 through forest and rangeland affectation to agricultural development has consequently led to their serious degradation. Agricultural land development has become important in Al-Batinah coastal plain, chiefly because the forest lands that formerly covered the area were fertile, particularly those under the once very extensive and dense *Prosopis cineraria* stands. The misuse of water resources resulting from the extension of the cultivated areas at the expense of woodlands and rangelands has triggered full desertification processes that resulted in agricultural land abandonment.

4.2.2.3 Infrastructure construction

Prior to the advent of modern roads and transport vehicles, pastoral communities followed systematic well-organized and planned seasonal migration routes with their flock, which secured a safe utilization of the resource. Now that wells and boreholes have been dug all over the range area, the herds have ceased moving and when necessary, supplementary feed is fetched by transport vehicles and delivered to them on the spot. This leads not only to severe overgrazing and browsing, but also to soil trampling and compaction.

4.2.2.4 Man-made catastrophes

Pasture fires are among the most frequent voluntary or accidental man-made catastrophes affecting woodlands and rangelands. In the case of Oman the Jabal war that broke out in 1965 in Dhofar had resulted in much destruction of woodlands and rangelands.

4.3 Effects of deforestation and of forest and range degradation

4.3.1 Loss of land productivity

Rangeland and woodland resources used to provide on a sustainable basis, the most reliable source of nutrition for all categories of livestock herds. At present, most of them are degraded. Palatable grass, shrub and tree species have become sparser and vegetation cover has decreased. In many instances, the plant resource has lost its original diversity, many species being incapable of regenerating following continuous grazing, browsing and trampling.

Woodlands are degenerating at such rate that some areas, densely covered only a decade ago, have become completely devoid of tree cover. The formerly dense woodlands of Dhofar Mountains, have now only scattered *Ficus spp.* *Anogeissus dhofarica*, *Ziziphus spina-christi*

and *Olea europea trees*. Woodlands become gradually invaded by weed species such as *Dodonea viscosa*, *Callotropis procera*...

Other effects of rangeland and woodland degradation include the following:

- The soils in the upper plain of the Dhofar region are mostly developed on alluvial fan deposits. They have been until recently, persistently reworked by termite activity, but this has ceased since the removal of the termites' main woody food material⁵³.
- The Al-Batinah plain used to be densely covered with extensive stands of *Prosopis cineraria*, near the coast, before being converted to accommodate agricultural and urban development. In a few decades the forests, victims of relentless land distribution, have lost much of their area. This is still ongoing and landmarks of private land distributions are to be seen in many of the remaining natural woodlands. This undoubtedly constitutes not only a loss in wooded surface area but also a loss in genetic capital.

4.3.2 Soil erosion increase

In the Dhofar Jabals, wet high clay content soils are vulnerable to compaction and surface sealing that contribute to reducing range productivity, decreasing rainwater infiltration rates and increasing surface runoff and erosion. Livestock hoof smearing and sealing are so widespread in these Jabals that in some places, up to 40% of the surface has been degraded following this process. Less obvious, but more widespread and potentially more serious, is sheet erosion, which confirms the verbal saying that "rocks are growing" following loss of topsoil⁵⁴.

4.3.3 Surface water wastage & groundwater recharge decline

This topic has been partly treated earlier, when referring to the misuse of water resources. An additional impact of rangeland and woodland degradation is evident in the form of increased runoff, thus water wastage, and reduction of water recharge due to a decline in water infiltration.

4.3.4 Poverty expansion

Poverty results from an excessive increase in human and animal populations, and a severe decline of natural resources. The reduction of renewable natural rangelands & woodlands' fodder/forage production capacity has led to a substantial increase in the use of purchased supplementary feeds. The subsequent increase in production costs inhibits considerably the marketing of the national meat and dairy products because of the sharp price competition from cheaper imported meat and milk products. As a result, animals are maintained alive. The limited off-take results in steadily over-crowding of natural rangelands and woodlands, reduction of fodder/forage production capacity, absence of marketing etc. The vicious circle

⁵³ Source: Land Use Study in Jabal Dhofar, Phase 1, Final Survey report.

⁵⁴ Source: Land Use Study in Jabal Dhofar, Phase 1, Final Survey report.

may continue unabated with increase in herders' debt accumulation and poverty expanding gradually to affect high proportions of the livestock breeders and herders.

5. Status of knowledge

5.1 Lessons learned

5.1.1 Policy and development choices and issues

5.1.1.1 Policy

There has been no attempt up to now, to integrate all the necessary disciplines (particularly forestry) and activities in addressing woodland and rangeland issues.

The absence of such specialized United Nations' organizations as FAO is unfortunate as it is felt that it could play a major role in promoting the development of the sector, while providing invaluable direct and indirect training opportunities to enhance the development of the country's human resources.

5.1.1.2 Development choices

There is up to now a failure to address the legitimate goals and needs of the present woodlands and rangelands users, as there is a failure to organize them and involve them in development planning and decision-making through appropriate extension and technology transfer. Due to the absence of a solid participatory approach in dealing with livestock and rangelands, there is a lack of well-targeted incentives and there exists on the contrary counterproductive ones.

There has been an unjustified failure prior to this date, to address the woodlands and rangelands issues, outside the Dhofar region. There is however, growing recognition of the fact that the same resources in North and North East Oman require attention and need to be managed and developed.

Rural to urban migration constitutes the real threat of the future. Its prevention requires that employment and off-farm, as well as off-soil revenue opportunities that feature positive impacts on local production systems be developed urgently by enhancing stakeholders' interest and investments.

5.1.2 Administrative and legislative aspects

5.1.2.1 Legislative aspects

The current legislation and regulation frameworks are inadequate and inoperative with regard to woodlands and rangelands use, management and development; They focus furthermore exclusively on the Southern Dhofar region, ignoring the need to address urgently the severe degradation and deforestation problems occurring in the North and North East of the country.

5.1.2.2 Institutional set up and capacity

There appears to be some institutional confusion at national level as to who does what, with regard to conserving, managing and developing the woodland/rangeland natural resource.

There is an institutional inadequacy within the MAF, which gives unwarranted weight and importance to the animal wealth as compared to the natural resources that not only sustain it, but also ensure a key environmental role for the nation. The MAF's organization chart should reflect better the strategic importance of woodland and rangeland management and development, lest others do it in its place.

An extreme deficiency in trained senior and field staff in the domains of forestry, rangeland management and desertification control characterizes the rangeland and forestry department at the MAF.

5.1.3 Natural rangeland and woodland resources estate and significance

Having failed to address the animal production issue in a comprehensive way in the past, the Omani authorities and technicians have begun to learn that whatever their fodder and forage contribution may be, the natural pastures, rangelands and woodlands play a major social and economic role and have a capital and environmental impact in the country, and as such, need to be paid close attention to enhance their protective and productive roles and contribution to desertification control.

Contrary to the widespread belief, the Sultanate of Oman is unquestionably endowed with substantial woodland and shrub-land natural stands, which tend to decrease in quantity and quality and overlap with rangelands in terms of land use. There is however a lack of basic data and information particularly statistical data related to the importance of the estate, the areas affected by deforestation and degradation, and the change of vegetation cover.

5.1.4 Resource use and management

5.1.4.1 Animal production

Animal production in Oman needs to recognize the importance and urgency of addressing the issue of sustainable management of the natural pastures, rangelands and woodlands, in spite of their relatively still limited contribution to forage and fodder production. Regarding livestock production, there has been so far undue emphasis put on partial solutions, such as that the reduction of animal stocks, rather than a comprehensive approach in addressing the problem.

5.1.4.2 Woodland and rangeland management

Forest and range management in the Sultanate as in other arid lands, need to recognize the close interdependence of various natural vegetation forms and strata, on one hand, and the dependence of man and livestock for food, feed, wood, fibres as well as for other "services"

provided by all forms of natural vegetative cover, be they called forests, woodlands, shrublands, wild-lands or rangelands.

Range management implies the need to make use of silviculture in order to:

- Regenerate and rejuvenate fodder trees and shrubs;
- Enhance and sustain their potential for fodder production, and
- Improve the fodder harvesting and direct utilisation techniques.

There is a lack of funds and investments allocated to woodland and rangeland management and development, as this does not seem yet to be considered a priority intervention by the government.

5.2 Gaps in knowledge

Following are the major gaps in knowledge and some key aspects related to range and woodland resources, which require action, study or research:

5.2.1 Extent & consequences of degradation & desertification

Useful information on the aspects, dynamics, extent and impacts of deforestation and rangeland degradation lacks severely. Described in vague and general terms, the causes of degradation and desertification are of little help in devising appropriate response approaches. Harsh as they may be, the cumulative effects of decades of resource neglect and mismanagement have not triggered a full appreciation of the sombre prospects such environmental setbacks represent for the Sultanate.

5.2.2 Capturing pastoralists' experience, technical and managerial skills

Traditional knowledge of grazing conditions and livestock movement patterns as observed by herders in the past are gradually being lost, as are their livestock and rangelands' managerial skills. The disruption of the traditional pastoral communities' organization has not benefited from a modern socially acceptable, environmentally suitable and economically viable alternative to the traditional knowledge and practices. At present, as a result of the above, rangelands are being misused on a continuous basis.

5.2.3 Lack of basic information and of statistical databases

The information relative to the structure and extent of the natural woodland and rangeland estate is descriptive and narrative. The areas covered by these resources, their overall available biomass, their total wood reserves etc. are not documented and no inventory has ever been carried out at any level, to assess them accurately. Likewise, quantitative data on deforestation, degradation and desertification are quasi-inexistent, particularly with regard to affected areas, and subsequent shift in vegetation cover. No national up-to-date information and data are available on a timely basis for the purpose of sound development planning.

Box 3: Problems and constraints related to medicinal and aromatic plants in Oman

The medicinal and aromatic plants of Oman have been documented to some extent in Dhofar. At the national level, medicinal and aromatic plants face a number of problems and constraints as described hereafter:

- There is a lack of information on wild medicinal and aromatic plants, their proper traditional utilization and their distribution outside Dhofar mountains;
- The uncontrolled and excessive cutting and overgrazing together with woodland clearing for agriculture and urban development may have caused irreparable loss to some wild medicinal and aromatic plants in the country;
- There is a lack of research to improve on traditional management and utilization of medicinal raw material from collection to processing, which could prove detrimental as traditions tend to die down;
- Likewise, there is a deficiency in interest and research in developing medicinal and aromatic plants' propagation and regeneration techniques in their natural habitats.

The country is short of facilities to run data collection and processing systems. It lacks furthermore the expertise to operate such systems, and above all, neither the MAF, nor the MRME, have the field capacity to undertake punctual and regular field inventories and collect/process quantitative/qualitative field data and information. As a first step towards establishing networks of decentralized statistical planning databases, the technical ministries need to upgrade their capacity to undertake periodic field inventories to assess the resources and their evolution.

No long-term historical records on climatic data exist in Oman. Even recent records are scarce given the country's shortage in agro-meteorological stations. This is a major handicap in planning management interventions and understanding degradation and desertification causes and trends. Up-to-date rainfall prediction and records are weak and not readily available at field level, where they are most needed.

5.2.4 Lack of capacity in resource management

The lack of knowledge and experience with regard to different native woodland/rangeland species and their respective management options is a serious handicap. There is no reliable and comprehensive data/information on arid-zone species' growth rates and productivity upon which to base management strategies, approaches and prescriptions. No records exist with reference to woodlands and rangelands' productivity in terms of wood and non-wood forest products. There are also no statistics related to the country's requirements and to the quantities effectively harvested, commercialised and consumed or utilized. More information is needed concerning plant species and varieties matching the social, economic and environmental contexts, particularly under arid and hyper-arid conditions. Basic livestock information such as numbers, herd sizes, etc. for different animal types is needed to improve their management.

Because of very limited in-house institutional staff and knowledge, there is a strong dependence on expatriates to formulate and implement environmental development and protection strategies, programmes and activities.

5.2.5 Awareness raising on environmental degradation and on participation

Participation in the sense of decentralization of planning and decision-making does not seem to be on the agenda. Prior to reaching this stage it is perhaps wise to attempt raising awareness among the general public and national authorities over the vital and urgent necessity to protect and manage more efficiently rangelands and woodlands. Management models need therefore to be developed. Concurrently, it is necessary to train specialized extension personnel and upgrade their capacity to communicate the information to the large public, the direct land users and the country's officials in the government's upper hierarchy.

6. Conclusions

Following are some conclusions drawn from the present case study:

6.1 *Development choices and issues*

Land degradation and desertification have drastically intensified in extent and in severity during the last decades, as a result of a growing population with rising livelihood expectations and demands.

Rural development programmes initiated so far have resulted in important improvements in the fields of irrigated agriculture, fisheries and water resources' mobilization. They have however been of little assistance in improving the conservation and sustainable management of the natural woodland and rangeland national estate.

Five-Year Development Plans from 1976 to 1995 did not include desertification and natural resources' degradation control issues among the government's aims and priorities.

Dhofar has been the focus of efforts to preserve and manage rangelands and woodlands in Oman, while other regions are still largely neglected.

Development policy needs to consider giving more attention and efforts to safeguarding the remaining, extremely misused natural woodlands and rangelands.

The lack of realistic land use and tenure policy with respect to rangeland and woodland management discourages herders from investing in these resources' protection and improvement.

Though poverty is not a present-day issue in Oman, population growth, and decline in natural resources increase the probability for future unemployment and poverty expansion.

6.2 Institutional set-up, capacity and capability

Institutional capacity is weak in most national organizations entrusted with environmental resources' management and development. Activities related to woodland and rangeland management are for the most implemented by expatriate foresters and rangeland management specialists.

Besides the excessive centralization of planning, decision-making and budget allocation, there is a lack of comprehensive policies, strategies, legislations, regulations, standards and funds that spell out clearly the precedence to give to woodlands and rangelands' conservation, management and development, and the need to formulate without ambiguity the institutions' shared responsibilities in that regard.

The lack of an effective forestry and range institution and the inadequacy of environmental and natural resources' monitoring and assessment contribute to natural resources' degradation.

The enforcement procedures of existing legislation are not clear, while their capacity of execution is quasi non-existent.

6.3 Natural resources and resource use and management

6.3.1 Biodiversity

Conservation of natural resources and the biodiversity they encompass is vital to Oman's fragile ecosystems and scarce renewable natural resources, challenged as they are by multiple interacting factors (overgrazing, felling, erosion, desertification, land degradation etc.). There is evidence that many terrestrial species have either disappeared or are being subjected to severe threats.

6.3.2 National rangeland and woodland estate

The national rangeland and woodland estate does exist and plays a very important socio-economic and environmental role, however modest the area covered by it may be. It is believed, according to rough estimates, that Oman is endowed with 1,4 million ha of natural woodland and rangeland cover, of which 0,9 million ha in northern Oman and 0,5 million ha in Dhofar.

6.3.3 Resources' use and management

Range resources are not only multi-purpose assets that protect soils, provide fodder, wood, fuel-wood, NWFPs, water seepage from monsoon mist, they are also the land bank for agricultural expansion.

The inefficient, uneconomical and unsustainable livestock management and breeding programmes negatively impact upon natural resources, causing deforestation, degradation and loss of productivity of rangelands and woodlands.

The role of planted urban and peri-urban trees and orchards has long been recognized as important. However, that of planted forests and trees elsewhere needs yet to become a national preoccupation. Much wants to be done to improve the cost efficiency and sustainability of planted forests and trees.

7. Recommendations

A number of recommendations are formulated with regard to the following:

7.1 *Development choices and issues*

7.1.1 Decentralized Planning

In view of the uncertainty of future oil prices, utilizing wisely the country's scarce natural resources will necessitate careful decentralized planning and decision-making, giving priority to local capacity building and institutional build-up in the next decades.

7.1.2 Assessment and monitoring of the resources

There is a need to assess and monitor urgently and over the entire country, the structure, state and importance of the natural woodland and rangeland estate to allow for future wise development planning. To achieve this, it is recommended to:

- Develop the national assessment, monitoring and evaluation capacity;
- Formulate and approve a programme of national, regional and local periodic natural resources surveys.

7.1.3 Popular participation⁵⁵

Because community and particularly household-based tenure systems are generally more effective than government sponsored forms of management, involving local communities and families in efforts to manage and conserve natural resources for their own benefit makes good sense. It is therefore recommended that government development authorities focus more on regulating, facilitating and coordinating biological resources' management, while enhancing communities' capacity to invest in improving and protecting the resource-base. It is also recommended that:

⁵⁵ Guiding principles inspired from Agenda 21.

- Participatory, community and family-based development programmes, projects and activities be adopted together with long-term partnership arrangements between local populations and governmental and non-governmental stakeholders;
- Their respective roles, rights and responsibilities be defined;
- Cooperative mechanisms developed, and levels of intervention and corresponding resources' allocation for the implementation and monitoring of the programmes, projects and activities be agreed upon by all stakeholders;
- Training and communication programmes be developed and provided to community representatives, governmental and non-governmental stakeholders that would address environmental and development issues, community involvement and participation in rural development etc.

7.1.4 Poverty alleviation

In order to prevent rural to urban migration and achieve sustainable natural resources' protection, management and development, it is indispensable to initiate, enhance and promote durable employment and revenue opportunities among those of the forest and rangeland dwellers that constitute the "poor of the poor" of rural Oman. In this regard, consideration should be given to expanding the vocational training capacities, to provide additional and specifically targeted training in crafts, apiculture (bee-keeping), managing, processing and marketing of non wood forest products, eco-tourism, cheese and gee production, processing and marketing of medicinal plants, cosmetics, oils etc.

7.2 *Administrative and legislative improvements*

There is an urgent need for the development of an appropriate and well-coordinated institutional and legislative framework with clear mandates, responsibilities and resources to support more efficiently and durably, the initiation and implementation of rangeland, woodland and watershed management, environmental protection, desertification control, and rural development programmes through:

7.2.1 Institutional arrangements between MAF & MRME

Clarify the respective duties and responsibilities of the MRME and the MAF and to promote their coordinated efforts (see detailed proposals in annex 7) in safeguarding, managing and developing woodland and rangeland resources.

7.2.2 Institutional arrangements within MAF

Upgrade in a mid-term perspective, the Rangeland Department to the level of General Directorate of Forestry, Range and Desertification Control within the MAF, with decentralized departments distributed over the main regions of the country; and enhance its capacity, making use of all training and cooperation opportunities (see detailed proposals in annex 7).

7.2.3 Institutional coordination

In order to improve the functioning of the existing coordination institutions and mechanisms, define accurately the respective assignments, duties, responsibilities and specifications of all the institutions concerned with environmental matters, particularly those involved with the protection, management, utilization and development of woodlands, rangelands and pasture lands.

7.2.4 International Cooperation

Request FAO's cooperation and backstopping in developing training programmes, and strengthening the MAF's capacity in the fields of woodland, and rangeland rehabilitation, protection and management, watershed management and desertification control, and in promoting sustainable rural development, by developing woodland and rangeland sustainable participatory management approaches and models;

7.2.5 Legislation

Prepare and adopt a very comprehensive Forest and Range Law, to be well coordinated with the already existing environmental laws. There is a need for the promulgation of related decrees and regulations regarding woodland and rangeland protection, utilization, management and development. Furthermore, legislation needs to be put in a broader perspective, with clear objectives in terms of integrated and community-based development and management, so as to promote sustainable growth and improved social and environmental conditions.

The basic legal requirements should consist in securing, within a decentralized community-based context, land tenure and supplying security for land and water rights, employment and revenue opportunities, to regulate allocation and utilization of resources and provide protection against abuses.

7.3 *Changes in resource management*

7.3.1 Land tenure in woodland and rangeland management⁵⁶

There is a need to formulate a tenure system that reproduces some basic features of the pastoral nomads' territory, including winter and summer pastures with permanent water points and access to market as well as a system of communities' representatives that exercise authority over organizing livestock movement, protecting and managing rangelands, and settling minor disputes through consensus.

The government is recommended to approve such formulated land use and tenure system, that would give organized groups of herders official title to the land utilized by their flock,

⁵⁶ Source: Range Management Project 87/013 – Oman, 1990.

granting them enough tenure security and motivation to invest and actively participate in, and take responsibility for the conservation and the development of their woodlands and rangeland resources.

7.3.2 Land distribution

It is recommended that the existing urban and agricultural land allocation system be reconsidered in order to ensure that land is allotted in a way that reflects market demand cost-wise and at the same time safeguards the national biodiversity, particularly the plant diversity and gene pool.

Allocating land for urban or agricultural development in areas of ecological significance (unique types of forests; woodlands⁵⁷), should be subjected to the strictest “No Environmental Objection Declaration”. In the eventuality that extensive distribution of woodland/rangeland areas is inevitable, it is recommended to ban complete clear-cutting and conserve control plots equivalent to 5% of total area within the most valuable stands to be considered as gene pools and benefit from maximum protection.

7.3.3 Management and regeneration of natural woodlands and rangelands

Giving high priority to be given to the safeguard, the regeneration and the sustainable use, management and development of the natural woodlands and rangelands, it is recommended to:

- Develop a woodland/rangeland extension programme;
- Set up sustained planting and seeding operations under all possible favourable conditions;
- Establish a programme for the rehabilitation and protection of pasture and tree plant species as indicated in tables 3 and 4 respectively (annex 8).

7.4 Enhancing the role of planted forests and trees

7.4.1 Tree planting and water constraints in urban forestry

Water being a very scarce and expensive commodity in the Sultanate of Oman, all tree planting schemes in urban and peri-urban areas need to be carefully scrutinized with respect to their own impact on water consumption, particularly considering that, irrigation operations may be permanent in nature. In addition, more emphasis should be given to local drought resistant species such as *Prosopis cineraria* and others.

The continued promotion of tree planting outside forests is very important. Urban and peri-urban forestry particularly are indispensable. Cities such as Salalah need to develop their own long-term plantation programme. It is recommended to promote strongly irrigated plantations

⁵⁷ Woodlands such as those of *Prosopis cineraria*, which have been converted over large areas to urban settlements and agricultural land, particularly in Al Batinah

using treated wastewater effluents and to increase the treatment capacity in the major cities and industrial complexes. A close collaboration with the Range Department is highly desirable.

7.4.2 Promoting reforestation and afforestation in potential areas of Oman

The country needs to develop substantially its reforestation and afforestation programmes, to compensate partly for the losses affecting the natural woodland and rangeland assets. Careful environmental studies will have to be carried out, and at the same time, trials and experimentations must pave the ground for successful planted forests in diverse regions of the Sultanate. For the time being, Dhofar is most favourable region for the initiation of the following tentative Five-Year reforestation programme that would more than double the present man-made planted forest estate of Oman is presented below for the region of Dhofar.

Planting of fodder species in the mountains areas of Dhofar

It is proposed to plant annually 100 000 seedlings, equivalent to 200 ha in the monsoon affected mid to high altitude areas of the Jabal Dhofar. Local species would be given priority. Among these, *Anogeissus dhofarica*, *Ficus vasta*, *F. sycomorus*, *Ficus salicifolia*, *Tamarindus indica*, *Ziziphus spina-christi*, *Ziziphus leucodermis*, *Acacia Senegal*, etc. *Acacia victoria*, an exotic promising fodder tree species, would be introduced on an experimental basis.

Reforestation programme for the foothills or “Gerbib” area of Salalah

At some distance from the Salalah underground water reservoirs, large surfaces of totally degraded rangeland and woodland previously covered with significant numbers of *Boswellia sacra* trees, require to be urgently reforested. The objective is to protect the city from floods, improve their carrying capacity as rangelands, augment the production of incense for local demand and serve as a recreation area. Given the aridity of the site, the plantations need to be irrigated during 2-3 seasons. Sufficient quantities of irrigation water will soon be available from the wastewater treatment plant of Salalah. The programme would concern some 25 000 seedlings to be planted over 50 ha annually during 5 years (250 ha). The species proposed at this stage are: *Boswellia sacra*, *Acacia tortilis*, *Acacia nilotica*, *Acacia ehrenbergiana*, *Ziziphus spina-christi* and *Z. leucodermis*. *Acacia victoria* would be introduced on experimental basis.

7.4.3 Promoting TOFs in agroforestry and sylvo-pastoralism

Encourage planting trees outside forests that play a major role in agroforestry, particularly in view of the fact that most agricultural fields are irrigated in Oman and trees can benefit from irrigation water for crop production, thereby improving its efficiency. Trees outside forests need also to be promoted in the rehabilitation of degraded woodlands and rangelands, particularly under the favourable conditions of the Jabals and the Wahiba sands.

7.5 Further recommendations for action

Reviving the use and conservation of medicinal and aromatic plants

It is recommended to promote and stimulate the use and conservation of medicinal and aromatic plants by:

- Developing strategies for collecting, surveying and identifying medicinal and aromatic plants as part of the National Biodiversity Strategy and Action Plan;
- Promoting and funding research programmes on regeneration and management of important medicinal and aromatic natural stands;
- Developing improved medicinal and aromatic plant collection, processing and packaging techniques;
- Encouraging small industries to supply local markets with processed and packaged medicinal and aromatic plant extracts and commodities.

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Annexes

ANNEX 1: TERMS OF REFERENCE OF THE MISSION

TORs International Consultant

Background: It is proposed that country case studies will be prepared in the Near East region in Iran, Tunisia (North African Mediterranean) and Oman (Gulf States) in readiness for the Regional Workshop for the Near East to be held in Iran in August/September, 2002. These case studies will outline the causes and effects of deforestation and forest degradation; lessons learned and priority needs strategies and methodologies to enhance the role of planted forests, trees outside forests in integrated landscape management and economic significance of NWFPs. The country study reports will be published in English/Arabic in advance of the International Workshop together with guidelines for each participating country to prepare their inputs. The consultant will also assist in providing technical advice in preparation and conducting the workshops and co-ordinating and reporting outputs.

Tasks to be Undertaken: With respect to enhancing the role of planted forests and trees outside forests for production of wood and non-wood forest products (including fuel-wood, wood products, food, livestock fodder, medicines, protection of soil and water values, shelter, shade etc) in individual country case studies, the international consultant, assisted by a national consultant, under the supervision of task managers will consult stakeholders widely to evaluate and detail for each country case study:

1. Background highlights with direct or indirect impacts upon the forestry sector, including population pressure, food security, land access, land-use rights, availability of credits, market access, forest resources (natural and planted), deforestation, forest degradation, desertification, afforestation and other key indicators of the significance and state of the forestry sector;
2. Policy, legal, planning and institutional frameworks outlining the vision and commitment of the Government, detailing strengths and weaknesses in capacity and capability (technical, technology and financial) and awareness of the environmental, economic, social and cultural value of these forest resources and ecosystems for the livelihoods rural populations;
3. Related to 1 above, inter-sectoral linkages, conflicts in land-use policy and practice, incentives and subsidies which impact upon the forestry sector;
4. Appropriateness of current policies as reflected in alternative mechanisms and practices, programmes and projects for achievement of sustainable forest management;
5. Information, data and reports on the extent (quantity and quality) of planted forest resources (forest plantations - rain-irrigated and/or with treated waste water and trees outside forests) and production of the main wood and non-wood forest products and their respective roles in provision of goods and services;
6. Meet with all stakeholders (line ministries, Municipal Affairs; communities, rural families, NGOs, private sector, research and academic institutions and international

agencies etc) to discuss and report the perceived appropriateness of current policies and priorities in planning and soundness of alternative mechanisms, practices, programmes and projects in achieving sustainable forest management and equitable sharing of opportunities, risks, costs and benefits; and

7. Formulate a list of the key issues, constraints, opportunities, lessons learned, success stories and recommended development proposals within the capacity and capability of each country to be presented as case studies at the regional workshops to represent different ecological zones, institutional and stakeholder circumstances.

The case study reports are to be prepared and presented to FAO in English within 1 month of completion of the fieldwork to allow time for review, translation to Arabic and dissemination to country participants prior to the regional workshops. A guide will be prepared for the format and content of the country case studies.

The consultant will support the FAO task managers with technical advice and recommendations on the format, content, activities and outputs from the regional workshops, with potential (to be confirmed) to attend as facilitators for the working groups. The workshop will be conducted in English and the proceedings and outputs will be presented in English and Arabic.

Duration: 3 person months, between February - April 2002

Locations: Iran, Tunisia and Oman, brief and debrief for case studies in Rome prior to and after completion of field missions

Task Managers: Hassan Abdul Nour, Near East Regional Office, FAO supported by Jim Carle and Syaka Sadio, Forest Resources Division, FAO, HQ, Rome Italy and FAO representations in the instances of Tunisia and Iran.

TORs National Consultant

Background: It is proposed that, country case studies be prepared by an international consultant, with support from an in-country national consultant in each of Tunisia, Oman and Iran in readiness for a Regional Workshop for the Near East to be held in Iran in August/September, 2002. These case studies will outline the causes and effects of deforestation and forest degradation; lessons learned and priority needs strategies and methodologies to enhance the role of planted forests, trees outside forests in integrated landscape management and economic significance of NWFPs. The country study reports will be published in English/Arabic in advance of the International Workshop together with guidelines for each participating country to prepare their inputs.

Tasks to be undertaken: With respect to enhancing the role of planted forests and trees outside forests for production of wood and non-wood forest products (including fuel-wood, wood products, food, livestock fodder, medicines, protection of soil and water values, shelter, shade etc) in individual country case studies the national consultant will provide support to the international consultant to facilitate effective and balanced in-country participation with stakeholders; ensure appropriate approvals, background resources and logistical support are available for meetings and field visitations; and to achieve a dispassionate and professional case study document. Specific tasks include:

1. Provide the link between the key stakeholders and the international consultant to identify key resource persons, organize meetings and stakeholder forums, contribute fully to discussions, arrange field visitations and provide logistical support as necessary;
2. Ensure that documentation and resources as detailed in the terms of reference for the international consultant (attached) are available in a timely manner and assist in interpretation;
3. Assist the international consultant to prepare and review the draft case study report to reflect the current status and key issues, constraints, opportunities, lessons learned, success stories and recommended development proposal priorities of the country;
4. Other tasks as identified during the case study

Duration: Full time, 1 person month, between February - April, 2002 (during fielding of international consultant)

Locations: One national consultant in each of Tunisia, Oman and Iran - field visits included

Task Managers: Hassan Abdul Nour, Near East Regional Office, FAO supported by Jim Carle and Syaka Sadio, Forest Resources Division, FAO, HQ, Rome Italy; and in-country supervision and administrative support by FAO representations in the instances of Tunisia and Iran.

ANNEX 2: ITINERARY, PLACES VISITED BY THE MISSION

- 25/3/02 Arrival international consultant in Muscat;
- 25/3/02 Departure international consultant to Salalah, meeting with Mr. Mohamed Al Masheikhi
- 27-28/3/02 Weekend Salalah
- 20/3-4/4/02 Field visits in Dhofar, meeting with Officials
- 5/4/02 Travel of international consultant to Muscat
- 6/4/02 Meeting with Mr. Al-Jabri Ali Abdallah, General Manager, Directorate General of Animal Wealth Resources, MAF;
Meeting with Mr. Yasser Ashikeili, Animal production engineer;
Meeting with Mr Saeed Al Alaoui, Forest engineer.
- 7-9/4/02 Field visits with Mr S. Al-Alaoui and Mr. Y. Eshikeili to: Al-Sharqiya and Al-Dakhiliya;
- 10/4/02 Field visit to Al Batinah, with Mr S. Al-Alaoui and Mr. Y. Eshikeili;
- 11/4/02 Return of international consultant to Salalah
- 12/4/02 Weekend in Salalah
- 13-20/4/02 Bibliographic research, interviews and report writing
- 21/4/02 Return to Muscat
- 22/4/02 Debriefing session with Eng. Khaffan Saleh Mohamed Al-Naabi, Undersecretary of The Ministry of Agriculture and Fisheries;
- 23/4/02 Departure of international consultant to Teheran

ANNEX 3: PERSONS MET BY THE MISSION

A.I-Hadabbi Abdullah Mohamed Yahya (Mr.):	General Manager Directorate General of Animal Wealth and Fisheries, Dhofar Region
Abdul Aziz Salim Al-Harthy (Mr.):	Engineer, Assist. D.G. of Agricultural Research & Extension, MAF
Al-Alaoui, Saeed (Mr.):	Forest engineer
Al-Balooshi, Derwish (Mr.):	General Manager, General Directorate of Agriculture, Animal Wealth Resources and Fisheries, Ibra – Al-Sharquiya region
Al-Harthy, Abdelaziz (Mr.):	Agricultural Research Centre
Al-Hasni Habib Abdullah Habib (Mr.):	Director of International Affairs, MAF
Al-Jaafari Khalifa (Mr.):	Director of Agricultural Research Station, Al-Sharqiya
Al-Jabri Ali Abdallah (Mr.):	General Manager, Direct. General of Animal Wealth Resources, MAF
Al-Masheikhi Mohammed (Mr.):	Head of Rangeland Department, Directorate General of Animal Wealth Resources, MAF
Al-Shandooli, Hamid (Mr.):	Department of Agricultural Land Resources, MAF
Al-Shikeili Yasser (Mr.):	Rangeland Department, Direct. General of Animal Wealth Resources, MAF
As-Saadi Salem (Mr.):	Director of Biodiversity, Department of National Biodiversity Strategy and Action Plan. Ministry of Regional Municipalities and Environment
El Hag Bakhit Ahmed Koll (Mr.):	Expatriate expert in range management, Directorate General of Animal Wealth and Fisheries, Dhofar Region
Ghaouas Ahmed (Mr.):	Technical Assistant, Directorate General of Animal Wealth and Fisheries, Dhofar Region
Khaffan Saleh Mohamed Al-Naabi (Mr.):	Engineer, Undersecretary of the Ministry of Agriculture and Fisheries
Mirza, Mohamed (Mr.):	Director Animal Production Research Centre

- Moqqadem Said (Mr.):** Department of Desertification Control Strategy,
Ministry of Regional Municipalities and
Environment
- Salah Eldin A.M. Ageib (Mr.):** Forestry specialist, Dept. of Range and Forestry,
Salalah – Oman
- Slimane Al-Hadjri (Mr.):** Engineer, Agricultural Research Station, Al-
Sharqiya;
- Suleiman Nasser Al'Higri (Mr):** Animal Production engineer, Animal Production
Research Centre

ANNEX 4: LIST OF PLANTS USED IN TRADITIONAL MEDICINE AND FOR HEALTHCARE PRODUCTUS

- *Aloe barbadense* Preparation of a cooling eye ointment;
- *Aloe inermis* Preparation of a cooling eye ointment;
- *Echolium viride* Used to clean the teeth (toothbrush);
- *Cassia sophera* Used in tea form against stomach ache;
- *Petropyrum scoparium* Has tonic properties;
- *Andrachne aspera* Has various medical applications;
- *Monsonia helitropoides* Used as snakebite remedy;
- *Olea africana* Used to make poultices for livestock wounds and sores;
- *Ephedra intermedia* Used as ointment for sores;
- *Commiphora spp.* Have various medicinal uses and are appreciated as aromatic stimulants;
- *Commiphora quadricincta* Medicinal gum;
- *C. foliacea Sprague* Used in various medicinal preparations made from the resin it exudates;
- *C. gileadensis* (L.) C. Chr. ” ”
- *C. habessinica* (Berg) Engl. ” ”
- *Calotropis procera* Used as antiseptic and as fixing agent for perfume;
- *Boswellia sacra* Has various medicinal uses, and is appreciated as aromatic stimulant.

ANNEX 5: FAO DEFINITIONS USED IN TEXT

Forest or woodland

A forest (woodland) is a land supporting tree growth with a crown cover of 10% or more over an area superior to 0,5 ha. Forest or woodland trees should be able to reach 5 m in height at maturity *in situ*. Forests or woodlands may consist of closed forest or woodland formations, where trees of various storeys and undergrowth cover a high portion of the ground. They may also consist of open forest or woodland formations with a continuous vegetation cover, in which tree crown cover exceeds 10%. Young natural stands and all plantations established for forestry purposes, which have yet to reach a crown density of 10% and a tree height of 5 m are included under forest. Likewise, they include all areas normally forming part of the forest area, which are temporarily under-stocked as a result of human intervention or natural causes, but which are expected to revert to forests or woodlands.

Forestlands exclude land predominantly used for agricultural practices, but include forest nurseries and seed orchards that constitute an integral part of the forest; they also include forest roads, cleared tracks, firebreaks and other small open areas. They comprise as well forests in national parks, natural reserves and other protected areas. Forests embrace windbreaks and shelterbelts, which are more than 20 m wide and cover over 0,5 ha together with plantations primarily used for forestry purposes, including rubber-wood plantations and cork-oak stands.

Other wooded land

Land supporting trees capable of reaching 5 m at maturity *in situ* with a crown cover of 5-10%, or supporting trees with more than 10% crown cover that cannot reach 5 m in height at maturity *in situ*, or supporting shrub cover of more than 10% cover.

Definition of trees outside forest (TOF)

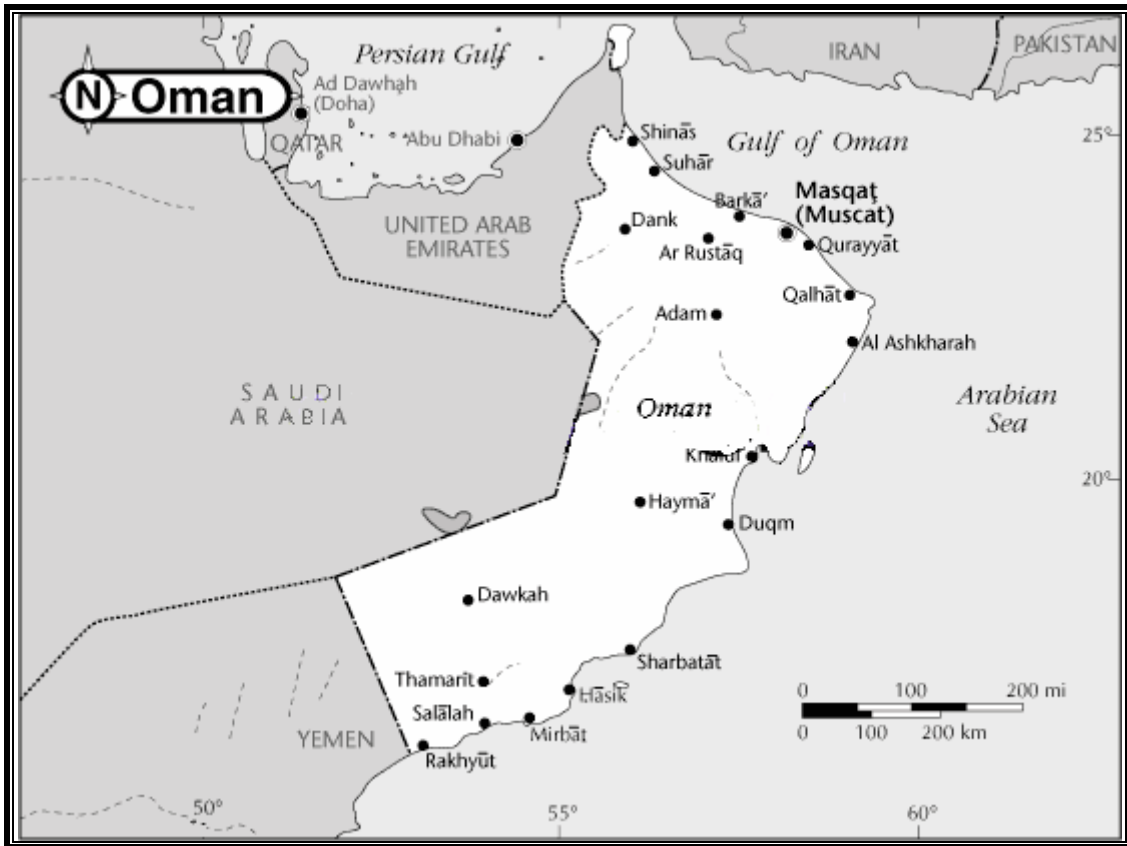
The term “trees outside forests” includes forest and non-forest trees and shrubs on land not defined as forest or other wooded land. TOFs include among others:

- Trees on land that fulfils the requirements of forest and other wooded land, except that:
 - The area is less than 0,5 ha;
 - Trees are able to reach 5 m height at maturity *in situ*, but the crown cover remains below 5%;
 - Trees that do not reach 5 m in height at maturity *in situ*, where the stocking level is below 10%;
 - Trees in shelterbelts and river galleries of less than 20 m width and below 0,5 ha area;
- Scattered trees in permanent meadows and pastures;
- Permanent tree crops, orchards and “prés-vergers” such as industrial trees, coconut trees, palm trees;
- Trees of agroforestry systems such as coffee, cocoa, home gardens;
- Trees in urban settings (human settlements) and infrastructure environment such as parks and gardens, trees around buildings and in lines along streets, roads, railways, rivers, streams and canals.

The term tree refers to a woody perennial able to reach 5 m in height at maturity, with a single stem, or in the case of coppice, with several stems, having a more or less definite crown. This definition includes bamboos, palms and other woody plants meeting the above criterion. Shrubs and bushes are woody perennial plants, generally of more than 0,5 m and less than 5 m in height and without a definite crown.

In Oman's context, the terms forest and/or woodland are not normally used. These vegetation forms are considered to be an integral part of the national rangelands, of which they constitute an important component, particularly during the dry season.

ANNEX 6: MAP OF THE SULTANATE OF OMAN



ANNEX 7: DESIRABLE ADMINISTRATIVE IMPROVEMENT REFORMS

There is an urgent need for the development of an appropriate and well-coordinated institutional and legislative framework with clear mandates, responsibilities and resources to support more efficiently and durably, the initiation and implementation of rangeland/woodland and watershed management, environmental protection, desertification control, and rural development programmes through:

Institutional arrangements between MAF & MRME

Following interviews carried out with Senior Officers⁵⁸, it appears that besides a number of important other assignments and prerogatives, the Ministry of Regional Municipalities and Environment (MRME) is also in charge of the implementation of conservation, rehabilitation, management and development of rangelands and woodlands, desertification control activities, watershed management, as well as research related to all of the above.

While it is quite legitimate for this MRME to translate the government's concerns with regard to the above subject matters in a normative manner, it is to hope that the conception and implementation aspects would become the prerogative of the Ministry of Agriculture and Fisheries (MAF). The MAF is indeed more specialized, better equipped for, largely present in rural areas and well introduced among the rural communities.

The MRME would carry the responsibility for the formulation of national policies, strategies, laws and regulations and national action plans relative to the above domains. It would also be in charge of assessing the extent and status of existing natural resources, of periodically monitoring the activities carried out in woodlands, rangelands, watersheds etc. and evaluating their impacts on the resources. It should be in a position to alert its partners on a timely basis, following any serious and imminent environmental impact threat and participate in the formulation of immediate curative responses. Finally, the MRME would have full charge of the national parks, reserves, urban and peri-urban plantations etc.

The MAF would be in charge of implementing national policies and strategies and action plans in the above-mentioned domains. It would also, based upon the above, formulate national, regional and local programmes, projects and interventions to be implemented by its decentralized institutions. The MAF would be in charge of enforcing the laws and regulations governing the resources it administers. It would also cooperate with the MRME in providing it with field data and information for its regular and periodic monitoring and evaluation activities.

Institutional arrangements within MAF

Assuming the recommendation above is received by the government and considering the immense task that would await the MAF, in the fields of desertification control, watershed management, rangeland/woodland protection, rehabilitation, sustainable management and development etc. it is highly recommended to consider upgrading for the long-term, the present Rangeland Department of the General Directorate of Animal Wealth, into a, General Directorate of Forestry, Range and Desertification Control with decentralized Departments within the main regions of the country. This could be materialized over a period of ten years

⁵⁸ Mr. Said Moqqadem Department of Desertification Control Strategy; Mr. Salem As-Saadi Department of National Biodiversity Strategy and Action Plan.

following approval of the recommendations. This interval would be fully utilized to upgrade the human resource capacity of the present Range Department as indicated below:

Upgrading the capacity of the MAF's Rangeland Department

The present absorptive capacity of the MAF's Rangeland Department is quasi-nil, particularly with regard to its main mission of woodland/rangeland protection, rehabilitation, management and development. Yet, the state of natural resources dictates that very substantial efforts, be urgently undertaken to enhance the department's capacity, which requires sizeable trained and experienced human resources. In order to tackle adequately the department's future needs in specialized work force, the following is recommended:

- Identify the relevant national expertise available in the fields of desertification control, arid zone forestry, rangeland management, watershed management etc. and proceed to the temporary assignment of those not active within their field of specialization, to the Rangeland Department within the MAF;
- Assess the complementary needs of the future G.D of Forestry, Range and Desertification Control and:
 - Send carefully selected candidates to existing forestry and rangeland schools in the Arab world (Syria, Sudan, Tunisia, Morocco, etc.);
 - Request international organizations such as FAO, to provide the Sultanate of Oman (under conditions to be discussed) with well targeted Technical Cooperation Programmes for in-country training of personnel already active, or to be recruited in the fields of desertification control, woodland/rangeland management, watershed management etc.
 - Under guidance of FAO, make the best use possible of opportunities existing to secure bilateral graduate and post-graduate scholarships from friendly countries;
 - Establish a mid-term capacity-building objective and negotiate with the Oman's traditional partners all support that could be lent in establishing adequate inland training capacities - Sultan Qaboos University, technical schools, vocational training schools etc.
 - Convince international institutions and organizations such as the World Bank, FAO, the Global Environmental Facility etc. to support the training programme developed.
- A technical committee of experts that includes NGOs, international organizations, universities, various ministries etc. would be established to look at training and research needs of the Future General Directorate of Forestry Range and Desertification Control. It would propose curricula to respond to issues related to the present context of natural resources' general misuse, abandonment and accelerated degradation.
- Enhance the human resource base and upgrade the MAF's technical and managerial skills and capacity through the development and teaching of well-targeted training modules. Likewise initiate a sound education and extension programme that has the cooperation of local communities in the fields of animal production, rangeland management, silviculture, rangeland and woodland conservation, expansion and development etc. The objective of the extension programme would be to induce positive changes in people's perceptions, attitudes and actions and achieve sustainable resource management.

Some of the training needs are summarized below:

- Forestry specialists:
 - Seedling production;
 - Tree planting;
 - Sand dune mechanical and biological fixation;
 - Watershed management and soils and water conservation;
 - Natural regeneration of species and stands;
 - Silviculture oriented towards enhanced fodder production etc.
- Range management specialists:
 - Grazing capacity of pastures and range sustainable improvement;
 - Rangeland management through various rotational grazing, deferred grazing, aftermath grazing, fenced grazing, forest aerial fodder harvesting, grazing exclusions, seasonal pasture, selective grazing, pasture regeneration etc.
 - Taxonomists;
 - Land survey specialists etc.

ANNEX 8: PASTURE AND TREE SPECIES OF OMAN THAT REQUIRE PROTECTION ./..

Table 3: Pasture species of the Sultanate of Oman that need protection.

Species	Geographical distribution	Degradation	Cause	Plant density
<i>Elusine compressum</i> (P)	Parts of North & Centre Oman	High	Overgrazing	Low
<i>Lasiurus hirsutus</i> (P)	Parts of North & Centre Oman	High	Overgrazing	Low
<i>Apluda mutica</i> (P)	Dhofar mountains	Medium	Overgrazing	Medium
<i>Themada quadrivalvis</i> (A)	Dhofar mountains	High-Medium	Overgrazing	Medium
<i>Cenchrus ciliaris</i> (P)	Parts of North & Centre Oman	High-Medium	Overgrazing	Medium
<i>Cenchrus pennisetiformis</i> (A+P)	Batinah coast/parts north Oman	High-Medium	Overgrazing	Low
<i>Chenopodium album</i> (A)	Parts of North Oman	High	Overgrazing	Low
<i>Ochthochloa compressa</i> (A)	Parts of Oman	High	Overgrazing	Low

Source: Said Bin Hamed Bin Khamis Al-Alawi – Agricultural Research, Rumais (Oman).

(P) = Perennial (A) + Annual

See table 4 (Tree species that need protection) in next page.

ANNEX 8: PASTURE AND TREE SPECIES OF OMAN THAT REQUIRE PROTECTION

Table 4: Some tree species of the Sultanate of Oman that need protection.

Species	Distribution	Degree of degradation	Cause of degradation	Agents of degradation	Plant use
<i>Maerua crassifolia</i>	All districts except highlands	High	Overgrazing & tree cutting	Humans & all animals	Good browsing & beekeeping
<i>Juniperus macropoda</i>	Jabal Akhdar > 7 000 feet	High	Overgrazing & tree cutting	All animals especially donkeys	Medicinal/browsing/beekeeping
<i>Tecomella undulata</i>	Northern valleys especially	High	Tree cutting	Humans & animals	Wood/oils production
<i>Delonix elata</i>	Dhofar Jabal	High	Grazing at seedling stage	Animals	Oils production
<i>Acridocarpus sp.</i>	Northern Oman	High	Overgrazing & seed collection ⁵⁹	Humans & animals ⁶⁰	Medical oil
<i>Ceratonia oreoethaum</i>	Jabal Aswad	High	Overgrazing (wild Arabic goat)	Animals esp. goats/Arabian goats	Good browsing
<i>Calligonum comosum</i>	Wahiba sands	High	Overgrazing & cutting	Humans & animals esp. camels	Browsing/sand dune stabilization
<i>Calligonum crinitum</i>	Empty Quarter sands	High	Overgrazing & cutting	Humans & animals esp. camels	Browsing/sand dune stabilization
<i>Acacia senegal</i>	Eastern plains of Dhofar	High	Overgrazing	Animals especially camels	Good browsing/beekeeping
<i>Ziziphus hajerensis</i>	Jabal Akhdar	High	Overgrazing	Animals especially donkeys	Good browsing/beekeeping
<i>Adansonia digitata</i>	Eastern plains of Dhofar	High	Overgrazing & no protection	Camels & tree cutting	Shading
<i>Boscia arabica</i>	Eastern plains of Dhofar	High	Overgrazing & no regeneration	Animals especially donkeys	Browsing/beekeeping
<i>Sageretia spiciflora</i>	Jabal Akhdar	Medium	Overgrazing & tree cutting	Human & animals	Wild fruit & browsing
<i>Reptonia mascatensis</i>	Jabal Akhdar	Medium	Overgrazing & tree cutting	Human & animals	Wild fruit & browsing
<i>Olea africana</i>	Jabal Akhdar/Dhofar Mount.	Medium	Overgrazing & tree cutting	Human & animals	Grazing & wood
<i>Moringa peregrina</i>	All wilayats	Medium	Grazing/seeds for oil extraction	Human & animal	Medical oil & browsing
<i>Anogeissus dhofarica</i>	Dhofar Mountains	Medium	Overgrazing	Human & animal esp. camels	Good browsing
<i>Boswellia sacra</i>	East/West plains of Dhofar	Medium	Overgrazing/luban collection	Human & animal esp. camels	Incense production & browsing
<i>Avicenia marina</i>	Lagoons in coastal plains	Medium	Overgrazing & tree cutting	Camels & donkeys especially	Browsing/ good for fish breeding
<i>Salvadora persica</i>	Sand formations North Oman	Medium	Overgrazing	Camels & donkeys especially	Browse/dune fixation/tooth brush

Source: Said Bin Hamed Bin Khamis Al-Alawi – Agricultural Research, Rumais (Oman).

⁵⁹ Seed collection for oil extraction

⁶⁰ Especially donkeys and camels.

ANNEX 9: THE CLIMATE OF THE DHOFAR REGION⁶¹

The Inter-tropical Convergence Zone (ITCZ) allows the Indian Ocean South-Western Monsoon to reach the southern part of the Sultanate in the “Kharif” season. For three months every year, from June until mid-September, mist and clouds build up over the escarpments parallel and at the same time close to the southern coast affecting an area of about 2 000 km² equivalent to 2% of Dhofar southern region’s land area. The clouds hanging some 200 m above sea level, build up against the escarpment mountains, but are unable to rise because of a temperature inversion created by a flow of hot air from the north, at an altitude of about 1 500 m. These south-facing escarpments are blanketed in moisture-laden clouds and as a result, are covered in dense woodland restricted to a narrow belt of some 240 km long and 3-30 km wide. The clouds quickly disperse as they spill over the mountain ridges.

The clouds, however seldom yield heavy rains due to their relatively low altitude, which maintains higher temperatures during the monsoon season. Precipitation is mostly in the form of mist and drizzle and is heaviest at mid-altitudes, where clouds accumulate into thick fog. The coastal plain descending below the cloud cover receives lower precipitation. Areas above mountain ridges falling north and east of the Dhofar Range receive little precipitation as they fall under the dispersal zone of the monsoon clouds.

Rainfall data for the mountains is scarce. The mean annual rainfall for the coastal plain is 100 mm, and annual means on the wet Jabal range most likely between 200-500 mm. Vegetation however plays a very significant role in condensing humidity as the moisture intercepted by tree crowns results in a drip that increases the total precipitation by several folds⁶². One large olive tree in west Qara at 920 m a.s.l. has collected 50-70 000 litres of water during a 75-day monsoon, which is equivalent to 300-400 mm beneath the crown. On a larger scale, the potential contribution would be of 50-300 mm, depending on altitude, local topography, and the density and structure of the canopy⁶³. In Jabal Al Qara, the measured fog interception was greatest at 600-900 m altitudes, intermediate between 450-600 m and least below 450 m.

Dhofar falls also within the area of action of tropical hurricanes, which generate high wind speeds and periodic cyclones that bring heavy downpours. These might contribute up to 25% of the yearly precipitation⁶⁴. Minor storms occur every 3 years, while major ones take place at nine years intervals in average.

No temperature readings are available for the mountain area, but at Salalah, the highest temperatures occur in May and June, with a mean monthly of 32⁰ C. During the monsoon, temperatures drop, while relative humidity reaches its highest at 96-97% during the months of July and August. Temperatures rise again when the monsoon lifts in September. The lowest temperatures are recorded from January to February with means of 27-28⁰ C.

⁶¹ Source: Miller A.G. & Morris, M. (1988). Plants of Dhofar: The southern region of Oman, traditional economic and medicinal uses, Diwan of Royal Court, Sultanate of Oman.

⁶² This type of occult precipitation has been investigated in some detail (Barros & Whitcombe, 1989, Cowiconsult 1992, cited by Travers Morgan). Artificial screens have been shown to capture up to 150 liters/m²/day at high altitudes sites on Jabal Al Qara.

⁶³ Source: (Barros & Whitcombe, 1989)

⁶⁴ Source: A.G. Seif El Din, June 1990: Rangelands Management Programme – Project OMA/87/013

ANNEX 10: WOODLAND VEGETATION IN THE DHOFAR MOUNTAINS⁶⁵

As one travels across the coastal plain, over the mountains and further west, into the desert, distinct vegetation strips can be identified. These reflect climatic climate and topographic factors as well as soil types and amount of precipitation from drip condensation rain. The six main vegetation types met are:

Vegetation of the coastal plain

The plain has suffered damage to its vegetation as a result of overgrazing, indiscriminate use of off-road vehicles and urban development. Near the mountains, the tree cover was cleared for security reasons during the war. There is normally little vegetation cover on the plain. However, after the monsoon rains, the whole plain turns green with a cover of ephemeral herbs and grasses including the endemic *Dichanthium micranthum*. *Avicennia marina* forms the remaining mangroves and moving inland, scattered trees and shrubs such as *Acacia tortilis*, *Ziziphus leucodermis*, *Tamarix aphylla*, *Cadaba baccarinii*, *C. farinose*, *Commiphora Abyssinica*, *C. foliacea*, *C. gileadensis*, *Caesalpinia erianthera* are found in association with succulents such as *Adenium obesum*, *Aloe dhofarensis*, *A. inermis*, *Euphorbia cactus*, *E. hadramutica*, etc.

Escarpment woods and grasslands

The woodlands at lower altitudes, up to 500 m, consist mainly of deciduous bush-land and thicket composed of spiny, multi-stemmed shrubs of the species *Acacia Senegal*, *Commiphora spp.* *Maytenus dhofarensis*, *Croton confertus* and *Blepharispermum hirtum*. On the open slopes there are a few emergent tree species such as *Delonix elata*, *Anogeissus dhofarica*, *Sterculia africana*, *Lanea spp.* and *Euphorbia smithii*. The valleys are home to dense riparian woodland dominated by *Ficus sycomorus*, *F. vista*, *F. lute* as well as the commonly occurring *Tamarinds indicia*. Where these valleys meet the coastal plains, the spiny *Ziziphus spina-christri* and *Acacia nilotica* are plentiful. Above 500 m altitude, the woodland gradually converts to semi-evergreen woodland and thicket, with *Olea europea*, *Euclea schimperii*, *Commiphora spp.* *Dodonea angustifolia*, *Carissa edulis*, *Rhus somalensis* and on the rolling grass-covered mountain top, thickets of *Anogeissus dhofarica*, *Maytenus dhofarensis* and large trees of *Ficus vasta* are common. The grasses commonly associated with trees at these elevations are *Apluda mutica*, *Themeda quadrivalvis*, *Brachiara spp.* *Anthraxon spp.* and *Cenchrus spp.*

Vegetation of the foothills

Beyond the plain, running along the base of the escarpment mountains is a distinct zone, formerly heavily wooded and now dominated by the evergreen *Boscia arabica* and xerophytes such as *Commiphora spp.* *Grewia spp.* *Premna resinosa*, *Croton sp.*, *Jatropha dhofarica* ;

Vegetation of the dry plateau

Inland, away from the influence the sea and the monsoon mist, grass becomes shorter and trees thin out with stands of *Olea europea* and *Anogeissus dhofarica* becoming less common, giving way to dwarf shrub-land dominated by *Euphorbia balsamifera* and *Commiphora spp.*

⁶⁵ Source: Plants of Dhofar, the Southern Region of Oman – Traditional, Economic and Medicinal Uses- By: Anthony G. Miller and Miranda Morris, illustration by Susanna Stuart Smith. 1987. Prepared and published by the Office of the Advisor for the Conservation of the Environment, Diwan of Royal Court, Sultanate of Oman.

North draining wadis and cliffs

Moving further inland, the vegetation becomes gradually sparser as evidenced by the increasing bare grounds encountered. In this zone of dry gravel covered hills, shadowed by the high escarpment mountains, little benefit from the monsoon mist is left. Wadis drain northwards. The most common tree is *Acacia etbaica*. The rosette tree *Dracena serulata* is locally abundant and in some places, stunted *Commiphora spp* and *Grewia spp.* are found, in association with *Euphorbia spp.*

Desert and pre-desert

Still further inland, the ground levels into a landscape of small rounded rocky hills and gravel covered plains. Scattered throughout this area, the most famous tree of Oman, *Boswellia sacra* thrives in gullies and depressions. Less common is *Acacia etbaica*. Large areas in this zone are devoid of vegetation, but in shallow depressions and in wadi valleys are found dense colonies of the ground palm *Nannorrhops ritchieana*.

ANNEX 11: *BOSWELLIA SACRA*, THE FRANKINCENSE TREE OF DHOFAR⁶⁶

The genera *Boswellia* belongs to the *Burseraceae* family, which is characterized by the existence of resin ducts in the bark, from which the frankincense resin is collected. Only one species, *Boswellia sacra* is found in the Arabian Peninsula, where it extends from Dhofar (Oman) to eastern Hadramout (Yemen).

Frankincense trees grow in fairly restricted habitats, preferring arid zones beyond the reach of monsoon rains, but within the reach of the cool winds that blow steadily during the khareef season. The trees, which reach 5 m in height at maturity, bear sometimes a single trunk, but more commonly, several stems from the base. The bark is papery and peeling and the young branches are densely tomentose. All parts of the tree are highly resinous.

Boswellia sacra, which was of vital economic, social, cultural and religious importance in the past, is without doubt the most famous plant in Dhofar. In its prime days, frankincense commanded fabulous prices as these were equated with that of gold in the markets of the Roman Empire. Burned as an offering to the gods, frankincense was also important medicinally. Greek and Roman physicians used the gum in treating numerous diseases. Remedies making use of frankincense appear as well in Middle Age Muslim practitioners writings, and in Indian and Chinese medical texts. Some remedies that have relevance to usage in Dhofar are:

- Extracts of the plant were used primarily as an astringent, often prescribed in suppository form to treat haemorrhoids;
- Childbirth was often protected by fumigation of frankincense;
- Crushed frankincense was used in poultices and plasters to treat a wide variety of skin lesions and eruptions;
- Gum pills were utilized in the treatment of blood spitting and in abdominal and chest pain;
- Frankincense was a common ingredient in the preparation of collyria for the treatment of ophthalmic diseases;
- The gum was an ingredient of many mixtures prepared to cure known ills and to act as antidote to all known poisons;
- The soot produced by burning frankincense was used in treating wounds, ulcerations and cancerous growths;
- The gum was chewed to strengthen teeth and gums, and was considered as a beneficial tonic for the heart and the brain;
- Hysteria and various psychic disorders were treated with frankincense;
- Frankincense was taken internally to dispel forgetfulness, for which it is still appreciated in Southern Arabia.

⁶⁶ Source: Plants of Dhofar, the Southern Region of Oman – Traditional, Economic and Medicinal Uses- By: Anthony G. Miller and Miranda Morris, illustration by Susanna Stuart Smith. 1987. Prepared and published by the Office of the Advisor for the Conservation of the Environment, Diwan of Royal Court, Sultanate of Oman.

In Dhofar, *Boswellia sacra*, was likewise of great importance for its foliage, bark, fruit and flowers. In more recent times, the frankincense gum continued to be tapped on a lesser scale and more sporadically. The curly, bright green leaves were an extremely important fodder in the arid areas. The trees' buds, flowers and fruit provided a tasty and astringent mouthful for herders, and were considered to deodorise the mouth. The delicately perfumed yellow flowers were used as a very superior fodder and were likewise appreciated by honey- bees. The red-coloured under-bark was widely used in the dyeing of cotton to a red-brown colour and in tanning leather to a mahogany red colour.

Nowadays, frankincense still is widely used in various ways in Oman, Yemen, Ethiopia, etc. It is highly appreciated for the scent of its fumes as well as for the protection it is said to provide against attack by evil spirits and the eye of jealousy and envy. In Yemen, women too enjoy chewing pieces of gum from the female frankincense. The gum is also a common ingredient in various remedies prepared to treat a wide variety of illnesses, especially psychotic, neurotic and hysterical ones. In Ethiopia, fumigation is used to soothe sore or tired eyes. Melted and boiled in cow or goat milk, the gum is used to calm a cough. Dried gum crushed to a powder with myrrh and dried Aloes sp. juice makes an antiseptic powder used on wounds and ulcers to dry them out.

The mean annual production of a big, mature tree, ranges from 3 kg in the monsoon affected areas, to 5-8 kg of Najdi and Hojeri high-quality incense, in the northern wadi areas not affected by monsoon. It is roughly estimated that between 1-1,5 million productive frankincense trees exist in Dhofar. According to a report by the ex- Public Corporation for Agricultural Products Marketing, The total incense production for the year 1990, amounted to 5MT.

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