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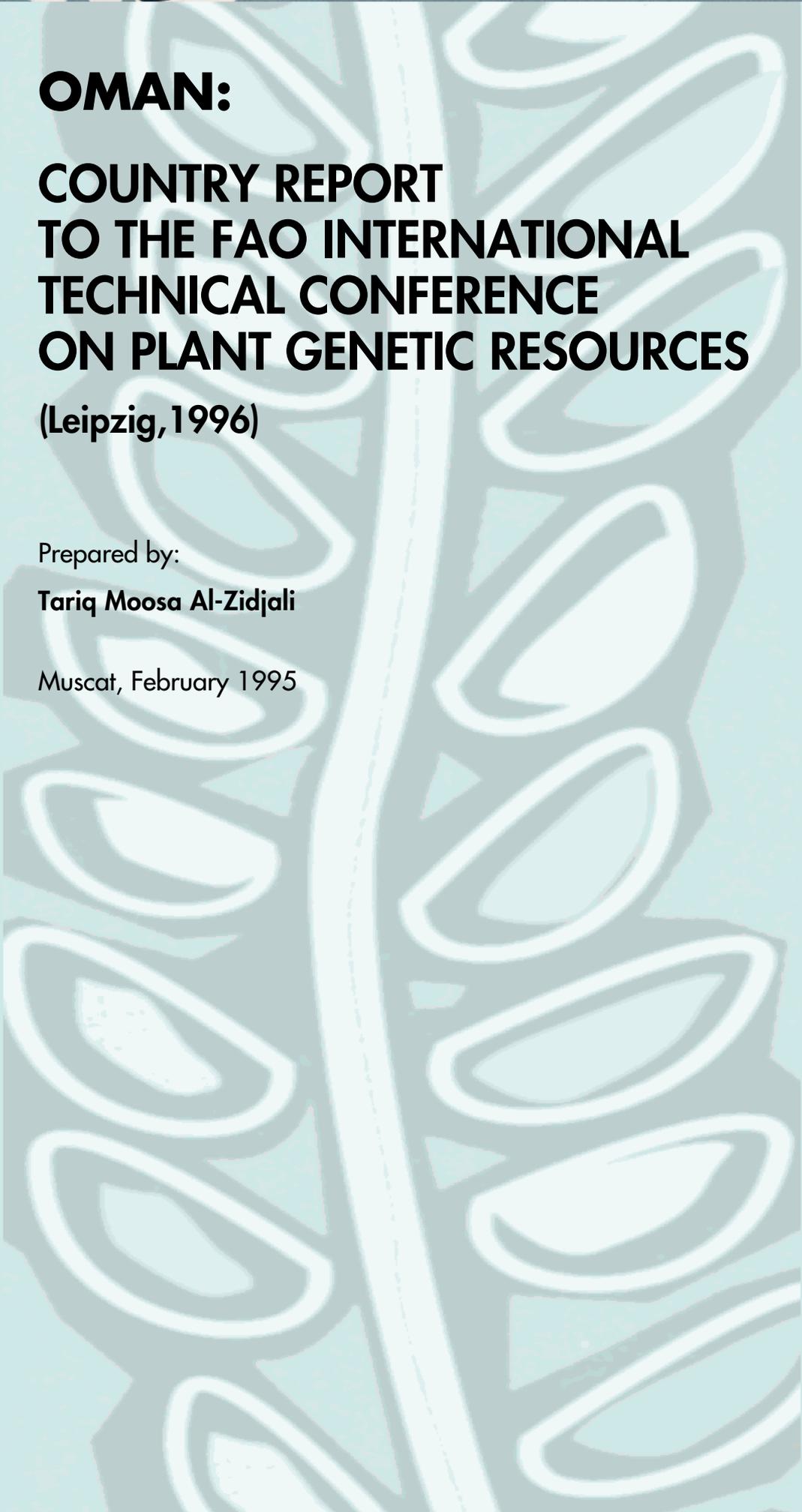
**COUNTRY REPORT
TO THE FAO INTERNATIONAL
TECHNICAL CONFERENCE
ON PLANT GENETIC RESOURCES**

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Note by FAO

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CHAPTER 1

Introduction to Country and its Agricultural Sector

1.1 SULTANATE OF OMAN

The Sultanate of Oman is located in the South Eastern tip of the Arabian Peninsula. Its land borders with Saudi Arabia and the United Arab Emirates in the West and by the Republic of Yemen in the South. The eastern side of the Sultanate borders on the Gulf of Oman and the Indian Ocean with a coastline of nearly 1,690 kilometres. Oman's territory also includes the tip of the strategically important Musandam Peninsular, which is separated by the United Arab Emirates from the rest of Oman. Oman's geography also encompasses the Island of Masirah, off the eastern coast. Oman has an approximate area of 300,000 sq. km. Northern Oman has a mountain chain with heights up to 3,000 m. The Jebel Al Quara in Dhofar in the South divides the Coastal Plains of Salalah from the interior plains of the Nejd.

As the guide to Oman rightly points out `...Oman is alive with children'. While this is an excellent provision for the development of the country it presents a greater than 50% increase in Omani nationals by the year 2000. Present trends seem unlikely to substantially alter over such a short time frame, so the additional food energy demands for the country will be expected to rise by 65% of the present consumption, (reflecting the shift in age distribution within the population).

1.2 AGRICULTURAL PRODUCTION

The area and production of field crops that are grown in Oman are presented in Table 1.



Table 1: Area and production of field crops in Oman

Sl. No.	Crop	Area (ha)	Production (000 t)
1.	Alfalfa	9,241	372.70
2.	Sorghum and maize	616	2.70
3.	Wheat	551	1.50
4.	Barley	253	0.70
5.	Tobacco	400	2.00
5.	Others	814	4.90

Source: Agricultural Statistics of Oman (1991 and 1992)

Biotic and abiotic constrains

The most important problems of agriculture in Oman are:

1. Limited water resources for irrigation. This problem is already clear in the decision maker policy. A Sultan decree no. 88/82 was imposed on 12 November 1988 to consider water resources reserves as national resources; their use is subject to permission. Another decree no 89/72 on 23 July 1989 imposed modern irrigation net in Batinah region as a result of increased salinization of soil.
2. Because of scarcity of water crop production has no economic return in general, except for vegetable and fruits.
3. During the last decades there has been a clear migration from the countryside to the cities. Besides, the expertise for modern agriculture is lacking.
4. Capital investment in agriculture is limited in Oman.

Different pests affect agricultural production in Oman. During 1994, the Ministry of Agriculture and Fisheries sprayed 17 thousand feddans by insecticides using helicopters. More than 100 tons of insecticides were distributed to farmers for agricultural protection.

The most important plant in Oman (Dhofar) is the Frankincense tree *Boswellia sacra* or "Mughara", which yields the resin called locally "luban", an important article of commerce in ancient times. One of the gifts brought to Christ-child by "wise men from the east". Frankincense is common near Raysut and on the northern slopes of Jabal-al-Qara and at Hasik. Luban is still harvested on a small scale for domestic use.



1.3 CLIMATE

With the exception of the mountains of the Southern Region, which has a tropical monsoon climate, Oman is a sub-tropical desert. In the summer the coastal areas are hot and humid and the interior parts hot and dry, while the winters are comparatively cool. The climate is influenced by the prevailing winds, the up-welling of coastal water and cyclones, and is temperate at high level.

Annual mean temperature varies between 17.8°C and 28.9°C. The hottest period is June and July and the coldest month is January.

Except for the Dhofar and the Hajar mountains, the rainfall is low and irregular. Mean annual rainfall is below 50 mm in the interior, the major part of the country, and about 100 mm in the coastal area. The Hajar mountains receive 100 to 300 mm and the Dhofar mountains which are influenced by the monsoon, having 200 to 260 mm of rainfall. Mist is common in this area, adding important amounts of moisture to the vegetation. In the period from September to November there is practically no rainfall in Oman.

1.4 AGROCLIMATIC REGIONS IN OMAN

The following agroclimatic zones are recognized in Oman based on the parameters which influence crop water requirements and efficient use of water, land and water resources potential and cropping patterns:

Northern Oman

- a. Batinah Coastal plain
- b. Interior Oman and Dahira plains
- c. Jebel Akhdar
- d. Sharqiya plains

Southern Province, Dhofar

- a. Salalah plain
- b. Dhofar Jebel
- c. Nejd



1.4.1 Northern Oman

Batinah coastal plain

By far the most important agricultural area in Oman is the Batinah. It is a low-lying alluvial plain extending for about 240 km from Muscat to the border with U.A.E, and extending about 30 km inland from the coast. It is sandwiched between the Hajar mountain ranges and the sea. The Batinah sustains almost 60 percent of all the agricultural production and has witnessed vigorous development in recent years. Crop production depends entirely on irrigation, the main crop being dates, fruit crops, alfalfa, vegetables and other forage crops. Alfalfa is often intercropped in the fruit orchards. Perennial forage grasses are grown and in Sohar sun farms, many exotic species have been introduced and grown. Tobacco is a commercial crop grown in Shinaz area.

The climate of Batinah is characterized by generally high temperatures reaching 48°C in the Summer, mean temperatures during winter range from 15°C to 24°C. Relative humidity may reach over 90 percent. Daily windruns are comparatively short. Rainfall ranges from 76-100 mm annually.

Irrigation water is derived from the alluvial deposits which are recharged annually by storm run-off down the wadis and over longer periods by continuous underground flows from the Hajar mountains. Direct recharge from rainfall on the plain is practically non-existent. The main body of the fresh ground water rests on sea water and the interface of the two bodies becomes more and more shallow as one approaches the sea. Thus local over-pumping has led to sea water intrusion and the problem of salinity in areas bordered by the main highway and the sea is becoming more and more serious.

Interior Oman and Dahira plains

The interior plains lie within the inner foothills of the Hajar mountain ranges and constitute a transitional range classed either as the mountain region or the interior lowlands. They include Buraimi plain, Ibri, Wadi Quriyat, Bahla and Nizwa. The main crop in this zone is dates, occupying 30-60 per cent of the irrigated land. Intercropping with fruit trees is usual but not to the extent practiced in the Batinah. Alfalfa is second in importance occupying 20%, and wheat is third 10-15% of the cultivated land.

The development of the ground water resources of the interior plains and the Wadi region is being achieved either through the traditional aflaj systems or



through hand-dug wells. Nearly 50 per cent of the total area under irrigation is served by the falaj system and the remaining 50 per cent by wells.

The average size of farm irrigated from wells is 0.5 to 3.0 ha. Water is pumped in a small distribution reservoir from where it is channeled to the fields through cement canals. Farmers in the interior plain practice basin or border irrigation. The quality of water of the interior plains varies extensively. Most falaj water is generally of good quality.

Jebel Akdhar or Saiq plateau

Jebel Akdhar at an altitude of 3,000 m, constitutes a uniquely different climatic zone than any other region of the Sultanate. It is characterized by considerably lower temperatures to the extent that winter minimum temperatures satisfy the chilling requirements of a number of temperate deciduous fruit and nut trees, such as peaches, apples, pears, apricots and almonds. Furthermore, summer temperatures averaging 30°C make this mountainous region much cooler throughout the year. In addition, annual rainfall (300 mm) is significantly higher than elsewhere in Oman, with the exception of Dhofar Jebel, and it is distributed throughout the year. However, effective rainfall is only 45 mm, while evapotranspiration (E. Penman) remains high at 2,800 mm, obviously because of the relatively low atmospheric saturation, the relative humidity remaining at the low level of around 30% during the summer months.

Sharqiya plains

The water resources situation in this region is similar to that of the northern mountain zone. Recharge of the alluvial aquifers of the coastal plains of Qurayat and Sur, and their interior plains of Mudiabi and Wadi Batha (Ibra to Bani Abu Ali) is from surface runoff from the eastern ranges of Hajra mountains.

In wadi Al Batha, agriculture is concentrated around Ibra, Ad Dariz, Al Ghabbi and Al Wafi. The area under crops is estimated at 1,500 ha in 26 Oases irrigated mainly by falaj system. The Qurayat and Sur plains seem to have a very limited potential for development due to sea water intrusion. In contrast, the Wadi Batha plain seems to offer best potential because of the existence of highly suitable soils associated with good quality groundwater in the Jalaan district around Al Kamil and Al wafi. Irrigation in this region is achieved by falaj systems in the traditional way. Private farms supplied from wells employ flood or furrow irrigation methods.



1.4.2 Southern region

The southern region occupies almost one third of the area of the Sultanate. Apart from the coastal plain extending from Raysut in the west past Salalah, the wooded hills reaching up to 1,500 m elevation behind the plain constitute a separate climatic zone. The southern slope of the hills known as the 'Jebel' are rather steep, deeply incised narrow wadis, and receive southwesterly monsoon rains. The northern slopes called the 'Nejd' are much gentler and the wadis dissecting them are wider and less deeply incised.

Salalah plain

Salalah plain lies in the coastal area of the southern province of Dhofar. Dhofar is the only region in Oman to benefit from a substantial amount of rainfall from the southern monsoon *Kharif*.

The average annual rainfall is about 110 mm but can range from about 70 to 360 mm. July-August is normally the 'wet' period. Ground water derived from aquifers in the central part of plain is of good quality. Some of the spring water is utilized by falaj to provide irrigation water for parts of the plain. Recharge is by underflow from the mountains and from the springs. Irrigation practices and methods are similar to those employed in the Batinah. Modern irrigation techniques are in operation in large commercial farms mainly for the production of forage crops such as alfalfa and rhodes grass.

Dhofar Jebel

The Jebel mountain ranges form a separate agroclimatic zone of their own. Dense mists are held back by the ranges from the interior desert. Rainfall is particularly high, ranging from 600 mm to 700 mm, the highest than in any other area in the country, supporting a permanent vegetation cover. The rainfed pasture land is concentrated on some half a million hectares on the Jebels Qara and Qamar. The Dhofar Jebel maintains two-thirds of the total cattle and one third of the total goat populations in the Sultanate, hence the importance of livestock in this area.

Nejd

In contrast to the Jebel and the coastal plain, in the Nejd, there is a quick decrease in precipitation and moisture marked by a rapid transition from the grass lands and Savannah-type vegetation found on the Jebel. At the same time, temperature differences increase and a desert climate replaces the more



humid climate of the plain and the southern slopes. Although the annual precipitation on the Jebel ranges from 500-750 mm, rainfall in the Nejd is only in traces. Evaporation rate at Thumrait reaches 5,500 mm annually.

The region is known to be underlain by an extensive carbonate aquifer the Umm Er Radhuma and artesian flows occur in some areas. Water quality is generally poor and the soils structureless, of poor fertility and highly permeable. Although the agricultural potential of these areas may be limited, the investigations have identified suitable areas of the Nejd with potential for agricultural development.



CHAPTER 2

Indigenous Plant Genetic Resources

2.1 DHOFAR NATURAL VEGETATION AND ECOSYSTEMS

Five ecological zones have been identified (Lawton 1988). They are as follows:

1. desert
2. semidesert scrub
3. short grassland
4. long grassland
5. woodland

Anogeissus dhofarica is the main woodland species.

J.B. Sale has described six vegetation types:

1. Desert: *Dichanthium foveolatum*, *Zygophyllum* sp., *Herniaria* sp., *Farsetia longisiliqua*
2. Desert (edge): *Limonium axillare*, *Aristida adscensionis*, *Heliotropium* sp., *Zygophyllum* sp.
3. Desert (edge): *Aristida adscensionis*, *Zygophyllum* sp., *Fagonia* sp., *Jauberia aucheri*
4. Semi-desert: *Viola cinerea*, *Kickxia hastata*, *Farsetia longisiliqua*, *Helichrysum somalense*
5. Semi-desert scrub: *Eragrostis ciliensis*, *Kickxia hastata*, *Aristida adscensionis*
6. Long grassland: *Themeda quadrivalis*, *Brachiaria deflexa*, *Setaria pumila*

In October-November two common tall grasses, *Themeda quadrivalis* and *Apluda mutica*, are cut and collected by women for thatching, bedding and for feeding young stock. Maize, sorghum, millet and beans are grown during the monsoons.

In arid coastal plain short grasses are *Eremopogon* sp., *Cenchrus pennisetiformis*, *Leptothrium senegalense* and *Cenchrus setigerus*. The tree species are *Acacia tortilis*, *A. nilotica* subsp. *leiocarpa* near the wadis, clumps of *Tamarix* sp. in some wadis. The creeping root systems and woody stems of the suffrutex *Limonium* sp. stabilizes shifting sands in the coastal zone and this plant species is very good forage crop for indigenous honey bee *Apis*



flora. Near the springs fig trees namely *Ficus salicifolia*, *Ficus vasta* and *Ficus sycomorus* occur.

On the slopes the tree species are *Delonix elata*, *Ziziphus spina-christi*, *Tamarindus indica*, *Cadaba longifolia* and *Acacia sp.* are the common trees. *Anogeissus sp.* is the most common dominant tree species. Old specimens of *Olea africana* associated with *Euclea schimperi*, *Dodonaea viscosa*, *Maytenus spp.*, *Rhus somalensis* and *Commiphora spp.* form the woodland association in some areas and represent old woodlands. *Dichanthium annulatum* and *Loudetia flavida* are some common grass species associated with *Themeda quadrivalis* and *Apluda mutica*. The short grasses are *Eragrostis viscosa*, *Aristida adscensionis*, *Eragrostis paspaloides*, *Dactyloctenium scindicum*, *Chrysopogon plumulosus* and *Eragrostis ciliansis*. The frankincense tree *Boswellia sacra* and *Acacia spp.* occur in the desert. The dwarf shrub *Euphorbia balsamifera* subsp. *adensis* is considered essential for the maintenance of the final grazing zone adjacent to the desert.

2.2 THE FLORA AND WILD RELATIVES OF CROP PLANTS

The Omani flora includes more than 1,100 flowering plant species. While Dhofar have a strong phytogeographic affinity with Socotra Island and N.E. Africa and S. Iran, the rest of the country is desert. Dhofar has two endemic genera and about 50 endemic plant species which proves that the region is a refugium for relics of mesic circum-Tethysan flora. These are concentrated in the monsoon woodlands of Dhofar, and to a lesser extent in the northern mountains of Oman.

Important crop genera represented by wild relatives in Dhofar are: *Amaranthus*, *Pistacia*, *Lactuca*, *Ipomoea*, *Citrullus*, *Cucumis*, *Ricinus*, *Vigna*, *Abelmoschus*, *Gossypium*, *Ficus*, *Okra*, *Citrus*, *Corchorus* (*Dicotyledons*) and *Eleusine Panicum*, *Pennisetum*, *Saccharum*, *Setaria*, *Sorghum* and *Asparagus* (*Monocotyledons*).

Other relatively minor crop genera include *Ziziphus*, *Lavandula*, *Ocimum*, *Solvia*, *Acacia*, *Alysicarpus*, *Desmodium*, *Indigofera*, *Lotus* and *Rhynochoria*. Of the grasses *Cenchrus*, *Chloris*, *Dactyloctenium* and *Dichanthium*.



Of the shrubs and trees with obvious potential for forestry in semi-arid regions are *Anogeissus dhofarica*, *Acacia* spp. and *Ormocarpum dhofarense*. There is evidence that *Ormocarpum* and *Blepharis dhofarensis* are undergoing a serious genetic erosion. *Cadaba* species and browse species of *Capparaceae* are being heavily overgrazed.

Among the wild/weedy crop relatives the most important species are *Abelmoschus esculentus* and *A. manihot*, *Cucumis sativus* and *C. melo*, *Gossypium stocksii*, and *Vigna radiata* var. *sublobata*.

2.3 MAIN FOREST AND TREE STAND OF DHOFAR

1. Semi-desert grassland with scattered *Acacia tortilis* on alluvial soil, and semi-desert shrub land with *Commiphora* spp and some succulents on rocky outcrops in the coastal plain.
2. Deciduous shrubland with *Boscia arabica*, *Commiphora* spp., *Jatropha dhofarica*, *Croton confertus*, *Adenium obesum* *Grewia* spp and *Cissus quadrangularis* in the foothills of escarpment.
3. On the escarpment itself and upto 500 m there is deciduous shrubland and thicket dominated by *Commiphora* spp., *Acacia Senegal*, *Maytenus dhofarensis*, *Croton confertus*, *Anogeissus dhofarica*, *Delonix elata* and *Sterculia africana*.

Above 500 m there is semi-evergreen bushland with *Commiphora* spp., *Olea africana*, *Dodonaea angustifolia*, *Euclea shimperi* and *Ficus* spp., which dominate the riparian woodland.

4. On the plateau summits there is grassland and shrub grassland with *Euphorbia balsamifera*.
5. Out of the reach of the mists there is semi-desert shrubland including *Acacia etbaica*, *Dracaena serrulata*, *Commiphora* spp., *Grewia* spp.
6. In Nejd there desert with *Boswellia sacra* and *Acacia etbaica*.
7. A typical desert thorn tree is *Prosopis cineraria*, which form isolated stands in ecologically rich habitat in the open sandy desert of Al-Wahiba.

Trees show differences between woodland provenance, with respect to their structure and topography. Trees between and within provenances are highly variable in density, size and morphology.



2.4 LOCAL CROP VARIETIES

- Bread wheat (*Triticum aestivum*) - Local name: Kamah

Five local varieties have so far been documented and these are: Cooley, Sarraya, Hamira, Waledi and Missani. Cooley is by far the commonest cultivar (occupying 90% of the area under local varieties). Nearly sixty percent of the wheat area is occupied by these local cultivars. They are low yielding and are susceptible to lodging and almost lack rust and smut tolerance. They are preferred generally because of their use in local preparations.

- Barley (*Hordeum vulgare*) - Local name: Shaiir

Barley (six-row type) is sown frequently with alfalfa. Traditionally, along the coast it is not grown for grain (90 ha) but is grown as fodder. In the Western Hajar (50 ha), it is grown for grains but again for animal consumption. In Musandam, some land races (e.g. Cv. Doraqui) are grown on a limited scale for human consumption. In Oman, barley comes to heading in January-February in Batinah and mid-March in the interior areas. It is cut green for fodder along with the alfalfa but it is not resown into the perennial stands of alfalfa.

Cultivars: there are two barley varieties under cultivation in Oman viz., Omani local Bathini and Beecher. The variety Beecher - a dual purpose variety has been introduced recently from ICARDA materials. However, the farmers are not aware of the existence of different varieties of barley. The beecher variety is a rainfed variety and varieties suitable for irrigated conditions need to be identified. It has been observed that this variety lodges when irrigated with sprinkler.

- Maize (*Zea mays*) - Local name: Durra Shami

The farmers in the interior and Salalah use the local cultivars. The local varieties are referred by their color such as local white, local red and local yellow. However, exotic varieties have been introduced and recommended such as Katamani 503, Composite 2 (small seeded), Hybrid 622 (big seeded), Giza 2 and IRAT 81. In government farms, many exotic cultivars have been introduced for green fodder purposes.

- Sorghum (*Sorghum bicolor*) - Local name: Durra rafia

In northern Oman, two local varieties identified as Local red and local white are grown. In southern plains, there are three local varieties - local white, red and yellow. After a series of trials three exotic varieties for green forage have been recommended in 1985 and they are Honey dew, Sugardrip and F.sx Dekalb 17.



- Pearl millet (*Pennisetum typhoides*) - Local name: Addakhan (El Musaiblo)

The local variety is tall but seeds are borne on small earheads. A dwarf exotic variety with large earhead has been introduced by the farmers. This genotype characteristically retains green leaves even at maturity.

- Alfalfa (*Medicago sativa*) - Local name: Berseem, Get, Qat

Alfalfa enjoys the status of a favorite forage crop among farmers in Oman both in the north and the south (although it is not grown on the dhofar mountains) despite a threat from the successful rhodes grass (*Chloris gayana*) on the Batinah, Salalah plains and the interior desert plains of Nejd. This feature seems to be the common case throughout the arabian peninsula. Most holdings have alfalfa basins which add up to nearly 20% of the total cultivated area (9,241 ha) in the country. It accounted for almost half the agricultural output (by value). The crop is called 'qat' or 'get' in northern Oman and by misnomer 'berseem' in the south. Eighty five local alfalfa collections were sown at Rumais in unreplicated screening nursery and were evaluated for their performance. Some of the entries from Sharqiya region performed better than others. Local germplasm collection in alfalfa¹.

Cultivars: a number of agro-ecotypes which have been differentiated over centuries have been recognized mainly on the basis of longevity. The variants of 'Batini' type have an expected life span of 8-10 years in the batinah; however perform miserably when grown in the mountains. There are local strains in the Hajar mountains which are believed to persist over ten years with the exception of 'qaryati' but fail when grown on the coast. There are also distinct types grown viz., 'Sharqiya' (around Sur) and 'Qaryati' (interior). The crop is grown as an annual on the Salalah plains, succumbing Crown rust (*Melanospora zamiae*?) in the *Kharif*. The strains growing in the south were found to be distinct from those of the north. Genetic erosion does not seem to be a danger, except perhaps in Musandam, where seed from the Batinah is distributed by the Musandam development committee at subsidized prices to expand the area of the crop quickly. In Salalah, where the local variety tends to annual due to its susceptibility to various diseases some exotic introductions such as ADL - 7605 and SW 32/AN4 have been recommended for cultivation.

¹ Guarino, L. (1987). Collection Mission Rep. - Sultanate of Oman IBPGR, Rome.



- Cowpeas (*Vigna sinensis*) - Local name: Lubia

Local cultivars are used and they are identified based on the seed color as 1: brown, 2: black and 3: mottled. The seed size in all the cultivars is medium and all of them are dual purpose varieties.

- Chickpeas (*Cicer arietinum*) - Local name: Hummus

The local cultivar which is being cultivated for long periods is small seeded. New introductions from ICARDA - ILC 237 and FLIP- 80-5 are recommended which are large seeded cultivars. All of them are Kabuli type chickpeas.

- Sesamum (*Sesamum indicum*) - Local name: Simsim

There are three major cultivars grown in Oman- Hindi white and Hindi black apparently from India and Giza-23 from Egypt.

- Tobacco (*Nicotiana tabacum*) - Local names: Ghaliyoon, Dukhyan, Tambak and Tabac

The varieties that are being cultivated are Suwaida, Musdaria, Fannashia, Omlaein and Hitathi. These have desirable qualities preferred by the consumers in Oman and U.A.E.

- Sugarcane (*Saccharum officinarum*) - Local name: Kasab Sukkar

The local varieties are Bahlavi, Nizwavi and Dhofarvi. The exotic cultivars are Co 419, Co 997 and Co 678.

- Cotton (*Gossypium arboreum*) - Local name: Koton

Only local variety which has brown lint is grown.



CHAPTER 3

National Activities in Conservation and Use

3.1 GERMPLASM CONSERVATION

Exploration

In 1980, IBPGR had made a reconnaissance survey for germplasm collection and made eleven alfalfa germplasm collections.

During 1987 and 1988, the Ministry of Agriculture and Fisheries invited IBPGR collector from Cyprus, Dr. L. Guarino, to conduct a germplasm exploration with a view to collect local germplasm in all the crops grown in Oman. The ministry officials accompanied and helped him in collecting germplasm. In his two visits, he made an extensive tour in all the regions of Oman and collected germplasm in almost all the crops including 83 alfalfa accessions (11 from Batinah, 18 from Interior, 15 from Western Hajar, 4 from Eastern Hajar, 2 from Dhahira, 10 from Sharqiya, 6 from Jalan/Sur, 1 from Jabel Akhdar, 2 from Musandam and 1 from Jau).

Orchard genebanks

The Directorate General of Agricultural Research has 12 research farms and nurseries, where tropical and sub-tropical fruit trees are grown for systematic research. A new research farm is coming up at Gadafan, which will become a major center of germplasm collection for tropical and subtropical fruits.

At present an orchard gene bank for date palm exists in Wadi Quriyat in Oman Interior where 167 female and 20 male collections are being grown since 1988.

Proposed locations for orchard gene banks in Oman

Location	Crops
Sohar	Mango, Ber
Salalah	Banana, Coconut, Papaya, Custardapple, Guava
Jimmah	Grape, Sweetlime
Tanuf	Pomegranate
Rumais	Acidlime



Cold storage facilities

Three cold rooms with temperature control systems are available for temperate and nut seeds conservation.

Date palm genotype collection

Being the most important crop in the country, date palm germplasm collection is the biggest in the Arabian Peninsula. These genotypes are grown in representative research farms in the country. Some of these plantings are 4 to 10 years old depending on the location. The biggest collection in the interior of the country include 191 genotypes.

3.2 FORESTRY IN NORTHERN REGION

Knowledge on the techniques and practicality of reforestation is under research through the extension of three "Woodland Pilot Areas" and the establishment of a "Forest Research Site" at the Agricultural Research Center, Rumais. The identification of future reforestation sites are also in progress at Rumias.

The pilot areas are typically 40,000 m², which are protected by fencing. Preference is given to the utilization of native tree species; like Ghaf (*Prosopis cineraria*), Sidr (*Ziziphus spina-christi*) Samar (*Acacia tortilis*) and but exotic species are also being screened for their potential economic superiority. Two of the pilot areas have been planted. Mejais (near Sohar) has been planted with 1,600 trees in pits. This site offers the excellent opportunity of assessing the performance of both native and exotic tree species grown under highly saline conditions. Kubarah (near Ibri) has over 700 trees planted. Both pilot areas will be further planted and assessed. At Danq (near Ibri) plans for planting will proceed this summer.

The new Forestry Research Site at Rumais will comparatively test the adapted local and exotic tree species under specific plant density conditions. Land will be reserved for the testing of new exotic tree species, as required.



Future reforestation sites will be identified with the help of a computer map of the woodland cover of Oman, which is currently under preparation at Rumais. This map illustrates the distribution of all known woodlands in Oman.

It also will store spatial information such as soils, water resources and climate, which are relevant to the selection and management of future reforestation projects in Oman.

3.3 FOREST GENETIC RESOURCES USE

In depth study of silvicultural methods of *Prosopis cineraria* tree in Oman showed that it is an excellent multipurpose tree, particularly to provide fodder, fuelwood and shade in sand deserts. It is a suitable plant for afforestation of sites with saline and degraded soils.

Two other desert trees are also used in afforestation programs in Oman. These are *Ziziphus spina-christi* and *Acacia tortilis*. Both species can be used for apiculture.

All forest area is used for grazing livestock as well as it is for wild life. Many trees and shrubs are the source of forage for goats, camels and sheep. The number of livestock in Oman is much more than the carrying capacity of rangelands. Sometimes it is as much as 20 times more than what the rangeland can produce. This is partly a result of incentives policy of the government, and partly is a tradition to keep as much livestock as possible.

A few projects of rangelands rehabilitation and reseedling have been executed. Some were with moderate success. Trials were also made to propagate local trees and shrubs. Public awareness was also the focus of some of these activities.

3.4 CONSERVATION: ENVIRONMENTAL AND GENETIC CONSIDERATIONS

Conservation issues are important as the soil and water is in danger of degradation in quality, most often through salinization. The use of pesticides is extensive so considerable attention is given to identify suitable pesticides that cause the least environmental hazard. This is especially important for



herbicides and nematicides. A new programme in studying the toxicity and persistence of applied pesticides to fauna and flora under the prevailing conditions is to be started in the middle of 1993.

With the importation and selection of high performing genotypes, there is the danger that the local genetic resources are put at risk. Collaboration on genetic conservation is international and the services of the International Board for Plant Genetic Resources (IBPGR), the International Centre for Agricultural Research in the Dry Areas, (ICARDA), Kew Gardens and the International Institute of Tropical Agriculture (IITA) have been sought in protection of local landraces of the smaller plants and some rare leguminous trees. With big fruits e.g. dates and mango, and with the local animal breeds provision for conservation has been made in country. With smallstock, there is a genetic improvement programme for the Omani sheep and three Omani breeds of goat. Over 1,200 breeding animals are involved and the source flock represents a pool of animals from all parts of the Sultanate.

Research on Omani dates and their characterization is an important research area supported by the establishment of a "Date Research Farm" in which all the named Omani date palms have been planted under identical conditions, in a single location, at the same time. For the support of the date palm rehabilitation programme of the Ministry, that has been the establishment of a micropropagation laboratory and a lignocellulose research facility.

A programme to conserve the Omani lime germplasm is scheduled for mid 1993 in view of the risks of loss through disease and market constriction. Likewise conservation through multiplication of the Omani garlic will be undertaken.

3.5 THE ECONOMICS OF AGRICULTURAL PRODUCTION

The are tremendous historical and social ties with domestic production. However, these have suddenly been exposed to the pressures introduced through national development, which has introduced a large degree of freedom from subsistence farming. Many farming practices are likewise evolving from a subsistence to commercial enterprise so Research is studying the economic aspect of all recommended or new technologies, even at the research station level. "On farm" studies look at the broader impact of market fluctuations, farmer resources and off farm income. It is apparent that many agricultural enterprises have to be bolstered with financial support from non-



farm activities and often involve a large number of members of the farming family.

3.6 PROTECTION FOR BOTH CROPS AND ANIMALS

One of the consequence of intensification has been the rise of disease and pest problems. This can be directly due to the proximity of susceptible plants of animals, or the build up of the pest through management. However, there is also the risk of the introduction of exotic pest or the vectors of endemic diseases in the absence of well developed quarantine system. Great stress is placed upon the role of Biological control to limit reliance upon pesticides with the adoption of early warning techniques as a component of Integrated Pest Management (IPM). Regular regional survey work has revealed the extent of viral, pathological and nematological problems experienced at the farm level. This programme is scheduled to extend to the Sharqiya in 1994. Integrating such information within the geographical land cover, soil and water types information within the GIS is intended.

3.7 DIVERSIFICATION OF AGRICULTURAL PRODUCE AND THEIR UTILIZATION

A new venture will be the research/industrial interface when developing technologies of product utilization to the commercial scale. The major crop, date palm, is being investigated for its processing into various commercially desirable products such as fructose, vinegar, medical alcohol etc. Though this work is possible at the laboratory scale it is intended to provide advice and costs of implementation at the plot plant stage of production. It is intended that processing of other agricultural food stuffs should be examined in this manner.

As a national resource the date palm is a potential source of wood products for construction and feedstuffs for animals. Both aspects are catered for under the research programmes of the lignocellulose and animal nutrition.

As this discussion started with the evidence of a worsening pressure on land and water, it is appropriate to finish by saying that a major contribution of research will be in the development of the Nedj for appropriate agricultural expansion. Such a step will have to coincide with severe restrictive legislation



to redress the current imbalance in resource use and lay the foundation for a new agricultural production base to the benefit of the generations to come.



CHAPTER 4

National Needs and Opportunities

Agriculture development

The agricultural sector presents unique and vital challenges to the government and the people of the Sultanate. Faced with the actual high growth of the population, and the desire for part self sufficiency in agricultural products and for employment opportunities to be met with the constraints of finite and limited but enhanceable water resources.

The social challenge is for the government of Oman to rekindle with financial incentives the Omani people's traditional role in agriculture to help in the intensification of agriculture.

Development objectives are:

1. To maximize the utilizable renewable water resources by the use of efficient irrigation systems.
2. To increase irrigated crop production as part of increasing home food production.
3. To improve the management and productivity of irrigated and natural graze/browse areas.
4. To create employment opportunities.

Research programme on local varieties

1. Survey and selection of indigenous germplasm for high yield and good fruit qualities in Omani mango, Omani lime, sweet lime and banana.
2. Multi-location trial of varieties of mango, lime and papaya for evaluation.
3. Screening for adaptation and acclimatization of:
 - hybrid selection of mango;
 - citrus species;
 - guava, sapota and custard apple;
 - banana, papaya, pineapple and passion fruit;
 - fig, grapes, pomegranate.



Needs and goals

1. Collection, conservation, evaluation and utilisation of available local germplasm in field crops.
2. Evaluation of local germplasm for biotic and abiotic stresses.
3. Utilisation of local germplasm in breeding programme.
4. Scientific manpower and training on different disciplines of Plant Genetic Resources.

Needs for Conservation

Natural species

- Collection and identification of plant species - Setting up a herbarium

Requirements:

1. Training of a staff for procedures of collection, preservation, identification and cataloguing of the plant species.
2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
3. Exchange of information on similar lines with other institutes.
4. Information on related literature.

- Collection and preservation of seed germplasm collection

Requirements:

1. Training of a staff for procedures of collection, preservation, identification and cataloguing of the plant species.
2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
3. Exchange of information on similar lines with other institutes.
4. Information on related literature.

- Conservation on germplasm by tissue culture

Requirements:

1. Training of a staff for procedures of collection, preservation, identification and cataloguing of the plant species.



2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
 3. Exchange of information on similar lines with other institutes.
 4. Information on related literature.
- Conservation of germplasm *in situ*

Requirements:

1. Training of a staff for procedures of collection, preservation, identification and cataloguing of the plant species.
2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
3. Exchange of information on similar lines with other institutes.
4. Information on related literature.

Crop germplasm collection and preservation

- Collection, preservation and characterization of crop germplasm in Oman

Requirements:

1. Training of a staff for procedures of collection, preservation, characterization and cataloguing of the plant species.
2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
3. Exchange of information on similar lines with other institutes.
4. Information on related literature.

- Conservation on germplasm by tissue culture

Requirements:

1. Training of a staff for procedures of collection, preservation, identification and cataloguing of the plant species.
2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
3. Exchange of information on similar lines with other institutes.
4. Information on related literature.



- Conservation of germplasm *in situ*

Requirements:

1. Training of a staff for procedures of collection, preservation, identification and cataloguing of the plant species.
2. Detailed information on the facilities to be created in terms of equipments and laboratory facilities along with the detailed specifications and source for them.
3. Exchange of information on similar lines with other institutes.
4. Information on related literature.

- Training

1. In country courses on germplasm collection and preservation;
2. Training of staff at WANA regional office;
3. Software available;
4. Electronic mail.

- Other points

1. Availability of data for the germplasm collected from Oman earlier;
2. Availability of software for characterization and evaluation of crop germplasm;
3. Related literature on these lines.



Locations for germplasm collection in Oman

Crop	Location
Wheat	Interior Wilayat, Sharqiya, Rostaq, DAP Nejd, Salalah, Dahira, Mountain Area of North Oman
Barley	Interior Wilayat, Sharqiya, Rostaq, DAP Nejd, Salalah, Dahira, Musandam, Mountain area of north Oman.
Alfalfa	Mountain Area of North Oman, Salalah, Interior.
Sorghum, millets and cowpella	Rostaq Mountain, Salalah.

Germplasm collection areas for fruit crops

Crop	Collection area
Mango	Northern Oman, Batinah coast (Sohar, Musannah, Seeb, Shinas) Capital area Quriyaat. Interior Oman, Nizwah, Wadi quriyaat, Bahla, Dahirayah
Banana	Northern Oman, Batinah coast (Sohar, Musannah, Shinas) Interior, Sharqiyah, Quriyaat, Salalah
Coconut	Salalah
Papaya	Northern Oman (Batinah coast) Quriyaat, Sharqiyah, Interior, Salalah
Pomegranate	Jabal-al-akhdar, Interior Oman Wadi-jeel, Bahla, Batinah coast, (Wadi misthal) Salalah
Grape	Interior Oman, Sharqiyah, Jabal-al-akhdar, Salalah, Wadi misthal, Mountain areas
Guava	Salalah, Batinah coast
Custardapple	Salalah, Batinah coast
Ber	Batinah coast, Interior Oman, Dahirah, Sharqiyah
Acidlime	Batinah Coast, Interior Oman, Sharqiyah, Dahirah
Sweetlime	Sharqiyah region, Woosta, Interior



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