Experiences of Near East Countries on Utilization and Processing of Non- Wood Forest Products

Cases of Gum Arabic, Bee-Honey, Pistachios, Rosemary & Stone Pine





Food and Agriculture Organization
Office for the Near East
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Foreword

Today, an estimated 1.6 billion people around the world use forest resources to meet some of their needs for food, shelter, medicine and cash income. Forests and rangelands in the Near East countries have been an integral part of the society's economies, providing a wide array of goods and services and as such offer many opportunities to contribute to the economic, environmental and social development of the region.

Productive functions of forests, trees, shrubs and rangelands in the Near East region comprise provision of non-wood forest products (NWFPs). NWFPs include a wide range of products such as browse and range material; bush meat; bee-honey and wax; gums, resins and latex; silk; bark derivatives; fruits, nuts & seeds together with medicinal, aromatic & culinary, mushrooms, essential oils etc.

In light of this, I would like to draw the reader's attention to three important aspects of this book. The first one is the highlight of the environmental benefits of some NWFPs in the Near East region. The second aspect is related to the socio-economic benefits in general and their contribution to the livelihoods and food security of the rural communities in the production countries. The third aspect is in connection with countries' experiences in development and maximization of benefits from NWFPs.

This publication portrays five commodities that represent the flagships of the forest production in the Near East; namely Bee- honey in Yemen, Gum Arabic in Sudan, Pistachios in Islamic Republic of Iran (IRI), Rosemary in Tunisia and Stone Pine in Lebanon. It features information on nomenclature of NWFPs; the history of country's involvement in the product; production and ecological classification. It also relates stakeholder involvement and their roles, resource ownership; production and processing, existing research & extension activities on the product and puts in evidence all institutional/legislative and socio-economic aspects of the forest exploitation, measurable environmental and other benefits to communities and the country; as well as existing marketing opportunities and trade.

FAORNE which has been dedicated to highlighting and disseminating information on the importance of forest and ranges and the vital role they play in the livelihoods of rural people and general food security in the region, hopes that the information in this NWFPs publication will help broaden and deepen the debate on model of governance of forests and rangelands and stimulate actions at all levels in the Near East and beyond and more financing.

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Mr. Mohamed Saket, as the Senior Forestry Officer, initiated this work and coordinated the preparation of the publication. Soalandy Rakotondramanga, Junior Professional Officer contributed to the review and helped finalizing the report.

Abbreviations & Acronyms

AFDC	Association for Forests Development and Conservation
AP	Aromatic Plant
APIA	Agence de Promotion d'Investissement Agricole
B Hi	Bee Hives
BH	Bee Honey
BHi	Bee Hives
BK	Bee Keepers
BK	Bee Keeping
BW	Bee Wax
FAO	Food & Agriculture Organization of United Nations
FDA	Food & Drug Administration
FHA	Forest Harvesting Agency
FNC	Forests National Corporation (Forests Service of Sudan)
FP	Forest Policy
FRA	Forest Resources Assessment
GA	Gum Arabic
GAB	Gum Arabic Board
GAC	Gum Arabic Company
GAFRDC	General Administration of Forests, Range & Desertification Control
GAP	Good Agricultural Practices (GAPs)
GAPA	Gum Arabic Producer Associations
GAPC	Gum Arabic Processing Company
GASE	Gum Arabic Stock Exchange
GDA	Groupement de Développement Agricole
GDF	General Directorate of Forests
GMP	GMP Good Manufacturing Practice Regulations
GPPK	Green Peeled Pistachio Kernel
GRIN	United States Department of Agriculture, Agricultural Research Service,
Ha	hectare
HB	Honey Bees
HC	Honey Comb
HPS	Hand Picked Selected
IPA	Iran Pistachio Association
IPRI	Iranian Pistachio Research Institute
IRI	Islamic Republic of Iran
ISIRI:	Institute of Standards and Industrial Research of Iran
JECFA	Joint FAO & WHO Expert Committee on Food Additives
LDL	low density lipoprotein
MAI	Ministry of Agriculture & Irrigation
MoA	Ministry of Agriculture
MTs	metric tones
NCRS	National Center for Remote Sensing
NCSR	National Centre for Scientific Research
NEFRC	Near East Forestry & Range Commission
NGO	Non Governmental Organization
NWFP	Non Wood Forest Product
OWL	Other Wooded Lands
P.R.I	Iranian Pistachio Research Institute
RNE	Near East Region
RPC	Rasha Pistachio Company

SAP	Sirjan Adel Pistachio
SSMO	Sudanese Standards & Metrology Office
TND	Tunisian Dinar
WHO	World Health Organization

Introduction

Forests and rangelands in the Near East Region (RNE) have significant protective and productive functions and as such offer many opportunities to contribute to the economic, environmental and social development of the region. As such, they can contribute to poverty alleviation and the enhancement of the well-being of people living in the vicinity of forests and of the country at large.

Protective functions of forests, trees and rangelands in RNE encompass their safeguard of watersheds & water sources; conservation of bio-diversity; protection & fixation of soil; shielding of agricultural systems; provision of habitat for livestock & wildlife and shelter to human settlements.

Productive functions of forests, trees, shrubs and rangelands in the region include provision of wood and non-wood forest products (NWFPs). Wood products include lumber, sawn timber, industrial wood, building poles, firewood, charcoal and wood products such as paper, plywood and boards. NWFPs on the other hand include a wide range of products such as browse and range material; bush meat; bee-honey and wax; gums, resins and latex; silk; bark derivatives such as cork, cinnamon & tanning material; fruits, nuts and seeds such as almonds, pistachio and pine seeds together with medicinal, aromatic and culinary herbs such as basil, rosemary and thyme.

This note, intended to be the first in a series, has the purpose to:

(a) Highlight the environmental benefits of some NWFPs in Near East Forest & Range Commission (NEFRC) member countries,

(b) Their socio-economic benefits in general and their contribution to the livelihoods and food security of the rural poor in the countries where they are produced in particular,

(c) Reflect on countries' experiences in development and maximization of benefits from NWFPs

The note portrays five commodities that represent the geographic diversity and extent of NWFPs in RNE; namely Bee- honey in Yemen, Gum Arabic in Sudan, Pistachios in Islamic Republic of Iran (IRI), Rosemary in Tunisia and Stone Pine in Lebanon.

For each product a number of aspects are highlighted. These include: Definition of product; nomenclature of trees, shrubs or herbs, involved in production; brief history of country's involvement in the product and main production areas in the country; ecological classification & nature of plant formation where product is produced; resource ownership; sustainability of production; methods of production; who is involved, role of small producers, community organizations and large scale producers; research & extension activities on the product /resource; processing; institutional/legislative and socio-economic aspects; recognized measurable environmental and other benefits to communities & the country; marketing and trade; usage of product in country & worldwide and volume & value of trade.

Part I - Experiences of Near East Countries on Utilization and Processing of Non-Wood Forest Products

By H. O. Abdel Nour

Bee-honey in Yemen[1]

Bee honey (BH) is a sweet food made by bees of the Genus *Apis*, using nectar from flowers. BH gets its sweetness from the mono-saccharides fructose and glucose, and has approximately the same relative sweetness as that of granulated sugar.

Several kinds of BH are produced in Yemen which carry the names of forage plants on which bees feed or locations where they are produced. The most commercially known and valuable are Du'ani and Juranai from Al-sidr (*Ziziphus spina christi*) produced in Hadramaut and Shabwa Provinces respectively and Salum from Salum (*Acacia ehrenbergiana*) in Tihama.

Four subspecies of honey bees (HB) are known in Yemen: Indigenous Yemeni sub-species *Apis mellifera jemenitica* , two varieties in Sogetra: *A. carnica* and *A.m. fasciata*, Italian variety *A.m. ligustica* and Egyptian variety *A.m. lamarckii*. All varieties are adapted to the environment through continuous mobility and natural selection.

Bee rearing and honey production in Yemen dates back to the 10th Century BC when prosperous Yemen was famous for its incense and honey. Honey trade continued to rank fourth in old Yemen. The predominance of BH production lasted up to the 1970s when the sector deteriorated due to the spread of Varroa and Nosema diseases and lice together with bacterial, fungal and viral diseases. The government intervened then through projects to protect bees and enhance honey production. Projects included the introduction of modern bee hives (B Hi) from Egypt and Syria. In 1998 the Ministry of Agriculture & Irrigation (MAI) and through German support staged the Yemen-German Honey Project with the aim of extension, training, introduction & dissemination of modern hive techniques.

Yemen may produce up to 5 000 tons of BH, which is mainly exported to Saudi Arabia and the Gulf States and the revenues from these exports reaches some US$40 million per year.

All 21 Governorates and ecological zones of Yemen are known to produce BH. However the most productive ones are Hardamaut, Abien, Shabwa, Ebb, Taiz, Lahaj, Hudeidah and Hijja.

Several traditional agroforestry systems exist in the different ecological zones of Yemen. These systems represent a form of integration of woody species with crop cultivation or animal rearing, which increases overall revenue and protects soil productivity. The indigenous species most commonly used in these traditional agroforestry systems are: *Acacia negrii, A. tortilis, Cordia abyssinica, Dobera glabra, Ficus vasta, Tamarix nilotica, and Z. spina-christi.* Recently, Yemenite farmers have started to introduce fast growing exotic species used as shelterbelts and for the fixation of sand dunes in Tihama and Maareb. The most commonly used exotic species are: *Azadirachta indica, Cononcarpus lancifolius, Melia azedarachta, Parkinsonia aculeata, Prosopis chiliensis, and P. juliflora*.

Resource ownership is indexed to land tenure. The latter is 80 percent private ownership by individuals, 15 percent by private institutions and 5 percent by the State. People of Yemen have, for centuries, been concerned and involved in building of dams and irrigation systems which deeply entrenched the practice of settled agriculture and BK. The number of BHi and keepers are perpetually on the increase. Records of the MAI indicate that aperies have increased from 106 911 producing 178 tons in 2000 to some 1 239 692 producing 2 486 tons in 2009.

[1] Based on Report by National Consultant Gameel Abdel Samad Al Emad, for full text see Country reports.

Traditional BK methods in Yemen use a long, thin hive-box hollowed from a log. Modern hive boxes based on the same principle are wooden 80-100 cm long and 12x12 cm in cross section. The front has a hinged door with V-shaped bee entrance and the rear closure is plugged and sealed with mud. This can also be of pottery pipes made in three sections and supported on a metal frame, enabling the hive to be opened in two points in its length.

In all these BHi the queen and brood (larvae and developing queens) inhabit the front of the hive while the honey combs (HC) naturally built by the bees in parabolic shape, are suspended longitudinally for maximum ventilation and cooling. The HC is extracted through the rear of the hive which is sealed with mud and thus easily opened, causing minimum disturbance to the brood inside.

Apiaries are kept in banks of 10-100 hives, stacked 3-4 rows high on a metal stand covered with grass or similar cooling material, which in turn is covered with blue plastic sheet.

Bee keeping in Yemen has originated and remains in the hands of individuals and families in the country side some of whom adopt bee keeping as a mainstay occupation while the majority practices it as part-time job together with agriculture or petty trade. There are several Bee Keeper Associations but are not effective.

Agricultural, Forestry Research & Extension are the prerogative of the MAI through Agricultural Research Corporation and General Administration of Forests and Range & Desertification Control (GAFRDC).

After honey maturation, bee keepers undertake various stages of processing: - HC harvesting and collection in special utensils,

- Mature combs (85 percent wax sealed) are packed in stainless steel containers. Some are sold as honey chunks,

- Manual honey separation or through sun heating. In some modern aperies electric centrifuges are used,

- Separation of wax from honey,

- Packing of honey in glass or plastic containers of 1.7 or 14 kg.

In 2008 total population of Yemen was 22.1 million increasing at 3.1 percent per annum of whom 74 percent were rural living in areas devoid of basic services and where 46.6 percent were living on less than 2 US$ /day. Forty five percent of population in BK areas were living on less than US$2 /day. In a 1999 survey 25 and 75 percent of BH were owned by poor and better to do families respectively. Thirteen and 78 percent of BH production is marketed by poor and better to do families respectively.

The most important benefit of HB is cross pollination of plants effecting biodiversity and nature balance. Some 88 000 BK making up 500 000 families live in Yemeni country side for whom bee pollination increases field and horticultural crops by 20-30 percent particularly for such crops as palm dates, coffee, grapes, mangoes and cotton.

After HB processing, producers sell directly to consumers, retailers or export agents. Some market their produce direct to agents in Arab countries especially during marketing festivals such as International Village in Dubai or Autumn Expo of Kuwait.

BH is widely used as food and medicine. Seventy percent of BH produced in Yemen is locally consumed and 30 percent exported. Total honey production in the last few years is

estimated at 2 400 tons at an estimated value of US$45 million of which some 800 tons are exported to Kingdom of Saudi Arabia, United Arab Emirates, Kuwait, Bahrain, Qatar, Jordan, Egypt, Syria and other countries for a value of about US$11million.

Gum Arabic in Sudan[2]

Gum Arabic (GA) is the term originally given to exudates which ooze out when stems or branches of the Hashab tree (*Acacia senegal*) are injured (tapped). GA came to be defined by international regulatory bodies as the dried exudates from the trunk and branches of *A. senegal* or *A. seyal*, of the family *Leguminosae*. However, gum from the latter tree Talh (*A. seyal*) is more friable than and inferior to Hashab gum. The old definition confines GA to the exudates of *A. senegal* and closely related species.

Overall GA production in Sudan spans eleven: W. Darfur, N. Darfur, S. Darfur, C. Dardur, E. Darur, N. Kordofan, S. Kordofan, White Nile, Sennar, Blue Nile and Gadaref.

Gum producing trees thrive in low and high rainfall savanna of central Sudan in association with *Balanites aegyptiaca* and *A. mellifera* . The most common associated grasses are *Aristida pallida*, *Eragrostis tremula* and *Cenchrus biflorus.*

GA is produced in a typical land use practice that prevailed in Kordofan, western Sudan as shifting cultivation with or without bush-fallow. The *A. senegal* agroforestry system is practiced as a means of restoring the soil fertility and promoting GA production. Traditional *A. senegal*-based agroforestry system was recognized and considered one of the most successful forms of natural forest management in the tropical drylands and regarded as sustainable in terms of its environmental, social and economic benefits. Agroforestry with GA based on indigenous knowledge associated with gum production system was acquired by farmers in the gum belt communities over a long time, and the system is sustainable as long as it is maintained along its cycles.

GA trees are managed with agricultural crops such as sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum typhoideum*), groundnut (*Arachis hypogaea*), sesame (*Sesamum indicum*) and karkadeh (*Hibiscus sabdariffa*). This agroforestry system allows a period of 10-15 years for restoring the soil fertility after a short period of arable cultivation.

About 87 percent of the land allocated to gum production is privately owned, the rest is owned by the Government. Gum orchards owned by GA farmers organized in producer associations are estimated at 600 000 hectares (ha).

In spite of periodic drought spells and civil strife in the gum belt, Sudan sustained the production of sought quantities and quality of GA at reasonable prices through various forest policies and management plans.

Gum production encompasses two stages:

i. Gum tapping and collection: Gum hashab is collected after tapping, whereas gum talha is collected as a result of natural exudation. Traditional methods of tapping were replaced with a specially designed tool. After injury, tears of gum form on the exposed surfaces and are left to dry and harden. After five weeks the first collection of gum is made, with further collections from the same trees at approximately 15–day intervals until the end of February; up to five or six collections in total.

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[2] *Based on report by National Consultant* **Sayeda Ahmed A. Khalil,** For full text see Country reports.

®. Such as Joint FAO/WHO Expert Committee of Food Additives (JECFA)

ii. Post–harvest handling: Cleaning and sorting is undertaken by the producer and subsequently by large traders after sale in auction markets.

GA producers, small village traders, GA Producer Associations (GAPA) , and GA companies are collectively involved in organizing production. A complete protocol of regeneration, tapping, collection, grading, initial processing and marketing has been elaborated for GA by Sudanese farmers, foresters and businessmen over decades of practice.

In recent years research on GA has been developed to include improvement of production, marketing, tree physiology, specifications, ecology and environment of GA. Forests National Corporation (FNC) annually disseminates extension programs through States offices for local communities, GAPA, producers, farmers and other GA dependants.

Gum processing is undertaken by private sector companies. It encompasses several activities, most important of which are:

A. Grading: The international gum trade has come to recognize three grades of raw gum:

1. ***Hand Picked Selected* (HPS):** raw un-broken or chipped globules of clean GA,
2. ***Cleaned grade gum*:** broken or chipped gum lumps with no limit on the granule size.
3. ***Dust*:** GA by-product from screening/grading or cleaning processes.

B. Processing: Three types of processing are recognized:

1. ***Kibbled gum*:** Mechanically broken granules of gum with a maximum size of 14 mm and a minimum size of 3mm and a range of 8mm.
2. ***Mechanical powder***: White powder of mesh size inferior to 200 microns resulting from mechanical crushing
3. ***Spray dried***: White powder of mesh size inferior to 100 microns, which results of a process by which raw gum is dissolved in water, centrifuged to remove impurities, pasteurised and sprayed in hot air to evaporate water.

Local communities (women and men) are involved in the production process from tree tapping to collection, cleaning and grading. FNC initiated the idea of GAPA to develop the production. The total number of registered associations is about 1 481 with membership of 1 881 800 individuals.

Throughout the last centuries gum was produced by individual producers and exported by private sector companies. In 1969 a public Liability Company; the Gum Arabic Company (GAC) was established and was granted the concession as the sole exporter of raw gum. The concession was removed in 2009 and a regulatory body was established; the Gum Arabic Board (GAB). GAB is sovereign regulatory body for GA and responsible for establishing effective monitoring system, organizing local markets, state strategies, policies, directives & rules, follow-up execution of policies with government or private institutions. In 2010 GAB establishment the Gum Arabic Stock Exchange (GASE) was created to grantee the production, funding, quality control and marketing.

Environmental, socio-economic benefits of GA are incalculable: The gum belt acts as a natural barrier to protect more than 40 percent of the total area of Sudan from desert encroachment. The belt is natural habitat for a wide variety of flora and fauna. The belt is the resource base for most of Sudan's production of staple cereals, cash crops and livestock. It is estimated that six million people nation-wide depend on GA for income. GA plays an important role as major source of foreign exchange, accounting for 13.6 percent of the annual non-oil export income.

Sudan was known as a source of GA since ancient Sudanese and Egyptian civilizations that used gum in the treatment of their sick, mummification of their dead, painting of temples and dying of clothes. Early in the 18th century, Arab traders took GA from Red Sea and Mediterranean ports to Europe hence the name. GA was the leading source of revenue and source of foreign cash earnings for Sudan until the introduction of cotton in 1920. Current annual cash earnings from GA export are around US$80 million.

As early as 2000 BC, GA was used by Ancient Egyptians in food, adhesives and paint. Locally GA is used in soft drinks, laundry starch, famine food and in plastering. The world demand for GA is because of unique properties as an emulsifier for citrus oils in fruit based drinks and cola type drinks, thickener, binder, cosmetics, drugs, sweets, chewing gum, stabilizer and adhesive. Other uses are in confectionery, pharmaceutics and photography. Of late GA has become a food ingredient and a major component of health foods because of its high content of soluble fibres and low calorific value.

Sudan commands over 80 percent of the world's GA production and trade. The major consumers of the gum are West European countries and The United States of America. However, minor amounts go to Japan and countries from the Far East. The main countries that import the GA are; France, United Kingdom, Japan, Italy, Germany, Denmark, Belgium, Spain, Greece, Netherlands, Portugal and Ireland.

Pistachios in Islamic Republic of Iran[3]

The Pistachio is a relatively small tree mostly grown in the arid parts of the world close to 30th parallel latitude. It grows from sea level (e.g. Attica, Greece) to an altitude of 1 800 meters above sea level (e.g. Kerman, Iran). The combination of latitude and altitude provides enough chilling hours in winter and long hot and sunny summer conditions to produce a viable crop.

Pistachios bear laterally on one-year-old wood. This causes an alternate bearing habit, so prominent in pistachio production with extensive commercial consequences.

The pistachio of commerce is the only edible species among the 11 species in the genus *Pistacia*; all are characterized by their ability to exude turpentine or mastic. Several are referred to as pistachios, but the name is generally reserved for the edible nut of commerce. Its Latin name is *Pistacia vera* L. A member of the family *Anacardiaceae*, it is related to the cashew, mango, poison ivy and oak, pepper tree and sumac. Other *Pistacia* species include *P.terebinthus*, *P. palaestina*, *P. lentiscus*, *P. chinensis* , *P.afghanistania* and *P. atlantica*.

Pistacia plants are shrubs and small trees growing to 5–15 m tall. The leaves are alternate, pinnately compound, and can be either evergreen or deciduous depending on species. All species are dioecious, but monoecious individuals of *P. atlantica* have been noted. The genus is estimated to be about 80 million years old. It may require more than 200 years for trees to reach one meter diameter and trees up to 2 m in diameter are known. Trees exceeding 50 cm are rare in most areas and in some areas trees harvested by the time they reach 30 cm.

Pistachio cultivation spread into the Mediterranean world where it has continuously prospered in Syria, Turkey, Greece and Sicily. Pistachios were already well known in Late Antiquity. Since 1970s, pistachios have become a commercial crop in many countries which fall around the 30th parallel north and south of the equator. These regions include: California, North Africa, New South Wales in Australia, South Africa, Argentina and Chile.

The individual pistachio nut grows in fruit clusters of multiple nuts. Botanically, they are drupes. All drupes consist of three parts; an exocarp, a fleshy mesocarp (together called hull) and an endocarp (shell) that encloses a seed (kernel). In pistachios the seed is consumed, rather than the mesocarp as in stone fruit.

Commercial cultivars vary in how consistently they split open. Each pistachio tree averages around 50 kg of seeds, or around 50 000 nuts every two years. The trees begin to bloom with the arrival of warm weather in late March. The male pollinates the female via the April winds, and the shell of the nut is fully developed by mid-May. Before June ends, the seed inside the shell has begun its rapid expansion and by the first of August, the seed has filled the shell. The nuts, splitting at the seams, are usually ready to be harvested beginning September.

Pistachios are a rich source of vitamins and minerals, fibre, antioxidants and unsaturated fat for a healthy diet. A serving size of pistachios provides more nutrients than most other nuts and snacks.

There have been numerous studies highlighting the health benefits of pistachios. The US Food & Drug Administration (FDA) published a statement in 2003 approving scientific

[3] Based on report by national consultants Mustafa Jafari and Simin Raisi Zadeh. For full text see Country Reports.

evidence suggests that eating 1.5 ounces per day of pistachios, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease. Pistachios may help curb less-than-ideal levels of LDL "bad" cholesterol, according to another study published in 2008. In research at Pennsylvania State University, pistachios in particular significantly reduced levels of low-density lipoprotein (LDL cholesterol) while increasing antioxidant levels in the serum of volunteers.

The principal producing area in Iran is Kerman province, which is located in the arid southeast. Extensive plantings are located in the vicinity of Rafsanjan, Anar, Kerman, Sirjan, Zarand, Shahr-e-Babak, Ravar, Rayen and others cities (Kerman had a plantation area in 2010 of 209 000 ha and a total production 137 000 of tons crop on dried in-shell basis) also Khorasan-e-Razavi, Yazd, Fars, Khorasan-e-Jomoobi, Semnan, Sistan-o-Baluchestan, Makazi, Esfahan, Qom, Qazvin, Tehran and other provinces in Iran (Subtotal Iran of 292 000 ha and 210 000 tons crop dried in-shell basis production in 2010)

Ownership of pistachio orchards, pistachio industry and export & imports businesses mainly belong to private sector as individual farmers or companies.

A recent study of distribution, age gradation and diameter classes of Pistachio shrubs in plantations and wild indicated the long term sustainability of production in IRI.

Most of the production is from orchards that account for 53 percent of world planted area, but there are a few places, such as in the Zagros Mountains, where wild Pistachio (*P. atlantica*) persists in natural and extensively managed semi-natural stands. Wild Pistachio, known as Baneh in Iran, is the most economically important species for rural people in areas of natural forests.

The pistachio industry in Iran is made up of three main sectors: farming, post harvest processing and trade.

The trees are planted in orchards, and take approximately seven to ten years to reach significant production. Production is alternate bearing meaning the harvest is heavier in alternate years. Peak production is reached at approximately 20 years. Trees are usually pruned to size to make the harvest easier. One male tree produces enough pollen for eight to twelve nut-bearing females.

Pistachios have been cultivated in Iran for thousands of years. Commercial cultivation of pistachios in Iran started expanding about one hundred years ago. The upward trend of production has continued ever since. It is estimated that the amount of pistachios produced in Iran rose from around 2 000 tons in 1950s to about 25 000 tons in 1975. The average nationwide production in the closing years of the millennium exceeded 150 000 tons.

At present, around 150 000 farmers harvest the crop from about 290 000 ha of pistachio orchards nationwide; more than 70 percent of the production is coming from small scale producers (those who manage orchards of 2 hectares or less). Currently, annual pistachio production capacity is around 280 000 metric tons. All pistachio orchards in Iran are hand-harvested. Average annual yield of bearing Iranian pistachio orchards is 800 kg per hectare. Individual farms may produce from 300 to 3 000 kg per hectare.

It is hoped that new plantings in areas with abundant water resources by corporations rather than individuals would, in future, open the way for establishment of modern, industrial scale orchards. Iran Pistachio Association is already promoting such initiatives through the Model Pistachio Orchard Project.

According to the external shape of the pistachio it is divided to four or five major groups: Jumbo, Round, Long, Kernel and Closed Pistachios.

Research on pistachio production in Iran was started in 1960 by the two departments of plant protection and horticulture in Rafsanjan city, the main pistachio growing area of Iran. In recognition of the importance of pistachio production in desert and arid areas of the country, the Iranian Pistachio Research Institute (IPRI) was established by combining the previous pistachio research departments and was complemented with four new departments in 1993. At the present time, there are six departments in the IPRI which are dealing with different aspects of pistachio production. Furthermore, there are six research stations under the supervision of the Institute in different pistachio growing regions of the country. The scientific staff in the different departments and research stations comprise 35 researchers and 15 technicians.

The pistachio processing industry in Iran is gradually moving from traditional, low-capacity, home or farm based, sun-drying units towards specialized, industrial high-capacity plants utilizing hot forced air for drying. Traditionally, processing plants acted as service providers to the growers.

Currently, the largest industrial pistachio processing plant in the country has a capacity of 350 tons of fresh pistachios per day. Although the number of high-capacity plants is small, the total number of mechanized processing units is quite large and growing every year.

A typical modern Iranian pistachio processing plant processes freshly harvested pistachios as follows: weighing, unloading and sampling; hulling; water floatation tank; heated, forced air continuous pre-drying; adhering hull separation and removal; dryer and sun drying; mechanical separation of open-shell nuts from closed-shell nuts; mechanical sizing; picking conveyor belt and/or picking table and packing.

The Ministry of Agriculture is responsible for horticulture issues. There various policies and laws on forestry sector which cover the pistachio issue.

The Iranian Pistachio Association (IPA) is the national Non Governmental Organization (NGO) responsible for development of the industry. It offers various services to its members with the aim of promoting their interests, as well as the interests of the Iranian pistachio industry as a whole, both within Iran and internationally.

Pistachio plantations have many socio-economic and environmental benefits. Some 1.5 million people depend on pistachio production for their livelihoods. Domestic consumption in 2010 was 30 000 tons.

Pistachio as a strategic commodity for IRI and is the major non-oil export item. Fifty five percent of world pistachio production and 60 percent of global exports are from Iran. Annual exports are in the order of 160 000 tons for a value of US$1.5 billion, largely to UAE, Hong Kong, Russia, Germany and Spain. Other producer and exporting countries include USA, Syria, Turkey and Greece.

Pistachio production in the world stood at 548 759 tons in 2002 with Iran ranking first with a production of 300 000 tons, the U.S. 127 000 tons Turkey 40 000 tons, Syria 39 208 tons and China with 26 000 tons.

Rosemary in Tunisia[4]

By definition, the name rosemary derives from the Latin "*Rosmarinus*" which literally means "dew of the sea" in an indication to the Mediterranean origins of this herb which is now planted throughout the world.

Known for its therapeutic virtues, Rosemary oil is used to facilitate bowel movement, calm coughs, stimulate the gall bladder and the breathing system, as well as to remedy stomach aches.

Rosemary (*Rosmarinus officinalis*) is a woody, perennial herb with fragrant, evergreen, needle-like leaves. It is a member of the mint family Lamiaceae, which also includes many other herbs.

R. officinalis is one of only two species in the genus *Rosmarinus*. The other species is the closely related but less commercially viable *R. eriocalyx*, of Tunisia. Named by the 18th century naturalist and founding taxonomist Carolus Linnaeus, it has not undergone much taxonomical change since. Its Arabic name is "Iklil''.

Plant form ranges from upright to trailing; the upright forms can reach 1.5 m tall, rarely 2 m. The leaves are evergreen, 2–4 cm long and 2–5 mm broad, green above, and white below with dense short woolly hair. Flowering is common in mature and healthy specimens and occurs in summer in the north, but the plants can be ever blooming in warm-winter climates. Flower colors are variable, being white, pink, purple, or blue.

Since it is attractive and tolerates some degree of drought, it is used in landscaping, especially in areas having a Mediterranean climate. It is considered easy to grow for beginner gardeners, and is pest-resistant

Rosemary grows on friable loam soil with good drainage in an open sunny position. It grows best in neutral to alkaline conditions with average fertility. Rosemary is easily pruned into shapes and has been used for topiary. When grown in pots, it is best kept trimmed to stop it grow wild. It can be propagated from an existing plant by clipping a shoot 10–15 cm long, stripping a few leaves from the bottom, and planting it directly into soil

Tunisia is a Mediterranean country where many aromatic plants (AP) such as Rosemary, *Myrtus comminus, Thymus capitatus* etc. grow naturally. Rosemary constitutes a durable biological product used in pharmaceutics, cosmetics and food etc.

Because of its economic, environmental and social values, Rosemary was highly regarded by the Ministry of Agriculture (MoA) which has invested considerably in its protection and rational use through research, planning and development, production, regeneration and valorization of the produce.

Rosemary is a perennial plant (chamaephyte) that usually grows in the guarrigue type of vegetation and under forests of pine (*Pinus halepensis*), *Tetracnilys articulata* or *Juniperus* sp. It is found in various bioclimates from the sub-humid to the upper arid. But it is widely dominant in the semi- arid Mediterranean bioclimatic stage.

[4] *Based on report by National Consultant* **Ahmed Bargaoui,** For full report see Country reports.

In Tunisia it's found in the centre of the country: Kasserine, Kairouan, Siliana and Zaghouan, and in the North-west; Le Kef. It is also found in small stretches in the North-east; the Medjerda valley, the Cap Bon and even in the south; Matmata.

Rosemary grows in Tunisia, naturally in "shrub" type formation which is characteristic of the Mediterranean climate. It is resistant to prolonged droughts. The plant association which characterizes the shrub formation in the garrigue is composed essentially of *R. officianalis, myrtus comminus, arbutus unedo, Erica arborea, pistachia lentiscus, cistus monspellensis* and *C. laurifolius*. In Tunisia, Rosemary is also planted but in restricted areas.

Ninety percent forests of in Tunisia are State owned including 340.494 ha occupied by Rosemary. Private owners have some 4 300 ha. MoA, General Directorate of Forests (GDF) and Forest Harvesting Agency (FHA) are responsible of management, protection and exploitation of the Rosemary resource in the country.

As most of the Rosemary areas belong to the State, MoA is responsible of its management and exploitation with the objective to keep sustainable production. GDF develops and implements an action plan based on two to five years rotation and according to the state of the resource. The whole area is divided into groups based on two, three and five year rotation. This method of controlled exploitation guarantees continuous regeneration of the Rosemary vegetation.

Forestry legislation in Tunisian obliges the GDF to ensure that exploitation of the resources is done on sustainable basis following the rotation system and adequate techniques of resources harvesting.

Rosemary plant is used for many purposes:

Leaves of rosemary are used fresh or dry in traditional Mediterranean cuisine. They can be used to make infusion.

Upper parts of rosemary are used to extract essential oil for use in perfumes, pharmaceutics, and other cosmetic products

In Tunisia, the exploitation of Rosemary spans two periods; distillation period from March to June and drying period from March to September. The method of production is fixed depending on the end use of the plant

1) Use of fresh and dried leaves

For this purpose, the upper parts of the twigs and branches of 5mm diameter are collected. The twigs with leaves are dried in the shade

2) Use for extraction of essential oil

The extraction of essential oil is done following an old traditional way namely extraction by water vapor. The harvest (leaves and twigs) is placed in the "alembic" with a capacity of about 800 kg. When water is heated, the vapor goes through the vegetal matter taking with it the essential oil and passes in a tube swimming in cold water. The vapor condenses in a recipient where the essential oil less heavy than water is recuperated at the surface.

Companies, NGOs and the private owners are involved in the production and business of Rosemary. Many activities were developed and jobs created in this system of production from exploitation of the green matter by the local population to extraction of essential oil by specialized distillers to transport, storage, trade and export by companies.

Exploitation of rosemary is organized by the GDF and the FHA following the elaborated action plan. The sale of right of the exploitation of right of exploitation on the State land is regulated by the forest law. The trade and marketing are regulated by the general country law on foreign trade

Rosemary oil is a safety net for the local population. Its production generates for them an additional income of about 300 US dollars per worker per year. There are many stakeholders in the process of rosemary management, production and marketing. Among those we find public institutions, private companies, local population, NGOs, GDAs and the private sector.

The chain of rosemary has tremendous environment benefits for the country. Among these are:

Properly managed rosemary vegetation cover helps combat advance of desertification and protects soil against erosion

The vegetation cover of rosemary and the associated species constitutes a habitat for rich biodiversity including rich wildlife

Well conserved rosemary vegetation develops pollinators including bee keeping and production of biological products bee honey.

There are other recognized measurable benefits to rural communities and various strata of population. Among those benefits, it is important to mention:

Employment opportunities to the local population. Thousands of jobs are created seasonally every year.

Development and promotion of industrial and trade companies

Contribution to the economy of the country including as source of foreign currency.

In 2011, the cost of production of one (1 kg) of rosemary oil was about 28 US dollars. That includes harvesting of the product, handling, distillation, transport, storage, and trade

The average of more than 90 percent of the national production is exported. The rest is consumed by the local market. The amount annually exported during the last few years averaged 150 000 tons fetching US$3 million. It is largely exported to Saudi Arabia, France, Italy, Belgium, United Arab Emirates, and USA.

Stone Pine in Lebanon[5]

Stone Pine is one of the most important elements of the Mediterranean vegetation stages in Mount Lebanon. The impressive landscape of its forests, its distinctive shape and its edible seed (stone) contribute to the economic, social, cultural and environmental value of *Pinus pinea*.

Fruit of the stone pine (*P. pinea*) is commonly called pine nut in English, pignon in French and Sanawbar or boundok in Arabic (Boundok is also the Arabic name for hazelnuts).

Pine nuts from Stone pine (*P. pinea*) have been eaten in Europe and Asia since the Paleolithic period. Seeds of other Pine species that grow in Lebanon (*P. halepensis* and *P. brutia*) are not eaten in Lebanon. *P. pinea* has been cultivated for over 6 000 years and harvested from wild trees far longer in Mediterranean countries.

Pine nuts are a major component of the Lebanese cuisine and are added to meat, fish, salads, vegetable dishes and sweets.

Depending on the species, pine nuts contain 10–34 percent protein, with Stone Pine having the highest content. They are also a source of dietary fiber. The nutrients are stored in the embryo in the centre. Although a nut in the culinary sense, the pine nut is a seed in the botanical sense. The shell must be removed before the pine nut can be eaten. Unshelled pine nuts have a longer shelf life if kept dry and refrigerated than the shelled nuts.

Throughout history, Stone Pine forests were over-exploited on a continuous basis by all the different invaders. During the period of the Ottoman occupation, and specifically between 1914 and 1917, and the French and British mandates that followed, large surfaces were harvested to cover the war needs. Stone pine forests were almost entirely harvested and the slopes were left empty.

The majority of Stone Pine forests are located in the Metn (Mount-Lebanon) and Jezzine (South Lebanon). The largest number of pine nuts producers are found in the village of Ras el Metn.

Forests in Lebanon constitute an important natural resource. The main forest types widespread in Lebanon are *Quercus calliprinos, Q. infectoria, Q. cerris var. pseudo cerris, Juniperus excelca, Cedrus libani, Abies silicica, Pinus pinea, P. halepensis, P. brutia* and *Cupressus sempervirens*. The bulk of the forest area consists of Oak and Pine stands. In addition, the Lebanese forests contain a wide range of aromatic, wild, and medicinal plants.

Pine forests constitute the second largest type of forests (after oak-broadleaves) in the Lebanese landscape. Some 17,200 ha of the three pine species (*P. brutia, P. halepensis*, and *P. pinea*) are distributed in different bioclimatc stages, while the Stone Pine alone covers more than 46 percent of this surface (some 8 000 ha).

Woodlands (forests, other wooded lands and part of the other lands with trees) ownership in Lebanon is almost equally distributed between the private sector, public sector and religious communities, under several tenure systems. The users of the forest areas may not be the owners. Rentals, usufructs, customs and agreements are used to regulate this system. Forest workers, private rural companies or shepherds may be allowed to use the space under these

[5] Based on report by National Consultant Fady Asmar. For full report see Country reports

usage systems. The ownership of Stone Pine forests follows the same pattern as the forests and other wooded lands.

Production of pine nuts from *P. pinea* forests remains one of the rare income-generating activities related to forests and other wooded lands. It would be affected by the open market strategies, mainly because of the high production costs and the competition by imported nuts. *P. pinea* stands are also affected by the uncontrolled urban sprawl, lack of labour, aging of trees and limited interest of the young generation in such an activity.

Most of the *P. pinea* forests currently existing in Lebanon are planted. A few single standing old trees are scattered in the landscape, in the villages, in the forests. In the absence of any wood production, Stone Pine forests in Lebanon are the main type of forests with a primary production function.

Stone Pine tree starts to produce fruits (cones) around the age of thirty. It is a monoecious species, where female and male flowers are found on the same tree, but on different organs. The fertilized cone takes three years to reach maturity. During the first year, it is a small cone of up to 2 cm long; it becomes as large as a walnut during the second year; it reaches its full size during the third year. The cone reaches maturity during the fall of the third year after flowering. It is composed of brown scales, each containing two brown hard shelled seeds, covered with black dust. The pine nut is found inside the seed. Each tree bears at the same time cones of the three different growth stages.

After the cones are harvested between November and April, they are spread over a flat surface, under the sunshine, until they are fully opened. Then they are gathered and brought into the processing plant. They are put in a drum that separates scales and cones from the black seeds. Another drum breaks the black seeds and separates the tegument from the seed, the nut. A fan blows away the thin layer covering the seeds to reveal the beautiful white seed, the pine nut.

Plantation density of *P. pinea* in Lebanese forests is around 250-300tree/ha. At maturity and depending on the site, age and management trees produce between 15 and 750 kg of cones/year. Every 5 kg of cones produces 1 kg of seeds; every 5 kg of seeds produces 1 kg of pine- nuts.

Production cost varies with the density, management and interventions. Every 4 years the forest needs pruning; cleaning the undergrowth is done on a yearly basis; some farmers use fertilizers, mainly chicken manure to improve the growth and production. The average production cost would range between US$27 and 28 per kg.

Producers are organized in a Syndicate, with around 530 members, both Lebanese and Syrians. Being organized, they are able to better protect the production and to exercise the appropriate pressure on the Government whenever it is needed.

Research and extension activities on Stone Pine remains limited, mainly because of the absence of a forest research institute and the absence of formal forest education.

In 2011, the whole sale price of pine nuts is US$40/kg; the retail price varies between US$43 and 55, depending on the quality, size and cleanliness of seeds and on retail shop.

In order to protect national production from imported products (mainly from Turkey and Asia), the Ministry of Agriculture has imposed a tax policy of US $10/kg of imported pine nuts. This tax policy increases the competitiveness of the national product.

According to the Syndicate of Producers of Pine Nuts, around 50 000 families depend on Stone Pine as their partial or major source of income. This involvement is spread over all the phases related to production, from forest management, weeding, cleaning, tree-pruning, and spreading of fertilizers to harvesting and processing.

There are around 100-150 processing units in the Mount Lebanon, mainly in the Metn area. The owners of the processing units buy the cones or the black seeds from producers in different parts of the country.

Processing units are usually family owned. They involve the participation of the family members (mainly women) and some external manpower. Being a delicate job, the final cleaning, sorting and packing is usually undertaken by women.

Like other types of forests, Stone Pine forests play a major role in the conservation of soil and water and in the provision of social and environmental products and services. In particular, they are known to be more fire resistant than other pine forests, mainly when they are properly managed. The landscape offered by Stone Pine forests is highly appreciated by Lebanese people and by foreigners who like to visit the regions where such forests grow.

Pine nuts are widely used in Lebanon, in the Middle-East and in all the Mediterranean Countries. It usually accompanies all kinds of dishes, meat, poultry, fish, vegetables and sweets. It is an important ingredient of many Mediterranean dishes. It is the main ingredient of the Italian Pesto (Pine nuts, basil leaves, garlic, Parmesan cheese and olive oil); a pine nuts ice cream is available in Italy.

According to the syndicate of producers of pine nuts in Lebanon, the yearly production is around 800 tons/year; according to data from the MoA the yearly production is around 600 tons/year.

Most of the production is consumed locally, or exported in small quantities by travelers while leaving Lebanon. It is only in 2010 that some 500kg were exported to the Gulf countries.

Part II- Country reports

1. THE CASE OF BEE-HONEY IN YEMEN

By: Eng. Gameel Abdel Samad Al Emad (Yemen)

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2. THE CASE OF GUM ARABIC IN SUDAN

By: Sayeda Ahmed A. Khalil (Sudan);

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3. THE CASE OF PISTACHIO NUTS IN ISLAMIC REPUBLIC OF IRAN

By: Dr Mustafa Jafari (Iran)

Head of TPS for LFCCs

Eng. Mrs Simin Raisi Zadeh

Senior Expert of Europe and North America and LFCCs

4. THE CASE OF ROSEMARY IN TUNISIA

By: Ahmed Bargaoui (Tunisia)

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5. THE CASE OF STONE PINE IN LEBANON

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Bee-honey in Yemen[6]

DEFINITION OF PRODUCT

Honey is a sweet food made by bees using nectar from flowers. The variety produced by honey bees (the genus *Apis*) is the most commonly referred to as the type of honey collected by bee keepers (BK) and consumed by humans. Honey produced by other bees and insects has distinctly different properties.

Bee honey (BH) gets is sweetness from the monosaccharides fructose and glucose, and has approximately the same relative sweetness as that of granulated sugar (Wikipedia 2010).

Several kinds of BH are produced in Yemen which carry the names of forage plants on which bees feed or locations where they are produced (Table 1).

TABLE 1: **Honey types in Yemen**

Kind	Forage plant		Province/ District	Colour	Price range (US$/kg)
Du'ani	Al-sidr	*Ziziphus spina christi*	Hadramaut	Yellow	60
Jurdani	Al-sidr	*Z.spina christi*	Shabwa	Yellow	60
Salum	Salum	*Acacia ehrenbergiana*	Tihama	Black	40
Dabbah	Dabbah	*A. mellifera*	Widespread	Yellowish	35
Asak	Asak	*A. asak*	Widespread	Brown	35
Ammak	Ammak	*Euphorbia ammak*	highlands	Colourless	25
Range	Range plants		Widespread	Various	15

Yemen has a diverse flora and fauna as a result of variation in topography and climate. Some 3 000 plant species have been recorded of which 44, 29 and 27 percent are trees, shrubs and herbs respectively. Some 30 tree genera and species are known for their abundance of pollen grain including *Ziziphus, Acacias, Moringa, Anogeissus, Cordia, Maerua, Phoenix* and *Tamarindus*.

Four subspecies of HB bees are known in Yemen:

- Indigenous Yemeni sub-species *Apis mellifera jemenitica*: This is known for its abundance & wide distribution, highly fertile queens and resistance to diseases.
- Two varieties in Sogetra: *A. carnica* and *A.m.fasciata*,
- Italian variety *A.m. ligustica*,
- Egyptian variety *A.m. lamarckii*.

[6] Prepared in Arabic by *Dr. Gameel AbdelSamad El Emad*, GDFRDC, Yemen,
Translated into English by Hassan Osman Abdel Nour, FAO Consultant, P.O. Box 8116, Amarat, Khartoum, Sudan. E-mail: ibnosman44@yahoo.com

All varieties are adapted to the environment through continuous mobility and natural selection.

PRODUCTION

Bee rearing and honey production in Yemen dates back to the 10th Century BC when prosperous Yemen was famous for its incense and honey. Honey trade continued to rank fourth in old Yemen. The predominance of BH production lasted up to the 1970s when the sector deteriorated due to the spread of Varroa and Nosema diseases and lice together with bacterial, fungal and viral diseases.

The government intervened then through projects to protect bees and enhance honey production. Projects included the introduction of modern bee hives (B Hi) from Egypt and Syria through the Agricultural Research Station and establishment of Honey Division in 1990. In 1998 the Ministry of Agriculture & Irrigation (MAI) and through German support staged the Yemen-German Honey Project with the aim of extension, training, introduction & dissemination of modern hive techniques. The government also ensured that all rural development projects encompassed components for BH development and honey production through training of producers, extensionists and trainers.

Main production areas in the country

Yemen may produce up to 5 000 tons of BH per year, which is mainly exported to Saudi Arabia and the Gulf States and the revenues from these exports reaches approximately US$40 million per year.

All 21 governorates of Yemen are known to produce BH. However the most productive ones are depicted (Table 2).

TABLE 2: Governorates of Yemen producing most of the honey

Governorate(s)	Bee Hives (%)	National production (%)
Hardamaut	27	32
Abien	19	15
Shabwa	14	13
Ebb, Taiz,Lahaj	17	15
Hudeidah, Hijja	13	15
Others	10	10

ECOLOGICAL CLASSIFICATION

All ecological zones of Yemen are involved in BH production in one degree or another. The most prominent zones in this respect are Hadramaut Plateau, South Eastern Highlands, Tihama Plateau and Western Highlands.

Several traditional agroforestry systems exist in the different ecological zones of Yemen. These systems represent a form of integration of woody species with crop cultivation or animal rearing, which increases overall revenue and protects soil productivity. The indigenous

species most commonly used in these traditional agroforestry systems are: *Acacia negrii, A. tortilis, Cordia abyssinica, Dobera glabra, Ficus vasta, Tamarix nilotica, and Z. spina-christi*.

Recently, the Yemenite farmers have started to introduce fast growing exotic species used as shelterbelts and for the fixation of sand dunes in Tihama and Maareb. The most commonly used exotic species are: *Azadirachta indica, Cononcarpus lancifolius, Melia azedaracht, Parkinsonia aculeata, Prosopis chiliensis, and P. juliflora*.

RESOURCE OWNERSHIP

Resource ownership is closely tied to land tenure. The latter is 80 percent private ownership by individuals, 15 percent by private institutions and 5 percent by the State.

Sustainability of production:

People of Yemen have and for centuries been concerned and involved in building of dams and irrigation systems which deeply entrenched the practice of settled agriculture and BK. The number of BHi and keepers are perpetually on the increase. Records of the MAI indicate that aperies have increased from 106 911 producing 178 tons in 2000 to some 1 239 692 producing 2 486 tons in 2009.

METHODS OF PRODUCTION

Traditional BK methods in Yemen use a long, thin hive-box hollowed from a log. Modern hive boxes based on the same principle are wooden 80-100 cm long and 12x12 cm in cross section. The front has a hinged door with V-shaped bee entrance and the rear closure is plugged and sealed with mud. This can also be of pottery pipes made in three sections and supported on a metal frame, enabling the hive to be opened in two points in its length.

In all these BHs the queen and brood (larvae and developing queens) inhabit the front of the hive while the honey combs (HC) naturally built by the bees in parabolic shape, are suspended longitudinally for maximum ventilation and cooling. The HC is extracted through the rear of the hive which is sealed with mud and thus easily opened, causing minimum disturbance to the brood inside.

Apiaries are kept in banks of 10-100 hives, stacked 3-4 rows high on a metal stand covered with grass or similar cooling material, which in turn is covered with blue plastic sheet (Lush, 2009).

- **Stacked Bee Hives-Yemen**

PRODUCERS

Bee keeping in Yemen has originated and remains in the hands of individuals and families in the country side some of whom adopt bee keeping as a mainstay occupation while the majority practices it as part-time job together with agriculture or petty trade. There are several Bee Keeper Associations but are not effective.

RESEARCH & EXTENSION

Agricultural, Forestry Research & Extension are the prerogative of the MAI through Agricultural Research Corporation and General Administration of Forests Range & Desertification Control (GAFRDC).

PROCESSING

After honey maturation, bee keepers undertake various stages of processing:

- HC harvesting and collection in special utensils,
- Mature combs (85 percent wax sealed) are packed in stainless steel containers. Some are sold as honey chunks,
- Manual honey separation or through sun heating. In some modern aperies electric centrifuges are used,
- Separation of wax from honey,
- Packing of honey in glass or plastic containers of 1.7 or 14 kg.

INSTITUTIONAL/ LEGISLATIVE ASPECTS

Since 1990 and up to 2008, management and organization of BK was assigned to MAI (Bee & Honey Production Division). Since the restructuring of MAI in 2008, BK is assigned to the General Administration of Animal Wealth Development.

No National policy directives in this respect have been issued since 1990.

SOCIO-ECONOMIC ASPECTS AND ENVIRONMENTAL BENEFITS

In 2008 total population of Yemen was 22.1 million increasing at 3.1 percent per annum of whom 74 percent were rural living in areas devoid of basic services and where 46.6 percent were living on less than US$2 /day. Forty five percent of population in BK areas were living on less than US$2/day. In a 1999 survey 25 and 75 percent of BH were owned by poor and better to do families respectively. Thirteen and 78 percent of BH production is marketed by poor and better to do families respectively.

The most important benefit of HB is cross pollination of plants effecting biodiversity and nature balance. Some 88 000 BK making up 500 000 families live in Yemeni country side for whom bee pollination increases field and horticultural crops by 20-30 percent particularly for such crops as palm dates, coffee, grapes, mangoes and cotton.

MARKETING & TRADE

After HB processing, producers sell directly to consumers, retailers or export agents. Some market their produce direct to agents in Arab countries especially during marketing festivals such International Village in Dubai or Autumn Expo of Kuwait.

BH is widely used as food and medicine. Seventy percent of BH produced in Yemen is locally consumed and 30 percent exported as depicted in (Table 3).

TABLE 3: **Quantities of bee honey produced & exported by Yemen**

Year	Production		Exports		Export destination countries
	tons	US$1 000	tons	US$1 000	
2000	178	500	59	379	
2001	515	580	-	-	
2002	680	7 349	321	3 469	50% kingdom of Saudi Arabia, United Arab Emirates, Kuwait, Bahrain, Qatar, Jordan, Egypt, Syria and other countries.
2003	1 485	3 716	350	3 575	
2004	1 771	4 389	279	2 308	
2005	1 879	4 984	484	4 911	
2006	1 930	31 345	201	5 976	
2007	2 410	42 392	199	1 869	
2008	2 439	43 900	622	6 549	
2009	2 486	44 745	866	11 232	

SOURCE: Book of Statistics, Ministry of Agriculture & Irrigation; Annual Book of Statistics, Ministry of Planning & International Cooperation, Yemen.

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The case of Gum Arabic in Sudan[7]

DEFINITION OF PRODUCT

Gum Arabic (GA) is the dry exudate from the trunks and branches of *Acacia senegal* or *Acacia seyal*, of the family Leguminosae (JECFA, 1999). However, gum from the latter tree Talh (*A. seyal*) is more friable than and inferior to Hashab gum (AbdelNour, 1996).The old definition confines GA to the exudates of *A. senegal* and closely related species. GA is the term originally given to (exudates) which ooze out when stems or branches of the Hashab tree (*A. senegal*) are injured (tapped).

- *Acacia seyal* stand and Gum hashab nodules, Sudan

Name of plant source

Acacia senegal (local name: Hashab) is the source of GA, and it is mixed with *Acacia seyal* (local name Talha) which is a known source for a different grade of GA, and associated with *Balanites aegyptiaca* and *Acacia mellifera* (El Amin, 1990). The most common associated grasses are *Aristida pallida*, *Eragrostis tremula*, *Cenchrus biflorus*.

PRODUCTION

GA is mostly produced by small-scale farmers in traditional rainfed farming areas. It's a means of subsistence and a way of life for the producer.

HISTORY

Sudan the leading producer and exporter of GA, considers it as a national wealth and heritage that should be used, conserved, improved and developed. GA was the leading source of

[7] Sayeda Ali Ahmed Khalil, Sudan.

revenue and source of foreign cash earnings for Sudan until the introduction of cotton in 1920. Sudan has exported GA under the names "hashab" and "talha" to distinguish between them.

Main production areas in the country, Kordofan region produces more than half of the Sudanese gum. Darfur with around 20 percent of the national production (and most of Sudanese talha) is also an important gum producing region. However, Darfur's gum production potential, comparable with Kordofan, is limited by its remoteness from export ports. Overall gum Arabic production spans eleven States: W. Darfur, N. Darfur, S. Darfur, C. Darfur and E. Darfur, N. Kordofan, S. Kordofan, White Nile, Sennar, Blue Nile and Gadaref.

ECOLOGICAL CLASSIFICATION AND NATURE OF PLANT FORMATION

A. senegal and *A. seyal* are arid zone tree species, dominating the central regions of Sudan forming the gum belt. The belt is a natural buffer between the desert in the north and the tall savannah in the south. The GA belt lies within the low-rain savannah zone. The term GA belt is used to indicate a zone of 480,000 km² in area that extends across Central Sudan between latitudes 10° - 14° N accounting for one fifth of the country's total area (Gaafar, 2005 and AbdelNour, 2011). The low rainfall savannah has principally heavy dark clay soils in the east and sand in the West, dominated by thorny Acacias such as Acacia mellifera and A. seyal, A. senegal and Balanites aegyptiaca.

GA is produced in a typical land use practice that prevailed in Kordofan, Western Sudan, in the past known as shifting cultivation with or without bush-fallow (Seif El Din, 1984). The A. senegal agroforestry system is practiced as a means of restoring the soil fertility and promoting GA production (FAO, 1978). The traditional A. senegal-based agroforestry system was recognized and considered one of the most successful forms of natural forest management in the tropical drylands (Fries, 1990), and regarded as sustainable in terms of its environmental, social and economic benefits. Agroforestry based on indigenous knowledge and associated with gum production system acquired by farmers in the gum belt communities over long time is sustainable as long as it is maintained along its cycles (Abdel Magid & Warrag, 2011).

GA trees are managed with agricultural crops such as sorghum (*Sorghum bicolor* (L.) Moench), pearl millet (*Pennisetum typhoideum* Rich.), groundnuts (*Arachis hypogaea* L.), sesame (*Sesamum indicum* L.) and karkadeh (*Hibiscus sabdariffa* L.). This agroforestry system allows a period of 10-15 years for restoring the soil fertility after a short period of arable cultivation (Ballal, 2002).

RESOURCE OWNERSHIP

Forests owned by GA farmers in societies is estimated at 6 00 000 ha (FRA, 2010). About 87 percent of the land allocated to gum production is privately owned (FO, 2006) and the rest is owned by the Government.

SUSTAINABILITY OF PRODUCTION

Sustainable management of the gum gardens is threatened by severe droughts and indiscriminate clearing of *A. senegal* and i stands for firewood and charcoal production as a short-term source of income (Elfadl et al., 1998). Gum yields have decreased, however, because of biotic, physical, socioeconomic and institutional factors. The implementation of

appropriate policies and investments to support improved gum processing and marketing will generate additional income for small producers and thus ensure sustainability.

METHODS OF PRODUCTION

Gum production encompasses two stages:

i. Gum collection (tapping): Gum hashab is collected from *A. senegal* by tapping, whereas all gum talha (from *A. seyal*) is collected as a result of natural exudation. Traditional methods of tapping were replaced with a specially designed tool. After injury, tears of gum form on the exposed surfaces and are left to dry and harden. After five weeks the first collection of gum is made, with further collections from the same trees at approximately 15–day intervals until the end of February. Up to five or six collections in total.

ii. Post–harvest handling: Cleaning or sorting is undertaken by the producer of the gum. Some degree of cleaning and sorting may be undertaken by small village traders to whom the producer sells his gum, but it is usually undertaken by the large traders after it has been sold and prior to selling.

- ***Gum sorting and grading, Sudan***

Who is involved? : GA producers, small village traders, GA associations, and GA companies are collectively involved in organizing production. A complete protocol of regeneration, tapping, collection, grading, initial processing and marketing has been elaborated for GA by Sudanese farmers, foresters and businessmen (AbdelNour, 1996).

Research & extension: In recent years the research on GA has been developed to include improvement of production, marketing, tree physiology, specifications, ecology and environment of GA. Database of Network of Gums and Resins of Africa documented more than 200 research activities in Sudan (NGARA, 2005). Forests National Corporation (FNC) annually disseminates extension programs through States offices for local communities, Gum Arabic Producer Associations (GAPAs), GA producers, farmers and other GA dependants.

PROCESSING

Gum processing encompasses several activities, most important of which are:

Grading

The international gum trade has come to recognize three grades of raw gum:

- Hand Picked Selected (HPS): raw un-broken or chipped globules of clean GA specially sorted and graded. 2. Cleaned grade gum: gum lumps broken manually, with no limit on the granule size. 3. Dust: GA by-product from screening/grading or cleaning process (SSMO).

Processing:

- **Kibbled gum:** Mechanically broken granules of gum with a maximum size of 14 mm and a minimum size of 3mm and a maximum range of 8mm.

- **Spray dried:** White powder of mesh size inferior to 100 microns, which results of a process by which raw gum is dissolved in water, centrifuged to remove impurities, pasteurized and sprayed in hot air to evaporate water.

- **Mechanical powder:** White powder of mesh size inferior to 200 microns results from mechanically crushing (SSMO).

Local communities (women and men) are involved in the production process from tree tapping to collection cleaning and grading. FNC initiated the idea of GAPA to develop the production. The total number of registered associations is about 1 481 with membership of 1 881 800 (GAB, 2010).

Institutional/legislative Aspects: Sudan has been exporting Gum Arabic from times immemorial. Throughout the last centuries gum was produced by individual producers and exported by private sector companies. In 1969 a public Liability Company; the Gum Arabic Company (GAC) was established and was granted the concession as the sole exporter of raw gum. The concession was removed in 2009 and a regulatory body was established; the Gum Arabic Board (GAB). GAB is sovereign regulatory body for GA and responsible for establishing an effective monitoring system, organizing local markets, state strategies, policies, directives & rules, follow-up execution of policies with government or private institutions (GAB, 2010).

In January 2010 the GAB establishment the Gum Arabic Stock Exchange (GASE) was created to guarantee the production, funding, and quality control and marketing.

Policy regulating production and trade: the Forest Law (2002) encourages the increase of tree planting. The focus of policy options on GA is to increase share of benefits for the owners of the land and workers in the production activities of the commodity (FP, 2006). The GA marketing and pricing policy is controlled by the GAC before 2009. Recently liberalization of external trade in gums in 2009 established a direct link between producers and consumers, encouraged incorporation of producers in local trade groups, production cooperatives and producer associations to develop local enterprises, and enhance processing capacity. The government promotes the free operation of the private sector and limits its interventions to the supplying of services and developing of infrastructures supportive to production and marketing (FP, 2006; GAB, 2010).

In 2002, a presidential decree was passed to withdraw the concession from GAC with the objective to allowing more firms to trade in raw GA in order to revive gum production. In 2003 and 2004, the Ministry of Investment granted 12 licenses to gum Processors, including the four main GAC international agents who established processing facilities.

SOCIO-ECONOMIC ASPECTS AND BENEFITS

Gum production is a pillar of family economy and considered as an income-generating source that requires only a low input of work after the rainy season. (Gaafar, 2005).

Who is involved in processing? GA companies, Farmers, GA associations, foresters, small scale producers, processors**.**

Environmental benefits: The salient environmental benefits of the GA belt of Sudan include:

Acting as a biological/live buffer between the Sahara Desert and the Savannah in the south,

Acting as a reservoir of biological diversity of fauna & flora and traditional knowledge,

Benefits

It is estimated that some four-five million people nation-wide depend on GA for income. GA plays an important role as major source of foreign exchange, accounting for 13.6 percent of the annual non-oil export income (FP, 2006).

Marketing & Trade: Historically Sudan is known as a major exporter of GA in the world. Trade started in the Sudan during the second decade of the 19th century. Trade records show that in 1819, Great Britain imported 1 313 lbs. of GA from Sudan for a total value of £67. 19s.4d (67 Pounds Sterling, 19 Shillings and 4 Pence) . The first export firm was established in 1873. It maintained a firm trade link between Red Sea and European ports (Awouda, 1973). GA marketing and trade as described by (AbdelNour, 1996) starts with a small producer who sells to a village merchant in a weekly village market. Big producers and freelance subsidiary merchants have the option of taking their amounts to auction markets since 1922.

In 1969, the Minister of Supply and Internal Trade granted the GAC, a public company incorporated under the Companies Ordinance of 1925, an exclusive concession to export raw GA. Export marketing of GA for Sudan has been characterized by the monopoly of the GAC for over forty years. This cartel situation has translated into declining gum production and exports. Since the recent development of the processing industry, farmers have started to receive better prices.

Usage

Since Ancient Egypt and as early as 2000 BC, GA was used in food, adhesives and paint (Seif el Din and Zaroug, 1996). The development of the processing industry has resulted in increased domestic competition for raw gum. Locally GA is used in soft drinks, laundry starch, famine food and in plastering (Freudenberger, 1993). The world demand for GA is because of its unique properties as an emulsifier for citrus oils in fruit based drinks and cola

type drinks (Chikamai, 1996), thickener, binder, cosmetics, drugs, sweets, chewing gum, stabilizer and adhesive. Other uses are in confectionery, pharmaceutics and photography (Barbier, 2000).

EXPORTS

Sudan commands over 80 percent of the world's GA production and trade. The major consumers of the gum are West European countries and The United States of America. However, minor amount go to Japan and countries from the Far East. The main countries that import the GA are: France, USA, United Kingdom, Italy, Japan, Germany, Denmark, Belgium, Spain, Greece, Netherlands, Portugal and Ireland (Table 4).

Table 4: Total GA Exports (2001-2010)

Year	Export/t	Value (US$)
2001	20 322	21 309 952
2002	30 462	28 009 612
2003	30 285	29 303 892
2004	25 843	45 899 700
2005	33 383	101 002 600
2006	23 508	52 388 000
2007	38 943	65 832 300
2008	36 910	61 745 820
2009	47 854	73 205 000
2010	55 054	77 978 000
Total	**266 711**	**556 674 876**

SOURCE: Sudan Customs, 2010

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The case of Pistachio Nuts in Islamic Rep. of Iran[8]

Iran's pistachio is one of the best pistachios in the world. Naturally this situation entails that IRI gains considerable success and progress in different processes of sowing, fostering and harvesting of pistachio (http://www.szpistachio.com/).

According to historical documents the primary growth areas of wild pistachio trees were in the northeast of Iran. These areas extended from the west to present Neishabur and from east to Balkh on both sides of Jeyhoon River. Since long time ago Iranians learned about nutrition qualities of pistachio such as hematopoiesis, livability and energizing. The variety of climate in Iran has provided good conditions for producing pistachio (http://www.szpistachio.com/).

DEFINITION OF PRODUCT

The Pistachio is a relatively small tree mostly grown in the arid parts of the world close to 30th parallel latitude. It grows from sea level (e.g. Attica, Greece) to an altitude of 1 800 meter above sea level (e.g. Kerman, Iran). The combination of latitude and altitude provide sufficient chilling hours in winter and long hot and sunny summer conditions to produce a viable crop.

Pistachios bear laterally on one-year-old wood. This causes an alternate bearing habit, so prominent in pistachio production with extensive commercial consequences.

The pistachio of commerce is the only edible species among the 11 species in the genus *Pistacia*; all are characterized by their ability to exude turpentine or mastic. Several are referred to as pistachios, but the name is generally reserved for the edible nut of commerce. Its Latin name is *Pistacia vera* L. A member of the family *Anacardiaceae*, it is related to the cashew, mango, poison ivy and oak, pepper tree and sumac.

HISTORY

The modern pistachio nut was first selected from wild *Pistacia vera* trees native to central Asia. The initial selection and improvement was first undertaken in the era of the Persian Empire which spanned from Eastern Mediterranean to central Asia. Ever since, pistachios have been an important crop in cooler parts of Iranian plateau.

Pistachio cultivation spread into the Mediterranean world where it has continuously prospered in Syria, Turkey, Greece and Sicily. Pistachios were already well known in Late Antiquity. Since 1970s, pistachios have become a commercial crop in many countries which fall around the 30th parallel north and south of the equator. These regions include: California, North Africa, New South Wales in Australia, South Africa, Argentina and Chile. Iran Pistachio Association: http://www.iranpistachio.org/about-pistachios.

[8] Mostafa Jafari & Simin Raisi Zadeh

The pistachio tree is an old tree with a great antiquity. There are many opinions about its origin. Some claim that the internal area of Iran is the original region where the tree has grown for the first time. The historic signs about its antiquity show that thousand years before Christ its nut has been eaten as food in Asia. After many years it was introduced and carried to some other parts of world.

ECOLOGICAL CLASSIFICATION AND NATURE OF PLANT FORMATION

Botany

- Edible seed of *Pistacia vera,* Mastic resin from *Pistacia lentiscus*

Pistacia plants are shrubs and small trees growing to 5–15 m tall. The leaves are alternate, pinnately compound, and can be either evergreen or deciduous depending on species. All species are dioecious, but monoecious individuals of *Pistacia atlantica* have been noted. (İsfendiyaroğlu & Özekera, 2009) The genus is estimated to be about 80 million years old. (Parfitt & Badenes, 1997).

The bush grows up to 10 meters (33 ft) tall. It has deciduous pinnate leaves 10–20 centimeters (4–8 inches) long. The plants are dioecious, with separate male and female trees. The flowers are apetalous and unisexual, and borne in panicles.

Commercial cultivars vary in how consistently they split open. Each pistachio tree averages around 50 kg of seeds, or around 50,000, every two years.

Ecological classification and Nature of plant formation

The trees begin to bloom with the arrival of warm weather in late March. The male pollinates the female via the April winds, and the shell of the nut is fully developed by mid-May. Before June ends, the seed inside the shell has begun its rapid expansion and by the first of August, the seed has filled the shell. The nuts, splitting at the seams, are usually ready to be harvested beginning September 10th (IAP, 2011).

- Pistachio

(Photos from RPC, 2011)

Pistachios thrive in areas which have winters cool enough to break bud dormancy and hot, long summers. They are drought resistant and very tolerant of high summer temperatures, but cannot tolerate excessive dampness and high humidity. The tree has about the same cold resistance as almonds and olives but flowers later in spring than almonds.

The pistachio tree is found growing in areas with a hot dry climate, such as Lebanon, Syria, Iran, India, Southern Europe, the desert countries of Asia and Africa, and California. Actually the pistachio tree is native to western Asia and Asia Minor, and was introduced into Mediterranean Europe at approximately the beginning of the Christian era. The principal producing area in Iran is Kerman, which is located in the arid southeast. Extensive plantings are located in the vicinity of Rafsanjan, Sirjan, and Zarand (http://www.rashapistachio.com/pistachio_trees.html).

It may require more than 200 years for trees to reach 1 M diameter and trees up to 2 m in diameter are known (Zangeneh, 2003; Arefi et al., 2006) .Trees exceeding 50 cm are rare in most areas and in some areas trees harvested by the time they reach 30 cm. Qalajeh forest is typical of Zagros forests that have a wild Pistachio component. Wild Pistachio trees are infrequently cut. Natural stands include a variety of age classes and may include many large, old trees. However , in recent years a lack of wild Pistachio regeneration has been observed there (Ebrahimi et al., 2003).

Morphology

The individual pistachio nut grows in fruit clusters of multiple nuts. Botanically, they are drupes. All drupes consist of three parts; an exocarp, a fleshy mesocarp (together called hull) and an endocarp (shell) that encloses a seed (kernel). In pistachios the seed is consumed, rather than the mesocarp as in stone fruit.

Nutritional & health value

Pistachios are a rich source of vitamins and minerals, fiber, antioxidants and unsaturated fat for a healthy diet. A serving size of pistachios provides more nutrients than most other nuts and snacks:

There have been numerous studies highlighting the health benefits of pistachios. The USA Food & Drug Administration (FDA) published a statement in 2003 approving scientific evidence which suggests that eating 1.5 ounces per day of pistachios, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease. Pistachios may help curb less-than-ideal levels of LDL "bad" cholesterol, according to another study published in 2008. In research at Pennsylvania State University, pistachios in particular significantly reduced levels of low-density lipoprotein (LDL cholesterol) while increasing antioxidant levels in the serum of volunteers (FDA, 2011). Other attributes of pistachios include reducing risk of lung cancer besides anti-inflammatory benefits.

PRODUCTION

The principal producing area in Iran is Kerman province, which is located in the arid southeast. Extensive plantings are located in the vicinity of Rafsanjan, Anar, Kerman, Sirjan, Zarand, Shahr-e-Babak, Ravar, Rayen and others cities (Kerman total production in 2010 was 137 000 tons crop on dried in-shell basis from some 209 000 ha.) also Khorasan-e-Razavi, Yazd, Fars, Khorasan-e-Jomoobi, Semnan, Sistan-o-Baluchestan, Makazi, Esfahan, Qom, Qazvin, Tehran and other provinces in Iran (Subtotal Iran of 292 000 ha and 21 0000 tons crop on dried in-shell basis production in 2010) (IPA, 2011).

RESOURCE OWNERSHIP

Ownership of pistachio orchards, industry and export & imports businesses are private sector as individual farmers or companies.

SUSTAINABILITY OF PRODUCTION

A recent study was undertaken to investigate size class distribution of the wild pistachio component in Qalajeh forest (Kermanshah – Iran) to assess the long- term sustainability of the species. Specifically, the aim was to answer two questions: (1) is the current diameter distribution of wild pistachio consistent with sustainability, and (2) if the diameter distribution is unsustainable, what might be required to perpetuate wild pistachio in the long-term—i.e., what are the diameter-class deficits? Forest types with an important *P. atlantica* component occupy approximately 16 percent of the Zagros region (Ghazanfari et al., 2004). In Qalajeh forest there are three important forest types that are closely correlated with elevation: *Quercus persica* (<1500 masl), *Q. persica-P. atlantica* (1500-2170 m), and *Amygdalus orientalis* (>2170m). The forests are sparsely stocked; nearly 90 percent of Zagros forests have canopy cover less than 30 percent (Ghazanfari et.al., 2004). Wild pistachio is slow growing in Qalajeh; diameter increment ranges between 2 and 6 mm per year (Zangeneh, 2003). As a result, diameter distribution should reflect age class distribution. Upon inspection, the data confirmed that pistachio trees were rare in the smaller size classes. The modal diameter class was 30 cm, with 71 tally trees or 1.6 trees/ha in that size class (Pourreza et al., 2008).

METHODS OF PRODUCTION

Most of the production is from orchards that account for 53 percent of world planted area (Razavi, 2006), but there are a few places, such as in the Zagros Mountains, where wild Pistachio (*Pistacia atlantica* Desf.) persists in natural and extensively managed (i.e, semi-natural) stands. Wild Pistachio, known as Baneh in Iran, is the most economically important species for rural people in areas of natural forests. The pistachio industry in Iran is made up of three main sectors: farming, post harvest processing and trade.

The trees are planted in orchards, and take approximately seven to ten years to reach significant production. Production is alternate bearing or biennial bearing, meaning the harvest is heavier in alternate years. Peak production is reached at approximately 20 years. Trees are usually pruned to size to make the harvest easier. One male tree produces enough pollen for eight to twelve nut-bearing females.

Pistachios have been cultivated in IRI for thousands of years. Commercial cultivation of pistachios in IRI started expanding about one hundred years ago. The upward trend of production has continued ever since.

It is estimated that the amount of pistachios produced in Iran rose from around 2 000 tons in 1950s to about 25 000 tons in 1975. The average nationwide production in the closing years of the millennium exceeded 150 000 tons (IPA, 2011).

At present, around 150 000 farmers harvest the crop from about 290 000 ha of pistachio orchards nationwide; more than 70 percent of the production is coming from small scale producers (those who manage orchards of 2 hectares or less). Currently, annual pistachio production capacity in an "on" year is up to 280 000 metric tons. This is from orchards in Kerman, Yazd, Khorasan-e-Razavi, Khorasan-e-Jonoobi, Fars, Semnan, Markazi and some other provinces.

All pistachio orchards in Iran are hand-harvested. Average annual yield of bearing Iranian pistachio orchards is 800 kg per ha. Individual farms may produce from 300 to 3000 kg per ha.

It is hoped that new plantings in areas with abundant water resources by corporations rather than individuals would, in future, open the way for establishment of modern, industrial scale orchards. Iran Pistachio Association is already promoting such initiatives through the Model Pistachio Orchard Project.

Types of products

According to the external shape of the pistachio it is divided into four or five major groups. Five types of production provided by different producer and exporters including “Sirjan Adel Pistachio” company as mentioned bellow (SAP, 2011):

- Jumbo Pistachios (Fandoghi), 2. Round Pistachios (Kalleqouchi), 3. Long Pistachios (Akbari, Ahmadaghaee, Badami), 4. Kernel Pistachios, 5. Closed Pistachios

Kernels are classified into two types:

- Natural Kernel (Unpeeled),
- Skinned Kernels. (Green Peeled Pistachio Kernel = GPPK)

- Pistachio kernels

These are prepared from closed mouth Pistachio prior to shipment; therefore have a very fresh flavour.

RESEARCH & EXTENSION ACTIVITIES ON THE PRODUCT /RESOURCE

Research on pistachio production in Iran was started in 1960 by the two departments of plant protection and horticulture in Rafsanjan city, the main pistachio growing area of Iran. It is estimated that 380 000 ha pistachio orchards exist in Iran. In recognition of the importance of pistachio production in desert and arid areas of Iran, the Pistachio Research Institute (PRI) was established by combining the previous pistachio research departments and was completed with four new departments in 1993. At the present time, there are six departments in PRI which are dealing with different aspects of pistachio production.

Furthermore, there are six research stations under the supervision of the Institute in different pistachio growing regions of the country. The scientific staffs in the different departments and research stations comprise 35 researchers and 15 technicians.

PROCESSING

Post Harvest Processing: The pistachio processing industry in Iran is gradually moving from traditional, low-capacity, home or farm based, sun-drying units towards specialized, industrial high-capacity plants utilizing hot forced air for drying. Traditionally, processing plants acted as service providers to the growers.

Currently, the largest industrial pistachio processing plant in the country has a capacity of 350 tons of fresh pistachios per day. Although the number of high-capacity plants is small, the total number of mechanized processing units is quite large and growing every year.

- Pistachio Post Harvest Processing

(Photos from RPC, 2011)

A typical modern Iranian pistachio processing plant processes freshly harvested pistachios as follows: Weighing, unloading and sampling; Hulling; Water floatation tank; Heated, forced air continuous pre-drying; Adhering hull separation and removal; Dryer and sun drying; Mechanical separation of open-shell nuts from closed-shell nuts; Mechanical sizing; Picking conveyor belt and/or picking table; Packing.

INSTITUTIONAL/LEGISLATIVE ASPECTS

Information on the institutional and legislative aspects on the horticulture and also other agricultural related issues in general can be found on the following link of the Ministry of Agriculture (www.maj.ir). Various policies on forestry sector cover the pistachio issue. Also various laws and regulations on trade cover pistachios too.

SOCIO-ECONOMIC ASPECTS

The IPA offers various services to its members with the aim of promoting their interests, as well as the interests of the Iranian pistachio industry as a whole, both within Iran and internationally.

Below are some of the services that IPA offers to its members:

1- News and information dissemination

2- Establishing an information pool for Iranian pistachio industry insiders

3- The promotion of pistachios and the expansion of Iranian pistachio exports to world markets

4- Organizing international tours for IPA members to acquaint them with the pistachio industry in other countries.

5- Screening of members

6- Identification of current and future problems in horticulture, processing and trade of Iranian pistachios and suggesting solutions to our members in order to remedy the existing problems (IPA, 2011).

RECOGNIZED MEASURABLE ENVIRONMENTAL AND SOCIO-ECONOMIC BENEFITS TO THE COUNTRY

Pistachio plantations have multi benefits including environmental benefits in dry semi-arid areas which are mainly faced with salinity problems. It is reckoned that some 1.5 million people depend on pistachios for their earnings. According to the data of year 2000 , Kerman Province has 75 percent of planted areas and 82 percent of country production, which require three million work days for harvesting their production.

MARKETING & TRADE

Usage of product in country and worldwide

Domestic consumption on 2010 in Iran was 30 000 tons.

The domestic trade in pistachios is conducted exclusively by local traders who assemble pistachios, bought from small to medium sized producers, into lots of from tens to hundreds of tons. The bigger exporters buy their needs from such traders, whereas, exporters who focus on quality mainly buy from medium to large farmers or processors.

Pistachio as a strategic product has a very prominent place in Iranian trade. It is the most important non oil product in the country. Currently about 55 percent of world pistachio production and 60 percent of global exports belong to IRI.

Exports

Iran is the largest net-exporter of pistachios in the world with an average annual amount of 160 000 tons (dry basis) and an estimated current grand total value of around US$1.5 billion. This amounts to more than 60 percent of the world net-export figures. The main consumer markets for Iranian pistachios are the Far East, the European Union, CIS countries, the Middle East and the Indian subcontinent in that order. There are tens of export houses in Iran. These established exporters, as a group, command about 95 percent of total Iranian pistachio exports.

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The case of Rosemary in Tunisia[9]

DEFINITION OF PRODUCT

By definition, the name rosemary derives from the Latin “Rosmarinus” which literally means "dew of the sea" in an indication to the Mediterranean origins of this herb which is now planted throughout the world.

Actually, known for its therapeutic virtues, Rosemary oil is used to facilitate bowel movement, calm coughs, stimulate the gall bladder and the breathing system, as well as to remedy stomach aches.

COMMON (ARABIC/ENGLISH) AND LATIN NAME OF TREES INVOLVED IN PRODUCTION

Rosemary (*Rosmarinus officinalis*) is a woody, perennial herb with fragrant, evergreen, needle-like leaves. It is native to the Mediterranean region. It is a member of the mint family *Lamiaceae*, which also includes many other herbs.

Taxonomy *Rosmarinus officinalis* is one of only two species in the genus *Rosmarinus*. The other species is the closely related but less commercially viable *Rosmarinus eriocalyx*, of Tunisia. Named by the 18th century naturalist and founding taxonomist Carolus Linnaeus, it has not undergone much taxonomical change since. Its Arabic name is “ Iklil’’.

Description

Flowering Rosemary: Forms range from upright to trailing; the upright forms can reach 1.5 m tall, rarely 2 m. The leaves are evergreen, 2–4 cm long and 2–5 mm broad, green above, and white below with dense short woolly hair. Flowering, very common in mature and healthy specimens, occurs in summer in the north, but the plants can be ever blooming in warm-winter climates; flower colors are variable, being white, pink, purple, or blue.

Cultivation: Since it is attractive and tolerates some degree of drought, it is used in landscaping, especially in areas having a Mediterranean climate. It is considered easy to grow for beginner gardeners, and is pest-resistant. Rosemary grows on friable loam soil with good drainage in an open sunny position. It does not withstand water logging and some varieties may be susceptible to frost. It grows best in neutral to alkaline conditions pH (pH 7–7.8) with average fertility. Rosemary is easily pruned into shapes and has been used for topiary. When grown in pots, it is best kept trimmed to stop it grow wild, though when grown in a garden, rosemary can grow quite large and still be attractive. It can be propagated from an existing plant by clipping a shoot 10–15 cm long, stripping a few leaves from the bottom, and planting it directly into soil.

[9] Bargaoui Ahmed

PRODUCTION

Brief history of the product

Tunisia is a Mediterranean country where many aromatic plants (AP) such as Rosemary, *Myrtus comminus, Thymus capitatus* etc. grow naturally. Rosemary constitutes a durable biological product used in pharmaceutics, cosmetics and food etc.

Because of its economic, environmental and social values, Rosemary was highly regarded by the Ministry of Agriculture (MoA) which has invested considerably in its protection and rational use through research, planning and development, production, regeneration and valorization of the produce.

Main Production in the country

In Tunisia, Rosemary grows from the sub-humid to the semi-arid climate on a total estimated area of production of 344 794 ha (state & private). The area of Rosemary in the private land is not well known. The Administration knows only the extent of vegetation that was requested for exploitation by owners which is in the region of 4 300 hectares. The area owned by the state is presented in table 5.

TABLE 5: Area of Rosemary in Tunisia by region

Region	Areas (ha)
Kasserine	181 249
Le kef	63 300
Siliana	44 276
Kairouan	26 090
Zaghouan	25 579
Total	**340 494**

SOURCE: FHA, 2011

ECOLOGICAL CLASSIFICATION AND NATURE OF PLANT FORMATION

Rosemary is a perennial plant (chamaephyte) that usually grows in the guarrigue type of vegetation and under forests of pine (*Pinus halepensis*), *Tetracnilys articulata* or *Juniperus* sp. It is found in various bioclimates from the sub-humid to the upper arid. But it is widely dominant in the semi- arid Mediterranean bioclimatic stage.

In Tunisia it's found in the centre of the country: Kasserine, Kairouan, Siliana and Zaghouan, and in the North-west: Le Kef. It is also found in small stretches in the North-east; the Medjerda valley, the Cap Bon and even in the south; Matmata

Rosemary grows in Tunisia, naturally in "shrub" type formation which is characteristic of the Mediterranean climate. Shrub is vegetation lower than forest at maturity. It is resistant to prolonged droughts.

The plant association which characterizes the shrub formation in the garrigue is composed essentially of *R. officianalis, myrtus comminus, arbutus unedo, Erica arborea, pistachia*

lentiscus, cistus monspellensis and *C. laurifolius*. In Tunisia, Rosemary is also planted but in restricted areas.

RESOURCE OWNERSHIP

Ninety percent forests of in Tunisia are State owned including 340 494 ha occupied by Rosemary. Private owners have some 4 300 ha. MoA, General Directorate of Forests (GDF) and Forest Harvesting Agency (FHA) are responsible of management, protection and exploitation of the Rosemary resource in the country.

SUSTAINABILITY OF PRODUCTION

As most of the Rosemary areas belong to the State, MoA is responsible of its management and exploitation with the objective to keep sustainable production. GDF develops and implements an action plan based on two to five years rotation and according to the state of the resource. The whole area is divided into groups based on two, three and five year rotation. This method of controlled exploitation guarantees continuous regeneration of the Rosemary vegetation.

Forestry legislation in Tunisian obliges the GDF to ensure that exploitation of the resources is done on sustainable basis following the rotation system and adequate techniques of resources harvesting (which part of the plant may be collected).

The first rotation was applied on 1986 to the main areas of Rosemary. Each one was divided to three small areas according to the 2,3 or 5 year rotation system for protection of the resource (Tables 6 & 7).

Table 6: **Rosemary areas based on the state of plant**

Region	State of the plant (ha)			Total (ha)
	Good	Average	Degraded	
Kasserine	66 862	56 183	58 204	**181 249**
Le kef	25 287	16 691	21 322	**63 300**
Siliana	17 499	8 951	17 826	**44 276**
Kairouan	5 290	12 900	7 900	**26 090**
Zaghouan	16 043	8 436	1 100	**25 579**
Total	**130 981**	**103 161**	**106 352**	**340 494**

SOURCE: FHA, 2011

Table 7: **Rosemary areas by rotation period**

Region	Rotation (ha)		Protection area of 5 years (ha)	Total (ha)
	2 years	3 years		
Kasserine	66 862	56 183	58 204	181 249
Kairouan	5 290	12 900	7 900	26 090
Siliana	17 499	8 951	17 826	44 276
Le Kef	25 287	16 691	21 322	63 300
Zaghouan	16 043	8 436	1 100	25 579
Total	**130 981**	**103 161**	**106 352**	**340 494**

SOURCE: FHA, 2011

Usage

Rosemary plant is used for many purposes:

- Leaves of rosemary are used fresh or dry in traditional Mediterranean cuisine. They can be used to make infusion.
- Upper parts of rosemary are used to extract essential oil for use in perfumes, pharmaceutics, and other cosmetic products

Management Plan

For the implementation of the action plan based on the rotation system, the GDF each year assigns the areas of Rosemary to be exploited. Table 8 shows the areas designated for exploitation over eleven year's period and the percent of areas effectively exploited.

Table 8: Exploitation of rosemary over 11 year's period

Year	Area proposed (ha)	Area exploited (ha)	Percentage (%)	Total Price (TND)	Mean price (TND/ha)	Mean Price (US$/ha)
2011	98 546	64 390	65	938 200	14,6	**11**
2010	102 818	71 523	70	758 300	10,6	**8**
2009	92 742	65 596	71	1 199 300	18,3	**13**
2008	117 754	72 238	61	493 600	6,8	**5**
2007	99 218	74 921	76	467 000	6,2	**5**
2006	114 003	31 278	27	230 500	7,4	**5**
2005	114 792	36 308	32	284 600	7,8	**6**
2004	100 300	47 435	47	340 400	7,2	**5**
2003	95 004	62 310	66	565 700	9,1	**7**
2002	76 748	56 933	74	420 750	7,4	**5**
2001	76 440	56 100	73	694 800	12,4	**9**

SOURCE: FHA, 2011

METHODS OF PRODUCTION

In Tunisia, the exploitation of Rosemary is as follow:

Distillation period from March to June

Drying period from March to September

The method of production is fixed depending on the end use of the plant

- **Use of fresh and dried leaves**

For this purpose, the upper parts of the twigs and branches of 5mm diameter are collected. The twigs with leaves are dried in the shade

- **Use for extraction of essential oil**

The extraction of essential oil is done following an old traditional way namely extraction by water vapor. The harvest (leaves and twigs) is placed in the "alembic" (Photo 3) with a capacity of about 800 kg. When water is heated, the vapor goes through the vegetal matter taking with it the essential oil and passes in a tube swimming in cold water. The vapor condenses in a recipient where the essential oil less heavy than water is recuperated at the surface.

- **Processing of distillation of rosemary**

Role of small producers, community organizations and large scale producers

Companies, Non Government Organizations (NGO) and the private owners are involved in the production and business of Rosemary. Many activities were developed and jobs created in this system of production from exploitation of the green matter by the local population to extraction of essential oil by specialized distillers to transport, storage, trade and export by companies.

- **Exploitation of Rosemary**

Generally the exploitation is done by local population. Harvest is bought by distillers by weight of green matter.

- **Extraction of essential oil**

This part of the processing of production is done by specialist distillers who are usually from local population and are paid per kg of oil produced for the export companies.

- **Industrial companies**

In Tunisia, ten companies are involved in the exploitation of Rosemary (fresh, dry leaves) extraction of essential oil, trade and export. They obtain the right of exploitation from GDF and agreement with distillers.

RESEARCH & EXTENSION ACTIVITIES ON THE PRODUCT /RESOURCE

Research on Rosemary has been ongoing for years to improve the production system and the quality of the product. Several studies had been done since 2000**.**

PROCESSING

Description of various stages of processing:

- Picking of green matter: it is done by the local population, who collect the upper parts of the plant of not more than 5 mm in diameter,

- Extraction of essential oil: it is done by distillers following established traditional methods.

- Storage, trade and export: it is done by companies

- **Hand Picking of Rosemary**

INSTITUTIONAL AND LEGISLATIVE ASPECTS

Exploitation of rosemary is organized by the DGF and the REF following the elaborated action plan. The sale of right of the exploitation of right of exploitation on the State land is regulated by the forest law. The trade and marketing are regulated by the general country law on foreign trade.

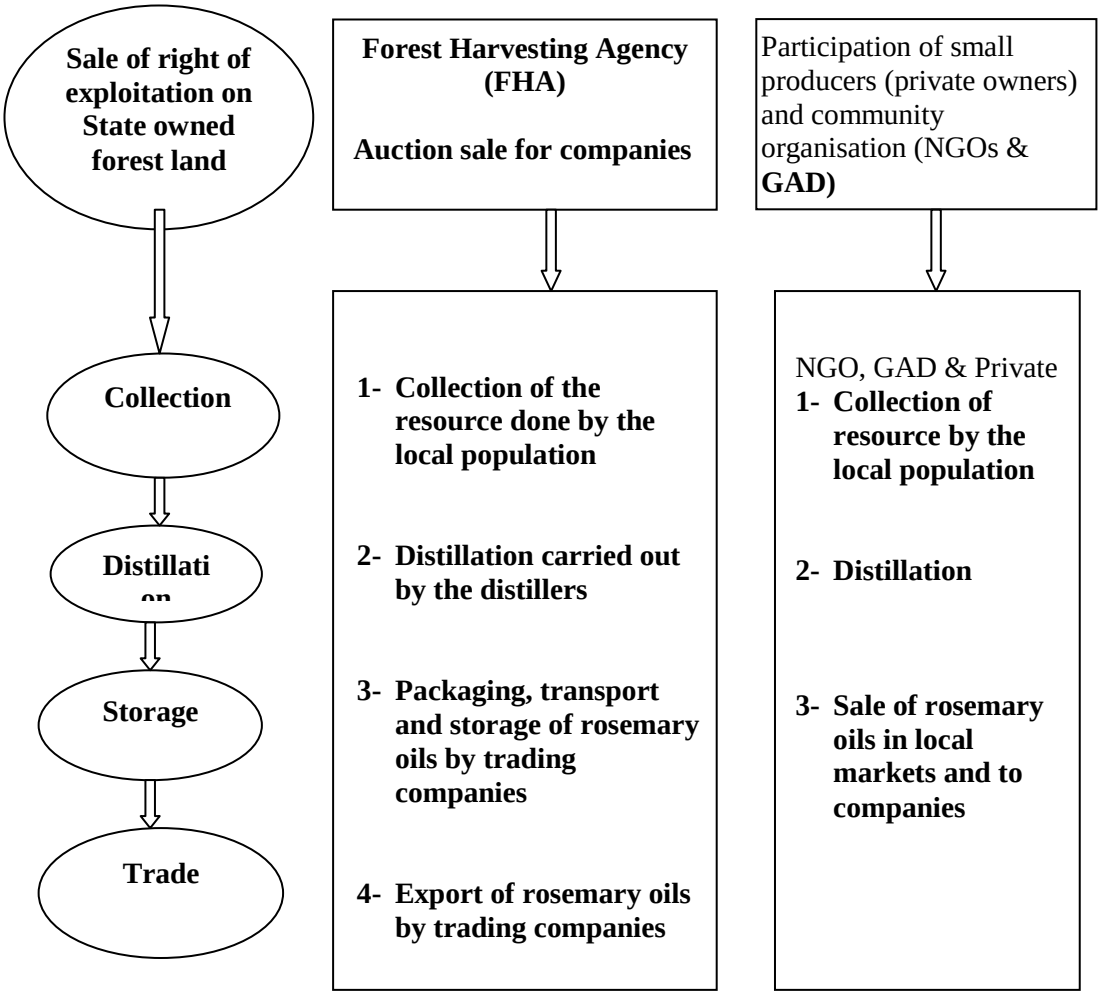
SOCIO-ECONOMIC ASPECTS

Rosemary oil is a safety net for the local population. Its production generates for them an additional income of about 300 dollars US per worker per year.

Who is involved in the processing

There are many stakeholders in the process of rosemary management, production and marketing. Among those are public institutions, private companies, local population, NGOs, GDAs and the private sector.

Figure 1: Interveners in the production of Rosemary oil



ENVIRONMENTAL BENEFITS TO THE COUNTRY

The chain of rosemary has tremendous environment benefits for the country. Among these:

Properly managed rosemary vegetation cover helps combat advance of desertification and protect soil against erosion,

The vegetation cover of rosemary and the associated species constitutes a habitat for rich biodiversity including rich wildlife,

Well conserved rosemary vegetation develops pollinators including bee keeping and production of bee honey

Recognized measurable benefits to rural communities and various strata of population:

Among those benefits, it is important to mention:

Employment opportunities to the local population: Thousands of jobs are created seasonally every year.

Development and promotion of industrial and trade companies

Contribution to the economy of the country including as source of foreign currency

COST OF PRODUCTION

In 2011, the cost of production of one (1 kg) of rosemary oil was about US$28. That includes harvesting of the product, handling, distillation, transport, storage, and trade.

Usage of product in country and worldwide

The average of more than 90 percent of the national production is exported. The rest is consumed by the local market.

Volume (tons) and value (US$) of trade

The table below shows the quantities exported and the generated income

Table 9: The export of the product over past 12 years

Year	Export/ tons	Annual value	
		TND	US$
2011(up to July)	129	2 351 830	1 704 225
2010	178	4 733 853	3 430 328
2009	111	4 110 169	2 978 383
2008	116	3 921 504	2 841 670
2007	109	3 234 596	2 343 910
2006	79	1 172 006	849 280
2005	49	1 181 317	856 027
2004	23	559 846	405 686
2003	15	566 768	410 702
2002	11	443 985	321 728
2001	36	917 616	664 939
2000	28	604 349	437 934
1999	32	568 664	412 075
Total	**916**	**24 366 503**	**17 656 886**
Mean	**70**	**1 874 346**	**1 358 222**

SOURCE: Ministry of Industry, 2011

Countries where the product is exported to are: Saudi Arabia, France, Italy, Belgium, United Arab Emirates, and USA.

SUGGESTIONS TO DEVELOP THE SECTOR OF AROMATIC PLANT

The country need to invest more for:

- Management of the resource and improved information base through inventory of the extent and state of the resource as well as knowledge through research
- Improvement of the production system by introducing more economic and efficient technology
- Adaptation of forestry legislation to take into account the new social, economic and environmental developments and to allow NGOs, GDA and associations to obtain the right of exploitation of rosemary
- Research on management of the resource, processing and marketing of the product and quality assurance to meet the requirements of the international market.

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The case of Stone pine in Lebanon[10]

DEFINITION OF PRODUCT

Stone Pine is one of the most important elements of the Mediterranean vegetation stages in Mount Lebanon. The impressive landscape of its forests, its distinctive shape and its edible seed (stone) contribute to the economic, social, cultural and environmental value of the *Pinus pinea L.*

Stone Pine (*Pinus pinea*) produces edible SEEDS, THE PINE NUTS. The seeds of other pine species growing in Lebanon (*P. halepensis* and *P. brutia*) are not consumed in Lebanon. *P. pinea*, has been cultivated for its nuts for over 6 000 years, and harvested from wild trees for far longer in the Mediterranean countries (*P. pinea* - Wikipedia).

Depending on the species, pine nuts contain 10–34 percent protein, with Stone Pine having the highest content. They are also a source of dietary fiber. The nutrients are stored in the embryo in the centre. Although a nut in the culinary sense, the pine nut is a seed in the botanical sense. The shell must be removed before the pine nut can be eaten. Unshelled pine nuts have a longer shelf life if kept dry and refrigerated than the shelled nuts (and unshelled nuts in warm conditions). Table 10 shows the nutritional value of the pine nuts (http://www.nutrition-and-you.com/pine-nuts.html).

Mediterranean Pine grove

[10] Fady Asmar

Table 10: Nutritional value of pine nuts: Percentage of Recommended Daily Allowance for adults)

Pine nuts, raw, Nutritional value per 100 g		
Principle	**Nutrient Value**	**Percentage of RDA (%)**
Energy	673 Kcal	34
Carbohydrates	13.08 g	10
Protein	13.69 g	24
Total Fat	68.37 g	228
Cholesterol	0 mg	0
Dietary Fiber	3.7 g	10
Vitamins		
Folates	34 µg	9
Niacin	4.387 mg	27
Pantothenic acid	0.313 mg	6
Pyridoxine	0.094 mg	7
Riboflavin	0.227 mg	17
Thiamin	0.364 mg	30
Vitamin A	29 IU	1
Vitamin C	0.8 mg	1
Vitamin E	9.33 mg	62
Electrolytes		
Sodium	2 mg	0
Potassium	597 mg	13
Minerals		
Calcium	16 mg	1.5
Copper	1.324 mg	147
Iron	5.53 mg	69
Magnesium	251 mg	63
Manganese	8.802 mg	383
Phosphorus	575 mg	82
Selenium	0.7 mcg	1
Zinc	6.45 mg	58
Phyto-nutrients		
Carotene-ß	17 µg	--
Crypto-xanthin-ß	0 µg	--
Lutein-zeaxanthin	9 µg	--

SOURCE*:* USDA National Nutrient data base

Pine nuts have been eaten in Europe and Asia since the Paleolithic period. They are a major component of the Lebanese cuisine and are added to meat, fish, salads, vegetable dishes and sweets.

Common (Arabic/English) and Latin

Fruit of the stone pine (*P. pinea*) is commonly called pine nut in English, pignon in French and Sanawbar or boundok in Arabic (Boundok is also the Arabic name for hazelnuts).

PRODUCTION

Brief history of Lebanon's involvement in the Stone Pine

All forests and natural vegetation have been historically subject to a very intense human intervention. Climate change in the Eastern Mediterranean threatens to exacerbate the effects of maladaptive practices (i.e. overgrazing, overharvesting of wood and NWFPs, urbanization in forestland, agriculture and pastoral land degradation) and hasten desertification and land degradation. The implications of the combined phenomena of climate change and forest and other wooded lands degradation and loss pose serious threats primarily to Lebanon's food and water security.

Forests, other wooded lands and most of the remaining vegetation formations, have always been used as grazing lands, providing a wide variety of species distributed over the different ecosystems and altitudes.

Throughout history, Stone Pine forests were over-exploited on a continuous basis by all the different invaders. During the period of the Ottoman occupation, and specifically between 1914 and 1917, and the French and British mandates that followed, large surfaces were harvested to cover the needs of the wars. Stone Pine Forests were almost entirely harvested and the slopes were left empty (Khouzami 2010).

Most of the current forests are planted on terraces, on the slopes of Mount Lebanon chain. The elderly in the villages confirm that these forests were previously used for cropping of cereals and different agricultural products. They were also used for grazing. Thanks to its high production and tolerance to sandy soils, Stone Pine has progressively replaced the small agricultural practices, while allowing for grazing to continue, whenever possible. (Masri 2000).

Terraces are now almost totally destroyed, but their ruins show the importance of the land management that was practiced decades or even centuries ago.

Stone Pine Forest of Beirut, known as the Forest of Beirut, was mentioned by a Byzantine poet in the Fourth Century. Idrissy, the Arab geographer (d.1166 AD) described this forest of around 3110 ha, saying that it provided wood for buildings, fleets and weapons. The Lebanese prince, Fakhreddine (1590-1635) has replanted this forest. Before the events that occurred in Lebanon and the civil war (1975-1990) the forest was surviving but not producing as much cones as it should, because of the mismanagement, and its situation in the heart of the city. It was almost totally destroyed during the war, but replanted in the 90's with the support of the French Government (Khouzami, 2010).

Main production areas in Lebanon

The majority of Stone Pine forests are located in the Metn (Mount-Lebanon) and Jezzine (South Lebanon). The largest number pine nuts producers are found in the village of Ras el Metn.

ECOLOGICAL CLASSIFICATION AND NATURE OF PLANT FORMATION

According to data from the 2010 FAO Global Forest Resources Assessment (FRA), forests cover 13.2 percent of the total land area of Lebanon (136 900 ha). An additional 10.2 percent of land classified as "other wooded land" (OWL) makes a total of 242 900 ha (23.4 percent of the Lebanese land area) of forests, woodlands and scrub. This makes Lebanon to be one of the most forested countries by total percentage in the Middle East (FAO, 2010).

Forests in Lebanon constitute an important natural resource. The main forest types widespread in Lebanon are *Quercus calliprinos*, *Q. infectoria*, *Q. cerris* var. pseudo cerris, *Juniperus excelca*, *Cedrus libani*, *Abies silicica*, *Pinus pinea*, *P. halepensis*, *P. brutia* and *Cupressus sempervirens*. The bulk of the forest area consists of Oak and Pine stands. In addition, the Lebanese forests contain a wide range of aromatic, wild, and medicinal plants.

Pine forests constitute the second largest type of forests (after oak-broadleaves) in the Lebanese landscape. Some 17 200 ha of the three pine species (*Pinus brutia, P. halepensis,* and *P. pinea*) are distributed in different bioclimatc stages, while the Stone Pine alone covers more than 46 percent of this surface (some 8 000 ha).

Native to the Mediterranean region, Stone Pine has existed in Lebanon for thousands of years. It covers wide forest areas on the Western slope of Mount-Lebanon chain, mainly in the regions of Metn, Baabda, Bkassin and Jezzine up to an altitude of 1 500m.

Stone Pine forests currently found in Lebanon were mainly planted during the period between 1920 and 1940, according to the analysis of the different tree rings samples taken in the different stands. They were planted in the same vegetation stages as their natural area of extension, in the different regions and altitude levels of the Lebanese mountains.

At an altitude ranging from 500 to 1 000 meters, lays the Eu-Mediterranean zone, mainly covered by maquis vegetation dominated by *Quercus calliprinos* and *Pistacia palaestina*. Additionally, Pine forests (*P. pinea* and *P. brutia*) are largely found in these areas together with the associated species to the oak maquis like *Cercis siliquastrum*, and *Styrax officinalis*.

The Supra-Mediterranean zone (1 000 -1 500) situated above the evergreen vegetation is characterized by a deciduous forest. In this zone, vegetation cover is denser as the population density is lower and major human settlements are more recent. At present, this zone is occupied by *Q. calliprinos* and *Q.infectoria*, *P. brutia* and *P. pinea.*

The Eastern Mount Lebanon foothills are steppic and desiccated. They are either occupied by a heavily degraded garrigue or barren, and the sub-desertic soils support a poor, overgrazed rangeland. The pre-steppic vegetation zone ranging between 1 000 and 1 500 m is mainly composed of heavily grazed forestlands of *Q. calliprinos*. In the Supra-Mediterranean zone, *Q. calliprinos* and *Q. infectoria* are found. A few *P. pinea* stands are found sporadically on these slopes. (Asmar, 2005)

Stone pine prefers sandy soils with a pH value ranging between 4 and 9, and an optimal value of 5.5. (Masri, 2000).

RESOURCE OWNERSHIP

Woodlands (forests, other wooded lands and part of the other lands with trees) ownership in Lebanon is almost equally distributed between the private sector, public sector and religious communities, under several tenure systems. However, cadastre is not always updated and

surface areas and boundaries are not always clearly set. The users of the forest areas may not be the owners. Rentals, usufructs, customs and agreements are used to regulate this system. Forest workers, private rural companies or shepherds may be allowed to use the space under these usage systems. (Asmar, 2005). The ownership of Stone Pine forests follows the same pattern as the forests and other wooded lands.

SUSTAINABILITY OF PRODUCTION

Production of pine nuts from *P. pinea* forests remains one of the rare income-generating activities related to forests and other wooded lands. It would be affected by the open market strategies, mainly because of the high production costs and the competition by imported nuts. *P. pinea* stands are also affected by the uncontrolled urban sprawl, lack of labour, aging of trees and limited interest of the young generation in such an activity.

Harvesting the cones is a hazardous activity as it involves climbing on high trees with very primitive equipment and almost no security measures taken. Such an activity threatens the lives of the producers and should be better organised and managed.

Threatened by the urban sprawl and by the changes in land-use practices and in the livelihood systems Stone Pine forests should be protected by law. The production should be encouraged to maintain the heritage of Lebanon. Incentives should be provided to producers in order to maintain their activities. Life guarding and insurances should also be made available for the harvesters, along with strict measures regulating the cone collecting activity.

The appropriate management of the forests and other wooded-lands would play a very important economic role, allowing for the sustainable harvesting of wood and NWFPs and for the provision of services with a high market value, such as eco-tourism while protecting the forest cover and reducing the fire hazard. This sustainable management would have a direct and tangible effect on the different efforts aiming at poverty alleviation.

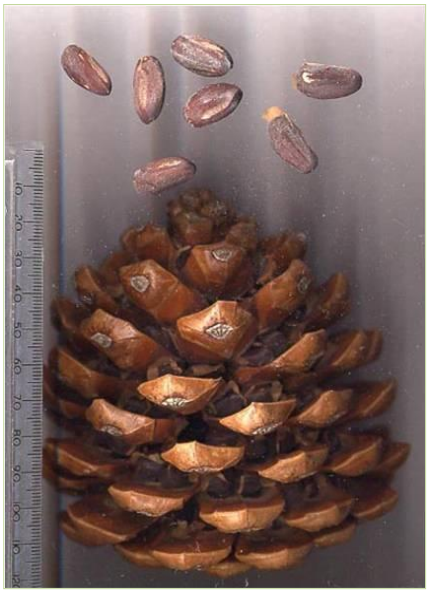
METHODS OF PRODUCTION AND PROCESSING

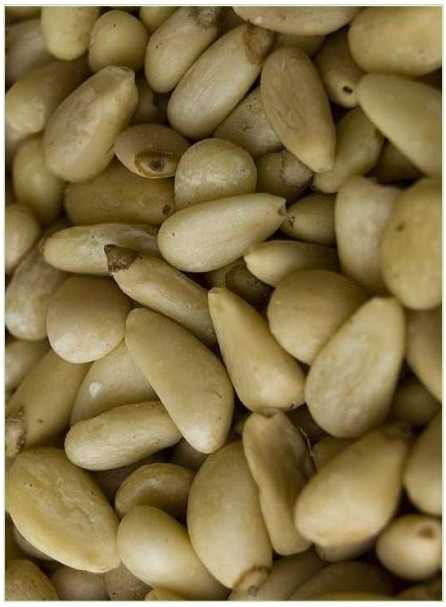
Most of the *P. pinea* forests currently existing in Lebanon are planted. A few single standing old trees are scattered in the landscape, in the villages, in the forests.

In the absence of any wood production, Stone Pine forests in Lebanon are the main type of forests with a primary production function.

Stone Pine tree starts to produce fruits (cones) around the age of thirty. It is a monoecious species, where female and male flowers are found on the same tree, but on different organs. The fertilized cone takes three years to reach maturity. During the first year, it is a small cone of up to 2 cm long; it becomes as large as a walnut during the second year; it reaches its full size (8-15 cm long; 7-10 cm wide) during the third year. The cone reaches maturity during the fall of the third year after flowering. It is composed of brown scales, each containing 2 brown hard shelled seeds, covered with black dust. The pine nut is found inside the seed. Each tree bears at the same time cones of the three different growth stages (Hignard & Pontoppidan, 1973).

- ***Pine cone*** ***Pine seed***





After the cones are harvested between November and April, they are spread over a flat surface, under the sunshine, until they are fully opened. Then they are gathered and brought into the processing plant. They are put in a drum that separates scales and cones from the black seeds. Another drum breaks the black seeds and separates the tegument from the seed, the nut. A fan blows away the thin layer covering the seeds to reveal the beautiful white seed, the pine nut.

Plantation density of *P. pinea* in Lebanese forests is around 250-300 tree/ha. At maturity and depending on the site, age and management trees produce between 15 and 750 kg of cones/year. (President of the Syndicate of Producers of Pine Nuts, personal communication, 2011).

Every 5 kg of cones produces 1 kg of seeds; every 5 kg of seeds produces 1 kg of pine- nuts.

Production cost varies with the density, management and interventions. Every 4 years the forest needs pruning; cleaning the undergrowth is done on a yearly basis; some farmers use fertilizers, mainly chicken manure to improve the growth and production. The average production cost would range between US$27 and 28 per kg.

Producers and organizations

Producers are organized in a Syndicate, with around 530 members, both Lebanese and Syrians. Although the Syndicate is open to Lebanese and Syrian producers, only Lebanese members have the right to elect and be elected. Being organized, they are able to better protect the production and to exercise the appropriate pressure on the Government whenever it is needed.

RESEARCH & EXTENSION ACTIVITIES ON THE PRODUCT /RESOURCE

Research and extension activities on Stone Pine remain limited, mainly because of the absence of a forest research institute and the absence of formal forest education.

Researchers from the National Centre for Remote Sensing (NCRS) in the National Centre for Scientific Research (NCSR) have undertaken some interesting research work on the *P. pinea*, its distribution, production, ecological specifications, etc. It is appropriate to mention here the late Dr. Talih el Masri, who has worked for several years on the subject and has produced some very useful and interesting research works on Stone Pine.

At university level, some research work is being undertaken by students. However this research remains modest, mainly because of the limited capacities and importance given to forest research.

An inventory of the forest insect pests was undertaken by a team from the Ministry of Agriculture and the American University of Beirut. The insect pests that were identified on the *P. pinea* are the following: *Ernobius sp., Chalcophora detrita, Phytocecia sp., Pitophtorus pubescens, Tomicus piniperda.* It seems that these insects attack weak trees. The best identified control technique is to remove all dead trees and twigs, which are the primary niches for infestation outbreaks. (Asmar, 2005).

INSTITUTIONAL/LEGISLATIVE ASPECTS

➢ Prices and policies regulating trade

In 2011, the whole sale price of pine nuts is US$40/kg; the retail price varies between US$43 and 55, depending on the quality, size and cleanliness of seeds and on retail shop.

In order to protect national production from imported products (mainly from Turkey and Asia), the Ministry of Agriculture has imposed a tax policy of US $10/kg of imported pine nuts. This tax policy increases the competitiveness of the national product.

SOCIO-ECONOMIC ASPECTS AND ENVIRONMENTAL BENEFITS

According to the Syndicate of Producers of Pine Nuts, around 50 000 families depend on Stone Pine as their partial or major source of income. This involvement is spread over all the phases related to production, from forest management, weeding, cleaning, tree-pruning, and spreading of fertilizers to harvesting and processing.

There are around 100-150 processing units in the Mount Lebanon, mainly in the Metn area. The owners of the processing units buy the cones or the black seeds from producers in different parts of the country.

Processing units are usually family owned. They involve the participation of the family members (mainly women) and some external manpower. Being a delicate job, the final cleaning, sorting and packing is usually undertaken by women.

Recognized measurable environmental benefits to the country

Like other types of forests, Stone Pine forests play a major role in the conservation of soil and water and in the provision of social and environmental products and services. In particular, they are known to be more fire resistant than other pine forests, mainly when they are properly managed. However, their resilience to fire is not very high, as the *P. pinea* does not regenerate spontaneously after the fire, unlike the *P. brutia* and *P. halepensis.*

The landscape offered by Stone Pine forests is highly appreciated by Lebanese people and by foreigners who like to visit the regions where such forests grow.

Recognized measurable benefits to rural communities

As in most of the Mediterranean countries, wood does not constitute a major forest product. Several rural communities still depend on fuel-wood and on charcoal production. NWFPs are the main income generating activity from forests and several rural communities depend on these products for their living. These are mainly pine nuts, carob pods (for the production of edible molasses), aromatic and medicinal plants and grazing.

The understory of Stone Pine forests is usually very rich in aromatic and medicinal plants like *Origanum sp., Salvia sp.* and *Myrtus communis* that are usually harvested and processed by the local communities. Several shops in the regions where these forests grow often sell different kinds of distilled water, spices, home-made liquors, jams, honey and pickles from the forests. Carob production (*C. siliqua*) is also takes place in the same regions, where molasses producers are usually neighbouring pine nuts producers.

The management of Stone Pine forests requires the understory to remain very low and almost absent in order to allow for the different operations and to avoid losing the cones while harvesting. Grazing and wood harvesting for fuel wood and charcoal production are often undertaken. Some tourism activities are sometimes organized in some of Stone Pine forests. Such management practices while increasing the income generation of the local population, do not affect the productivity of the trees, if practiced in a sustainable manner.

The cones, scales and teguments resulting from the processing of the pine nuts are also used by the local communities as fuel wood. (AFDC, 2007).

MARKETING & TRADE

Usage of product in country and worldwide

Pine nuts are widely used in Lebanon, in the Middle-East and in all the Mediterranean Countries. It usually accompanies all kinds of dishes, meat, poultry, fish, vegetables and sweets. It is an important ingredient of many Mediterranean dishes. It is the main ingredient of the Italian Pesto (Pine nuts, basil leaves, garlic, Parmesan cheese and olive oil); a pine nuts ice cream is available in Italy.

Volume, internal consumption and export

According to the syndicate of producers of pine nuts in Lebanon, the yearly production is around 800 tons/year; according to data from the MOA the yearly production is around 600 tons/year.

Most of the production is consumed locally, or exported in small quantities by travelers while leaving Lebanon. It is only in 2010 that some 500kg were exported to the Gulf countries (President of the Syndicate of Producers of Pine Nuts, personal communication, 2011).

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