Value chains in Lebanon's Shouf Biosphere Reserve

Cultural landscapes and biodiversity in the Mediterranean Basin

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CULTURAL LANDSCAPES AND BIODIVERSITY IN THE MEDITERRANEAN BASIN

MAVA FONDATION POUR LA NATURE
OIKOS
AGENZIA ITALIANA PER LA COOPERAZIONE ALLO SVILUPPO
SHOUF BIOSPHERE RESERVE
محمية الشوف المحيط الحيوي

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Executive summary

Lebanon's Shouf Biosphere Reserve (SBR) is increasingly implementing projects around sustainable agricultural practices and appropriate use of the surrounding landscapes. These projects are helping to revive the region's culture and economy. To inform their work, SBR is studying six species that can help preserve local biodiversity and can be incorporated into sustainable value chains.

This report quantitatively and qualitatively explores the current situation and future production opportunities of six crops: pine nuts, figs, walnuts, sumac, pomegranate and oregano. We also provide recommendations for applying fair trade principles to local value chains.

Recommendations focus on growing value chains for each of the six products, including production practices, processing, packaging, storing and transportation to markets. We focus on production since it is the largest part of the value chain, as well as the most difficult to control. We separately review processing, packaging and storing of added-value products.

Overview

Methodology

The aim of this report is to identify the main value chains of six locally produced crops in 24 villages surrounding the Shouf Biosphere Reserve in Lebanon. The six crops were previously selected by a separate study (INFOPRO, 2019) and the scope of the present study is to assess and give recommendations of the current situation and future production opportunities for the six crops.

Survey

The main tool used to conduct this study was a door-to-door survey. We used two questionnaires: one specific for pine nuts and another for the other five crops. The questions focused on the quantities produced in each of the 24 villages and on the cultural practices involved in the production of each crop.

Open ended questions were used to identify previously unknown opportunities and/or risks involved in the production of each of crop. Targeted questions were used to assess the extent of current production in each of the villages. The questionnaires were housed in Google sheets and converted into a phone app, allowing surveyors to enter responses that automatically synchronized with an online database.

The survey targeted the 72 farmers in the region who have the biggest production size and are already part of, or are willing to be part of, the sustainable production program at the Shouf Biosphere Reserve.

Analysis

Each crop investigated in the survey is analysed in the report, including estimated quantity of production in every village and the agricultural practices used, with a special focus on sustainable farming techniques.

We also provide recommendations of additional studies to be conducted on food processing facilities (such as cooperatives) present in the study area. We further recommend product traceability methodology, from production of raw material to transformation into food products and packaging to transportation to the final market.

Study results: Snapshot

Below is a snapshot of the study's survey responses, conclusions, identified challenges and recommendations.

Survey responses[1]

- Sixty-three of the interviewed farmers showed interest in expanding their production area, and specified which crops they are willing to invest in. Their farms cover around 140 hectares of land total. The final decision of what to plant is dictated by the profit that they can generate.
- Only one farmer said he used to have an organic certificate with LibanCert (a certifying body for

[1] Note that these results generally apply to all of the crops that a farmer produces, with some exceptions.

organic foods), but LibanCert has since been closed. None of the other farmers mentioned having any certification.

- Only two people interviewed mentioned that they brand their products. One is Barouk Farmers' Cooperative (with the brand Arzakouna أرزاقنا). The other is Jabal Al Barouk (they brand their Zaatar).
- None of the farmers has special packaging for fresh products.
- Thirty-six farmers suffer damage from wild animals, especially wild boars, while 33 did not report animal damages.
- Twenty-three farmers said they do not have problems with crop prices, while 46 are losing some or a large amount of money due to low prices.
- Twenty-two farmers said that they do not have problems with pest control, while 24 do have pest issues.

Study conclusions

The unique location of the Shouf Biosphere Reserve provides opportunities for a diverse array of local agricultural practices, land resources and microclimates. The study area provides a vivid setting for sustainable agricultural intervention – if also stimulated with appropriate market opportunities.

The study area includes two sides: the Shouf, where high altitude, mountainous landscape and mainly narrow terraces dominate the landscape, and the Bekaa, with a less humid climate and a field structure with large pieces of land. The Bekaa side also hosts relatively large land owners that make it easier to implement new interventions, especially in Edde Farm in Aana, where a dynamic field engineer is in charge. Communities that rely on agriculture and retain good relationship with their lands, as exemplified by Edde Farm, have a strong foundation for implementing a proper agricultural plan.

Farmers in both the Bekaa and the Shouf need guidance and follow-up around sustainable practices and environmental awareness. The need for sustainable interventions is especially prevalent in the Bekaa side, where use of chemical pesticides and fertilizers is prevalent and central to their agricultural practice. One main issue is that the farmers' main source of information and guidance is the agricultural companies and pesticide providers.

Our study of six crops provided us with baseline information on land availability, willingness to invest in agriculture, types of practices, future opportunities, main agriculture challenges and levels of trust and respect for the Shouf Biosphere Reserve. Volumes produced and prices reported are from the most recent year, 2019.

Identified challenges

The study revealed multiple challenges in the region.

- The age of farmers is relatively high (51 farmers are above 51 years old).
- Unsustainable agricultural practices (heavy use of chemical pesticides and fertilizers, with 48 farmers using chemical pesticides).
- Guidance for farmers mainly comes from local pesticide providers and pesticides companies.
- Farmers face challenges in accessing markets, which can make it harder to upgrade or change processes.
- Small farmers are hesitant to enter new production and value chains.
- Most agricultural cooperatives lack know-how around business planning, management and governance. This results in a lack of collaboration between farmers and cooperatives.

Recommendations

We recommend a special effort to train cooperative representatives on governance and management in order to achieve the cooperatives' goals, as well as demonstrate that a union of farmers can address markets needs and challenges.

Additionally, processing capacity needs to be enhanced and adjusted to produce higher quality goods and to process new products. This will help empower the local agricultural sector, engage more stakeholders and benefit more people, overall resulting in increasing the value of the economic chain.

Additional efforts need to focus on hygiene standards and quality of equipment in processing units, in order to align with national and international standards.

1. Oregano

1.1 Overview

Oregano syriacum, better known as Zaatar in Arabic, is a perennial aromatic plant typical of the Mediterranean basin. It can reach to around one meter in height and grows well in any soil type, but requires good drainage. The plant prefers sunny sites, and blossoms from May to July. Flowers are hermaphrodite (have both male and female organs) and are pollinated by bees. Flower production depends on day length, with plants grown during shorter days (12-hours) having a larger leaf area and a greater total dry weight. Density of oil glands on the leaves is not affected by day length.

Sexual propagation

Oregano seeds are very small: 1,000 seeds weigh approximately 0.25 g. Seeds are planted in greenhouses in early spring (February/March) at 10 - 13°C at a shallow depth (1 cm). Germination usually takes place within two weeks (Figure 2). The seedlings are transplanted into individual pots. When they are large enough to be handled, they are transplanted to a permanent site outside, either in early summer or fall.

Fig. 1: Bee pollinating Origanum syriacum flowers

Asexual propagation

Plant material for propagation can be obtained between March and October. A divided plant includes shoots and roots, and these can be planted outside. It is best to plant smaller amounts of seedlings in pots and grow them under partially shaded conditions in an unheated greenhouse. These seedlings are then transplanted in the field during the following spring. Spring stem tip cuttings may be collected during the growing season and can be easily rooted under high humidity in plastic plug trays, filled with soil mixed with sand or perlite and peat moss (1:1). The shoots are cut to 5-10 cm and the foliage is removed from the basal, up to half of the stem. Cuttings are then dipped in a rooting hormone (auxin powder) and inserted into pots at 2-4 cm depth.

Fig. 2: Oregano seedlings

1.2 Production in the study area

The Oregano market is very big in Lebanon. Origanum syriacum is widely used as the main ingredient for the traditional Manaqeesh (plural of Manqousheh), a type of dough topped with a mixture of oregano, olive oil, sesame and sumac. The FAO reported in 2017 that an estimated 110 tons (dried) were exported.[2] Oregano is cultivated in the villages of the Shouf Biosphere Reserve, with support from the reserve.

[2] Ministry of Agriculture (2017). *Non-Wood Forest Product Value Chains in Lebanon*. FAO.

Production volume

- The total oregano (dried) production in the surveyed group was around 3,800 kg.
- Nineteen of the interviewed farmers produced between two and 50 kg of oregano and used it for their own consumption, or, in the best-case scenario, sold it to personal contacts (366 kg total was sold in the most recent survey year).
- Twelve farmers produced between 100 and 500 kgs. each.
- The main villages for oregano production are: Bmohray, Barouk, Ain Zebde, Baadaran, Aana, Aytaneet, Jbaa and Maaser el Shouf.

Fig. 3 – A typical restored agricultural terrace with pine nuts, lavender and oregano, following the standards of the "Sustainable agriculture programme" of the SBR.

Production[3]

- Most oregano produced was consumed or sold to direct contacts at different prices. At the low end was 15,000 LBP/kg (dried oregano) for wholesale (only one farmer) and at the high end was a retail price of 45,000 LBP/kg (personal contacts).
- The most common price was 25,000 LBP (10 farmers). Only one farmer was at the highest end, selling for 45,000 LBP.
- The lowest price for fresh oregano came from a farmer from Aytanete, a village in the Bekaa valley, where wide areas of lands are cultivated and large quantities of oregano are produced. This farmer produced the largest quantity of the interviewed farmers (500 kg) and sold for 19,000 LBP.

Cultivation methods

- Sixteen of the farmers used animal manure in their farms. Six used organic compost made of shredded oak pruning, mixed with cow manure, distributed for free by the Shouf Biosphere Reserve.
- Two used chemical fertilizers.[4]
- Two used both animal manure and chemical fertilizers.
- Nineteen of the farmers used chemical pesticides in their farms, but not necessarily on oregano, since oregano is resistant to many diseases.
- Seven of the farmers did not use chemical pesticides.

Processing and value chain

Oregano is mainly sun-dried, a natural process that can, unfortunately, decrease the quality of the final product. Sun causes the evaporation of not only water, but also essential oils in oregano's leaves and

[3] $1 USD is about equal to 1,500 LBP.
[4] Usually the chemical fertilizer is NPK (nitrogen, phosphorous and potassium) with percentages of 15.15.15 or 17.17.17.

flowers. It also reduces its marketable green colour. Furthermore, raw oregano is less profitable, with spice mixes that include oregano selling for higher prices.

The price of dried oregano ranges from $3 for low quality cleanliness and colour (sun-dried) to $10 for high quality, clean and shade-dried. The most common spice mix in the Lebanese market includes oregano, sumac, sesame and salt. Other mixtures include ingredients like chickpeas, walnuts, almonds, oat, flax seeds, black seeds (Nigella sativa), wild pine nuts and smashed Kaak (a Lebanese hardened, baked, sweet dough). Prices of these mixes range from $5 to $30 depending on the quality, branding and taste. Processing oregano can produce other products, such as distilled oregano water.

1.3 Recommendations

It is important to protect the interests of both large and small-scale oregano farmers. With different markets and prices, it is possible to support both types of farmers. Overall, we found that the larger the quantity of the product, the lower the price, with a farmer's production controlling the price. The larger the production, the more competitive a farmer can be, and the more likely they are to make a profit.

It is also important to distinguish between farmers who are producing small quantities for local sale as artisanal products. These farmers' products have higher prices than farmers that produce at a larger scale, and sell their high-value products in niche markets.

2. Pomegranate

2.1 Overview

The pomegranate, Punica granatum, is a naturally dense, deciduous, bushy, multi-stemmed shrub that typically grows five to six meters high and bears highly coloured fruit with juicy seeds. There are three general categories of pomegranate: sour, mild-sour and sweet. Sweet and mild-sour pomegranates are mostly sold fresh, while sour pomegranates are used to produce molasses.

Pomegranates; colourful orange-red flowers appear in spring and summer and are either bell-shaped (female) or vase-shaped (hermaphroditic), with the latter type being sterile. The edible portion of the fruit, called an aril, is comprised of hundreds of seeds surrounded by juicy pigments, each contained within a seed coat. The juice within the aril varies from light pink to dark red, but can also appear yellow or clear in some varieties. The juice ranges from very acidic to very sweet in taste. The rind (skin) is generally smooth but leathery, and can be yellow, orange or red in colour.

Fig. 4 – The sour pomegranate variety

Pomegranates are extremely heat tolerant, and grow best when temperatures are above 30°C (86°F) for at least 120 days a year. They are also drought-tolerant, though irrigation is necessary when trees are first growing and for commercial fruit production. Without irrigation during prolonged periods of drought, fruit production will be lost, and substantial injury to young trees is likely.

Pomegranates require at least six hours of direct sunlight a day in order to ensure good fruit colour and plant productivity. Aligning the orchard rows north-south maximizes sun exposure. There are some new varieties in the market that have a sour taste, have higher yields than varieties local to the study area and have dark red pigment.

Propagation

Pomegranates can be propagated from softwood or hardwood cuttings. Hardwood cuttings are the preferred means of propagation, but softwood cuttings collected in early fall can be used with varying degrees of success. A tree from a hardwood cutting will bear fruit in the second year after planting, while it takes at least three years to bear fruit if planted from a seed. Trees reach maturity in five to seven years.

Main diseases and pests

Common pathogens are mealy bugs, the fruit borer, fruit sucking moths and aphids. An organic treatment to control mealy bugs is a mixture composed of soap, hot pepper and garlic. To control fruit sucking moths, treatments include Spinozad at a rate of 0.02 percent or Cyazypyr at a rate of 0.075 percent.

Some diseases that affect pomegranate are fruit rot, bacterial spots and fruit splitting. Fruit splitting is caused by Boron deficiency which can be treated using foliar Boron spray. Fruit rot and bacterial spots

can be prevented by allowing air movement in the orchard and by using cupper-oxychloride sprays.

2.2 Production in the study area

Production volume

The total pomegranate production in the surveyed group was around 32,000 kg. Twenty-nine of the interviewed farmers produced less than 1,000 kg of fresh pomegranates and used them either for their own consumption or sold them to personal contacts. One farmer in Warhaneyeh produced 3,000 Kg and two farmers in Bater produce 10,000 kg and 15,000 kg respectively.

Prices

Two of the large farmers sold their produce on the wholesale market, while one sold all his produce to personal contacts. The price of fresh pomegranate ranged between 800 LBP (wholesale) to 3,000 LBP per kg (retail).

Cultivation methods

Most of the pomegranate production in the villages of the Shouf Biosphere Reserve takes place at lower altitudes, mainly in Bater and Warhaneyeh, where weather conditions are favourable .

- Fifteen of the interviewed farmers used animal manure to supplement the soil and did not use chemical fertilizer.
- Six of the small farmers used chemical fertilizers. Six farmers used both chemical and animal fertilizers.
- Three farmers used organic compost made of shredded oak pruning, mixed with cow manure, distributed for free by the Shouf Biosphere Reserve.
- Twenty-three farmers used chemical pesticides for pest control, usually organophosphates, to control fruit flies, aphids and other insects.
- Eight farmers used either organic pesticides or prevention measures.
- Among the farmers who did not use chemical pesticides on pomegranate were two large farmers in Bater, although one used chemical pesticides on other crops (he didn't use them on pomegranate because he discovered that using chemical pesticides on pomegranate caused more harm).

2.3 Recommendations

Expanding market opportunities

There is great potential to scale up the production of pomegranates in the surveyed villages. In particular, farmers in Bater and Warhaneyeh showed interest in expanding their production, and two farmers in Bater are planning to expand anyway. The farmer from Warhaneyeh, who is the head of the cooperative of the village, said that the cooperative members are searching for a profitable crop to invest in, and their location and the water availability in their vicinity will allow them to expand to pomegranate production if there is a promising market. Moreover, a women's cooperative in Bater (Jana al Basateen جنى البساتين) produces pomegranate molasses. They have capacity to produce more of the molasses if they can secure a market.

Sustainable production opportunities

Pomegranate aphids are more noxious if treated with insecticide, while pomegranates without chemical treatment are clean of aphids. Some of the farmers believe that natural enemies are more effective on pomegranates than on other crops. This finding presents an opportunity for other farmers to follow pesticide-free production.

Processing and value chain

The pomegranate industry can be broadened by diversifying products such as pomegranate syrup, pomegranate peal tea (medical and aromatic) and items for use in the cosmetics industry.

The production of pomegranate molasses can also be improved, especially for small producers, by adding starch and citric acid. Three kinds of pomegranate are used to make molasses or syrup: sour, mid-sour and sweet. Specifics around molasses processing can be found in Annex 4.

3. Sumac

3.1 Overview

The sumac tree, Rhus coriaria, is found in every part of Lebanon. This small tree grows at almost every altitude, is composed of single or multiple slender trunks and reaches two to three meters in height. Sumac trees occupy steep slopes and uncultivated lands. Sumac is drought-tolerant and can grow in poor, rocky soils with little access to water. Its foliage consists of toothed and pointed leaflets, arranged in five to seven pairs attached to a stem axis. No pathogens have been reported that affect sumac trees.

Uses

Sumac fruit has a sour taste. Dried and crushed, it is a popular spice in the Middle East. Immature fruits and seeds are also eaten. Sumac fruits were known to Europeans and used for their sourness well before lemons – in fact, sumac has been used in Europe since the time of the ancient Romans, who appreciated its sourness and used it in vinaigrettes.

Fig. 5 – The Sumac plant with some racemes almost

The leaves and the bark were traditionally used in leather tanning and contain tannic acid. Dyes of various colours, including red, yellow, black and brown, can be made from different parts of the sumac plant. Oil extracted from the seeds can be used to make candles.

3.2 Production in the study area

Production volume

One of the interviewed farmers, who is also the owner of a sumac mill, said that in the villages around him, two-thirds of the existing sumac was harvested. He added that in Warhaneyeh there were 5,000 kg of sumac, and in Nabeh el Safa (location of his mill) there was one family that brought him around 2,000 kg. If the price of sumac increases, more of the sumac will be harvested and planted.

- The total Sumac production in the surveyed group was around 2,000 kg.
- Twenty-five of the interviewed farmers produced between a few kg and 100 kg of sumac for their own consumption or to sell (820 kg was sold).
- Four farmers produced between 200 and 400 kg each.

Prices

- Most produced sumac was either consumed or sold directly to sellers' contacts.
- Sumac prices ranged between 14,000 LBP for wholesale and 30,000 LBP for retail.
- The most common price was 25,000 LBP (reported by five farmers), the second most common price was 20,000 LBP (reported by four farmers), while only one small farmer in Jbaa confirmed that he has sold sumac at 30,000 LBP.

- Retail brokers reported prices ranging between 10,000 LBP and 12,000 LBP.
- The lowest price for fresh sumac was reported by a farmer from Ain Zhalta who has a retail shop and sells his produce in his shop.

Cultivation methods

Sumac is widely available in the region and is rain fed. It flourishes in marginal lands around farms or in abandoned lands. Sumac cultivation and transformation is easy. The only critical harvesting concern is that the crop should be harvested before seasonal heavy rains. At this point, sumac is not harvested because the sour taste disappears.

Most of the villages surveyed produce sumac, while the greatest production was in Ain Zhalta, Barouk and Warhaneyeh. Neither fertilization nor pesticides are used in sumac production since it is considered a wild plant that does not require any additional management.

Processing and value chain

Sumac's value chain is limited to raw material and is mainly harvested by Syrian workers (whose wages range between $20 to $25 per day, 7 hours per day). Details on the grinding process are in Annex 4.

3.3 Recommendations

A large amount of sumac is consumed at the local market, while many wild sumac plants are left unharvested (some landowners where sumac is present are not farmers, and/or live outside the villages). Many farmers who work within the Shouf Biosphere Reserve are interested in expanding their sumac cultivation. Mixing sumac with Zaatar mix will help increase its economic viability.

Fig. 6 – The Sumac powder with its typical red-purple colour

4. Figs

4.1 Overview

The fig tree, Ficus carica, is native to the Middle East and western Asia. It has been cultivated since ancient times and is now grown widely throughout the world, both for its fruit and as an ornamental plant. Fig trees are easy to grow and have been cultivated from cuttings for generations. Figs are frequently found in vineyards because the growing practices are similar to those of grapes. There are two main traditional varieties cultivated in Lebanon: white figs and black figs.

For growing figs, soil is ploughed multiple times a year but never irrigated. If irrigated, the fruits become soft and prone to diseases, like rot and worms. Unprecedented worm attacks have been observed in some villages in the last few years. Another dangerous disease, the fig mosaic virus, has also been observed. Besides these threats, figs are generally resistant to drought and most diseases.

Fig. 7 – A well grown fig tree

Fig production is diminishing for several reasons. They are difficult to harvest – figs are a delicate crop whose fruit needs special packaging and handling. They also have a very short shelf life. Another challenge is that figs usually accompany grapes in vineyards, and grape production for molasses has decreased, resulting in an associated decrease in fig production. Without the co-production of grapes, fig production is unprofitable.

4.2 Production in the study area

Production volume

- Total fig production in the surveyed group was around 13,500 kg.
- Twenty-two of the interviewed farmers produced less than 300 kg of figs and used them for their own consumption or to sell (2,500 kg in total).
- Eight farmers produced between 500 and 3,000 kg each.

Prices

- Most figs produced in small operations were consumed or sold to direct contacts at different prices.
- Large fig producers sold at prices ranging between 1,500 LBP/kg wholesale (only one farmer) and between 2,500 LBP and 4,000 LBP for retail sale to personal contacts and farmers markets.
- The highest price was 4,000 LBP in a local shop.

Cultivation methods

- The main villages in fig production are Ain Zhalta, Barouk, Aana and Jbaa.
- Most do not use chemical or organic fertilizers for figs; the only thing they do is plough their fig fields once per year.
- None of the farmers use chemical or organic pesticides to control fig pests.
- Some farmers have observed worm attacks in figs in the past couple of years.

Processing and value chain

Figs are sold fresh or as jam. There is potential to produce additional fig products, thereby strengthening their value chain. For instance, pressed dry figs are highly desirable in the market, and at present are usually imported from Syria. In Lebanon, dry figs are not processed appropriately; communities need to invest in sun dryers that will assure better quality and demand better prices. A description for producing traditional fig jam is in Annex 4.

Fig. 8 – Fresh fruit of "white" figs

5. Walnuts

5.1 Overview

Walnuts, Juglans regia, or the so-called Persian walnut, is native to a broad region stretching from the Balkans to the Himalayas and China. It is widely cultivated across Europe. The walnut is a large, deciduous tree reaching heights of 25–35 meters, commonly with a short trunk and broad crown, though taller and narrower in dense forests. It is a light-demanding species, requiring full sun exposure.

Most walnuts planted in the surveyed villages are from old local varieties. Some of the new varieties, especially chandler, have been introduced from abroad. Some farmers plant seeds directly into the soil, but usually they buy seedlings from the market. Seedlings from planted seeds take up to eight years to yield fruit, while grafted varieties yield earlier in their life.

Fig. 9 – A growing walnut tree

Walnut trees typically demand high amounts of water, although expensive, high-quality varieties can survive in dry conditions. Walnuts are resistant to disease but are susceptible to some insects like the walnut husk fly, nut weevil, bark beetle and walnut shoot moth. These insects are not easy to control unless chemical pesticides are used.

5.2 Production in the study area

Production volume

Walnut production in the Shouf Biosphere Reserve is not practiced at large scale: most of the farmers interviewed have planted just a few trees for their own consumption. Although walnut production favours irrigation in the summer, some of the large-scale farmers cultivate them using rain. The total production in the surveyed group was around 1,470,000 nuts (in Lebanon walnut production is expressed in number of nuts and not in kg).

Forty-two of the interviewed farmers have between one and 85 walnut trees and used them either for their own consumption or to sell to personal contacts (this category includes 300,000 nuts). Five farmers own 7,500 trees and produced around 1,170,000 nuts.

Prices

Most of the small walnut producers either consumed their own product or sold to direct contacts at prices ranging between 10,000 BPL and 15,000 LBP per 100 nuts. The most common price (reported by seven farmers) was 12,000 LBP per 100 nuts.

Cultivation methods

The main villages in walnut production are Batloun, Aana, Ammiq, Niha and Mrusti. Two of the big farmers use cow and goat manure in their farms. Two other farmers use both animal manure and chemical fertilizers. All the big farmers use chemical pesticides to control for worms.

Processing and value chain

Walnut is not highly marketed beyond its primitive processing phase. However, there is a high level of local knowledge around walnut jam production. Walnut is also used in special Adha Eid cookies (Maamoul), but local producers do not promote maamoul with local walnuts – most maamoul uses imported walnuts. Promoting local walnuts for maamoul is one economic opportunity, and another is promoting new products like walnut bars.

Fig. 10 – Walnuts almost ready to be collected

6. Pine nuts

6.1 Overview

Introduction

The pine nut industry in the SBR is similar to the industry across Lebanon. Pine nuts prices are identical throughout the country. They are subject to supply and demand where supply is often in surplus, and the demand is subject to socio-economic (and political) situations.

Production in the focus villages is part of a national pine nut production network. This network consists of many players: land owners, pine collectors, workers, cone traders, black pine nuts sellers, shelling factories (white pine nuts shells) and the market.

The Shouf Biosphere Reserve contains a large Stone Pine forest which covers a one million square meter area, mainly in the villages of Ain Zhalta, Bmohray and Barouk. According to local accounts, pine plantations were begun 600 years ago by Emir Fakhreddin, who spent several years in exile, and who, upon his return, introduced pine varieties.

Fig. 11 – Seeds of the Pinus

Pine trees grow best in sandy soil. In Lebanon, pine trees are pruned; growers believe pruning pine trees once every three years is necessary for good harvests, although in many of the Mediterranean countries no pruning for pine trees is practiced. One main reason for pruning in Lebanon is the danger of branches breaking under heavy snow at high altitudes. No studies have been done to compare production yield between pruned and unpruned trees. Seeds are sold as food and the cones and shells are used as fuel.[5]

Stakeholders and collection methods

In the past, seeds were shelled through a tedious and lengthy manual process that called for the involvement of men, women and children, but today the cones are dropped into a mechanical device with rotating hammers that break them up and automatically sorts out cones, shells, pine nuts and dust. For details on manual pine nut collection, see Annex 4.

Fig. 12 - Pine nuts forest

The pine forest once provided a second income to collectors' families in the summer, when they harvested the 'Qandawl' or the Thorny Broom (Calycotome spinosa), one of the few plant species that can grow abundantly under pine trees. These spiny, dense bushes were cut, and their branches sold as fuel wood to village bakeries.

[5] Another local name for the Stone Pine is "Harf", the cone is called 'ras' (head) or 'karz'; the empty cone is called 'kanefcheh'; while the empty shells are called 'qra'a' or 'mreiryeh' (the small shells).

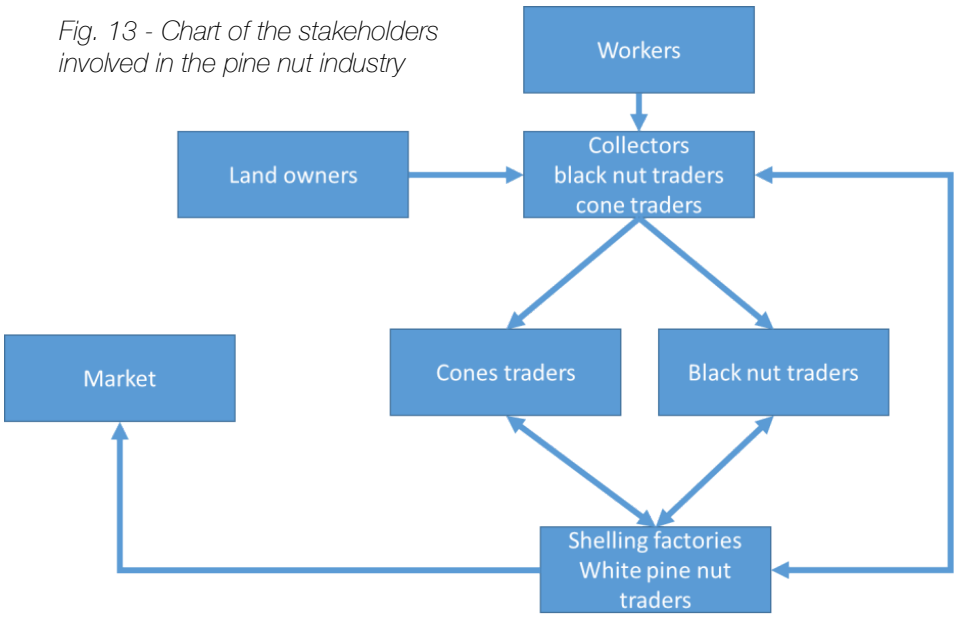

Fig. 13 - Chart of the stakeholders involved in the pine nut industry

6.2 Main diseases

Yield loss has been observed in Lebanon since 2011 and intensified in 2018. Preliminary observations and site visits revealed the presence of an alien invasive species, Leptoglossus occidentalis, a Coreidae, along with other previously observed insects. One of these insects is the Curculionidae, Tomicus destruens, a dangerous pest that destroys new young pine shoots. Its population continues to increase across Lebanon.

As a mitigation measure, the Ministry of Agriculture is conducting a campaign to spray chemical pesticides using helicopters on most pine forests. However, silvicultural practices in pine forest stands in Lebanon are not well defined, and an appropriate guideline for these practices, especially pruning, should be developed. We recommend, at minimum, that local authorities begin monitoring the Leptoglossus and Tomicus destruens species in all pine forests in Lebanon as a first step in an integrated management approach. We further recommend implementing training workshops for agricultural staff in the forestry department to learn monitoring tools. Finally, we suggest developing guidelines on silvicultural practices and pest management.

Fig. 14 - Sun-dried cones

Fig. 15 – Adult of Leptoglossus occidentalis

Fig. 16 - Adult of Tomicus destruens

6.3 Production in the study area

The economy of pine nuts is subject to several factors. These include climbers' wages, availability of collection workers, yield of pine trees, losses due to climate conditions and diseases, and market price. Climbers used to be from Lebanon, but today most climbers are Syrian.

Production volume and prices

The traditional measure unit used by pine nuts collectors is the Kantar, which corresponds to 250 kg of pine nut cones. Each Kantar usually yields 48 to 50 kg black pine nuts, but due to the Leptoglossus occidentalis that sucks sap from inside the cones, the yield has decreased from 50 kg to 35 kg for each Kantar. Every 5 kg of black pine nuts produces 1 kg of white pine nuts. The average price of white pine nuts in the Lebanese market is $55 to $60.

The total amount of pine nuts produced in the study area was estimated in two ways: interviews and a rough estimate based on unit area. For details about the unit area estimate, see Annex 4.

- The interviewed collectors in Ain Zhalta estimated that in the region of Ain Zhalta and Bmohray, the quantity of collected pine cones is around 1151 Kantars. 780 Kantars are sold as pine cones and 371 kantars are sold as black pine nuts (equivalent to 13 tonnes).
- In Barouk the estimated collected quantity is around 300 Kantars.

In total, an estimated 1450 Kantars was collected from these two villages, which yielded around 8,410 Kg of white pine nuts. The estimated value of the pine nuts market in these two villages was around $462,550.

Fig. 17 - Typical Pine nuts forest in the Shouf Biosphere Reserve

6.4 Summary table of economics of the pine nut value chain

	Cones/ha (Kg)	Black nuts/ha (Kg)	White nuts/ha (Kg)
Average production per ha	4.080	571	114

	Black nuts/cone (Kg)	White nuts/black nuts (Kg)	White nuts/cone (Kg)
Average production of 1 cone	0,14	0,20	0,028

	Project area (ha)	Nr of Pine trees/ha	Cones/tree (Kg)	Total potential cones (Kg)	Potential white nuts (Kg)
Potential production in the project area	1.160	204	20	4.372.800	132.518
Potential production in the project area (Ain Zhalta and Barouk only)	~ 222	204	20	362.500	10.150

	Workers' cost per Kg of cones (USD)	Collector margin per Kg (USD)	Price black nuts/Kg (USD)	Trader margin per Kg (USD)	Trader price white nuts per Kg (USD)	Retail price white nuts per Kg (USD)
Costs	4,86	4,64	9,50	1,50	55,00	60,00 to 65,00

Annexes

Annex 1: Summary of economic components and value chains

Zaatar (Origanum syriacum)

Cultivated

Area	Seedlings	Irrigation System	Irrigation System required	Annual seasons	Average production	Days of work required/year	Price per Kg
1.000 m²	4,000 to 5,000 depending on the landscape	Required	5,000 lt tank with main lines and GR 16 with 40 cm spacing Needed average of 70.000 lt of water/year	2	First year 100 – 120 Kg Second year 200 – 240 Kg Third year 380 – 450 Kg	30 – 45 days Depending on the quantity of weeds and the landscape	Wholesale: 8.000 LBP to 15.000 LBP depending on the collection, post harvesting, cleanliness and the quantity of flowers Retail: 25.000 LBP to 40.000 LBP depending on personal relation and contacts.

Wild collection; 1 annual season

Sustainable collection per day	Maximum harvest per day	Days of work required/year	Price per kilo
5 to 8 Kg	10 to 15 Kg	20 to 30 days depending on availability	Wholesale: 5.000 LBP to 10.000 LBP depending on the collection, post harvesting, cleanliness and the quantity of flowers (it can reach a maximum of 75% of the quality of the cultivated one) Retail: 25.000 LBP to 40.000 LBP depending on personal relation and contacts

This value chain can be improved by selling oregano as part of Zaatar mixes. Profits can increase up to 50% in the case of a traditional mix (sesame, sumac, salt) and up to 350% for other mixes (olive oil, sumac, wild pine, salt, whole sesame). Other mixes include oat flakes, flax and black seeds (Nigella sativa). Another important factor that can affect price is the quality of the drying process.

Sumac

The production rate of cultivated sumac and wild harvested sumac is the same. It is best to plant sumac at property borders and in harsh landscapes. Seedlings require three to five years to grow before they produce. 1,000 m² can accommodate a maximum of 150 seedlings.

1 annual season

Sustainable collection per day	Maximum harvest per day	Annual days of work	Price per kilo
5 to 10 Kg	8 to 15 Kg	20 to 30 days depending on availability	Wholesale (not grinded): 2.000 LBP to 5.000 LBP, depending on the collection, post harvesting and cleanliness, before grinding. Wholesale (grinded): The quality of grinded Sumac, depends on the mill used, that assures the minimum presence of seeds. Price: 10.000 LBP to 16.000 LBP, depending on the grinding process, cleanliness and the quality of sumac (colour and taste). Retail: 25.000 LBP to 35.000 LBP, depending on personal relation and contacts.

It is possible to improve the sumac value chain by including it in spice mixtures and marketing it for use on crackers and other snacks.

Figs

Traditional white figs usually have the highest demand. 1 annual season.

Figs product	Costs for the production of 1 Kg	Price per Kg Wholesale	Price per Kg Retail
Fresh figs	Very low costs, due to the fact that the fig tree requires few operational works and doesn't require any pesticides, nor fertilizers. The packaging though is the only cost to be considered.	Wholesale: 1.000 LBP to 3.000 LBP, depending on the quality, collection, packaging.	Retail price 2.000 LBP to 6.000 LBP
Sun-dried figs		2 to 3 Kg of fresh figs to produce 1 Kg of sun-dried figs (20-30 days to obtain the final product). Wholesale price 5.000 LBP to 8.000 LBP	Retail price 10.000 LBP to 15.000 LBP Price depend on the colour, texture and taste
Sun dried packed figs		Wholesale price 8.000 LBP to 12.000 LBP	Retail price 12.000 LBP to 20.000 LBP Price depend on the colour, texture and taste
Fresh fig jam, (sugar, water and sesame) 10 Kg figs + 4 to 5 Kg of sugar + 3 Kg toasted sesame seeds. The process needs a total of 6 hours of work. Might include mastic pebbles	Cost to produce 1 Kg: 3.500- 4.500 LBP	Wholesale: 7.000-8.000 LBP	Retail price 10.000 LBP to 12.000 LBP Price depend on the colour, texture and taste
Dry fig jam, (sugar, water and sesame) Might include mastic pebbles 10 Kg fig + 4 to 5 Kg sugar + 3Kg toasted sesame seeds. The process needs a total of needs 8 hours of work	Cost to produce 1 Kg: 6.500- 7.500 LBP	Wholesale: 9.000 LBP to 10.000 LBP	Retail price 12.000 LBP to 15.000 LBP Price depend on the colour, texture and taste
Whole figs in syrup, (sugar and water) might include cloves	Cost to produce 1Kg: 3.500 – 4.500 LBP	Wholesale: 7.000 LBP to 9.000 LBP	Retail price 12.000 LBP to 15.000 LBP

Pomegranate

Pomegranate is mainly cultivated, with just a few spontaneous plants found in the area. Usually the sour and mild-sour pomegranate are used for molasses.

1 annual season.

Pomegranate product	Cost to produce 1 Kg of product	Wholesale price	Price per 500 ml
Fresh pomegranate	Very low costs, due to the fact that the fig tree requires few operational works and doesn't requires any pesticides, nor fertilizers.	Wholesale per Kg: 1.000 LBP to 1.500 LBP, depending on the quality. Though on national level the wholesale price ranges from 500 LBP to 850 LBP per Kg	
Pomegranate sour molasses (pomegranate juice and salt). To process 20 Kg of fresh pomegranate will need 8 to 10 hours.	Costs: from 12.000 to 15.000 LBP	Wholesale per 500 ml: 15.000 LBP to 22.000 LBP	Retail per 500 ml: 25.000 LBP to 35.000 LBP Price depends on the taste, colour of the molasses and thickness
Pomegranate commercial molasses (pomegranate seeds to be cooked with starch, sugar, salt, citric acid) This product comes after the processing of the pomegranate sour molasses, as a complementary product, where the leftover is taken and boiled, to result in a sweet and sour molasses that is highly used in restaurants. 5 to 6 hours of work is needed.	Costs: 3.000 LBP to 5.000 LBP	Wholesale per 500 ml: 5.000 LBP to 10.000 LBP	Retail per 500 ml: 10.000 LBP to 18.000 LBP Whole sale price 5000 L.L. to 10000 L.L. The price is related to the quality of the final product and how natural it is reflecting.
Pomegranate Syrup Usually produced from sweet and/or mild- sweet pomegranate (pomegranate juice and sugar). The leftover is as well transferred into the previous process. 6 to 8 hours is needed to process 20 Kg	Cost: 8.000 LBP to 11.000 LBP	Wholesale per 500 ml: 12.000 LBP to 18.000 LBP	Retail per 500 ml: 18.000 LBP to 30.000 LBP The price is related to the quality of the final product and how natural it is reflecting.

Walnut

There are no in-depth studies of walnuts. The new commercial varieties introduced in the Skaff and Edde farms need two years before they can build a real value chain.

Annex 2: Main producers

Pomegranate			
Name	Town	Phone	Production (Kg)
Anwar Shareef Ghanem	Warhaneyeh	76693374	3.000
Kamal Khattar	Bater	78824537	11.000
Khaled Amin Wehbe	Bater	03956014	15.000
Sumac			
Name	Town	Phone	Production (Kg)
Akram and Jehad Abou Ayshi brothers	AinZhalta	03760742	400
Twfeek Abou Alwan	Barouk	03288581	350
Mahmoud Salman Azzam	Maaser	05350070; 03037274	100
George Bou Malhab	Bmehray	03686690	100
Ebraheem Azzam	AinZhalta	76815677	200
Anwar Shareef Ghanem	Warhaneyeh	76693374	250
William Georges Wakim	Maasser	81060486	100
Oregano			
Name	Town	Phone	Production (Kg)
George BouMalhab	Bmohray	03686690	100
Zaher Jamal Aldeen	Barouk	71241800	500
Zain Chazbek	Baadaran	03808783	200
Albert Saab	AinZebde	81287704	400
Eve Shartouni	Aana	70351357	200
Jemmy AlRasi	Aytaneet	70796309	400
Azzat Hsain Saadedine	Jbaa	3641441	160
Mhamad Ali Temraz	Maaser	71395803	500
George Elias Njeim	Maaser	70129039	500
Sharl Botros Njaim	Maaser	3300022	100
Omar Fares Azzam	Maaser	71903331	150
Fares Mhamad Zaidan	Maaser	70759331	200

Figs			
Name	Town	Phone	Production (Kg)
Akram and jehad Abou Ayshi brothers	AinZhalta	03760742	1.000
Wajdi Abo Saab	AinZhalta	70278585	3.000
Ali Amin Slim	Jbaa	71511289	2.250
Azzat Hsain Saadedine	Jbaa	3641441	800
Badri Mohamad Al Batlouni	Jbaa	78868354	2.000
Walnut			
Name	Town	Phone	Walnut (Nr. of trees)
Eve Shartouni	Aana	70351357	5.500
Abdallah Hanna	Ammiq	03601740	1.100
Hanna Abou Maroun	Saghbeen	03799991	400
Fouad Ahmad Abou Ali	Mrusti	5330151	500

Annex 3: Data collected

Number of interviewed farmers	72
Number of villages covered in the study	17
Farmers who showed interest in expanding their production with at least one crop	63
Total land area of the surveyed farmers	140 ha
Organic certificate holders	None
Number of branded products	2
Number of farmers who suffered from wild bores	36
Farmers who had suffered from low prices	46
Farmers who mentioned that they didn't have problem with the price	23
Total dried oregano production	3.800 Kg
Farmers who produce between 100 and 500 Kg of Oregano	12
The least wholesale price of oregano	15.000 LBP
The highest retail price of oregano	45.000 LBP
Most dealt price of oregano	25.000 LBP
Lowest price for mixed oregano	19.000 LBP
Farmers who produce more than 200 Kg of oregano and do not use any of what they produce	7
The total pomegranate production in the surveyed group	32.000 Kg
Number of farmers who have pomegranate production	32
Farmers who use chemical pesticides to control pomegranate pests	23
Lowest wholesale price for fresh Pomegranate	800 LBP
Largest retail price for fresh pomegranate	3.000 LBP
Biggest pomegranate production is in Bater (2 farmers) produce	25.000 Kg
Pomegranate processing cooperative and unit	1 in Bater
The total Sumac production in the surveyed group	2.000 Kg
Number of farmers who produced between 200 and 400 Kg of Sumac	4
Sumac production detected beyond the surveyed group	7.000 Kg
Lowest wholesale price for Sumac	14.000 LBP
Highest retail price for Sumac	30.000 LBP
The most dealt with price for Sumac	25.000 LBP
The second most dealt with price for Sumac	20.000 LBP

The total figs production in the surveyed group	13.500 Kg
Total number of farmers who produce figs	30
Number of farmers who produce more than 500 Kg of figs	8
Most important villages involved in figs production	Ain Zhalta, Barouk, Aana
Lowest wholesale price for Figs	1.500 LBP
Highest retail price for Figs	4.000 LBP
The most dealt with price for Figs	2.500 LBP
The total walnut production in the surveyed group	1.470.000 nuts
Farmers who have between one and 85 trees of walnut	42
Five farmers own a cumulative of 7500 trees the highest production of walnut	1.170.000 nuts

Annex 4: Crop processing details

Pomegranate molasses and syrup

After collecting the fruits, they are cleaned and squeezed to extract the juice. The juice is boiled until it is concentrated to half the original volume. At the end of the process, salt is added and the concentrate is bottled. The left-over seeds and pulp are boiled again and then starch, salt and sugar are added. The result is black molasses which is mostly used in restaurants. In some cases, sour and mild-sour pomegranate are mixed together to produce a lower quality molasses.

Pomegranate syrup is made by boiling sweet pomegranate juice and adding sugar. The seeds are used to produce sweet black syrup. Pomegranate peels are also mixed with herbs to create Lebanese folk medicine as a cure for stomach aches and to aid digestion.

Grinding sumac

First, the collected seed-raceme are cleaned and separated from remaining flower debris. This is done by shaking the seeds on a sieve, without applying water, in order to get rid of the bitter taste. Second, large stalks are removed and thoroughly dried so that the seeds are no longer sticky. Third, the dried seeds are taken to the mill. Different kinds of mills are used, and in most cases hammer mills are used. One issue with hammer mills is that they break seeds – when the seeds are then separated from the skin, some of the broken seeds do not make it to the finished sumac. In other types of mills, this problem is not present.

Fig jam

To produce traditional fig jam with whole figs, ingredients are ripe fresh figs, sugar (double the weight of the figs), pine nuts, mastic gum, a few leaves of pelargonium and citric acid. Put the figs in a pan and add the sugar and pine nuts. Cover with water, and add the pelargonium. Heat until the pine nuts turn brown. Smash the mastic gum and add to the pan.

To produce jam with smashed fresh figs, ingredients are ripe fresh figs, sugar (double the weight of the figs), sesame (toasted), mastic gum, a few leaves of pelargonium and citric acid. Smash the figs a few hours ahead of time. Add the sugar to the figs and mix well. Put the mixture in a pan and cook over medium heat. Add the citric acid and the pelargonium until the colour turns brown and the mixture thickens. Add the sesame and the smashed mastic gum.

Traditional pine nut collection

Collecting pine nuts is a difficult process that entails many steps. The collector must have a large surface area and/or storage facility (closed garage). Minimum equipment includes a pickup truck, climbing tool (Meakayleh, معقيلة), a long ladder, a long cutting sickle (Sahhabeh سحابة),and a big scale (to weigh at least 200-300 kg).

Pine cone collection has historically been performed by poor families who harvested pine nuts for rich landowners. Collectors carry a five-meter-tall metal ladder and a five-meter wooden pole ending with an inverted V-shaped metal fork. Climbers should be thin, flexible, not too tall and strongly built as this physical activity demands stamina. Seasoned climbers should not take their skill for granted, according to a Lebanese saying, “those who have too much self-confidence are the ones who fall off a tree.

To reach the pine canopy, which is 20 or 30 meters high, the collectors climb the ladder and hang the Maakayleh on the highest branch they can reach. They then use it to climb to the top of the canopy, referred to as 'Malak' (king). Here they collect the upper-most cones first by hitting them away from the branch, dropping them to the ground. The Maakayleh is also used to loosen hard-to-reach cones by pushing them back and forth with the metal hook.

The bags used to transport the cones are large, fitting 60 to 70 kilograms. Olive oil is used to clean away the sticky pitch and to soften the hands of cone collectors. Next, the collected cones are spread on roof tops and left exposed to rain, snow and sun until the cones start opening by themselves.

Pine nuts collection and yield

The average daily wage is around $65. Workers start at 7:00 am and end at 2:00 pm. Depending on the yield and size of trees, they can collect between 200 to 400 kg of cones, and if the yield is high a climber can collect up to 600 kg. Each climber needs a partner ($20/day) to collect cones from the ground. The team is usually composed of two climbers, two collectors and one supervisor.

Collection is the main cost: $170 per 250 kg per day. After collection, the cones are spread across an open area exposed to sun. When the cones begin to open, the black seeds are extracted. This is typically around late May but depends on the number of sunny days.

Extraction of shelled "black pine nuts" involves a processing machine that breaks the cones without breaking the seeds and sorts by seed size. 'Black' seeds are packed in large sacks which can weigh up to 90 kg each. Woody scales and the heart of the cones are also packed to be sold later as firewood for around $120 per tonne.

It is estimated that every hectare of pine forest can yield around five tonnes of cones.[6] Fouad Sleem, who works in the local pine nut industry, said that every large tree yields around 20 kg. The yield of one hectare is 204 x 20= 4,080 kg of cones. The total area of pine forests in the study area is estimated to be 1,160 hectares, which could theoretically yield 4,732 tonnes of pine cones.

The yield of white pine nuts for every Kantar is around 5.8 kg, sold for about $319 to $348. The collector gains the difference between the price of the black pine nuts and the cost of collection and extraction, which is estimated as $ 9.5 X 35 Kg = $ 332.5. From this, $170 is subtracted, and the cost of collection = $162.5. Then the white pine nut traders earn the difference between the price of the black and the price of the white. For every 5 kg of black pine nuts costing $47.50, they can extract 1 kg of white pine nuts, sold at around $55, so the profit is $7.50 per kg of white pine nuts.

[6] This estimation is based on the fact that the average planting layout, or density, needed is 49 m^2 (7X7 m), so for every 10,000 m^2 there are 10,000/49=204 trees.

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