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# Insights on the value chain and management practices of stone pine forests in Lebanon

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**Abstract.** Drawing the value chain of stone pine (*Pinus pinea* L.) forests (SPFs) in Lebanon requires defining habitat characteristics and vegetation composition, mapping stakeholders and forests governance structure, understanding local and international markets as well as collecting time series data on forests production and revenue. Remote sensing techniques and vegetation surveys were used to draw the ecological profile of SPFs. Information gathering on the extracted goods and annual cost and revenues of pine nuts resulted in a 20-years time series data (1996-2016). Data mining revealed limitations for the designed research study and prevailing narratives on the total annual production of pine nuts. Rapid appraisals with government representatives, land tenants and managers defined the existing administrative and management framework of these forests. The community of labors is regulated by the Order of Labors and Agriculture of SPFs. The workforce is mainly composed of foreigners with 400 forestland's tenants. The average annual production generated from 6-years life cycle for pruning reaches up 1,100 t (metric ton) of pine nut kernel. The average local market price of pine nuts remaining higher than the imported one, increased from US\$ 20 to 90 between 2000-2016. Turkey and Italy are the major importers of Lebanese pine nuts. The net revenue was estimated at US\$ 37.8 million in 2012 and US\$ 5.38 million in 1996. Since 2014, drop in the annual production was estimated at 500 t/year. The decrease in production is attributed to the Western Conifer Seed Bug (WCSB, *Leptoglossus occidentalis*). The insect has been affecting not only the annual production of nuts but also the land tenancy of SPFs.

**Keywords.** Nut – Value Chain – Net revenue – Lebanon.

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## I – Introduction

In Lebanon, pine nut is recognized as the “white gold” among managers and tenants of stone pine forests (SPFs). Stone pine, representing the second emblematic tree for Lebanese population next to Lebanese cedar, was initially introduced for soil stabilization in the 16<sup>th</sup> century (Saghieh, 2001). Those forests occupy 9.5% of the total forest cover in Lebanon (12,755 ha) (FRA, 2010) with 5,400 ha of productive area (Sattout *et al.*, 2005). They grow ideally between 800 to 1,500 meter altitude on sandstone and limestone soils, in the thermo-, eu- and supra-Mediterranean life zones (Abi Saleh *et al.*, 1996). While these forests are threatened by anthropogenic activities, they feature important ecological functions and socio-economic values. SPFs provide the highest gross revenue generated from direct forest goods in the country, followed by hunting (Sattout *et al.*, 2005, Sattout, 2014). The high demand of pine kernels results from its use in Mediterranean cuisine and delicacy as well as Arabic sweets and pastry in Jordan, Lebanon, Palestine, Syria and Turkey. The total annual Lebanese pine nuts production is estimated at 75 to 280 kg/ha with total annual revenues ranging from US\$ 16.5 to 52.5 million (Sattout *et al.*, 2005; Awad *et al.*, 2014; Sattout, 2014). The national market is being affected by the import of pine nuts from Turkey, which price is less than half the local production as it was the case in early nineties (Darwish *et al.*, 1996). The main goal of this study is to set the scene for a long-term research program on socio-ecological functioning and economic values of SPFs. The objectives are first to define the abiotic characteristics of SPFs and plant species composition, second to identify their management structure and practices, and third to estimate the net revenue generated from pine nuts over the past twenty years period.

## II – Materials and methods

### 1. Habitat characterisation and floristic composition

Remote sensing data acquired by satellite sensors including daily MODIS LST products MOD11 (EARTHDATA NASA), CHIRPS released by US Geological Survey (USGS) and Climate Hazards Group (CHG) scientists (Funk *et al.*, 2015), CHIRPS 2.0 and combined daily MODIS snow products were processed. The aim was to obtain the most recent accurate information on temperature, rainfall and snowfall in each of the districts of Metn, Shouf and Jezzine using the software ARCGIS 10.3.

Data collection on floristic composition of SPFs was performed in March and April 2016. Surveys were performed in 20x20m quadrats located in six different locations in Metn and Shouf. One sampled quadrat was randomly selected in the defined site. Sites selection aimed at capturing the different vegetation communities growing in SPFs.

### 2. Data collection and estimation of net revenue

Data collection and information gathering on pine nuts production, governance and management, as well as market dynamic including cost and revenue were done during winter and spring 2016. The methodology relied on Rapid Appraisals (RAs) with representatives from the Ministry of Agriculture (MoA) and the Order of Labours and Agriculture (OLA) of SPFs as well as forestlands tenants and managers in the Metn and Shouf districts.

The calculation of the Net Revenue of pine nuts production and associated byproducts (i.e. scales, shell, shell dust) took into account the cost of management and processing, in addition to their revenue. It was calculated over a period of 20 years based on time series data provided by the OLA of SPFs.

$$\text{Net Revenue} = (\text{Rpn} + \text{Rcp}) - (\text{Cch} + \text{Cpc} + \text{Cmgt})$$

Rpn	Revenue pine nuts
Rcp	Revenue cones byproduct
Cch	Cost of cones harvesting and collection
Cpc	Cost of cone processing
Cmgt	Cost of maintenance including pruning and understory clearing

Data on the importers and exporters were provided by the Chamber of Commerce, Industry and Agriculture of Beirut (CCIAB). The available database was restricted to the years 2012-2015.

## III – Results and discussion

### 1. Habitat and vegetation composition

SPFs are found at high density in Mount Lebanon in districts of Kesrouan, Metn, Baabda, Aley; in Shouf, Jezzine districts in South Lebanon; and in Marjeyoun and Hasbaya in Nabatieh. Stands with low density are found in Saida, Jbeil, Akkar and Batroun (Fig. 1). These forests are distributed mainly on leptosols and arenosols. They grow in area with an average temperature ranging from 12°C to 23°C and an average rainfall of 800-1,400 mm/year (Fig. 1). The six sites featured a variety of vegetation communities including *Quercus coccifera* L. and *Q. infectoria* G. Oliv., *Arbutus unedo* L., *Cercis siliquastrum* L., *Calycotome villosa* (Vahl.) Link, *Juniperus oxycedrus* L., *Cistus salviifolius* L. and *C. creticus* L., *Calluna vulgaris* (L.) Hull., *Myrtus communis* L., *Lavandula stoechas* L., *Origanum ehrenbergeri* Boiss. and *O. syriacum* L., *Salvia officinalis* L., and *Corydolithymus capitatus* (L.) Reich.

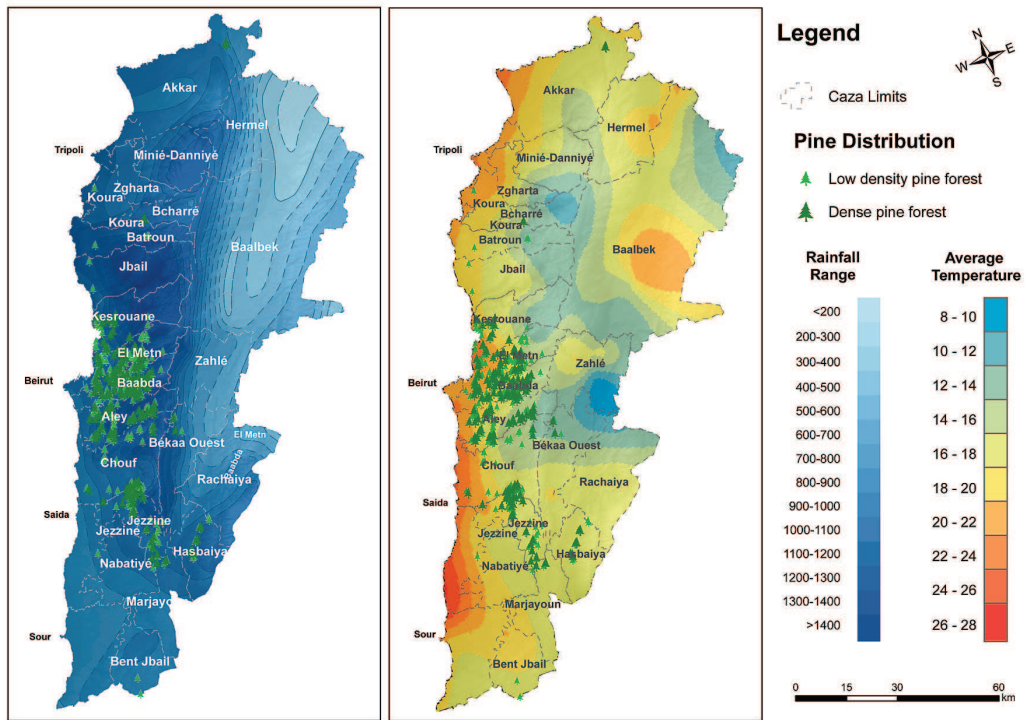


Fig. 1. Distribution and habitat characteristics of SPFs in Lebanon.

## 2. Governance

### A. Land ownership and workforce

Stone pine forests are distributed on communal, religious and private lands. Religious lands constitute 35 to 40% of the total area of SPFs. Those are subject to long-term land lease contracts. Communal lands occupy 20% of SPFs. The municipalities manage those lands in close coordination with the MoA. Following auctions procedures, they are leased on short-term basis with strict term of conditions. Private lands extend over 40% of SPFs, whereby the land's owners are direct users and managers in most of the cases, otherwise they sign short-term leasing contracts. The forestland tenants are around 400 in number. The workforce is mainly composed of foreigners because of the low labor's cost. Labors community falls under the stewardship of OLA of SPFs and workers are granted a yearly health insurance.

### B. Management practices

In Lebanon, SPFs are rainfed and traditionally managed. They exclude any agricultural practices such as fertilization, pulverization and mechanization. Thinning and understorey clearing are executed in the managed forests. Over the years, the management practices are still relying on manpower and exclude the use of new technologies and/or adoption of sophisticated protocols. The forests are pruned at 5-years interval, with restrictions on the removal of dead trees. The different pruning techniques revealed to impact yearly cone production, the know-how is based on skilled SPFs managers. Lately, the banning imposed on clearing dead wood contributed to the rapid spread of the pests (*Tomiscus destruens*) to nearby SPFs. Consequently, the outdated forestry laws

and existing regulatory measures are the main constraints to foresee the implementation of sustainable forest management in general. And in particular, they will affect the leasing of stone pine forestlands, in addition to the quality and quantity of their production.

### 3. Industry chains and revenues

#### A. SPFs goods and services

The good and services provided by SPFs could be classified under four business models (Fig. 2). The agroforestry and gardening industries constitute the outlet for forest provisioning services. The cone's scales and nut shells are used in gardening aesthetic, water and soil conservation and weed control. Dust resulting from cone processing is used as soil amendment. The 'ecological functioning' industry targets regulating services while the tourism industry combines under its umbrella the SPFs' landscape character and its aesthetic value as well as amenity services. Even though, some uses were not identified through the RAs done in the context of this study, it is worth mentioning that the resin is applied to goats as insecticide (Masri in Saghieh, 2001).

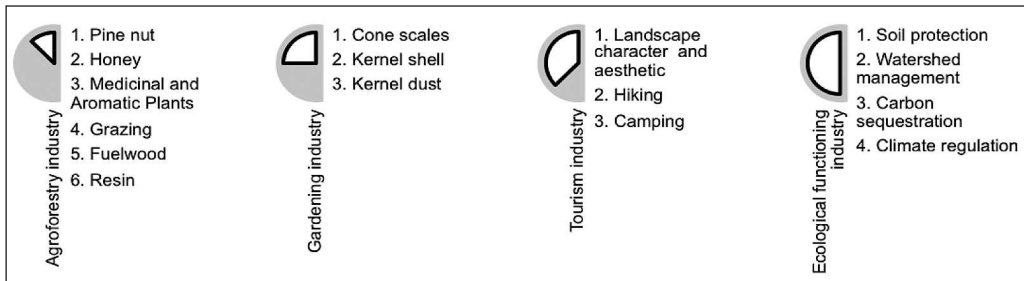


Fig. 2. Industry outlets of SPFs good and services.

#### B. Production and net revenue

Over the past two decades, the annual average pine nuts production at 6-years interval for pruning was approximately estimated as 1,100 t. The highest annual production reached up to 1,300 t and the lowest 500 t. An important drop in the quantity of pine nuts produced was observed during the last cycle starting 2014 whereby it ranged between 500 and 900 t (Fig. 3). All over the years, the fluctuation is attributed to the prevailing practices in SPFs management coupled with the production cycle of trees affected by biotic and abiotic conditions of sites. The RAs with managers revealed that total annual pine nuts production could reach up more than 2,500 t (Mr. Neaimeh E., personal communication – April 2016).

The average local market price increased from US\$ 20 to 40 between 2000 and 2010, to reach US\$ 90 in 2016 due to shortage. This year, the international market price reached US\$ 70. The main importers of pine nut are Italy, Turkey, Jordan, Qatar, Kingdom of Saudi Arabia, Brazil and United States. Revenues from transactions range from US\$ 9,000 to 12,250,000 between 2012 and 2015 (Eng. Massoud E., personal communication - CCIAB, 2016).

Time series data calculation of the net revenue showed the highest value in 2012 (US\$ 37.8 million) and the lowest in 1996 (US\$ 5.38 million) (Fig. 4). In the last few years, SPFs have been subject to the Western Conifer Seed Bug (WCSB) observed across the entire Mediterranean basin. In Lebanon, the pest affected not only the annual pine nuts production but also the forestlands lease. Tenants are abandoning the lands because of the depreciating ratio of cost/benefit.

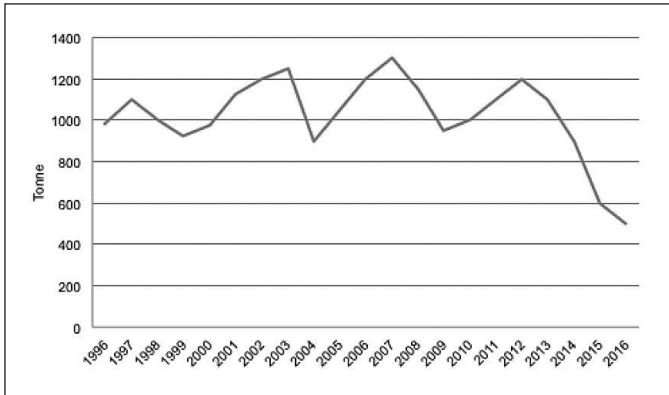


Fig. 3. Average annual production of pine nut kernel 1996-2016 (t).

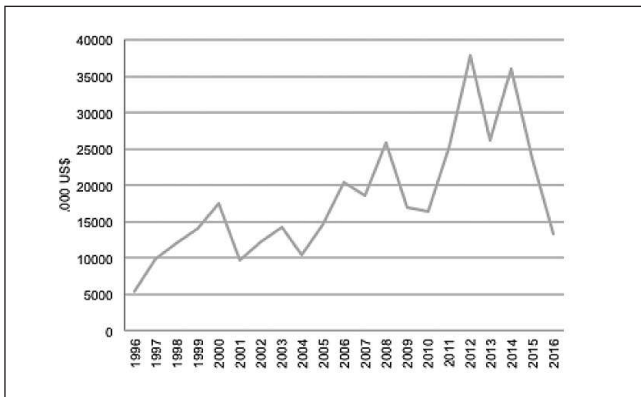


Fig. 4. Variation of net revenue of pine nuts production 1996-2016 (.000US\$).

## IV – Conclusion

The average Lebanese pine nuts production was approximately estimated at 1,100 t. Land tenants and skilled managers believe that annual pine nuts production could reach up more than 2,500 t. Those constructed narratives might be true or they may be overshooting the real value of total annual pine nuts production in the country. Insights on what could be lurking behind those spoken accounts, bring to the forefront various issues among which protection of stone pine forests from development projects, reforestation policy and conservation of SPFs landscape character. Those latter have an impact on real estate value.

With the time series data mining emerged the prevailing limitations for a complete study at this stage. Further research needs to foresee the validation of the time series data and consolidation of the existing national databases. The ambitious goal as expressed by local stakeholders highlights the importance of first acquiring a better understanding of the ecological conditions and management practices of SPFs and their impact on all services provided by these forests; second revisiting existing forestry laws (Law Nb. 85-12/9/1991, Law 558-24/7/1996) and national forest policy to ensure better an inclusive planning approach for the management of SPFs; and setting the path for their sustainable management.

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