WWF

for a living planet

Beyond Cork—a wealth of resources for people and Nature





Lessons from the Mediterranean

Editors N. Berrahmouni, X. Escuté, P. Regato, and C. Stein

Contents

1 **Foreword WWF**

2 **Foreword IPADE**

4 **Introduction** *Xavier Escuté, and Christoph Stein*

8 **Cork Oak forest Landscapes: a whole world beyond cork**
Nora Berrahmouni, and Pedro Regato

16 **Case 1** Apiculture products in sustainable agroforestry systems: bees as indicators of healthy and diverse natural landscapes.
Luigi Guarrera, and Xavier Escuté

34 **Case 2** Mediterranean coniferous forest products: stone pine nuts.
Enrique Torres, Pedro Regato, and Xavier Escuté

52 **Case 3** Mediterranean mushrooms: how to market them.
Davide Pettenella, and Susanne Kloehn

70 **Case 4** The economic value of aromatic and edible plants in multi-purpose cork oak forest landscapes: the case of myrtle.
Pedro Regato

92 **Case 5** Semi-domesticated Mediterranean forest systems: the carob tree.
Manuel Caetano, José Rosendo, and Xavier Escuté

106 **Conclusions** Recommendations for developing successful NTFP-based local economies supporting biodiversity conservation in cork oak forest landscapes.
Pedro Regato

Foreword WWF

If conservation is to succeed, it needs to forge a partnership with the world's rural people who can become nature's guardian. As in all partnerships, both parties must benefit. Rural communities need to find in conservation new ways of strengthening their livelihoods.

WWF, the world's largest conservation organization, has long been aware of this challenge, and addresses it in many ways: at the local level, integrating conservation and development in its work with communities in and around protected areas; in the market place, working to increase consumers' and producers' awareness of the value of the environment and the need to pay for its conservation, e.g. through certification and green products; at the national and international level, working to change the rules of the game, e.g. on trade, investment, taxes, and infrastructure, so that they are more favourable to rural environments and communities; and at the conceptual and technical level, promoting new approaches, supporting old ones, and encouraging the mix of old and new, always with the goal of fostering new opportunities for nature and rural people.

Regarding the mix of new and old approaches, several recent studies have advocated what in time may become a pivotal change in the way society looks at rural areas. According to these studies — most notably the Millennium Ecosystem Assessment — rural areas should be seen not only as providers of food, plant and animal fibres, and migrants, but also (in some cases principally) as the source of "ecosystem services" that are essential to the survival and well-being of both humankind and nature. These include: water and climate regulation, biodiversity, soil formation, polinization, protection against natural and man-made hazards, landscape protection, and still others.

But with few exceptions most of these ecosystem services are difficult to package and sell and hence carry a low value and command even lower prices. Here is where the old might complement the new: a host of traditional rural products and practices that conserve the environment can be recast as providers of natural goods and ecosystem services. This is the case with the five non-timber forest products of the Mediterranean cork oak forest which are analysed in this book: honey, pine nuts, mushrooms, carob-tree fruits, and myrtle.

All are part of rural cottage industries that are centuries old and can be sustainably produced while preserving the cork oak forest. Each product could be dismissed as insignificant, but that would be wrong. It is the combination of these and other sustainable activities, across landscapes and rural communities, that makes the difference. Yet technical improvements in the countryside are needed, as is market development in cities. This book, aimed at would-be producers and promoters, makes a valuable contribution toward that goal.

Washington DC, April 2007

Pablo Gutman
Senior Economist
WWF Macroeconomics Programme Office
E-mail: Pablo.Gutman@wwfus.org

1. The Millennium Ecosystem Assessment initiated by the United Nations, mobilized hundreds of scientists in an evaluation of the state of the world's environments (World Resource Institute, Washington, DC; 2005, also available at www.MAweb.org)

Foreword IPADE

The concepts of *environmental management* and *development*, protecting ecosystems and satisfying humanity's basic needs, are the two sides of the same coin. The environment cannot be dealt with aside from development issues: to achieve long-lasting results it needs to be integrated into sustainable-development strategies.

In addition, proper equitable management of the environment is crucial to the eight Millennium Development Goals: the eradication of extreme poverty and hunger, universal primary education, gender equality, lower child mortality, better maternal health, the battle against disease, environmental sustainability, development.

The Instituto de Promoción y Apoyo al Desarrollo (IPADE), is a Spanish development NGO that has accumulated considerable experience of environmental issues in its 20—year history, and continues to believe in the vital importance of ecological sustainability in the future.

With local partners IPADE promotes sustainable ways of living for rural populations in remote areas of Africa, Asia, and Latin America.

Many IPADE projects for vulnerable populations foster sustainable development through options that are ecologically sustainable, socially and culturally acceptable, and economically viable, and in which resources, benefits and decision-making are all shared equitably.

To maximize the long-term impact of its work, IPADE collaborates closely with international environmental organizations, seeking to pool its capacities and develop complementary points of view.

This publication is part of our programme (funded by the Spanish International Cooperation Agency) to boost sustainable livelihoods for vulnerable rural people in Morocco, Mauritania, and Tunisia.

Implemented by IPADE and its local partners and backed up by technical assistance from the WWF Mediterranean Programme Office, the programme is being carried out in Talassemtane National Park and the special site of biological and ecological interest at Bouhachem on the River Laou, both in Morocco, and in the Kroumerie region of Tunisia.

In these areas local people depend on natural resources for survival, yet their access to them is often restricted, and they suffer the consequences of environmental degradation.

The programme encompasses four main components:

- Promotion of rural income-generation activities from natural resources as a way of strengthening the livelihoods of, especially, vulnerable groups like women.
- Promotion of sustainable management of natural resources and acceptance that it is *healthy* ecosystems that best provide goods and services to the community, locally and beyond; definition and application of new methodologies and ecological criteria for forest restoration and fighting desertification and forest fires in Morocco and Tunisia.
- Strengthening the capacity of communities and civil society to ensure long-term sustainability of the programme results and the dissemination of lessons learned through environmental education activities in all three countries.
- Improving information and awareness levels among the Spanish public about environmental issues in the Mediterranean, illustrating the relationship between environment and poverty.

The programme supports, among other activities, the development in Morocco and Tunisia of non-timber forest products like honey, aromatic plants, stone pine nuts, and artisanal wood carving.

We are conscious of how important it is for local people to diversify, of new criteria that must be introduced to ensure the exploitation of natural resources remains sustainable, and of the need for different thinking by both public officials and the population.

The publication highlights different situations where the value of local resources has been maximized and they have become a new or better source of income. Alternatives to the traditional use of resources are also described.

Put together this represents a major contribution to the fight against over-exploitation of natural resources, over-grazing, over-fishing, and the destruction of habitats.

Raquel Álvarez Flores
Co-Director of IPADE
e-mail: ralvarez@fundacion-ipade.org
Fundación IPADE
C/ Altamirano 50, 1ª
28008 Madrid
Tel: 91 544 86 81
www.fundacion-ipade.org

Participants of the Sustainable Natural Resource Management workshop held in Tabarka (Tunisia) in June 2005 discussing with local forest workers at Ain Drahim forest © WWF – Mediterranean / Xavier ESCUTE

Introduction

The Capacity Building Component of the WWF Cork Oak Landscapes Programme

Acquiring the knowledge, skills, and understanding to manage forests sustainably

Beyond Cork—a wealth of resources for people and Nature is one of the main capacity building tools (CB) developed and published as part of the WWF's Cork Oak Landscapes Programme. CB is a cross cutting pillar supporting the three main modules of the WWF's Cork Oak Landscapes Programme (Good Practices, Markets, and Policy-Advocacy).

The education and capacity building efforts of WWF are an integral part of a global movement of environmental education for sustainable development, a movement encapsulated in the framework of the United Nations Decade of Education for Sustainable Development (2005-14). The decade is based on "Agenda 21", adopted at the 1992 UN Conference on Environment and Development in Rio de Janeiro. Agenda 21 outlines the following four components of Education for Sustainable Development:

- Public awareness and understanding
- Access to basic education (and lifelong learning)
- Reorienting existing education
- Training programmes for all sectors.

It is obvious that current socio-economic and political systems often produce unsustainable behaviour, and education is key to attaining much-needed social reorientation. Therefore educational processes have not only to build up knowledge and skills, but also encourage vision and critical reflection on objectives for social change. In the specific case of nature conservation and capacity building, education for sustainability means to:[1]

- Use educational processes.
- Engage and involve different stakeholders: community groups, NGOs, public administration, and the private sector.
- Address conservation and/or sustainable use or management of natural resources.
- Use informal settings like protected areas, workplaces, community houses.

To stop the loss of biodiversity and reduce poverty, education has to reshape mental maps and to share global collective knowledge. New knowledge, interdisciplinary exchanges, joint design of learning processes, and the facilitation of processes to turn knowledge into action are basic elements of informal education in the conservation field.

1. see also *Education for Sustainability in the WWF Network—A Survey.* WWF UK 2004.

Cork Land News, the electronic bulletin of WWF's Cork Oak Landscapes Programme. Cover of Issue 8 (October 2006 to June 2007), English version.

The Cork Land Resource Centre at www.panda.org/mediterranean (May 2007).

In the CB part of the Cork Oak Landscapes Programme, different tools and activities are used to:

- Build the capacity of and create links between the main actors working on conservation and resources management.
- Spread information, knowledge, and best practice.
- Foster dialogue and bring stakeholders together at the local level.
- Forge a lasting link between the north and the south of the Mediterranean region.

The range of tools used for CB has been tested since the start in 1994 of the Across The Waters *Project*, the CB initiative of WWF-Mediterranean. Tools used include trainings, seminars and workshops on different subjects (forest landscape restoration, sustainable natural-resource management, policy and advocacy, and economic incentives for sustainable forest management), exchange visits on technical aspects (FSC certification, forest restoration, protected areas management, etc.), an electronic bulletin *Cork Land News* in three languages (Spanish, English, and French) sent to more than a thousand subscribers, an internet resource centre, and best practice and case studies publications.

Participants of the Forest Landscape Restoration workshop held in Chefchaouen (Morocco) in May 2005 at the plant nursery of Ain Rami © WWF – Mediterranean / Xavier ESCUTE

The General Director of Forests of Tunisia at the exchange visit hosted by la Junta de Andalucía on FSC certification of cork oak forests and on stone pine forest management © WWF-Mediterranean / Xavier ESCUTE

The publication *Beyond Cork—a wealth of resources for people and Nature*

The main objective in preparing this publication is to provide concrete examples on what options exist in cork oak Mediterranean forest landscapes for developing a diversified economic system well balanced with a nature conservation goal, being socially relevant and providing equitable and fair benefits for securing local livelihoods. If local people participate in forest management and their rights of use and revenues are assured, they will take more responsibility and care in their use of forest land, with conservation objectives in mind to secure the long-term availability of the wide range of nature resources on which they depend.

This publication is focusing on a set of Non-Timber Forest Products (NTFPs) with high economic, social, and environmental significance, which may be complementary to cork production in a diversified management system. Considering that cork has a very strong and clear marketing system, which is quite restrictive in the case of North African countries, we have excluded this product from the publication.

This book is organized into seven chapters: an introduction to the cork oak forest landscapes, five case studies and one final chapter providing lessons learned and recommendations for developing community-based diversified economic initiatives in a sustainable way. Each case study is focusing on one product with the potential to play an important role in a diversified cork oak forest management system. One or two relevant initiatives show in each case study concrete experiences in the sustainable management, processing and commercialisation of each of these products, in most cases providing information about how producers based their economy in a diversified use of several NTFPs and forest services. Full details are given on production and commercialization, as well as on economic data (costs of production and potential revenue).

Each of the cases presented in this publication has been selected because it uses natural resources in a sustainable way, is of relevance to the reader, is a concrete and practical initiative, implies some sort of innovation on traditional practices, is replicable in other landscapes, and where possible is certified as organic.

The chapters can be read separately as fact sheets and in any order. The products are all interlinked: all of them exist in cork oak forest landscapes and can be jointly produced in addition to cork, providing good opportunities to diversifying and increasing local people's revenues while maintaining an environmentally healthy forest system. A list of sources is given at the end of each chapter for those who want to explore each product further. Contact details for the authors are also provided.

Finally, a lessons-learned chapter analyses and provides recommendations and ideas for those aiming to develop similar initiatives with the principles of maintaining a diversified forest ecosystem, involving a diversified set of social actors, and providing fair, equitable and self-sustainable economic benefits based on a diversified use of NTFPs.

Specialists involved in the production of the case studies

Each chapter has been prepared by one or more specialists in the subject and has been revised and commented upon by other specialists. The scientific committee reviewing and steering the specialists' work has been comprised by Pedro Regato, Nora Berrahmouni, and Xavier Escuté.
In the preparation of each section, the experts involved have been as follows:

- Cork oak forest landscapes: a whole world beyond cork: Nora Berrahmouni, and Pedro Regato with contributions from Xavier Escuté

- Apiculture products in sustainable agroforestry systems: Luigi Guarrera (Associazione Italiana per l'Agricoltura Biologica, AIAB) and Xavier Escuté with contributions from Pedro Regato, Luis Escudero (Apiarte), and Valerio Piovesan (Non Solo Miele).
- Mediterranean coniferous forest products: stone pine nuts. Enrique Torres (University of Huelva), Pedro Regato, and Xavier Escuté.
- Mediterranean mushrooms: how to market them. Davide Pettenella and Susanne Kloehn (University of Padova), with contributions from Pedro Regato and comments from Juan Martínez de Aragón (Forestry Technological Centre from Catalunya, CTFC)
- The economic value of aromatic and edible plants: the case of myrtle. Pedro Regato with contributions from Enricco Maddedu (University of Sassari) and comments from Nabil Assaf (Lebanese government forest engineer specializing in myrtle distillation).
- Semi-domesticated Mediterranean forest systems: the carob tree. Xavier Escuté based on information provided by Manuel Caetano (Associação Interprofissional para o Desenvolvimento da Producção e Valorização da Alfarroba, Portugal) and José Rosendo (Ministry of Agriculture, Portugal), and contributions from Pedro Regato, Marta Cortegano (Associação de Defesa do Património de Mértola, ADPM), and Dr. Zabel (Quinta da Figueirinha, Portugal).
- Conclusions. Pedro Regato with contributions from Nora Berrahmouni.

Authors

Xavier Escuté
Biologist and former Capacity Building Officer for the WWF Cork Oak Landscapes Programme.
E-mail: xavi.escute@gmail.com

Christoph Stein
Head of the WWF-Mediterranean Capacity Building Unit, Across The Waters,
E-mail: cstein@atw-wwf.org

Cork oak forest in los Alcornocales natural park (Spain) © Pedro REGATO

Cork Oak forest Landscapes: a whole world beyond cork

An outstanding world of biodiversity, goods and services

Extending over a surface of about 2,700,000ha (ICMC 1999) and found only in the western Mediterranean countries (Portugal, Spain, Algeria, Morocco, Italy, Tunisia, and France), the cork oak forest ecosystems are typically mosaics of mixed forest habitat types and woodlands, highly diverse scrub communities, pastures, and extensive agriculture, with high economic and cultural relevance.

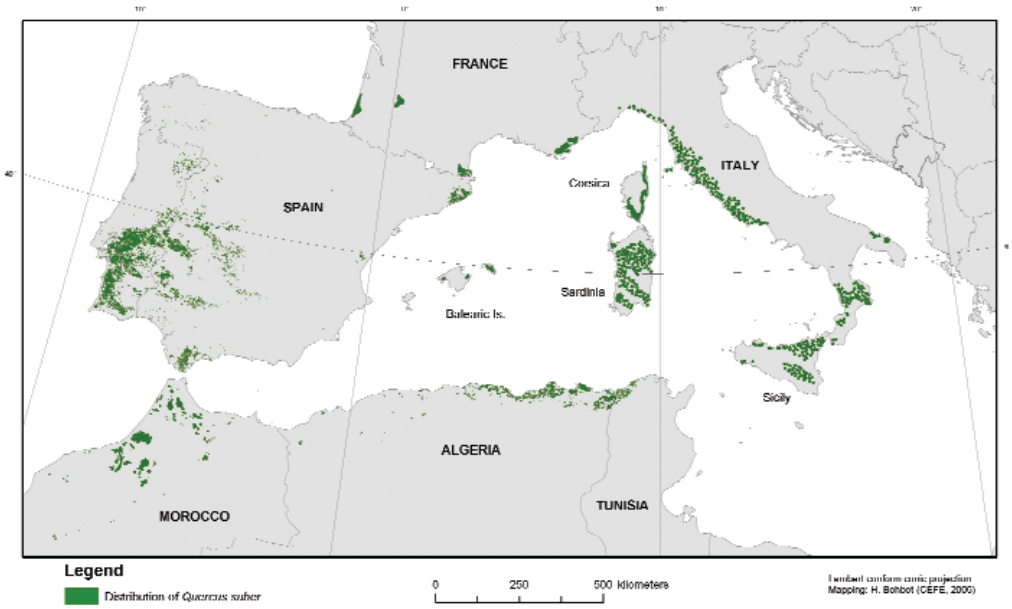
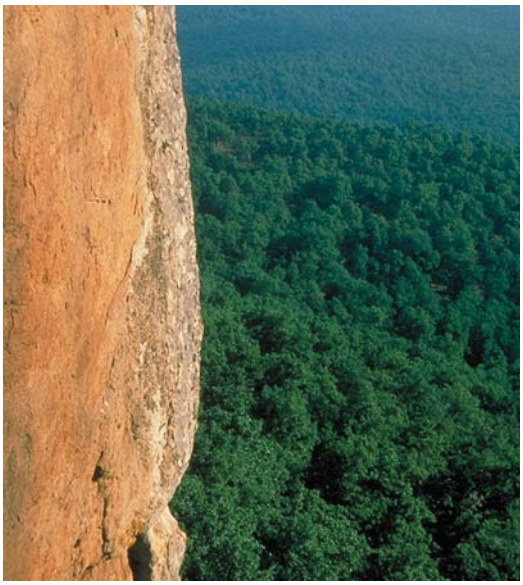
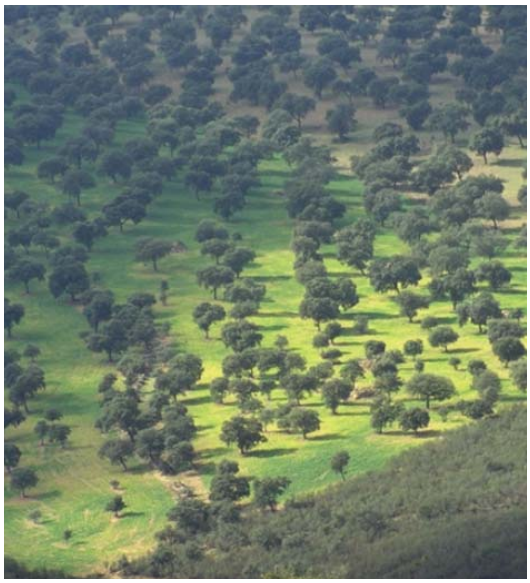


Figure 1. Approximate cork oak (*Quercus suber*) distribution from H Bohbot, J Aronson & C Fontaine CEFE/CNRS, Montpellier 2005. Carried out in the context of the EU funded CREOAK programme: QLRT2001-01594. Sources: Algeria (Alcaraz 1977; Barry *et al*. 1974; Gaussen, 1958 France (IFN, 1988-2003), Italy (Bellarosa and Schirone 1997), Morocco (Sbay *et al*. 2004), Portugal (DGF 2001), Sardinia (Arigoni 1968), Spain (www.inia.es 2006), Tunisia (Khaldi 2004 after IFPN-DGF 1955) Bulgaria (Petrov and Genov 2004).



El Feija National Park (Tunisia)
© Pedro REGATO



Dehesa, man-shaped silvo-pastoral open woodland in Andalucía (Spain)
© Pedro REGATO

In terms of biodiversity, cork oak forest landscapes reach levels of 60—100 flowering plant species per 0.1ha. The man-shaped silvo-pastoral open woodlands (the Portuguese *montado* or the Spanish *dehesa*) have extraordinary species-rich grasslands with up to 135 species per 0.1ha (Diaz *et al*. 2003). Most plant and fungi species from cork oak forest landscapes are valued as non-timber forest products for human use, many of them with aromatic, culinary or medicinal properties.

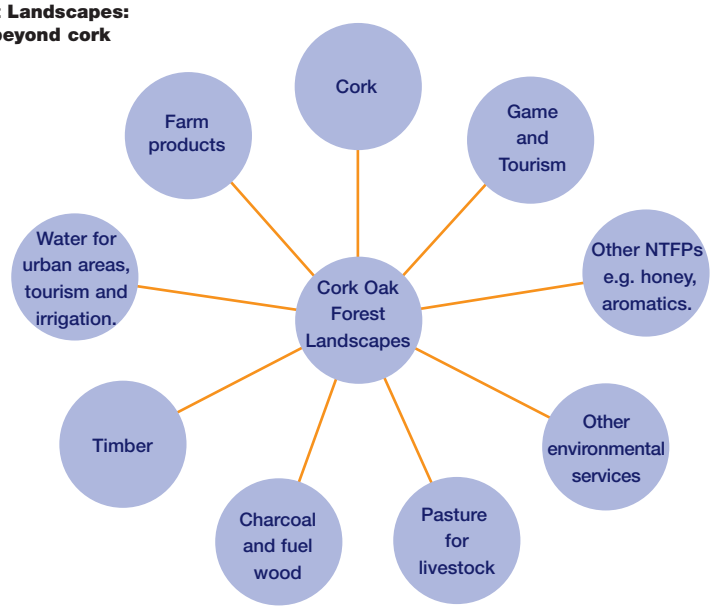
In terms of spatial scale, cork oak forest landscapes are very relevant for conservation purpose as large territories of several hundred thousand hectares still exist. These extensive areas maintain ecological processes and provide connectivity, space and habitat requirements for a large number of species. This is the case for some of the most critically endangered and charismatic Mediterranean large mammals and raptors, with their few remaining populations currently located in cork oak-related forest landscapes: the Iberian lynx (*Lynx pardinus*), the world's most endangered big cat with a reduced population of approximately 150 individuals and a clear dependence on a mixture of open and more forested habitats where rabbits, their main prey, are found; the Iberian imperial eagle (*Aquila adalberti*), one of the four most endangered birds of prey in the world, currently numbering 150 pairs; the Barbary deer (*Cervus elaphus barbarus*), Africa's only deer, which is critically endangered and thought to number below 200; large numbers of wintering birds from northern Europe, including virtually the entire European population of common cranes and others.

Economic diversity : the key option for reducing pressure and promoting sustainable rural livelihoods and markets

Cork oak forest landscapes represent one of the best Mediterranean examples of the development of the social, environmental, and economic functions of forests, maintained over thousands of years. In these landscapes, forest areas of high conservation-value alternate with multi-purpose farmland systems high in natural value, which integrate extensive agriculture, forestry, grazing, hunting, and other recreational uses.

These landscapes are mainly prized for cork stoppers, the backbone of the cork industry. Cork is the sixth highest global NTFP export with an estimated annual export value of around US$329 million. Cork products generate approximately €1.5 billion in revenue annually, 70% from the processing of cork for wine stoppers (Natural Cork Council 1999). On average, 300,000 tons of cork are produced from cork oak forest landscapes annually (ICMC 1999).

Cork Oak forest Landscapes: a whole world beyond cork



Although cork is the main product from an economic point of view, many others are harvested and used, mainly non-timber forest products: acorns from cork oak (*Quercus suber*) but also other oak species (*Quercus ilex, Q. ilex subsp. ballota, Q. canariensis, Q. afares, Q. faginea, Q. pyrenaica, Q. pubescens*), pine seeds from *Pinus pinea* and *P. halepensis* (the latter in Tunisia), aromatic plants for cooking, extraction of essential oils or for medicinal purposes (*Myrtus communis, Pistacea lentiscus, Thymus sp., Rosmarinus officinalis,* etc), mushrooms (*Boletus sp.,* truffles and other), honey and other apicultural products, cereal crops cultivated in patches, pastures for livestock (cattle, pigs, sheep, and goats) to produce meat, milk, wool, leather (and even fighting bulls in the Iberian peninsula), wild edible berries (*Myrtus communis, Arbutus unedo, Rubus sp*., and many more), resins from pine species, fruits from extensive cultivated trees (almonds, olives and carob), game, and also firewood and charcoal (especially in North African countries). In addition, these landscapes provide significant opportunities for ecotourism and for recreational activities. Most of the products are used and commercialized through informal markets, and therefore their value is not very well known.

Box 1

A balanced system under pressure[1]

In spite of being so valuable, cork oak landscapes are endangered by increasing population pressure through overgrazing, over-harvesting and forest clearance, by changing to plantations that grow faster, by poor management, by land abandonment, and by urban development in coastal areas. These threats, exacerbated by climate change, affect the health of cork oak landscapes and increase their vulnerability to diseases, pests, and big forest fires.

In North Africa only one quarter of the original 3 million hectares of cork oak forests remains today, including the last untouched cork forest areas. The population in rural areas is increasing and once nomadic people are settling, causing radical changes in the use of resources. Poverty is widespread and one third of the Maghreb's population now relies on the unsustainable use of forests, pastures, and agricultural land for their subsistence. Poor governance opens the way to illegal harvesting and forest use. Where the forests are managed for cork, poor harvesting techniques lead to high mortality of trees. Intense grazing also reduces the regeneration capacity of the forest and leads to trees being cut down for fodder.

In the Iberian peninsula the area of cork woodlands has increased in the last 50 years, but this hides a deeper malaise. The multi-purpose cork oak forest landscapes which have benefited from the interaction of people and nature over centuries are being disrupted, degraded, and destroyed. In southern Portugal and parts of Spain the

1. WWF Strategy document for the conservation of cork oak landscapes. Developed and written with contributions from WWF Forest For Life Programme (Duncan Pollard) and the WWF Cork Oak Landscapes Programme team.

Box 1

population of the inland region is declining and aging. The population drift from rural areas has reduced the availability of labour for farming and forestry. The resulting intensification and mechanization of operations has reduced the diversity of the forest under storey. Plantations of exotic forest species have replaced the traditional cork oak forest landscape in many areas, whilst in others, valuable scrub areas have been converted to cork oak plantations. These plantations typically have low biodiversity values. Often driven by agricultural and forestry subsidies, this combination of conversion, intensification, and changed land use has contributed to an increase in the incidence of fires and a reduction in the health of the cork woodlands. Almost three quarters of Portuguese cork forests are classed as having health problems.

Another major threat comes from the forecast decline of the global cork market from the growing use of substitutes for cork bottle-stoppers. This threatens to reduce the market value of cork and with it the incentive to preserve and manage cork oak forests.

In North Africa and the Iberian countries, livestock breeding is an important source of income. Many certified European meat products from the Iberian peninsula come from extensive cattle raising in these areas. For example, in 2004 in Spain, Jamón de Huelva Protected Designation of Origen (PDO) had 241 livestock farms registered, with an annual market value from protected and certified meat products estimated at nearly €24m (Torres 2006). Generally livestock breeding is based on unsustainable use of pastures in cork forest landscapes.

Furthermore, well managed cork oak forests provide valuable ecological services such as the conservation of soil, buffering against climate change and desertification, carbon fixation, water table recharge and run-off control. These values are still not fully quantified and forest managers do not yet receive compensation for these services.

Cork oak forest landscapes sustain a much diversified economy if based on the multiple and balanced use of a wide range of NTFPs in the same forest area. This is especially relevant in North African countries, where the state owns the production of cork and local communities can only benefit from low wages during the cork stripping season in summer. Although cork or any other NTFP (e.g. livestock) may have a major role in the forest economy, a balanced production based on several NTFPs (based on a real assessment and valuation of all potential) is crucial in order to make it environmentally sustainable, socially relevant, and economically beneficial.

Big forest fires pose a serious threat to cork oak landscapes
© WWF- Mediterranean

Loss of forest cover in slopes eases water erosion. Chefchaouen (Morocco) © WWF- Mediterranean / Xavier ESCUTE

The future of cork landscapes: multi-purpose management and the importance of the local community

A sustainable forest management system must balance diverse forest products. At the same time, rational use of a multi-purpose management system ensures biological diversity in cork oak forests. Too intense production in one area (like cork, livestock, or game), leads to the loss of other important forest products and their benefits, and will certainly result in forest degradation: reduced regeneration, poor structure, and very low biodiversity.

During the past decade, an important and fundamental shift in forestry and biodiversity conservation took place: from centralized planning by government agencies (especially in North Africa where the forest land is owned and managed by the government) to more participatory approaches that take local communities into account. The reason is a growing recognition by politicians, forest managers, and NGOs of the role of forests (environmental, social, and economic) and of the benefit to biodiversity and conservation that results from collaborative management. Sharing benefits and rights of use can help reverse the growing pressure on forest landscapes.

Indeed, managers and policy-makers have realized that forest departments cannot manage forests without involving local communities and all interest groups, and solving conflicts around use of and commercial access to resources, especially NTFP. People who live in the forest or its surrounding area are often poor and vulnerable and rely on the forest for a living. This is usual in many parts of the Mediterranean where forest areas and products make a significant contribution to livelihoods and the environment.

Community forest management is generally defined as forest management practiced by a range of social groups including long-term indigenous and non-indigenous communities, recent settler groups, associations of small, private landowners, and cooperative or business associations focused on a particular forest area.

In recent years, WWF's Mediterranean Programme (WWF MedPO) has collaborated with NGOs and governments (mainly forest departments) to develop community-based forest conservation and management projects in Tunisia, Morocco, Lebanon, Portugal, and Croatia based on the sustainable use of NTFPs: beekeeping, myrtle distillation, dairy products, medicinal plant production, etc.

Different lessons have been learned from these projects to ensure real participation by communities and sustainability of NTFP. The key principles that make the management of forests by communities for NTFP are:

- An independent body (like a reputable NGO) is key for coordinating the implementation of community management and securing equity and respect in the dialogue between local people and government.

- It is important to start projects with small-scale funding as economic resources are not easy to manage and can attract people who are not genuine. Fund management should be an important part of the capacity-building process and small-scale funding can be more easily correlated with a more credible commitment from the community participants. The objective is that the project generates income and the community (usually in the form of an association) grows and becomes self-sustainable.

- Support is needed for the capacity and expertise of the local association/community in enterprise management, concrete infrastructure management and installation, maintenance, harvesting methods, the certification process, packaging and marketing skills, etc. This support should be provided through workshops, training, visits to interesting initiatives and experts inside and outside the country.

- It is vital to develop an empowerment process by establishing clear rights, e.g. official recognition of the association's private work space and its tools. Clear lines of responsibility are also important and the association should allocate part of its profit to cover the expense of production, certification, and marketing .

- Environmental education should be seen as an important ice-breaking tool before any development activity. This type of awareness-raising will help identify reliable local partners with whom to start small pilot activities. The whole process should be very carefully implemented and monitored by an independent NGO. Before any programme starts, it is important to understand timing, stakeholder involvement, the action plan, and opportunities outside the project area like international training.

- Developing a cooperative or a community-based organization should be the culmination of a participatory process. This gives the participants time to understand the legal procedures, and what they imply in terms of commitment, work, and benefits and plan for it actively. This is how the association develops a sense of ownership of their own organization.

Authors

Nora Berrahmouni
Coordinator of WWF Cork Oak Landscapes Programme at WWF-Mediterranean
E-mail: nberrahmouni@wwfmedpo.org

Dr Pedro Regato
Associate Professor at the Universidad Politécnica de Madrid (Spain).
Former head of the Forest Unit at WWF-Mediterranean Programme.
E-mail: pregatopajares@yahoo.es

Bibliography

Berrahmouni, N. 2004. Non Wood Forest Products Participatory Community management. Paper presented at the Advanced Seminar organized by Azahar programme "Non-Wood forest products management and use in the Mediterranean region", 20 September -1st October 2004, Centre Tecnologic Forestal De Catalunya (CTFC), Solsona, Spain. www.ctfc.es

Berrahmouni, N. 2005. A strategy to ensure the conservation and sustainable management of the South West Mediterranean Cork Oak Landscapes. Paper presented at Regional Forum "Forestry Sector and sustainable development in the Mediterranean: Challenges, policies and governance", 24-26 November 2005, Rabat, Morocco. www.planbleu.org

Elena, M. 2005. La economía del alcornoque y el corcho. In Curso Restauración de Alcornocales incendiados. Proyecto SUBERNOVA. ICMC. Unpublished. Mérida. España

Elena, M. 2005. Curso Restauración de Alcornocales incendiados. Proyecto SUBERNOVA.

ICMC 2005. Curso Restauración de Alcornocales incendiados. Proyecto SUBERNOVA.

Robson, M, Berrahmouni, N and P Regato. 2004. Forest Certification: Environment and Development. Biligual publication by WWF MedPO and Soil Association Woodmark.

Torres, E and M A, Suarez. 2006. Unpublished. Benefits and threats of cork oak forests and cork.

Vantomme, P and S Walter. 2003. Opportunities and challenges of non-wood forest products certification. Paper accepted for presentation at the World Forestry Congress, 21-28 September 2003, Québec, Canada. Available at www.fao.org

WWF MedPO. 2003. A Project on Conservation and management of biodiversity hotspots in the Mediterranean. 10 Lessons Learnt. Publication & poster.

WWF MedPO. 2004. The Honey of El Feija: A Sweet Success.

WWF MedPO. 2006. Cork screwed? Environmental and economic impacts of the cork stoppers market. May 2006, WWF report. www.panda.org/mediterranean

Maamora forest (Morocco)
© Pedro REGATO

African honey bee *Apis mellifera adonsonii* foraging for pollen on a *Cosmos caudatus* bloom in Africa © WWF-Canon / Martin HARVEY

Case 1 Apiculture products in sustainable agroforestry systems: bees as indicators of healthy and diverse natural landscapes

Context

Honey is produced nearly in all latitudes, from Greenland and Alaska in the northern hemisphere, to Cape Horn and Namibia in the southern one. The total number of beekeepers in the world is estimated to be more than 6 million, managing at least 50 million beehives. Honey is one of the six most traded Non-Timber Forest Products worldwide: in 2004 the annual value of honey was of around 650 million euros, with 1.4 million tons of honey produced (FAOSTAT 2006). The biggest producers are China, the United States, and Germany (see figure 1). Of the countries of the western Mediterranean, the biggest producers are Spain, France, and Italy (see table 1).

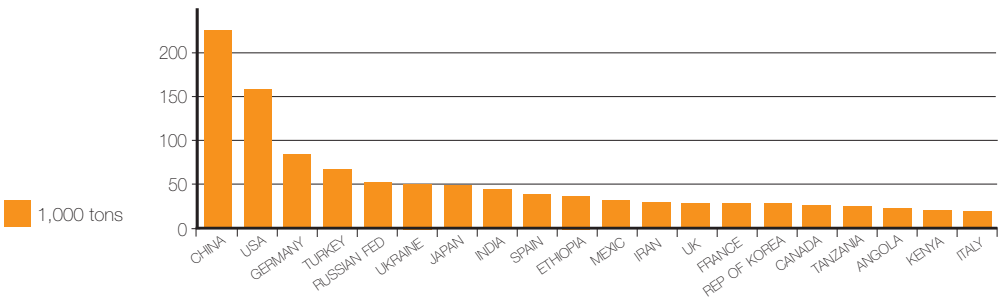


Figure 1. The 20 countries with higher honey production in 2004 (FAOSTAT)

cork countries	Spain	France	Italy	Portugal	Morocco	Tunisia	Algeria
1,000 Tons of honey produced (2004)	40.18	29.24	20.62	7.82	4.21	2.52	2.23

Table 1. Honey production per country in the west Mediterranean in 2004 (FAOSTAT)

The Latin word for bee (*Apis mellifera*) is of ancient Indo-European origin and its precise etymology is not known. The first fossil finding of a gregarious bee swarm was found in a marble area near Göttingen (Germany) and dates from at least 35 million years ago. But the first tangible evidence of a real relationship between man and bee goes back to the Neolithic era—a mural in El Abrigo de la Araña in Valencia (Spain) shows people collecting honey from a comb found in a hole between the rocks and surrounded with bees (Garcia-Yelo 2007). It was then that the discovery that wild swarms would settle in special containers transformed the plunder of wild beehives into real *beekeeping*.

The link between man and bees is present in all Mediterranean civilizations. The Egyptians were the first to attest to a well-developed apiculture, not only reported in paintings and bas-reliefs, but also by many witnesses of the use of bee products in everyday life. Aristotle, in his *History of Animals*, was probably the first author to write about bees seriously. In ancient tradition honey had many different uses: food, as a food preservative, as a medicine, as a condiment (honey vinegar), and as cosmetic. Honey and wax were produced for consumption and for barter, with salt, for example.

Beekeeping followed the decline of Roman civilization up to the 18th century, probably due to competition from sugar products (first cane then beet). Only at the end of the 19th century did the real beekeeping revolution start with the discovery of the "bee space" and the invention of the itinerant hive frame, which also permitted deeper investigation of bee biology and behaviour.

Apiculture in the Mediterranean area

The Mediterranean basin is ideal for apiculture: thanks to its high biodiversity it has historically harboured the breeding of such special insects. Although bees are originally from Asia, a total of 15 distinct bee subspecies can be found in the Mediterranean region.

Today apiculture is mainly considered to be an income supplement in diversified farming environments. Diversification of farming is one of the most important steps undertaken by farmers and communities trying to increase their income.

In southern Mediterranean countries we can still find traditional systems of beekeeping (along with modern ones), which should be preserved for historical and cultural reasons and which may encourage tourism. In the European Union (EU) there are more than 13 million beehives, half of which are in Mediterranean countries. Notwithstanding this, European consumption of honey far surpasses production, so more than 50% is imported (UNAAPI; Centro di Divulgazione Agricola della Provincia di Bologna).

Traditional bee-hives made of cork. El Feija National Park (Tunisia).
© WWF - Mediterranean / Alessandro BADALOTTI

Traditional bee-hive made of cork from Portugal © Pedro REGATO

As an example, Italian apiculture has a long tradition. Annual honey production is around 20,000 tons, while annual consumption is some 23,000 tons, so there is a need to import honey. To date, notwithstanding inadequate policies for apiculture, Italian beekeepers number around 70,000, out of which 7,000 are professionals, owning more than a million beehives. The sector's turnover exceeds 35 million euros a year. But the added value that apiculture produces thanks to the bees' pollination activity is priceless: in Italy it is calculated to be over 1,500 billion euros (Ministero per le Politiche Agricole e Forestali 2005)—a figure only for the value of crops dependent on bee pollination (See box 1).

Box 1

The pollination service

Beside the traditional image of the bee as a simple producer of valuable products such as honey and royal jelly, the role of the organized pollinator has grown. It consists of putting at the farmer's disposal beehives in good condition, and installing and managing them directly in the field. So the pollination service must be considered an important production tool just like fertilization, irrigation, pruning, and other cultural operations. It favours cross-pollination (flowers from one plant are pollinated with the pollen of other plants of the same species). Such crossing increases the mixing of the genetic characteristics of a plant and improves the offspring. Thanks to bees, many cultivars record an improved performance: number of seeds and germination success increases, as well as the sugar content and fruit calibre (Centro di Divulgazione Agricola della Provincia di Bologna 2000; Mertz 2006; Kutik 2006).

All this happens where the massive use of chemicals, monoculture, mechanization, and the disappearing of spontaneous species have combined to provoke the drastic decrease of useful insects, among which are a lot of pollinators. To this important factor, which is unfortunately increasing in the southern Mediterranean, we may add the fact that in fruit-tree crops there is the trend to use self-sterile cultivars and hybrid seeds which depend on cross-pollination. For some cultures the only valid form of pollination is entomophily: as a consequence, the production and reproduction of the vegetal subjects are only guaranteed by bees. In such a situation, the pollination service fulfilled by the bees becomes essential and can guarantee an additional income to the beekeepers, provided some specific technical arrangements are made, not only related to the use of chemicals like insecticides and herbicides, but also, for instance, to the position of the beehives or the type of cultures. A farmer in Italy pays around €25-30 per beehive and season.

The Mediterranean's honey-producing flora

The Mediterranean vegetation hosts a vast array of melliferous flora. In the cork oak landscapes many melliferous species are found: trees like cork oak (*Quercus suber*), holm oak (*Quercus ilex*), Aleppo pine (*Pinus halepensis*), stone pine (*Pinus pinea*); bushes like strawberry tree (*Arbutus unedo*), viburnum (*Viburnum sp.*), traveller's joy (*Clematis vitalba*), prickly juniper (*Juniperus oxycedrus*), lentisk (*Pistacia lentiscus*), heather (*Erica spp.*), rosemary (*Rosmarinus officinalis*), rock rose (*Cistus spp.*), laurel (*Laurus nobilis*), yellow sage (*Phlomis fruticosa*), Christ's thorn (*Paliurus spina-Christi*), hawthorn (*Crategus oxyacantha*), thyme (*Thymus vulgaris*), sage (*Salvia officinalis*), garden savory (*Satureia hortensis*), hyssop (*Hyssopus officinalis*), garlic (*Allium sativum*), rue (*Ruta graveolens*), and several liliaceae, orchidaceae, and leguminosae such as the furze (*Ulex europaeus*); and in the degraded soils of steppe-like areas, thistle (*Cardus sp.*), asphodel (*Asphodelus sp.*), sea onion (*Urginea marittima*), and others.

Thanks to bees, biodiversity reaches its apogee: their presence is an indicator of a healthy environment. Where intensive agricultural practices take place, with the use of pesticides, herbicides, and insecticides, or where environmental pollution is present, bees cannot survive or fulfil their invaluable role as pollinators. Bees, on the other hand, are very valuable allies where

Strawberry tree *Arbutus unedo* with flowers and fruits (Spain)
© WWF – Mediterranean / FOTOSTOCKMCB

Broom (*Cystus striatus*)
© Pedro REGATO

sustainable agricultural practices are followed, such as organic farming. In these cases, their pollination activity helps the farmer reach the best possible yield. On the International Day of Biodiversity (22 May 2004), the UN Secretary General Kofi Annan started his inaugural message by saying that biodiversity in many areas of the planet appears to be in grave danger as melliferous insects are dying out. Actually 95% of pollinator insects are included in the bee family. Where *Apis mellifera* is present, either bred or wild, biodiversity is always high.

Products from apiculture

When we talk about bee production, we refer to a balanced and complete "food plan" inside the hive. In addition to honey (the carbohydrates fraction), bees produce pollen (rich in proteins), medicines for the bee community (royal jelly, propolis), bee poison (for protection against intruders) and wax (the material to build the combs). Human beings can benefit from all bee products: not only from the nutritional point of view but also from the pharmaceutical one. Beyond its energizing and sweetening properties, honey has antiseptic and antibiotic properties, helping cicatrizing and the healing of burns. Honey can be used not only for colds or sore throats, but also for external use on cuts. The pharmacopoeia of the bee-hive includes royal jelly, pollen, propolis, and the useful but dangerous bee poison.

We tend to think of honey as a *foodstuff*, 20% water and 80% sugar. But it is not only that! Table 2 shows that honey contains more than 100 substances which are not only sugars but also include microelements, minerals, vitamins, and proteins in different percentages, all of them precious for human health. Honey represents an important food source, especially in severe or hostile climatic conditions, where water is scarce. Even in harsh and dry conditions, bees always find the appropriate melliferous sources, even if in a limited temporal "window". This implies that any human community (either nomadic or sedentary) can find in beekeeping a rich and nutritious food source.

Nutrient	Carbohy-drates	Minerals	Vitamins	Dietary fibre	Fat	Protein	Water	Energy
Quantity per 100g of honey	82.33g	73mg	0.6mg	0.2g	0.0g	0.3g	17.1g	300kcal / 1270KJ

Table 2. Specific composition of any batch of honey depends largely on the mix of flowers consumed by the bees. However, a typical batch of honey would contain the indicated substances (USDA)

Types of honey

As honey production is determined by the assortment of the melliferous sources where beehives are placed, honey itself can be considered a snapshot of the status of the environment surrounding the hive up to a maximum distance of about 10km. In the Mediterranean, the two main sources of products for honey are nectar from flowers and honeydew.[1]

Naturally bees produce honey from different melliferous plant species in their home range according to the different flowering periods of the year. This mixed honey is called polyfloral honey. Each variety of polyfloral honey is generally marketed under a name that indicates origin, such as "Millefiori of the Apennine", or "of the Alps", or "Millefiori of the Mountain", or "of the Mediterranean maquis".

Monofloral honey is produced from a single plant species (e.g. rosemary, chestnut trees, orange trees, etc.) during their flowering period. As an example, about 30 types of monofloral honeys are produced in Italy, although only 20 are produced regularly and are economically viable. In the Mediterranean, an interesting and high-value monofloral honey can be obtained from the rosemary (*Rosmarinus officinalis*) that has long been cultivated for ornamental purposes and as an aromatic and edible essence.

Other products from apiculture

Some beekeepers nowadays produce *honey vinegar* that preserves honey's healthy characteristics. This vinegar is produced through the alcoholic and acetic fermentation of honey by adding water and controlling temperatures and aeration. Helped by the presence of oxygen, acetic bacteria (*acetobacter*) slowly grow and change the sugar content of the honey. It is very important that the liquid is not pasteurised because it is essential for the bacteria to stay alive. Vinegar is then clarified by filtration or decantation to preserve the honey's properties. But its virtues do not stop there! The abundance of mineral salts and trace elements in honey vinegar give it remineralizing properties: it improves calcium fixation, prevents decalcification of bones, teeth, and hair, and relieves joint pain due to deposits of calcium in soft tissue. In addition, it is an excellent blood-toxin cleaner, so it is especially recommended for cholesterol and triglycerides problems. Some say honey vinegar is superior to cider vinegar: honey is composed of 25 natural sugars whilst apples have only eight. The quality of vinegar is directly proportional to the quality of the raw material and to the production process.

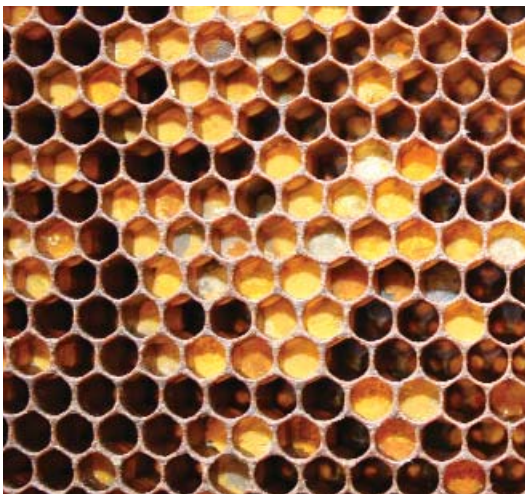
Also some producers prepare *honey sweets*. These are easily manufactured by heating honey with sugar and other products depending on the recipe (e.g. fondant, eggs, sugar, vanilla, lemon juice, etc.).

Royal jelly is the food produced for bee larvae and the queen bee. It needs to be immediately refrigerated once extracted from the beehive. Royal jelly includes all the fundamental food substances and has a tonic action for humans, helping with chronic fatigue and depression and combating loss of appetite in children. It is considered an ideal product for all vulnerable people—children, pregnant women, and the elderly.

Pollen is the powder formed in flowers which fertilizes other flowers when carried by the bees. Rich in substances necessary for growth, it contains proteins, glucosides, lipids, mineral salts, vitamins (especially of B group), and is important as a tonic, especially when run down, and with stress and anorexia; it also has a regulatory effect on the digestive functions. In the harvesting process, pollen needs to be carefully treated and frozen or dried.

1. Honeydew is a sugar-rich sticky substance secreted by aphids and some scale insects as they feed on plant sap. Ants and wasps may eat honeydew (ants may even "milk" the honeydew from aphids), while honeybees gather it and process it into a dark, strong honey that is highly prized in parts of Europe and Asia for its medicinal value. Aphids benefit from the presence of ants because they will drive away predators such as lady beetles. Many trees host aphids that are a honeydew source. (Adapted from wikipedia.org)

Monofloral honey from *Rosmarinus officinalis* is highly valued in the Mediterranean. © WWF – Mediterranean / Xavier ESCUTE



Pollen in a comb. Worker bees mix it with honey and convert it into a liquid. Eggs to become honeybee workers are then laid in this liquid and larvae grow eating it. Edyta T / Wikipedia

Propolis is a resin collected on some plants and used by the bees inside the hive as a building material, mixed with wax, to seal cracks or open spaces. It is also said to reinforce the structural stability of the hive, reduce vibration, make it more defensible by sealing alternate entrances, and to cover small animals that enter the hive and die inside because of bee stungs. Bees may also use it to fight disease and parasites. Propolis has approximately 50 constituents, primarily resins and vegetable balsams (50%), waxes (30%), essential oils (10%), and pollen (5%). Propolis production is variable according to the bee's race, being most productive some North African races (*Apis mellifera scutellata and also Apis mellifera intermissa*). It is used in pharmaceutical preparations for its antibacterial, antimycotic, anaesthetic, and cicatrizing properties. Some doctors recommend propolis for some degenerative, viral, or tumourous diseases, and its antioxidant properties seem to have a good anti-aging effect. It is also used in agriculture as a fungicide (EU Regulation 2092/91 on organic farming, annex II; www.propolis.it; UNAAPI; Wikipedia).

Another fundamental bee product with multiple properties, both therapeutic and commercial, is *wax*. Wax has been used for centuries to prepare candles, although nowadays real wax candles have become very rare on the market (which is dominated by paraffin candles). Wax candles are sought-after by tourists and consumers for their long-lasting properties and their smell.

Creams, soaps, and cosmetics, using honey or propolis as ingredients, can be found today in specialised shops and pharmacies. These products are developed for an elaborate and specialized market, and their production requires expensive equipment. These products (like soap) include small fractions of the original bee product, something consumers often do not know. See Krell's *Value added products from beekeeping* for further details (Krell-FAO 1996).

Bee poison is another product mainly used by the pharmaceutical industry. To collect it, some complicated tools are required (to stimulate the bees electrically to release their poison). Its administration as a medicine needs to be supervised by an experienced professional. It can have positive results with rheumatic pain, but only after establishing that the patient is not allergic to bee poison. Otherwise it could even cause death by anaphylactic shock.

The use of bee poison and all the other bee products is included in *apitherapy*. This is a natural medicine that treats human pathologies through various bee products. As an example of how effective this can be, the Burkina Faso government assisted by the International Federation of Apiculture (Apimondia), created a rural hospital where people are treated only with preparations from bee products. International apitherapy conferences also often take place (see www.beekeeping.com/apimondia for further details).

Honey production period and nomadism

Honey is produced from the beginning of spring to the beginning of winter, depending on local weather conditions and species. The main harvesting periods for honey are from the beginning of summer to autumn.

Some honey producers move around their beehives at night in order to expand the production period to the maximum. This practice is called *nomadism* and enables the production of monofloral honeys as it changes places with the flowering of plant species. This activity requires investments such as tools for beehive transportation by night, agreements with land owners and/or local authorities (local legislation dictates specific regulations and parameters to the nomadism), and also time to search for the right habitats, make visits to the hives. It also involves risks like theft and disease. Such activity increases the need for investment and work, but production and income also increase. As an example, the rare monofloral strawberry tree honey (*Arbutus unedo*) sells for 15—18 euros/kg in Italy.

The production cycle is as follows. Around February and March beehives can be placed in the Mediterranean maquis where the first blossoming starts; honey produced in this period is sold as "Miele di Macchia" or "of heather", "of rosemary", etc., depending on the main flowering plant in the area.

When this blossoming period in the maquis finishes, beehives can stay in the maquis or be taken to mountain or lowland areas. The bees that stay in the maquis will use the flowering of other species like the blackberries (*Rubus sp.*) that will flower over spring and at the beginning of August. Bees going to mountain areas will rely on *Taraxacum officinalis* and other herbaceous plants in late April and May, and chestnut in June. The ones moving to lowland areas will use a range of mainly cultivated species like the luzerne (*Medicago sativa*) and others. In September, again in the maquis area, other plant species start blossoming such as *Hedera helix* and in November the strawberry tree.

Socio-economic aspects of apiculture

Local communities find in apiculture an important source of income, especially if linked to other farming and forest activities. The services bees offer are numerous, through their presence as pollinators and their products. Even archaic beekeeping forms have to be kept alive: their survival is very important for cultural, educational, and even touristic purposes. There is a growing interest among the young in the natural value of bees; consumers see bee products as healthy.

As an example, WWF has been working since 1997 in Tunisia's El Feija National Park to help local communities produce and sell honey from cork oak landscapes (see box 2).

Apicultor and hives in El Feija National Park (Tunisia) © WWF- Mediterranean / Faouzi MAAMOURI

Box 2

Honey from El Feija National Park, Tunisia

In 1997, workshops were organised by WWF and the community in El Feija National Park to find development methods that could help the communities and protect the biological value of the park. Among the activities identified, honey was the first to be promoted in the region because it had a long tradition in the area, it needed modernisation, and demand and prices were high (20—25 Tunisian dinars/kg or 12—15 euro/kg). Honey does not take long to produce, the whole family can help, and it has a positive impact on the biodiversity of the area. Twelve heads of family were identified from four *douars* (villages) around the park using criteria developed by the community, WWF, and the park authorities.

As a first step, a training programme was developed with the Direction Générale des Forêts (national government) and the Bureau International du Travail (BIT) and implemented over ten days by an expert from the forest institute in Tabarka. The training was focused on breeding bees and on organic honey production. The course was followed by two field visits to other honey units based in Bizerte and Cap Bon. Twenty people from the four villages were trained.

In spring 1997 the families in Feija received modern beehives and equipment. An agreement was signed with a local veterinary surgeon to monitor the health of the bees during the early years. The community signed another agreement with the relevant national authority to produce, for the first time in Tunisia, certified organic honey. People soon started looking at the forest through new eyes: the park is excellent bee terrain and this will have direct impact in honey production. In 1998, about 800kg of organic honey were produced and sold to the park visitors. The community earned about 18,000 TD (around 10,800 euros). Each year, each beekeeper produces about 150—300 kg of honey (up to 3,750—7,500 dinars or 2,250—4,500 euros). This is about double what they earn from work with the forest department. Traditionally local people would have invested all their revenue in goats that would have been left to graze in the forest, degrading the understorey vegetation and competing with the endangered Barbary deer (*Cervus elaphus barbarus*).

Honey, for the first time, enabled them to work together and create a community-based organization: their *groupement forestier d'intérêt collectif* was born in 1999. More and more people joined this initiative and started not only to invest their own money but also applied for micro-credits. In 2003, the number of beekeepers increased to 40 and there were more than 700 beehives in the *douars* around el Feija. In 2005, a broader three-year initiative run by IPADE (a Spanish NGO) and WWF and funded by the Spanish Cooperation Agency (AECI) started in northern Tunisia to spread the knowledge gained in El Feija to neighbouring areas.

Legal aspects and labelling

All European and some Mediterranean countries have their own legislation for their apiculture sectors. At EU level, the most recent and most important regulations for apiculture are the directives 797/2004, on measures improving general conditions for the production and marketing of apiculture products, and 110/2001, revising the 74/409, regarding honey production and marketing.

Also, HACCP (Hazard Analysis and Critical Control Point) system, adopted by the Codex Alimentarius Commission (www.asept.fr/article2.htm) is a good tool for quality control in the production of honey. The system, which is science-based, identifies specific hazards and measures for their control to ensure the safety of food: it is a tool to assess hazards and establish control systems that focuses on prevention rather than end-product testing. HACCP requires a notebook is kept of all operations and production phases undertaken by the farmer in the bee chain, thus enabling traceability. There is then a record of treatments, medicines, and any other activity. After harvesting, the notebook should record the different production series (including number of pots, sizes, etc.). This permits full traceability in case of dispute or complaint.

Interest in organic cultivation and animal breeding methods has grown impressively everywhere in the world, especially in developed countries. In a world where pollution is unfortunately growing, consumers are increasingly searching for clean and healthy products. Against this background, interest in organic apiculture is also increasing, despite some related additional costs like control and certification.

Honey produced in El Feija National Park (Tunisia)
© WWF- Mediterranean / Faouzi MAAMOURI

Apiculture products in a local fair in Spain
© WWF – Mediterranean / FOTOSTOCKMCB

Organic apiculture methods, codified in Europe through the EC Regulation 1804/99, and their related quality standards, can be applied provided farmers have the skills and get technical assistance. The EC regulation gives precise parameters for conversion period, origin of bees, location of beehives, and bees' nutrition and medical care. In this case, only phyto-pharmaceuticals and homeopathic treatments can be used to fight disease.

Organic production labels ensure the quality of the product as well as good production. Even if the seal or certification cannot be achieved because of cost, producers should consider certification as the ideal to ensure quality for the consumer (hygienic standards, etc). See the section on information sources and bibliography for more references on certification.

In this chapter, a professional apiculture initiative from Spain, involving nomadic practices, certified organic and with a label of *denominación de origen*, is presented and completed with another initiative from Italy.

Lavander (*Lavandula stoechas*) © Pedro REGATO

The case of Apiarte in central Spain

Summary table

Name of the initiative	Apiarte
Location	Foothills of the Central Mountain Range (*Sierra Norte*) in the north of the province of Madrid (Spain). In the valley of Jarama river (from 700m to 2,100m above sea level, where the river starts).
Coverage	350 hives (DADANT type, prepared for transportation and harvesting of monofloral honeys) that occupy 10 hectares. Grouping hive locations in spring, summer and winter, approximately 1,000 hectares of mainly public land.
Year of creation	1985
Type of exploitation and infrastructures	Warehouse with refrigerated chamber, laboratory with extraction and bottling rooms, small warehouse, small shop, and office. Lorry, van, and trailer
Number of workers	Two people full-time year-round. Two more people full-time from April to September to help with harvesting and transportation of hives. In very busy years one more worker is hired.
Products sold	Monofloral honey Polyfloral honey Propolis Wax candles School visits
Distribution process and advertising	Distribution by van to health food shops and delicactessens shops. Marketing at local fairs. Visits to potential clients in autumn and winter. Word of mouth among clients. A website (under preparation).
Certification	Organic food label by Comunidad de Madrid. Label of *denominación de origen*
Initial investment	1,900 euros. Total invested to date: 410,000 euros, partly from EU integration funds and the Spanish Apicole Plan
Yearly revenue	This varies, but from a minimum of 26,250 euros/year to a maximum of 289,000 euros/year (considering a minimum of 10kg of honey per hive and no propolis, and a maximum of 96kg of honey and 3kg of propolis per hive per year, and average prices of 7.5 euros/kg of honey and 35 euros/kg for propolis).
Yearly costs	Over 60,800 euros/year considering salaries (minimum of 54,000 euros/year for three people full-time year-round), transportation costs of hives (5,600 euros/year) and running costs (1,200 euros/year). Sanitary treatment of hives varies from year to year.
Risks	Pests, drought, and spring frosts.

Description of the initiative

Apiarte started in 1985 in the foothills of the Central Mountain Range (Sierra Norte), in the north of the province of Madrid. This small enterprise is run by Luis Escudero and his wife Ana, and uses 350 hives for the production of honey, wax, and propolis. Hives are specially designed for transportation and extraction of monofloral honeys (DADANT type) and are organized in groups of 48. Hives are moved around the valley of the Jarama river following the flowering periods of different plant species. Transhumance is a must, according to Luis and Ana. In winter and spring, hives are located in the low part of the valley and in summer and autumn in the highest part. Altitude ranges from 700m above sea level to 2,100m at the top of the valley.

Hives are always located where natural vegetation occurs, far from villages, cities, monocultures, and chemical treatments, preferably in protected areas (natural parks or biosphere reserves). Vegetation ranges from evergreen holm oak (*Quercus ilex*) forests to deciduous oak forests (*Quercus pyrenaica, Q. faginea*), and large extensions of shrublands where aromatic plants (*Rosmarinus officinalis, Lavandula stoechas, L. spica*), rock rose (*Cistus* spp.), heather (*Erica* spp), and junipers (*Juniperus oxycedrus, J. phoenicea, J. communis*) predominate. These lands are used in part for cattle-raising, mainly cows and goats.

Hives are located in public land, although in some cases private land is used too. In these cases, the landowner is compensated with 12kg of honey for every 48-hive group.

Production chain

There were 350 hives in production in 2007, 100 fewer than the maximum possible number (according to Luis, it would be not possible to manage more than 450 hives properly). Hives are organised in groups of 48 because a higher number of hives in a single location causes stress to the bees and makes them aggressive.

Hives are moved every season following the flowering of plant species. However, distances between seasonal locations are always lower than 80km. Transport is by small lorry or in a van with trailer, depending on the number of hives to move. Usually, 48 hives are moved in each trip, at night in spring and summer because bees are less active and in the afternoons in winter.

A warehouse is used to store materials (empty hives, lids, drums, etc.) and a refrigerated chamber to store honeycombs to prevent wax of being spoilt by the greater wax moth (*Galleria mellonella*). Chemicals of any kind are not used in production and storage.

The laboratory includes an extraction room where honey is separated from the combs. Extraction is thus more hygienic and the bees are not stressed by seeing honey taken from the hive. In another room, bottling takes place. A maximum of seven tons of honey can be stored before being bottled. There is also a bottling machine.

A small workshop is used to repair and maintain materials and a small shop to sell different honeys. There is also a small office.

Apiarte employs two people full-time all year. During honey collection and transhumance (April to September), two more workers are hired full-time. In very busy periods (depending on each year's production) one more worker is hired to help with bottling and other tasks.

Commercial products are monofloral honeys (*Rosmarinus, Thymus, Lavandula, Erica, and Quercus*) and polyfloral honey from aromatic plants. All honey is extracted once it has been sealed in the combs with wax and is mature. The finished product is then of top quality, with a water content under 16%.

Bottling machine used by Apiarte
© Apiarte

Propolis is also collected and sold to laboratories preparing homeopathic products. Pollen, mainly from *Cistus* species, is also sold, frozen and dehydrated. Finally, pure wax candles are also made and sold and schools visit the facilities.

Distribution and marketing activities

Apiarte mainly sells directly to small health food shops and delicatessens. They do their own distribution by van.

Apiarte also sells products in fairs and local markets, publicizing their business in neighbouring areas. New clients are contacted through direct visits during autumn and winter when workload reduces and also by word of mouth.

Selection of organic honeys at the shop in Apiarte's facilities © Apiarte

Apiarte also appears in a local guide for enterprises in Sierra Norte and it is planning a webpage about products and activities.

Quality issues and labelling

All products produced by Apiarte are sold with the organic food label from the Comunidad de Madrid (*certificación ecológica*) and with a local *denominación de origen*. The labels help them compete with bulk imports and reinforce the firm's philosophy, although they imply lower production per hive, higher costs, and a fee to maintain the label (for the organic food label, the price paid to the certification bureau corresponds to the 1.5% of total income per year).

Economic value

Apiarte was started with an initial investment of 1,900 euros for 30 hives, an extractor, an uncapping machine, some drums for honey to mature in, and warehouse.

At present, Apiarte is based in a warehouse valued at 300,000 euros, partly paid through EU integration funds. The machinery is valued at approximately 60,000 euros, hives with bees approximately 38,000 euros, and spare hives and miscellaneous material at 12,000 euros. Part of the investment in machinery was covered by Spain's National Apiculture Plan.

Apiarte also invested 90,000 euros in the installation of 10kW of photovoltaic solar panels in the roof of the warehouse. This was recovered by selling electricity from the panels to power companies.

Economic sustainability was reached with 250 hives although production depends on weather and disease. Profit varies from year to year. Annual production per hive may vary from 10kg to 96kg (and total production from 3,500kg to 33,600kg). At an average price of 7.5 euros/kg, annual income may vary from 26,250 to 252,000 euros. However, a general *decline* in production has been observed. Propolis production per hive varies from 3kg to nothing (with a maximum of 1,050kg of propolis per year), depending on the length of spring and summer and on rainfall. Assuming an average price of 35 euros/kg of propolis, annual income may vary from nothing to 36,750 euros.

Annual costs vary, although an average would be 18,000 euros per person (two people full-time year-round and two full-time for six months amounts to 54,000 euros). Sanitary treatment changes from hive to hive, and treating hives under the organic certification label mean higher costs.

The transportation cost of a group of 48 hives is of around 200 euros per trip. Every year, there are around four trips per group of hives; assuming seven groups of 48 hives, this is approximately 5,600 euros/year. Finally, running costs are estimated at 1,200 euros (telephone, water, general supplies, etc).

Benefits to biodiversity and risks for apiculture

Apiculture benefits biodiversity as it increases the pollination of native plants. However, there are risks:

- Late frosts, dry springs, droughts that affect flowering and pollen production and help weaken bee colonies making them more sensitive to disease and pests that may be latent in hives.
- Extensive uses of pesticides that kill bees and other insects.
- Difficulties in dealing with big organic wholesalers demanding guaranteed yearly production.
- Production is unstable and shows a slowly decreasing trend.
- Industrial beekeepers installing massive groups of hives (up to 200 colonies) nearby, breaching organic regulations and ethics.

Lessons learnt and recommen-dations

After many years of production, some basic recommendations for honey production can be made:

- Hives must be placed in areas with wild flowering plants and low humidity, far from urban areas.
- Transport, manipulation, extraction, and bottling must be undertaken in the most hygienic conditions possible. The main points are: never leave combs/panels in the ground because they may get contaminated with micro-organisms (bacteria and fungi) and transport hives in a closed lorry or van to protect from dust.
- When harvesting honey, never mix frames between beehives. Always clean any tool/container before touching any part of the hive. Each bee family has their own bacterial flora, preventing pests. Label each container and keep track of production lots (when it was collected, when processed, to whom it was sold, prices, etc.). Always follow HACCP standards.
- The extraction room must have hot water to wash utensils and machinery. All elements in contact with honey should be made of stainless steel or glass and kept clean. Extraction, decanting, and maturation should take place before autumn when temperatures drop and honey becomes more dense and difficult to move. It is very important to avoid heating honey as it loses some of its characteristics.
- Once bottled, honey has to be kept in a fresh, dark place with little temperature variation. Honey should be sold in the year of production to ensure best quality.
- Interact with local shops and retailers. Get to know them and transport your products by yourself. Always promote the quality of your products.
- It is better to start with a small number of hives. This way mistakes and problems will be easily managed. It is important to start with low investments because production depends a lot on weather (rainfall, late frosts, etc) and it means hard work in spring and summer.
- Never use toxic products against pests. Only use natural products (search for information on them) and ensure good hygiene.
- It is advisable to attend initiation courses and work with experienced beekeepers to learn from them.
- Start producing honey and once you feel confident, consider diversifying (honey sweets, propolis, pollen, and wax). Consider setting up a small shop for selling honey to visitors.

- Always offer to show the laboratory and hives; help people know and value honeybees and apiculture.

- It is also advisable to join a local beekeepers association and to subscribe to specialized magazines. Check the internet often to be aware of the last advances, news, etc.

- It is always better to work on a cooperative basis to reduce operating costs.

Box 3

Non Solo Miele, a family farm from Italy and the diversification of apiculture products

Mr Valerio Piovesan founded his bee farm as a hobby in 1982 to produce honey for his own consumption. Nowadays, and after retiring, the family farm includes 60 hives that continue to produce top-quality honey and other products derived from apiculture. All his products and others produced by other firms (sweets, cosmetics, soaps, etc.) are sold in a farm shop, as well as directly to local groceries, supermarkets, and herbalists.

Non Solo Miele produces and sells pollen, propolis, royal jelly, wax and, sometimes, queen bees. Pollen fetches around 20—25 euros/kg but it's better to collect it only from the healthiest hives. After collection it has to be immediately frozen to preserve its properties. Propolis is bought by herbalist shops and pharmaceutical companies for 35 euros/kg. The production of royal jelly is low and the owner keeps it for his own consumption. Wax is partly sold to other beekeepers and herbalist shops.

Also, the farm receives visits from primary and secondary schools and agrarian institutes and from delegations from other countries (the farm is part of the Italian Federation of Beekeepers); it organizes and holds 40-hour training courses for prisoners (under an agreement with the Ministry of Justice), evaluates queen bees (as part of a study for the Institute of

Mr Piovesan in his bee farm in Italy © Non Solo Miele

Apiculture of the Ministry of Agriculture in Italy), and provides pollination services to both conventional and organic farmers.

Total income varies from year to year, but around 30 to 40 euros per hive per year is normal, from the selling of honey (15 to 40kg of honey per hive and year), propolis (100g/hive per year), and pollen (30g/hive per year); from training courses around 2,000 to 2,500 euros/year; from queen bees (evaluation or sale) around 2,500 to 3,000 euros/year; and 25 to 30 euros per hive for pollination service. There is no charge for the visits to the farm as visitors buy products from the shop.

The main costs are labour (one person for 60 hives is enough), maintenance, harvesting, processing, selling, transport, and treatment for disease. The main risks for hives are the use of pesticides in the surrounding fields and varroa and other pests.

Authors

Luigi Guarrera

Mr. Guarrera works in the Associazione Italiana per l'Agricoltura Biologica in Roma (Italy).
E-mail: l.guarrera@iamb.it

Xavier Escuté
Biologist and former Capacity Building Officer for the WWF Cork Oak Landscapes Programme.
E-mail: xavi.escute@gmail.com

Credits

We would like to thank Apiarte and Non Solo Miele for their kind collaboration in telling their story and also the invaluable help of the Federazione Apicultori Italiani and its president, Dr Raffaele Cirone, as well as the time taken by Luis Escudero and Valerio Piovesan, professional beekeepers, to answer all our questions and requests for clarification.

Information sources and bibliography

Quoted literature and websites

Agriverde S.r.l. - Via Stortini n.32/A - Caldari - Ortona (CH) - Italia.
Tel.: +39-85-9032101 - Fax: +39-85-9031089 E-mail: info@agriverde.it agriturismo@agriverde.it
Information on honey vinegar.

Apiarte. Bee-farm run by Luis Escudero. C/Torrearte, 10. Torremocha de Jarama, 28189 Madrid, Spain. Tel: +34 91 843 16 94. E-mail: apiarte@telefonica.net

Apicolturaonline. Website in Italian with a multi-lingual dictionary of apiculture terms, glossary and interesting information. www.apicolturaonline.it/dizionario/index.htm

Apitalia - monthly magazine edited by FAI-Federazione Apicoltori Italiani (different numbers)

Centro di Divulgazione Agricola della Provincia di Bologna. 2000. *Il Divulgatore 8 - Api & Miele: Vademecum del produttore e del consumatore*. Monthly magazine

Draper P. and Duggan M. 2001. *Small Enterprise Development: Beekeeping for Selling Honey and Beeswax*. FAO 2001. Also available in electronic format at www.fao.org/ag/AGS/Agsi/BeeBrochure/Maurice%20Bee%20BrochureRevised.htm#CHAP7

FAI - Federazione Apicoltori Italiani - Corso Vittorio Emanuele, 101 00186 Roma
Tel. +39-06-6877175 E-mail: federapi@tin.it www.agricoltori.com/FAI.html www.confagricoltura.it

FAO. Web with honey related information sources in English and French.
www.fao.org/docrep/008/y5110f/y5110f0f.htm.

FAOSTAT 2006. Website with statistical data on food production and trade. www.faostat.fao.org.

García-Yelo M. 2007. Article at the website www.Liceus.org with information on Spanish prehistoric art. At www.liceus.com/cgi-bin/aco/ar/06/06133.asp (in Spanish).

HACCP - www.asept.fr/article2.htm (here you can find everything in French about HACCP!)

INA - Istituto Nazionale di Apicultura - via di Saliceto, 80 Bologna Tel. +39-051-353103 Fax +39-051-356361 www.inapicoltura.org
Krell R., 1996. Value-added products from beekeeping. FAO Agricultural Services Bulletin. FAO. ISBN 92-5-103819-8. Also available in electronic format at http://www.fao.org/docrep/w0076e/w0076e00.htm

Kutik 2006. Website of Kutik's honey farm. Consulted in August 2006 at http://kutikshoney.com/crop_pollination.htm

Ministero per le Politiche Agricole e Forestali, 2005. L'Agricoltura italiana in cifre, 2005

Mertz, T. 2006. Pollination Services: no food without them. Rand report. Consulted in August 2006 at www.rand.org

UNAAPI - Unione Nazionale Associazioni Apicultori Italiani. They have a website in Italian with many informations on Apiculture. www.mieleditalia.it

USDA Internet Database (2007). www.nal.usda.gov/fnic/foodcomp/search/

Valerio Piovesan bee-farm, Non Solo Miele. Via Bassianese 305, 04010 Borgo San Michele (Latina). Lazio, Italy. Tel/Fax: +39 0773 240 948. E-mail: nonsolomiele@aliceposta.it

Wikipedia, the free encyclopedia. Interesting articles on honeybee, bee products and other information (September 2006). www.wikipedia.org

www.propolis.it. Website in Italian about propolis. Managed by Biomedical.

International Federation of Beekeepers Associations (with information of all beekeepers in North African countries)

Apimondia
Corso Vittorio Emanuele 101
00186 Roma - Italia
Tel. & fax: +39 06 6852286
Email: apimondia@mclink.it Internet: www.apimondia.org (in English, French, Spanish and German)

Organic Farming Associations working at Mediterranean level (based in Italy)

AIAB-Associazione Italiana per l'Agricoltura Biologica
Via Piave, 14 00187 Roma (Italia)
Tel.: +39 06 45437485, Fax: +39 06 45437469
E-mail: aiab@aiab.it Internet: www.aiab.it

AMAB-Associazione Mediterranea Agricoltura Biologica
Monastero di Montebello, 1 - 61030 Isola del Piano (PU) Italia
Tel.. 0721.720334, Fax 0721.720326
E-mail: amab@amab.it Internet: www.amab.it

Certification bodies working in the Mediterranean countries (with local branches in the southern Mediterranean):

EcoCert - Organisme de control et certification (with branches in Morocco, Tunisia, Spain, Portugal, Italy)
ECOCERT
BP 47
32600 L'Isle Jourdain
Tél : 05.62.07.34.24, Fax : 05.62.07.11.67
E-mail : info@ecocert.fr Internet: www.ecocert.fr

Icea- Istituto per la Certificazione Etica e Ambientale
Strada Maggiore 29
40125 Bologna (Italia)
Tel.: +39 051 272986, Fax: +39 051 232011
E-mail: icea@icea.info Internet: www.icea.info

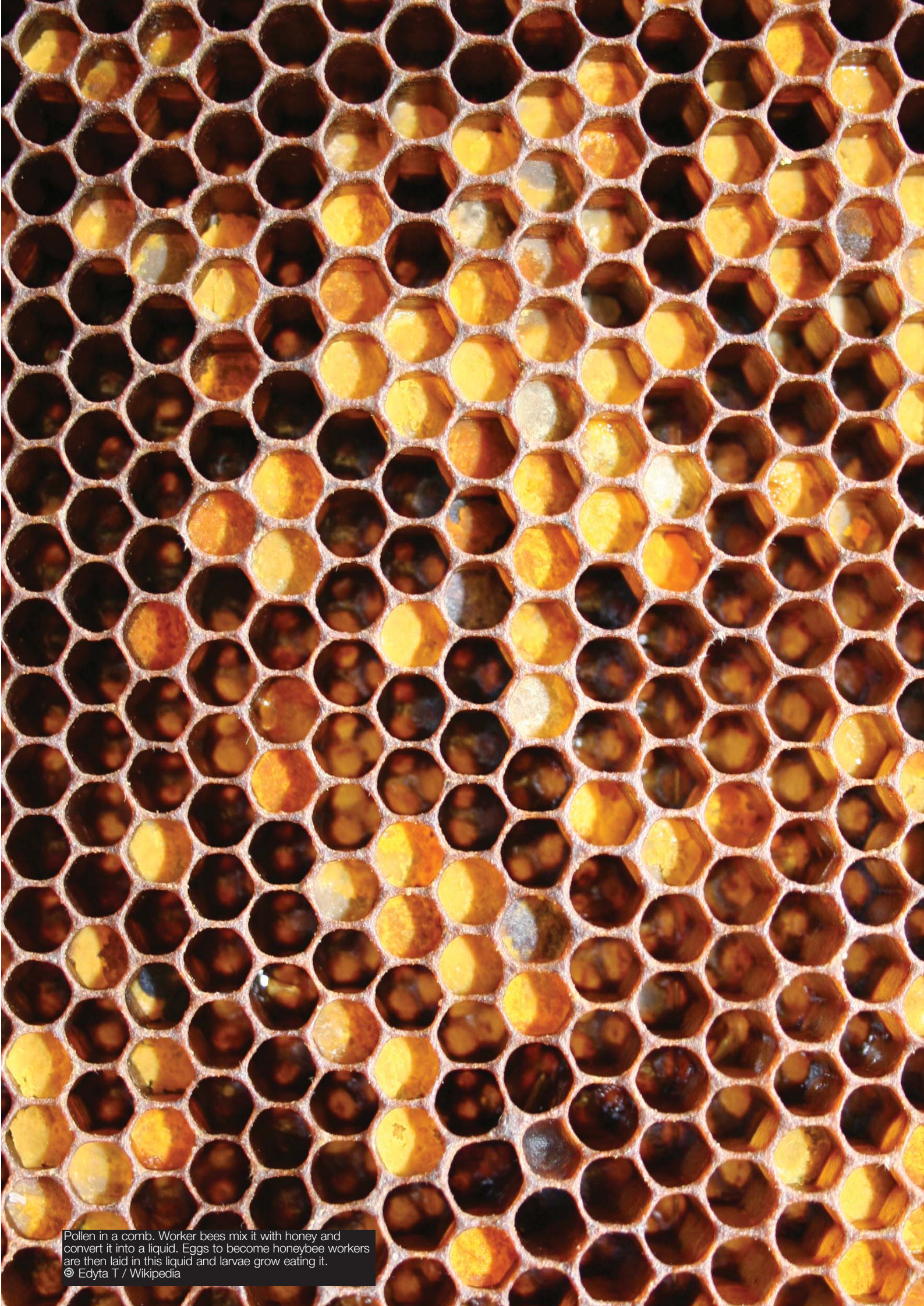
IMC-Istituto Mediterraneo di Certificazione
Via Carlo Pisacane, 32
60019 Senigallia (AN) Italia
Tel.: +39 071 7930179, Fax: +39 071 7910043
E-mail: imcert@imcert.it Internet: www.imcert.it

Fair trade associations:

IFAT: the International Fair Trade Association
Prijssestraat 24
4101 CR Culemborg
The Netherlands
Tel.: +31 345 53 59 14, Fax: +31 8 47 47 44 01
E-mail: info@ifat.org Internet: www.ifat.org

FLO International (Fair Trade Labelling Organization Int.)
Bonner Talweg 177
53129 Bonn
Germany
Tel.: +49 228 949230, Fax: +49 228 2421713
E-mail: info@ fairtrade.net Internet: www.fairtrade.net

EFTA-European Fair Trade Association
Kerkewegje 1
6305 BC Schin op Geul
The Netherlands
Tel.: +31 43 325 69 17, Fax.: +31 43 325 84 33
E-mail: efta@antenna.nl Internet: www.efta.int



Pollen in a comb. Worker bees mix it with honey and convert it into a liquid. Eggs to become honeybee workers are then laid in this liquid and larvae grow eating it.

Stone pine *Pinus pinea* forest in the province of Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

Case 2 Mediterranean coniferous forest products: stone pine nuts

Context

The stone pine (*Pinus pinea*) is a tree up to 30 metres high with a rounded or umbrella-shaped crown and a straight trunk. Flowering starts at age 15 to 20 years, when the tree has a trunk diameter of up to 20cm. Male and female flowers are located on the same tree. Blooming takes place in spring from March to May. Fecundation takes place two years after pollination and cones reach maturity in three years (Fady *et al*. 2004). This is why it is possible to find in each tree cones in three different annual stages of maturation. Seeds are heavy and generally dispersed by gravity or small mammals and birds.

Stone pine can be part of the Mediterranean cork oak forest landscapes, both as a natural habitat type or as a non-native tree plantation. At present, stone pine forests patchily cover nearly 700,000 hectares around the Mediterranean region. The Iberian peninsula hosts the majority of stone pine forests (554,188ha). Large forest stands are also found in Turkey, Italy, Lebanon, and France (Table 1). The rest of the stone pine distribution area is characterised by small patchy forest stands in coastal areas of Tunisia, Morocco, Israel, Greece, Albania, Algeria, Syria, Croatia, Bosnia and Herzegovina, Egypt, and Libya, as well as in some coastal areas of the Black Sea. The stone pine presence in North Africa is considered to be anthropogenic. Outside the Mediterranean region, some experimental plantings have been done in Georgia, Azerbaijan, Zimbabwe, South Africa, Argentina, and Brazil (Agrimi and Ciancio 1994)

Country	Spain	Portugal	Turkey	Italy	Lebanon	France	Tunisia*	Morocco*	Israel*	TOTAL
Area (in hectares)	476,000	78,188	40,000	40,000	14,000	13,515	15,000	3,000	2,000	667,703

*Considered non-native and therefore all populations are plantations.

Table 1. Stone pine forest world distribution (Montero *et al*. 2004 and Talhouk *et al*. 2001)

Figure 1. Distribution range of stone pine (*Pinus pinea*) (Fady *et al*. 2004; Sbay 1995; Khaldi 1995.)

The stone pine natural distribution area is difficult to define because:

- Mediterranean coastal forests have been over-exploited for timber since ancient times and intense land conversion took place for agriculture, grazing and human settlements.
- Again since ancient times stone pine has been cultivated by Greeks, Romans, and Arabs for pine-nut production.

Stone pine forest stands were thus cut and re-introduced as plantations and as a new species in many coastal areas, strongly modifying its distribution area and making it impossible to differentiate indigenous stands based on palaeobotanical and historical evidence, a number of scientists have concluded that the Iberian, Turkish, and Lebanese stone pine populations can be considered of natural origin (see Agrimi and Ciancio 1994). From the genetic point of view, *Pinus pinea* is a very uniform species, with no geographical races, ecotypes or cultivars.

Stone pine needs warmth and is characteristic of sunlit habitats of a wide altitudinal range from sea level to 1,000m above sea level. It resists sea breezes and even quite strong winds. Its optimum annual temperature varies between 10—18ºC. It cannot withstand intense and repeated frost. Stone pine grows mainly in areas with an annual rainfall of 400—1,000mm. The species can bear atmospheric drought if compensated by water table availability.

Stone pine prefers acidic or neutral sandy soil in coastal dunes, inland sand deposits, and rocky substrates (e.g. sandstone, granite, dolomite) (Costa *et al*. 1997), although it tolerates slightly calcareous substrates. It will not grow on thick, clay, or permanently flooded soil.

The socio-economic importance of the world's edible pine nuts

About 29 *Pinus* species from Europe, Asia, and North America produce edible seeds with high nutritional value. Most pine species with edible nuts are found in northern Mexico and the south-west United States, from which *Pinus cembroides*, *P. edulis* and *P. monophylla* nowadays have significant alimentary value. *P. pinea* kernels are used in the Mediterranean as a culinary delicacy and have a protein value comparable to that of beefsteak. The most abundant fat acids in several pine nut species are unsaturated oleate, linoleate and linolenate. Pine nuts from the Asian species *P. sibirica* and *P. koraiensis* are pressed commercially for the production of cooking oil (FAO 1995). *P. gerardiana* nuts are traditionally used as food by nomadic tribes in Afghanistan and Pakistan.

Type of nut	Protein (%)	Fat (%)	Carbohydrate (%)
P. pinea	34	48	7
P. edulis	14	62-71	18
P. monophylla	10	23	54
P. cembrioides	19	60	14
P. sibirica	19	51-75	12
P. gerardiana	14	51	23

Table 2. Nutrient content of several pine species producing edible nuts (Lanner in FAO 1995.)

Official statistics on world production of pine nuts are not available. The largest productions are those of *P. koraiensis* and *P. sibirica* nuts in Russia and China. While Russian pine nuts seem only to be sold domestically, China controls the largest international market in pine nuts, mainly exporting to USA (45%), EU countries (35%), and Japan (7%) (Table 3).

Country (Largest producing countries)	Tons of kernel	% Total production per pine species or species groups	Domestic consumption	% Export
Pinus pinea				
Spain	1,800/2,000	41%	60%	40%
Portugal	1,000/1,100	22%	20%	80%
Italy	950/1,050	21%	100%	
Turkey	700/800	16%	10%	90%
P. koraiensis* and *P. sibirica				
Russia	8,360	51 %	Almost 100%	
China	6,496	39.7%		Almost 100%
North Korea	1,500	9.3%		
P. gerardiana				
Afganistan/Pakistan	2,000	100%		
P. edulis				
USA	454-907*			

*Average annual production

Table 3. World pine nut production: 1998/2001 estimates. (www.pinenut.com/value.html)

Over the past decade the fast growing production and export of *P. koraensis* pine nuts from China has posed a new risk to the stone pine nut market from the low price of the Chinese nuts. Moreover nuts from *P. gerardiana* tend to be preferred to *Pinus pinea* by the confectionery industry due to their shape making it easier to be inserted into cakes and sweets.

Box 1

Historical aspects

Humans have eaten nuts from several pine species since prehistoric times in the American and Eurasian regions. Seeds of stone pine were used as food by humans and were widely traded. Theophrastus (c.372—287 BC) recorded it as domestic pine (see Gymnosperm database 2007). Stone pine seeds have been part of our diet since ancient times (Fundación Nucis 2007) and are still highly valued. In Ancient Rome, a wine was made from stone pine nuts. One recipe recovered from the Pompeii ruins consisted of a sort of mustard prepared with crushed pine nuts, almonds, and vinegar. Pine nuts were also used in sausages, salads, sweets, and as seasoning for boiled bulbs and various sauces. Their cones were used for rubbing the inside of wine vats.

In addition to its nutritional value, stone pine nuts have been considered an aphrodisiac all around the Mediterranean since ancient times. The Roman poet Ovid (first century BC), in his *Ars amatoria* (The Art of Love), provides a list of aphrodisiacs, including "the nuts that the sharp-leafed pine brings forth". Apicius, a Roman celebrity whose recipes were used up to the Middle Ages, recommends a mixture of pine nuts, cooked onions, white mustard, and pepper to achieve the same thing. The Arabic classic of erotic literature, *The Perfumed Garden*, referring to the writings of the ancient Greek physician and philosopher Galenos, advises that in order to achieve sexual vigour a man should eat 20 almonds and 100 pine nuts accompanied by a glass of thick honey for three nights (Moussouris and Regato 1999).

In this chapter two case studies from the Doñana National Park in south-east Spain are presented: the case of a public forest managed by the municipality of Hinojos (Huelva) and the case of a family-run processing industry selling organic pine seeds (Santiago Perea). Although neither provides a full picture, these case studies highlight interesting aspects of the stone pine forest management, processing and trading.

Stone pine forests: a highly managed ecosystem in Spain

The distribution area of stone pine in the Doñana National Park coincides with the warmest and driest areas where cork oak (*Quercus suber*) is found. Stone pine and cork oak forests and woodlands are characterised by a rich understorey dominated by shrubs that need warmth like Moorish juniper (*Juniperus phoenicea*), Kermes oak (*Quercus coccifera*), lentisk (*Pistacea lentiscus*), European fan palm (*Chamaerops humilis*), myrtle (*Myrtus communis*), phyllirea (*Phyllirea angustifolia*), rock-roses (*Cistus* spp.) and heathers (*Erica* spp.).

Silvicultural operations include pruning in the stone pine forest in Hinojos, province of Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

Stone forest in Hinojos, province of Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

Stone pine forests can be classified according to their origin and management goals as follows:

a Natural forests and naturalised forests: they have an important landscape-conservation and environmental-protection function. Annual cone production ranges from 130 to 450kg/ha and timber production from 1—2 m^3/ha. Adequate silvicultural practices consist of stand density controls (clearances) all through the forest life cycle, and progressive regeneration cuts to promote natural regeneration at the end of the rotation age. When timber production becomes a priority, clearances are less intense to maintain higher tree densities, and rotation ages become shorter (around 80 years). When cone production becomes the priority, stand density must decrease and rotation ages range from 120 to 150 years. Pruning is a common practice although there is some controversy about the effect on cone production.

b Reforestation stands: their main function is to protect against erosion by water and wind. Cone production is low and variable. Timber production can be up to 4m^3/ha/year. Silvicultural practices consist of clearing and pruning. Tree densities are variable but nowadays the tendency is to produce lower densities.

c Forest stands for intensive production of cones: this may be considered an agriculture crop. These stands do not have a protective function and their environmental services are less evident than in the above types. They are usually planted on flat and fertile land, using genetically selected trees. There are no clearance operations: the final number of trees corresponds to those planted. Densities are low and pruning is used to facilitate harvesting. Watering and fertilization may be used to increase cone yield. Grafting is also used to speed up cone production (starting at 5-6 years old in grafted trees, instead of 15—20 years old) and to ensure abundant yields. This is an alternative forestry activity for abandoned agricultural land or the conversion of unprofitable intensive plantations of exotic species (e.g. *Eucalyptus* spp.)

Products and services from stone pine forests

Since ancient times, stone pine trees and forest stands were favoured because of their aesthetic value and valuable products: pine nuts, timber, firewood and charcoal, bark (for tannin extraction), resin (rich in limonene), grazing, hunting, edible and medicinal plants, and apiculture.

Stone pine forests have also provided environmental services: carbon sink, sand-dune fixing, prevention of wind and water erosion, landscaping, biodiversity, and recreation.

Stone pine cones stored for sun drying in an industry in Huelva (Spain). © WWF-Mediterranean / Xavier ESCUTE

Cones (and pine nuts) are the most characteristic and valued products from stone pine forests. But this is a species with irregular fructification year on year, so yields can be very variable. However, a good yield is expected every three to four years. Yields also vary from one geographical area to another. The only linear pattern is that yield increases with the maturity of the stand. In very productive areas of Spain, Portugal, or Italy, annual yields can be over 1,000kg of cones per hectare per year; the average production in Spain ranges from 150 to 570kg of cones/ha/year depending on area, year and forest stand (Montero *et al.* 2004; Piqué 2005). Figure 2 shows the evolution of average cone production related to age. Data from southern Spain comes from different stone pine forests with different tree densities.

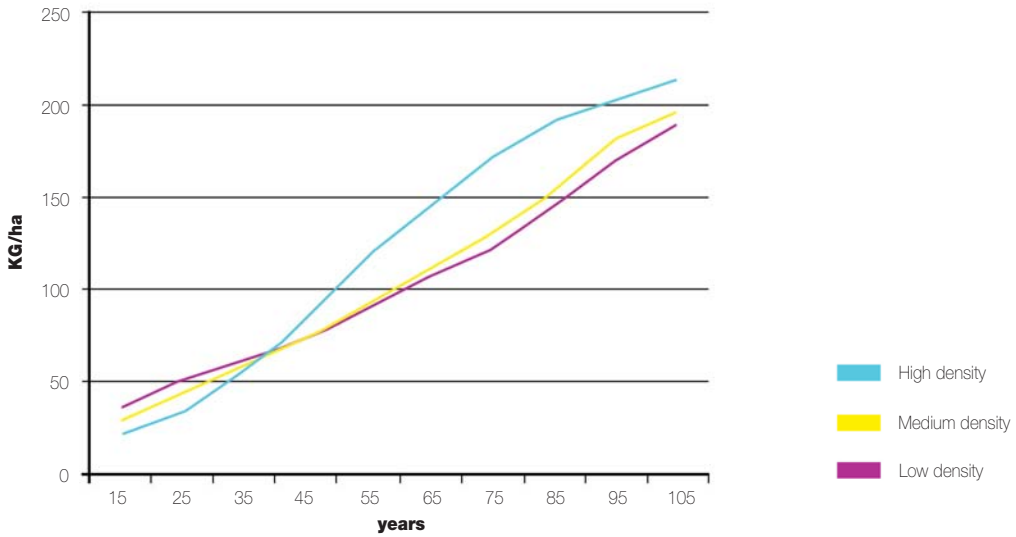


Figure 2. Evolution of the average production of cones (kg/ha) in stone pine forests of various densities. Data from southern Spain (Montero *et al*. 2004.)

Harvesting cones to extract pine seeds

Cones can be harvested manually or mechanically. Manual harvesting involves the use of a hook at the end of a long stick. A single worker can collect about 200kg/day (but this varies from 100kg to 400kg according to year, tree, and the worker's experience). In Tunisia harvesting does not usually exceed 80kg/day/worker (Saadani personal communication).

In flat areas of Portugal, Spain, and Italy with high production rates and medium-sized trees, harvesting is done with vibrating machines similar to those used in olive harvesting. In Spain, the official harvesting period for cones runs from 1 December to 15 April.

Cones can be processed while they are still green or once dried. Processing of green cones helps prevent theft from the forest by illegal harvesters (cones can be collected by forest owners a little earlier, in November) but implies a high investment in machinery. Moreover, cones have to be opened using boiling water, and, once extracted, grains have to be dried using hot air before they can be broken down.

In the traditional way, cones are processed after being dried in the sun. The process takes longer but requires less investment in machinery.

Economic and social aspects

Pine seeds are generally expensive in the world market. Final consumer prices vary from region to region, but an average 2006 price in Spain for a final consumer was €35/kg. It is difficult to establish margins and profits for every actor in the production chain because of the low transparency of this sector.

Piqué, from the Centre Tecnològic Forestal de Catalunya, found that prices paid per kilogramme of cone (once harvested) vary every year depending on production. In Catalunya, for the period 1998—2004, prices varied from 0.21 euros per kilogramme of cones (2001—2) to 0.48 euros per kilo of cones (1998—9) (Piqué 2005). Cones can also be sold in the forest, before being harvested, being the prices paid lower. An example is presented in the case study of Hinojos, where an average price of 0.13 euros was paid per kilogramme of cones before being harvested in 2005.

Taking into account estimates (Montero *et al*. 2004) that from 100 kilogrammes of cones an average of 4kg of pine seeds are extracted, table 4 shows the prices paid by each actor.

	Place of transaction	Price
Forest owner	**N/A**	**N/A**
Cone harvester	**Public auction or private transaction**	**0.13 euro/kg of cones (equivalent to 0.005 euro/kg of pine seeds)**
Merchant (if any)	**Forest**	**Unknown**
Processor	**Forest or wholesale market**	**0.21 to 0.75 euro/kg of cones (equivalent to 0.008 to 0.030 euro/kg of pine seeds)**
Retailer	**At wholesale market**	**22 euro/kg of pine seeds**
Final consumer	**Supermarket**	**35 euro/kg of pine seeds**

Table 4. Approximate prices paid in the pine-seed value chain in Spain (2006). (Piqué 2005; personal communications from Santiago Perea and Pinyons Empordà; and author's own research).

Vertical integration often occurs when the processor buys cones directly from the owner (auctioned before collection) and sells them directly to the final consumer. In this way, profits are higher and prices are easily set by the processing industry.

The pine-nut sector provides jobs to many people in the areas where there are stone pine forests. For example in winter in the province of Huelva, Spain (December to April), specialised workers harvest cones and in spring and autumn work on maintenance activities (pruning, etc). The processing industry does not employ many people as it is largely mechanised.

The main problem in this sector, according to consultation with some Spanish processing industries (Santiago Perea, Pinyons Torrent d'Empordà, Piñon Sol), is the competition from Asian countries and their lower-quality pine seeds from other species (*Pinus gerardiana* from Pakistan and Afganistan and *Pinus koreansis* from north-east Asia) at much lower prices. Major consumer countries are in the Mediterranean basin but also in the US where quality differences are not always recognized.

Box 2
The Aleppo pine nut in Tunisia: an important national market

The traditional cuisine in Tunisia includes the use of flour from the Aleppo pine seeds (*Pinus halepensis*). This flour is used to prepare custard, ice cream, yogurts, and other specialities and is prepared from the whole seeds (including the hard shell). Processing consists on breaking the cones and separating the seeds and then crushing the whole seeds until a powder is obtained. At present, there are approximately 297,000 hectares of Aleppo pine forests in Tunisia (35% of the country's forest area) (DGF 1995), but only 152,000ha are actually exploited. The annual production of Aleppo pine cones ranges from 450 to 600 tones and represents approximately 1.8m Tunisian dinars (just over €1m).[1] There are approximately 3,000 families that collect and process Aleppo cones and the revenue per season is around 600 dinars (Saadani personal communication).

Legal aspects and labelling

Pine nuts from protected areas in Andalucia (the Doñana, for example) are sold as organic food under the label of La Junta de Andalucía. At present, there is not a high demand for organic pine nuts but it is predicted to increase in the near future. Marketing to differentiate pine nuts from sustainably managed forest stands is important.

1. Currency conversion according to www.oanda.com, 20 November 2006: 1 dinar = 0.60 euro

The case of the public forests of Hinojos (Huelva, Spain)

Summary table

Name of the initiative	Montes Propios y las Paradejas de Hinojos. Public forests of Hinojos
Location	Hinojos, Spain
Coverage	3,896ha, owned by the city council of Hinojos
Year	-
Type of exploitation and infrastructure	Public forest
Number of workers	11,000 working days per year, equivalent to 55 full-time workers
Products sold	Wood, cork, pine cones, grazing, apiculture, and recreation
Distribution process and advertising	-
Certification labels	-
Initial investment	Unknown
Yearly revenue	351,645.12 euros
Yearly costs	71,952.40 euros
Risks to sustainability	None

Description of the initiative

The public forest land, Montes de Propios y las Paradejas, covers 3,896ha, from which 1,615ha are inside the Doñana park. This land belongs to the municipality of Hinojos in the province of Huelva (south-west Spain). It was declared a public good (*utilidad pública*) at the beginning of the 20th century so its conservation has been assured.

This forest land is at 75m above sea level and is flat. Soil consists of a superficial sand layer covering clay that retains humidity. The Mediterranean climate is warm and dry with a summer drought of about four months. Stone pine is typical in areas with a deeper sand layer and cork oak in areas with moister soil conditions from a clay layer closer to the surface. In the water courses, riparian forests appear where *Tamarix*, *Salix* and *Populus* species predominate.

Stone pine forests are formed by a mixture of natural stands, with trees older than 140 years, and plantations reforested in different periods. Very locally, small populations of *Eucalyptus globulus* can still be found, but they are being progressively uprooted and replaced by natural vegetation.

The Hinojos population is increasing, especially with individuals between 20 and 40 years old. This represents an important potential workforce for forest activities. More than 50% of the active population works in agricultural and forest activities, although at present this sector has a surplus of people.

Crown of a stone pine in Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

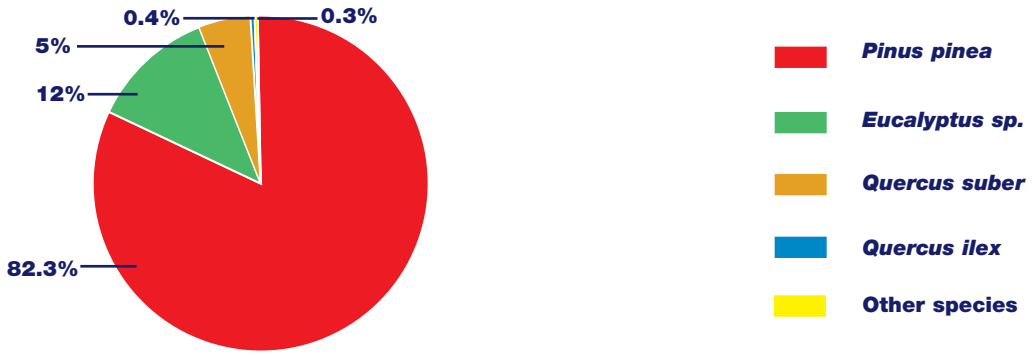


Figure 3. Percentage of surface covered by each tree species in the Hinojos communal forest.

Economic operators and the production chain

According to an agreement signed in 1994, forest management is responsibility of the environment department (Consejería de Medioambiente) from the Andalucía regional government. The regional environmental department produces all technical documents necessary to regulate forest activities, as well as providing technical assistance for the management of the forest. It is the city council's prerogative to use natural forest resources under guidelines laid down by the department. The city council has to pay to Regional Environmental Department 15% of the predicted profits, to be reinvested in the future. The exploitation of the existing forest resources is done through public auction which local enterprises (from the province) are eligible to apply for. The environmental department also uses public auctions to select those forestry enterprises in charge of the silviculture operations (Figure 4).

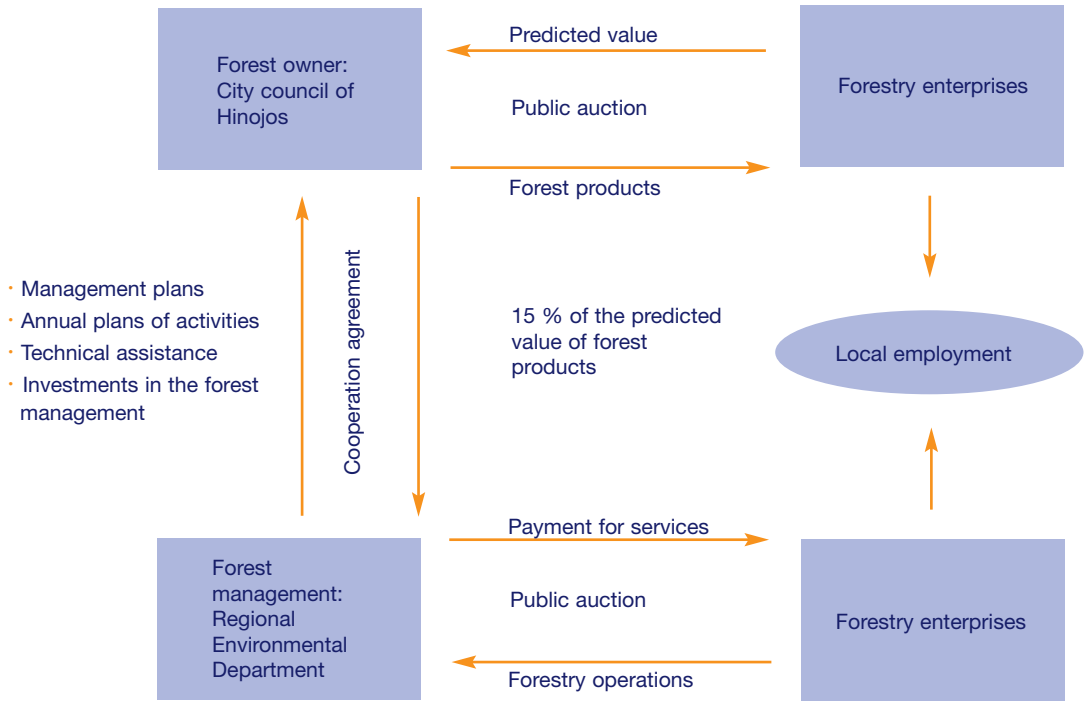


Figure 4. Actors participating in forest management and use of natural resources in Hinojos forest land.

Quality issues and labelling

The southern part of Hinojos forest land is inside the Doñana Natural Park (the Natural park area surrounds the National park), and management practices do not include the use of pesticides. The adjoining forest land of Almonte is certified organic by the Andalusian organic agriculture committee.

Economic value of the Hinojos forest land

The main managed species in Hinojos forest land are stone pine, cork oak and eucalyptus. Up until now, stone pine is managed as a high forest, with clearance operations to reduce density and improve regeneration, and a rotation age of 80 years. Sometimes pruning is also done. Cork oak is also managed as a high forest, encouraging natural regeneration and sometimes plantations. Where stone pine and cork oak form mixed forest stands, management practices favour cork oak over stone pine. Eucalyptus is only found in a small plot, managed with a rotation age of 12 years, and tending to its substitution for stone pine or cork oak depending on the soil characteristics.

The Hinojos forest provides, at present, the following products and services:

a Forest products: timber, cork and cones. Annually, 6,000m^3 of timber are harvested for wood (for sawmills), groundwood, and charcoal. Cork is harvested every ten years. The forest land is organized in five plots, so every two years, cork is stripped from each plot. From 1978 to 1998, cork production increased threefold. In 1998, around 138 tonnes of cork were extracted (nearly 3,000 quintales, 1 quintal = 46 kg). Forest management has been oriented to timber production, but cone production is also important. Annual production of cones is variable, ranging between 14,000kg in 1990 to 275,000kg in 1999.

b Hunting: the city council has transferred hunting rights for free to a local association of around 150 associates.

c Pastures: since 1997 forests can be freely accessed by cattle-raisers of the municipality, but the number of animals is low and apparently there is no over-grazing.

d Honey production: there are some beehives in the area although production is low and it is sold locally.

e Erosion control (protection service): Hinojos forest regulates the hydrological cycle and retains sandy soil that would otherwise be eroded by rain and wind.

f Recreation (social service): Hinojos forest receives many visitors from the village and from the nearby cities of Huelva and Seville. There is a recreation and picnic area managed by a local enterprise that pays the city council €4,200 a year. There are also two designated biking routes in the forest.

g Research work: there are some experimental plots in the forest to investigate good management practices and forest ecology (growth and production of stone pine and cork oak, natural regeneration, plant succession, etc.).

Eucalyptus camaldulensis wood cut and piled in the Doñana Natural Park © WWF- Mediterranean / Xavier ESCUTE

Cork oak *Quercus suber* experimental plantation in Hinojos forest land in Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

All these goods and services generate around 11,000 days work every year, corresponding to 55 full time jobs. There is infrastructure like a network of paths, fire-breaks, a forester's station, and two fire surveillance towers.

Hinojos forest production could be improved in the cork sector by promoting cork oak regeneration and plantations in the most favourable soils, and in the pine nuts sector by favouring cone production over timber.

Cone annual production varies a lot from year to year. Researchers estimate that in Hinojos forest every ten years there is one with very high cone production, one with high production, two years with normal production, three with low production, and three with very low production. It is not possible to predict which year will be the next one in terms of production, but this frequency study helps to calculate the cone production every ten years.

Under the current management plan, it is estimated that revenues coming from pine nut production will be around 6,750 euros/year (average for the next ten years). This is to say, the average income per year from pine nut selling will be of the order of 2.1 euros/ha. Timber and cork are still favoured in the Hinojos management plan (the percentage of the total income coming from timber will be some 65% and 32% from cork. See box 3 for further details).

Box 3
Summary of the forest management plan 2001-11 for the Hinojos communal forest

In the 10-year period 2001—2011, it is planned to extract 48,256m^3 of stone pine wood and 7,580m^3 of eucalyptus wood. If the price of wood is €36/m^3 for stone pine and €30/m^3 for eucalyptus, a total income of €261,035.82 is expected, if the price is updated every year by a constant 3.5% a year.

Cork production will change according to the surface of trees harvested every year. It is expected to range between 75,932kg and 169,359kg each year, depending on the number of trees harvested. Considering an average price of €1.74/kg, the total income from cork in the 10-year period will be of €1,142,461.60.

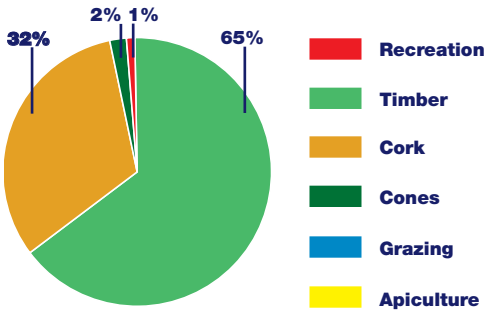
With an estimated cone production of 547,000kg in the next ten years, and assuming a price of €0.11 and €0.14/kg of cones before being harvested, the total income will be of €67,486.54.

The grazing potential has been estimated at 1,471 heads, which would imply €10,371.60 in the 10-year period. With 300 beehives income might be €2,622.84 in the period. Recreational use produces income of €45,723.86 for the rent of the picnic area.

The silviculture activities, consisting of regeneration, artificial reforestation, pruning of stone pine and cork oak, shrub clearing and other works cost €515,102.26, out of which €300,000 corresponds to stone pine pruning. Infrastructure conservation is around €47,031 and the protection plan against risks (erosion, plagues) is €8,009.59. Cleaning up after the recreational use implies €44,204 in the 10-year period and the revision of the management plan costs in total €105,177.12

The figure shows the percentage of each income source in the total income of the Hinojos forest for the ten-year period 2001—11.

Income 2001-2011 Hinojos comunal forest



Giving the total income of 3,576,451.21 euros and the total expenses of 719,523.97 euros, the balance is positive: €2,856,927.24, implying an income of €73/ha/year. The balance omits many non-market values of the Hinojos forest: informal recreation, CO2 fixation, biodiversity, etc. If we add to direct income the improvement of cone harvesting and commercialisation, the increase in the cork harvest, and the rest of the non-market values, the communal forests of Hinojos are both highly profitable and ecologically and socially useful.

Biodiversity: benefits and risks

Lynx pardinus, Iberian lynx, in Doñana National Park (Spain). © WWF-Spain / J. COBO

The Hinojos forests have been managed by the local community since ancient times, and biodiversity has been the beneficiary. Their fauna is rich and varied, including the Iberian lynx (*Lynx pardinus*), which uses the forests for dispersion of young individuals from Doñana natural and national parks, the wildcat (*Felis silvestris*), the eagle owl (*Bubo bubo*), the booted eagle (*Hieraaetus pennatus*), the short-toed eagle (*Circaetus gallicus*), and the imperial eagle (*Aquila adalberti*). All these species are protected by the EU Habitats Directive and the Bern Convention and are included in the red list of fauna of Andalucía or the CITES Convention.

Stone pine forests have a crucial role in the region, providing forest connectivity and corridor zones for wildlife movements between Doñana, the coastal line towards Portugal and the inland mountains of Sierra Morena. This is especially important for connecting the isolated Iberian lynx population of Doñana with the few viable ones in Sierra Morena. The growing land conversion for irrigated strawberry and citric crops in the coast is causing fragmentation and degradation of stone pine forests and natural forest cover. Enhancing the economic value of stone pine forests and restoring them as part of the coastal cork oak forest landscapes, may prevent biodiversity loss in this highly valuable agro-forestry systems.

Despite regulation, the activity that poses the greatest risk to biodiversity is hunting. This is focused on wild boar (*Sus scrofa*) and 11 species of small game: rabbit (*Oryctolagus cuniculus*), hare (*Lepus europaeus*), fox (*Vulpes vulpes*), red-legged partridge (*Alectoris rufa*), pheasant (*Phasianus colchicus*), wood pigeon (*Columba palumbus*), stock pigeon (*C. oenas*), pigeon (*C. livia*), song thrush (*Turdus philomelos*), mallard (*Anas platyrhynchos*), and collared dove (*Streptopelia decaocto*).

Processing-industry case study: Santiago Perea (Spain)

Summary table

Name of the initiative	Santiago Perea
Location	Bollullos del Condado, Huelva, Spain
Area occupied	Approximately 7,000m^2 of the village of Bollullos del Condado
Year established	Around 1941
Type of processing and infrastructure	Family-managed processing firm. Three generations of owners. Two warehouses in the village. In the first one, cones are stacked in a courtyard (6,000m^2) and the shelled grains separated and cleaned from the black dust. In the second one, shelled grains are broken, pine seeds selected and stored.
Number of workers	Up to 100 (*piñeros*) during harvest In summer in warehouse no. 1, six—eight temporary workers Warehouse no. 2 and maintenance work, four—five permanent staff
Products sold	Pine seeds for consumption. Cones and rest of hard shell for heating fuel on in poultry farms
Distribution process and advertising	Sells to clients in Spain. He distributes pine seeds in his van. Does not export to other countries. There is no advertising as the product is always sold to usual clients. Webpage under construction.
Certification labels	Pine nuts are sold as organic food (label of Andalucía regional government)
Initial investment	Total figure unknown as the machinery has been built and improved ad hoc over the years. The most expensive machine is the electronic colour-separator.
Yearly revenue	Unknown. Final selling prices in 2006 were: 50kg bags of pine seeds for €22 (for packaging industry, food industry, and bakeries) 250g pots for €6 (for final consumers and small retailers)
Yearly costs	Unknown
Risks to sustainability	None

Description of the initiative

Santiago Perea is located in the village of Bollullos del Condado (Huelva). It is a family enterprise started after the Spanish Civil War (1936-1939). The grandfather of the present manager progressively mechanised the industrial process and now commercial strategy is shifting to the processing of organic pine nuts (*piñón ecológico*) only. To access auctions to buy the harvest from the communal forests of the National Park, pine nuts have to be sold as organic food under the label of the Andalucía regional government.

The processing chain

Santiago Perea usually buys the right to collect cones from communal forests in public auctions (e.g. from the municipality of Hinojos). In years when cone production is low in southern Spain, and depending on market prices, it buys harvested cones from other regions of Spain (private or public forests). When collecting cones from public forests, the enterprise hires temporary workers to do manual harvesting (between December and mid-April) who are paid by the kilogramme. According to the enterprise, a worker can manually harvest an average of about 200kg of cones per day (from a range of 100 to 400, depending on the annual production of cones per tree). Sometimes it is difficult to determine the origin of the cones as some are stolen from other forest areas.

Worker harvesting stone pine cones from Almonte forest land using a long stick with a hook at the end © WWF- Mediterranean / Xavier ESCUTE

Stone pine cones stored for sun drying in Santiago Perea in Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

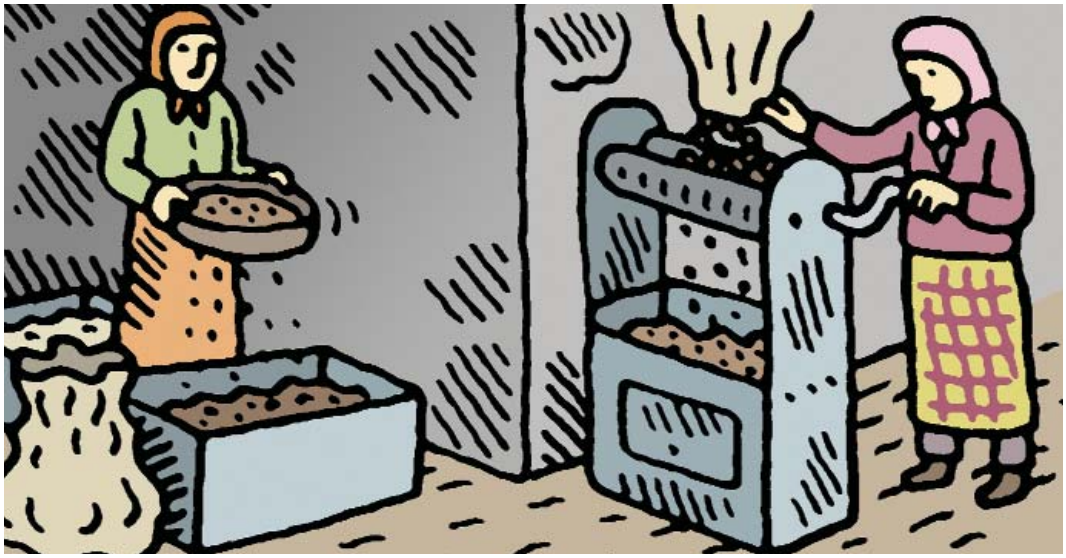


Figure 5. Simplified drawing of a partidora to shell pine-seeds and of the process to separate seeds from the remains of shell. Santiago Perea uses an automatic system. © WWF-Mediterranean/ Olison

Once the cones are in the warehouse they are stored until summer, when they will be dried in the sun. Cones are moved up, specially if it rains to keep them ventilated and reduce moisture. Depending on the weather, but usually in June, all the piles are flattened out for up to four days in order to allow cones to dry in the sun.

Once the cones are dry processing starts in the first warehouse, where the cones are broken down using a mill and the shelled grains are separated from the cone debris. In Spain, this machine is called a *desgranadora*. Cone debris is sold as fuel for heating to, for example, poultry farms. Afterwards, shelled grains are cleaned from the characteristic black dust using air jets and classified according to size. Dust can be collected and used for composting as well, although not here.

It is estimated that in one eight-hour day 4,000kg of cones can be processed. This unit gives work to six to eight people for three summer months, depending on the total harvest. The machinery has mostly been designed by the business and built by local engineers.

In the second warehouse, grains are sprinkled with water to humidify them and to make the white pine seeds sufficiently elastic to prevent them being damaged in the breaking of the shell. Grains are broken down using rollers (pairs of cylinders) (see Figure 5) and separated from the rest of the hard shell by means of a perforated tray. Usually, grains are classified before and processed according to their size or go through a series of three or four cylinders. This machine is called a *partidora*.

Once grains have been broken, a machine separates the remains of shell and the thin brown layer from the white seeds, and also classifies seeds by size. It consists of a set of perforated cylinders that rotate and separate the mixture.

Afterwards, a colour-sensitive electronic separator parts the white seeds from the yellow ones and the remains of shell. The pine seeds usually go through this machine several times until is clear of all impurities. Other processing firms sell these yellow seeds to the cosmetics industry as essential pine-seed oil can be extracted from them.

The final step is a quality check which is carried out by a worker who separates any remaining yellow pine seeds from white ones. This is done manually on a conveyor belt.

Once processed, white seeds are stocked in 50kg bags in a refrigerator chamber at 8—9ºC until sale. No chemical products are added to the pine seeds.

Pine seeds are sold to packaging industries, food producers (e.g. bakeries, sweet producers) and to small retailers. Each year, the quantities sold to each client vary depending on prices and market. The best season is the run-up to Christmas, when traditional food (*turrones*) is prepared for the season, especially in the Valencia area.

A yearly 500,000kg to 600,000kg of cones is processed (up to 24,000kg of pine seeds), although in a bumper year 1million kg of cones may be processed. In other years, depending on the market, part of the year's potential crop is left in the trees.

This industry does not invest in marketing as all the production is always sold among the usual clients. There is no formal advertising or promotion but a website is planned.

Distribution is done by van. The firm sells pine seeds to different clients in Spain (Andalucía, Valencia, and other regions).

Quality issues and labelling

Organic stone pine-seeds from Doñana ready to be sold in a 250g pot from Santiago Perea © WWF- Mediterranean / Xavier ESCUTE

All the production coming from Doñana Natural Park is sold under the Organic Agriculture label held by the Andalucía regional government, especially 250g pots (see picture). This is a condition for participation in the auction process. However, the manager states that at present this label is not required by the market and the organic price is not higher.

Economic value

Furthermore, all the pine seeds processed in the industry receive the same chemical-free treatment and excessive manipulation is avoided (e.g. cleaning of shelled white seeds using water and brushes). The manager states that if pine seeds with their shells are cleaned before breaking (the dust removed by air jets), it is not necessary to clean the shelled pine seeds.

50kg bags were sold for €22/kg in 2006. They also sold 250g pots to visitors or retailers for €6. The main competitors are in China and Turkey. Their product is cheaper (about half the Spanish price), but while the Turkish one is similar the Chinese version is tasteless (another species).

Authors

Dr Enrique Torres
Departamento de Ciencias Agroforestales at the University of Huelva, Spain
E-mail: etorres@uhu.es

Dr Pedro Regato
Associate Professor at the Universidad Politécnica de Madrid (Spain). Former head of the Forest Unit at WWF-Mediterranean Programme.
E-mail: pregatopajares@yahoo.es

Xavier Escuté
Biologist and former Capacity Building Officer for the WWF Cork Oak Landscapes Programme.
E-mail: xavi.escute@gmail.com

Information sources and bibliography

Quoted literature and websites

Agrimi, M and Ciancio, O. 1994. Le pin pignon (*Pinus pinea L.*). Monographie. Comité CEFFSA/CEF/CFPO des questions forestières méditerranéennes. Silva Mediterranea, Larnaca.

Campos, P and López-Linage, J. 1998. *Renta y naturaleza en Doñana. A la búsqueda de la conservación con uso*. Icaria editorial, Barcelona.

Catalán, G. 1995. The stone pine as producer of dried fruits. I *Reunión de la red de frutos secos de la FAO sobre el pino piñonero*. INIA, Madrid.

Centre Tecnològic Forestal de Catalunya (Spain): www.ctfc.es

Ciancio, O, Cutini A, Mercurio, R and A Veracini. 1986. Sulla struttura della pineta di pino domestico di Alberese. *Annali Istituto Sperimentale per la Selvicoltura*, 17:169-236.

DGF 1995. Direction Générale des Forêts. Résultats du Premier Inventaire Forestier National en Tunisie. Ministère de l'Agriculture, Tunis.

Fady, B, Fineschi, S and G G Vendramin. 2004. *EUFORGEN Technical Guidelines for genetic conservation and use for Italian stone pine (Pinus pinea)*. International Plant Genetic Resources Institute, Rome.

FAO 1995. *Non-wood Forest Products from Conifers*. NWFP Series No. 12. 1995. FAO. www.fao.org/docrep/x0453e/X0453e00.HTM

Fundación Nucis 2007. Fundación Nucis (Salud y Frutos Secos). www.nucis.org consulted on 12 January 2007.

Gymnosperm Database 2007. Edited by Christopher J. Earle. www.conifers.org/pi/pin/pinea.htm (consulted in February 2007)

Junta de Andalucía, 2001. *Proyecto de Ordenación de los Montes de Propios y Las Paradejas en el T.M. de Hinojos (Huelva)*. Consejería de Medio Ambiente, Junta de Andalucía, Seville.

Khaldi, A. 1995. Le pin pignon en Tunisie. *I Reunión de la red de frutos secos de la FAO sobre el pino piñonero*. INIA. Madrid.

Lanner, R M. 1981. The piñon pine, a natural and cultural history. University of Nevada Press. 208pp.

Montero, G, Candela, J A and A Rodríguez. (Coords.), 2004. *El pino piñonero (Pinus pinea L.) en Andalucía. Ecología, distribución y selvicultura*. Consejería de Medio Ambiente, Seville.

Moussouris, Y and Regato, P. 1999. Forest Harvest: An Overview of Non Timber Forest Products in the Mediterranean Region. www.fao.org/docrep/x5593e/x5593e03.htm
Oliet, J M, Costa, J C and M Estirado. (Dir.), 2004. *Puesta en valor de los recursos forestales mediterráneos. El injerto de pino piñonero (Pinus pinea L.)*. Consejería de Medio Ambiente, Junta de Andalucía, Sevilla.

Piqué, M. 2005. Producció i aprofitament de pinya de pi pinyer (pinus pinea L.) a Catalunya. *Catalunya Forestal* No. 76, October 2005. Available at www.forestal.cat/numero76/noti01.htm

Saadani, Y. Sous-directeur de l'économie forestière et de l'encadrement de la population forestière. Direction Générale des Forêts. Ministère de l'Agriculture et des ressources hydrauliques. Joint visit to Huelva, Andalucía about stone pine forest management and pine nuts processing, 11 May 2006

Sbay, H. 1995. Situation du pin pignon (Pinus pinea L.) au Maroc. Bilan des travaux de recherches. *I Reunión de la red de frutos secos de la FAO sobre el pino piñonero*. INIA, Madrid.

Talhouk, S N, Zurayk, R and S Khuri. 2001. Conservation of the coniferous forests of Lebanon: past, present and future prospects. *Oryx* 35 (3), 206-215

Contact details

Santiago Perea SL. Cruz de Montañina, 2. Bollullos del Condado (Huelva, Spain). Phone +34 959 410 231 (only in Spanish)

Pinyes i Pinyons Torrent d'Empordà SL. Can Jaume, Torrent d'Empordà (Girona, Spain). Phone +34 972 612 252 (only in Spanish or Catalan).

Piñon Sol, Castilla y Léon, Cooperativa. Pedradas de San Esteban (Valladolid, Spain). Phone +34 983 625 043 (only in Spanish). www.pinonsol.com

Silvicultural operations include pruning in the stone pine forest in Hinojos, province of Huelva (Spain) © WWF- Mediterranean / Xavier ESCUTE

Boletus edulis from Polish forests. Wikipedia / Kami

Case 3 Mediterranean mushrooms: how to market them

Context

Fungi are the great decomposers of the world (with some help from bacteria). Hawksworth (1992, 2004) compared the ratio of species of vascular plants to fungi in areas that had been relatively well studied and extrapolated that there might be around 1.5 million species of fungi in the world. Fewer than 20% of these are known to science, although in Europe, which has been well studied, the known percentage is far greater. Mushroom diversity in the Mediterranean is very high: recent research has found more than 3,800 mushroom and truffle species in Andalusia (Spain), making it the European region with the highest diversity of fungi. Mushrooms have been used for medicinal, ritual, and alimentary purposes since prehistoric times. Mixtures of fungi species with medicinal properties were found in several Egyptian tombs. The primaeval man found frozen in the Alps was carrying fungi pieces with him. Romans were known to eat several mushroom species such as *Amanita cesarea*. Pre-Columbian cultures used mushroom species in religious ritual activities around 3,000 years BC.

From an economic point of view wild mushrooms and truffles are very important non-timber forest products in many Mediterranean countries, particularly those of the northern part of the basin. The most common wild mushrooms harvested in the area are *Boletus spp., Cantharellus cibarius* and *C. lutescens, Amanita caesarea, Morchella esculenta*, while among truffles a key role is played by *Tuber magnatum pico*, *T. melanosporum, T. brumale, T. aestivum,* and *T. uncinatum.*

Mushroom benefits are concentrated in northern and especially western European countries, with average production values in the range of €2—10/ha of forest and year (Croitoru and Merlo 2005). It should be noted that in many countries these figures usually underestimate true benefits because mushrooms collected privately are not accounted for. Moreover, in the eastern countries no estimates are available. The scarcity of data does not imply an absence of mushroom species but reflects the fact that mushrooms are collected for free and sold on local markets, and quantities and prices are not known. Mushrooms account for less than 4% of the total economic value of Mediterranean forests (Croitoru and Merlo 2005).

Mushrooms and truffles are a source of income not only for harvesters and associated businesses but also, when forest property rights are properly defined and protected, for owners who get involved in the management of their forests; this has positive impacts on the protection of natural resources and the conservation of landscapes. When mushrooms and truffles become a source of revenue for forest managers, there is evidence that forests are significantly less exposed to fire, much more protected from overgrazing, while sound management practices are often seen (e.g. thinning, pruning, cutting of invasive plants, etc.).

As a good example, the case study focuses on northern Italy, a region with long tradition of well organized mushroom harvesting, where the best initiatives in exploitation and marketing can be found. Although this area of Italy is not part of the cork-oak forest landscapes, the same species of mushrooms that are exploited and marketed there, like the *Boletus* species, are also found in the cork oak landscapes.

In Italy, mushrooms and truffles have a role both as a commercial product as shown in table 1 and as a source of recreation.

Year	1950	1960	1970	1980	1990	2000
Mushrooms/ Thousands of tons	3.5	9.1	7.7	1.2	1.8	1.1
Truffles/Tons	30.4	76.4	83.8	71.4	107.4	97.9

Sources: website of the Istituto Nazionale per il Commercio Estero (ICE), www.ice.gov.it and the annual publication *Coltivazioni agricole, foreste e caccia* of the Istituto Nazionale di Statistica (ISTAT).

Table 1. Wild mushrooms and truffles collected as commercial products in Italy

The decrease in mushrooms collected from the 1980s to the 2000s may be explained by a decrease in professional harvesters relative to (uncounted) recreational harvesters. Another consideration is that the statistical service in Italy was decentralized in the 1980s and it is not clear whether data collection on non-timber forest products (mushrooms) was affected; but data on truffles, given their high value and controlled harvesting, would not have been.

In many areas in Italy, annual average income from selling mushroom-harvesting permits is now much higher than from timber. Figure 1 shows revenues for the mountain forests of Asiago, in north-east Italy, considered one of the country's most productive areas for high-quality wood.

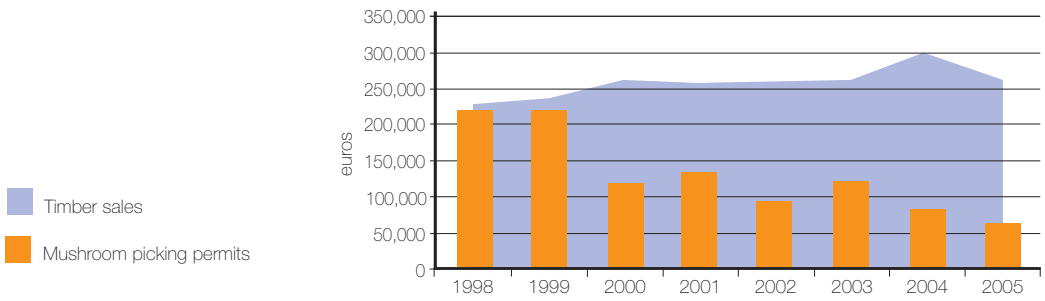


Figure 1. Revenues in euros from sales of timber (before felling) and mushroom-picking permits in the community forest of Asiago, north-east Italy (1998—2005)

The product

Mushrooms can be sold in many different forms (see www.asiagofood.it for more details). Fresh mushrooms are easily sold, although they only last a few days even when refrigerated; some species last longer.

Fresh mushrooms can be also sold frozen. Frozen mushrooms are cooked in the same way as fresh mushrooms.

Processed mushrooms can be sold in different forms: dried, powdered, or in oil, or as a preserve. In the first two cases, mushrooms need to be dehydrated first. Dried mushrooms can be commercialized whole, or sliced, or powdered. Powdered mushrooms are used as an aromatic. Dried mushrooms, whole or sliced, need to be rehydrated for 20 minutes in warm water before being cooked. When to be preserved in oil or water, they need to be fried or boiled respectively (usually sliced).

Economic and social aspects

The price of wild mushrooms is very high in Italy and an increasing trend toward importing, especially from Eastern Europe, can be seen. Mushrooms and truffles collected and sold in regions with a consolidated tradition in the sector usually fetch the highest price (Table 2). But prices differ greatly from transaction to transaction, and between operators. Coordination problems can be analysed in terms of horizontal coordination and vertical coordination.

Product	Amount [tons]	Value [millions of euros]	Price [/kg]		Main regions of production
			Average	Min-Max	
Mushrooms	3,189	36.65	11.5	6 - 15	Tuscany, Emilia-Romagna, Lombardia, Trento, Calabria
Truffles	94.1	21.3	226	7-716	Umbria, Abruzzo, Marche, Piedmont, Emilia-Romagna

ISTAT 2006

Table 2. Production and value of mushrooms and truffles in Italy (2005)

Without "horizontal coordination" (like associations, companies, and stable contractual agreements that determine price), forest managers are only "price takers". They cannot set prices and their profits are low. For example, single forest owners are less competitive and receive lower prices than associations of owners.

Very often mushroom companies are involved in further processing and selling the products ("vertical coordination"). When forest managers are vertically integrated and can sell fresh mushrooms directly to the final consumers or control processing and trading activities, their profits and contractual power are higher. Table 3 presents the prices in different market places and provides evidence that prices (and presumably profitability) increase more in the final steps of the value chain.

Agents along the value chain	Transaction place	Prices paid	Market power
Forest owner in Bosnia	N/A	No payment	No involvement in the business activity
Single mushroom picker in Bosnia	On the forest roadside (or in the rural village)	€0.2-0.5/kg	Very low
Merchant	Wholesale in the exporting market	€4-6/kg	Relatively high
Retailers in Italy	Wholesale in the exporting market	€10-15/kg	High
Final consumer	Wholesale in the exporting market	€15-30/kg	Very low

Table 3. Market power of different actors in the fresh *Boletus edulis* value chain (2005)

Mushrooms and truffles do not have transparent markets: informal business activities prevail, especially in the initial stages of the market chain. Croitoru and Gatto (2001) estimated the value of mushroom harvesting in Italy to be much higher than official figures at about €60m per year, assuming 3kg of mushrooms collected per hectare and 4 million hectares of mushroom-producing forests. These data on harvesting are confirmed by Bartolozzi (1988) who, in a detailed study in Tuscany, found an average harvesting rate of 3.1—4.2 kg/ha/year in beech forests. The whole value of the Italian truffle market was thought to exceed €400m per year, with around 500 tons (including imports) of processed products (www.raggivivai.it/prodotti/tartufo/sottomenu/curiosita.asp).

Mushroom and truffle economies have positive social impacts. Farolfi (1990) examines the role of mushroom gathering in the Casentino area in Tuscany. In the author's case study two low-income social groups have a fundamental role in mushroom picking: housewives and pensioners. Mushroom collecting provided important revenues: all their income for housewives and 30% for pensioners. Only the higher age groups were represented within the mushroom collectors (nobody less than 30 years old and most aged between 50 and 60) while 70% were women.

About 20% of the total harvest is consumed by the collector and the rest is sold to local stores, on markets, to restaurants, and private customers.

Legal aspects and labelling

Mushrooms in Italy are no longer public goods and forest managers or associations of forest owners are now allowed to make money from cultivating, collecting, and selling. This is due, as in some other densely populated countries in central and southern Europe, to a clear definition of property rights associated to NTFP harvesting. After the recent review of the Italian constitution, the government transferred almost all competencies in the forestry sectors to the regions. Property rights are regulated both by laws defining general principles and by specific regional and local regulations. On the basis of the current legislation local public authorities (provinces, mountain communities,[1] municipalities) and forest owners' associations[2] are allowed to sell daily, weekly, monthly, or seasonal permits for collection (daily permits allow no more than 2kg of mushrooms and cost 4 to 15 euros each). The law requires forest owners to mark the boundaries of their properties with special signs, or mushrooms may be considered a common good. However, in some protected areas like in national parks, the collection of wild products is never permitted while in other protected areas (e.g. regional parks), it may be allowed depending on each product. The need for signals and surveillance to combat illegal picking has stimulated the creation of forest owners' associations.

Usually permits for collecting mushrooms on public land are given free to local residents and people living around picking areas enjoy special treatment (reduced fees, large quantities, etc.) (Mantau *et al*. 2001). Regulations contain specific limits related to species, the amount of daily picking, and the collecting period. When permits are sold for picking mushrooms in public forest land, the law states that earnings —net of surveillance and other organizational costs— have to be reinvested in forest amelioration works. The collection of wild products is generally forbidden in private gardens, forests near houses, or when special cultivations are organized, like truffle production in oak forest planted with mycorrhized seedlings. Apart from buying the permit and adhering to its limits, no other requirements are made of mushrooms pickers. For the right to pick truffles, by contrast, pickers have also to pass an examination on recognition and sound picking techniques, like tools and techniques for protecting the mycelium and not damaging the truffles themselves.

In some regions, like Tuscany and Umbria, forest owners and associations of collectors have defined formal agreements to supervise and control forest land against illegal collectors. No rent is paid by the association, but the forest owners profit from protection and amelioration work done by pickers.

1. Associations of municipalities in mountain areas (*Comunità montane*).
2. In Italy associations of private forest owners have different institutional structures (history): from the traditional common properties reserved and managed by the local residents (very common in mountain areas, as in the case study presented in the following pages shows) to the more recently created cooperatives and associations of forest owners based on voluntary membership

The case of mushrooms in Borgotaro

Summary table

Name of the initiative	Consortium "Fungo di Borgotaro"
Location	Municipalities of Albereto and Borgotaro (Parma) and Pontremolli (Massa Carrara), Italy
Surface of the initiative	22,000ha, to be enlarged to 60,000ha
Year of creation	1995 (Consortium)
Type of exploitation and infrastructures	Community forest (owned by the residents of the villages in the area). Six local enterprises for mushroom processing and trading
Number of workers	28 full-time workers and ten seasonal workers in six local enterprises
Products sold	-Mushrooms: fresh (from the local area), dried, in oil, or frozen (imported). Sold through local retailers and restaurants. Fresh mushrooms only in autumn and spring -Mushroom picking permits
Distribution process and advertising	Website "Strada del fungo" (restaurants and agritourism) (www.stradesdelfungo.it) 25 family-run grocery shops in the valley Some of the processing companies have a website for e-selling
Certification labels	EC Geographic Protected Indication (GPI) "Fungo di Borgotaro"
Initial investment	-
Yearly revenue	(2005) € 2,820,000 from harvested mushrooms and picking-permit selling
Yearly costs	(2005) € 403,200 invested in forest maintenance work (from permit selling)
Risks to sustainability	There is no risk for sustainability as mushroom production is monitored in the areas by the consortium. Also the carrying capacity was established through scientific studies.

Description of the initiative

One of the most remarkable examples of development of the mushroom market is the community forests in Borgotaro, where a relatively large business activity is based on managing the forests under a special silvicultural regime, organizing picking activities, processing and selling local and imported mushrooms.

The successful marketing of Borgotaro mushrooms is based on long tradition. The trade of the local *Boletus* is known to date back at least to the 17th century. At the end of the 19th century the first two local enterprises for marketing *Boletus* mushrooms were founded, one of them still exists. At that time, mushrooms were dried and exported to North and South America. Since 1934 *Boletus* mushrooms of the region have been collected and sold under the name *Fungo di Borgotaro*.

Nowadays only four species (*Boletus edulis, B. aereus, B. aestivalis* and *B. pinicola*) are sold with the Fungo di Borgotaro label—the only European Commission protected geographical indication[3] (PGI) for mushrooms, (Figure 2).

Figure 2. The Fungo di Borgotaro trademark.
©Wikipedia / J.P.Lon

All the forest area bordering the two regions, Emilia-Romagna and Tuscany, has great potential for mushroom harvesting, but this chapter focuses on the Borgotaro area. The territory includes the municipalities of Borgotaro and Albereto in the province of Parma (Emilia-Romagna) and the municipality of Pontremoli in the province of Massa-Carrara (Tuscany) (see Figure 3).

3.Foodstuff which has to be either produced, processed, or prepared in a given geographical area.

Figure 3. Location of the study area

Forest management and mushroom production

In the Borgotaro area, 22,000 hectares of forest are delineated for the production of Fungo di Borgotaro mushrooms. Dominant tree species in the forests are beech (*Fagus sylvatica*), chestnuts (*Castanea sativa*), and oak (*Quercus* spp.). Other companion and scattered tree species are hornbeam (*Carpinus* spp.), hazelnut (*Corylus avellana*), poplar (*Populus tremula*), fir (*Abies alba*), spruce (*Picea abies*), black pine (*Pinus nigra*), and Scot's pine (*Pinus sylvestris.*)

Mushroom growing is dependent on forest management. From local experience coppice forests turned out to be more productive than high forests (Bartolozzi 1988), even with more frequent disturbance factors (wood harvesting with relatively short rotation periods). Coppice with standards (up to 100trees/ha) with rotation periods of 35 years has been acknowledged as the most productive management system for mushrooms. It was observed that coppicing of forests, with only the stump protruding after the above-ground part of the tree is cut, increases direct sunlight on the soil. Moderate levels of sunlight favour mushroom production. When the forest is coppiced, mushroom production ceases until the soil is stabilised and trees sprout. Then, as the mycelium is still related to tree roots, production of mushrooms starts again.

By contrast mushroom growing declines if coppice forests become too dense, dark, and over-mature. In figure 4 mushroom production in a beech forest under the silvicultural system described above is compared with the production under an even-aged high-forest system - the normal alternative when timber is the main objective. The graph shows that, under the even-aged high-forest management system, mushroom production declines when trees reach 50 years old, only to increase a little after the two regeneration cuttings around year 100 and 110. After the final cut, mushroom production increases again as the cycle starts anew.

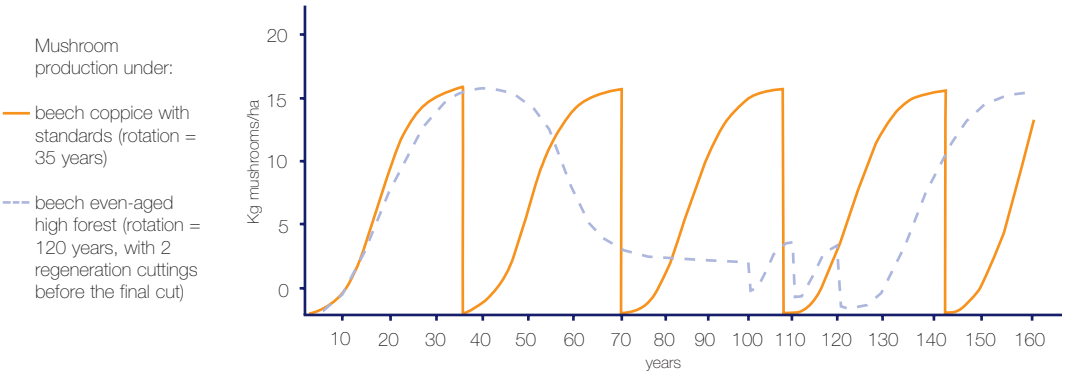


Figure 4. Mushrooms production under different forest-management systems

As stated by Giovannetti *et al*. (1998), the long-term presence in the Borgotaro forests of mycorrhize and spores of *Boletus* spp., not disturbed by improper management systems and external factors, has gradually increased mushroom growing. The site now generates 15-20 kg/ha a year with large fluctuations mainly related to climate.

Box 1

Coniferous forest management and *Boletus edulis* production in Soria, northern Spain

In the area of Pinares de Soria (Soria, Spain) a study was conducted from 1995 to 1999 to estimate *Boletus edulis* production in a *Pinus sylvestris* forest. Mushrooms were collected weekly each harvest season in different experimental plots and it was found that production was highest when the forest was between 31 and 70 years old (Martínez Peña 2003). The average production of *Boletus* was estimated at 20 kg/ha. Differences with beech forests under coppicing management may be explained by the fact that mycelium needs to be re-established after pine trees are cut (conifers do not re-sprout and grow from seeds or need to be replanted) and by microclimatic conditions at ground level (sunlight and humidity).

The total average annual harvested production of mushrooms in Borgotaro area is about 60—80 tons, but the quantity varies considerably. Some sources mention up to 200 tons in 1952, 1975 and 1981, in contrast to low production years like 1978 (4.4 tons), 1983 (7.5 tons) and 1970—71 (9.0 tons). In 1985 production was almost nil (www.agroqualita.it/dop/fungo_borgo.htm).

In 2004 production was not very high but prices were very good; meanwhile 2005 saw very high production but very low prices. In 2005 total production was estimated to be between 150 and 200 tons.

There is also a potential for the commercialisation of firewood and charcoal, although prices cannot compete with foreign imports, especially from the Balkans. Each forest owner (public or private) may sell small quantities of wood to private consumers. The revenue from this activity is low and unrecorded. Furthermore, many enterprises involved in the mushroom business also trade other non-timber forest products and the same forests are used to gather, for example, chestnuts or forest berries.

Box 2

Lactarius edible-mushroom production in Catalunya, north-east Spain

The *Lactarius deliciosus* and *L. sanguifluus* are highly valued species in north-east Spain, sold under the generic name of *rovelló*. These mycorrhicic species are related to pine tree species (*Pinus sylvestris, P. nigra, P. halepensis, P. pinea,* etc.). The economic value of these mushrooms in Catalunya is estimated at € 2m, with 242 tons traded on average every year (over the last eight years). As the total production for Catalunya is estimated at 230 tons a year in a study of production of these species undertaken in the Solsonès region of Catalunya during 2001 to 2003 (Martínez de Aragón *et al*. in review), imports from other areas of Spain are necessary. Other studies of the forest management and production of these species have been undertaken and it is known that production increases in forest stands under 50 years old (Bonet *et al*. 2004). This is similar to the *Boletus* species under a coppicing regime. Access is still not controlled in this area because of the long-standing tradition of mushroom picking by local people. However, as forest management is increasingly expensive and revenues from timber are decreasing, private forest owners are now considering limiting access to mushroom picking in private forests and putting in place a payment scheme.

Lactarius deliciosus from a Mediterranean forest in les Gavarres Protected Area (Girona, Spain). © WWF-Mediterranean / X. ESCUTE

Economic operators and production chain

Borgotaro forests are owned in common by the residents of the villages of the area. The basic management unit at the level of a village or borough is the *comunalia*. An association of *comunalia* provides general services to owners (see www.comunalie.com). A consortium was established in 1995 (see below) to help obtain the EC trademark and organize marketing. Membership of the consortium is open to individual members of the *comunalia*, *comunalia* associations, and buyers and processors of PGI mushrooms.

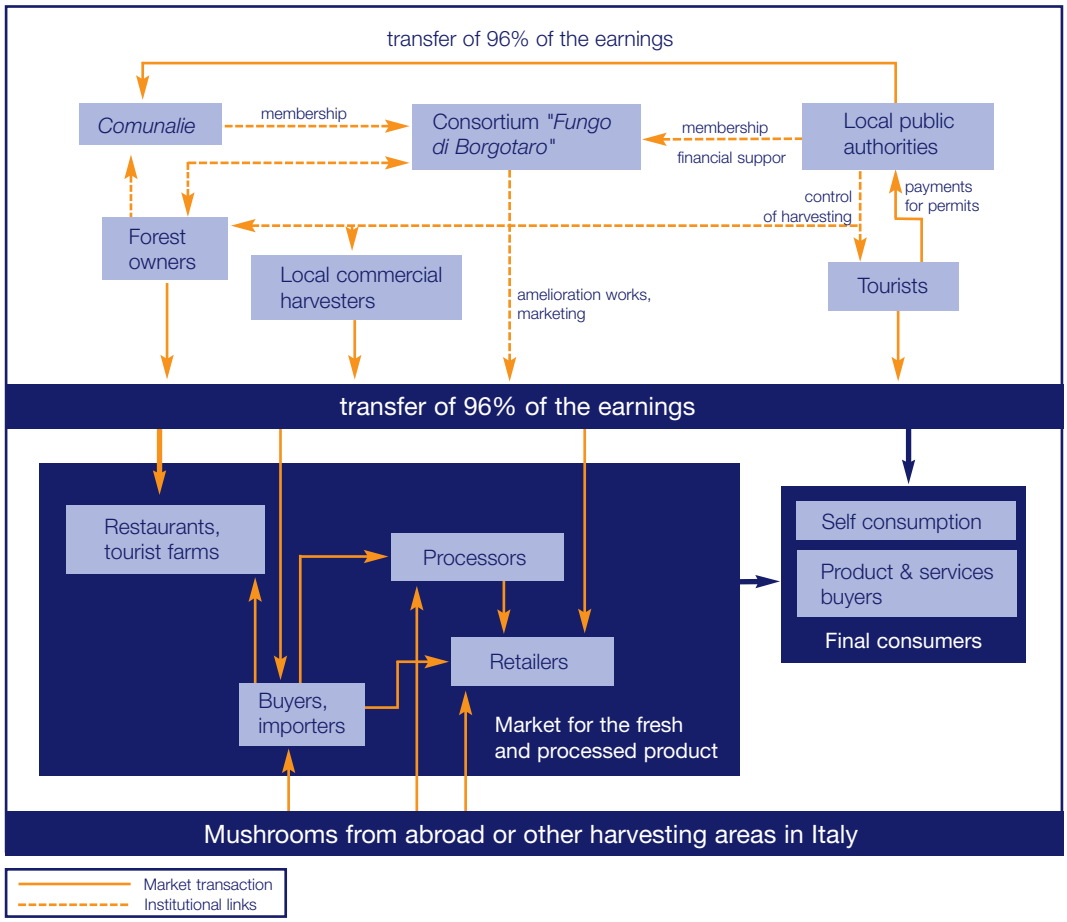


Figure 5. Main economic agents involved in the Borgotaro mushroom activities.

Boletus harvesting is a typical seasonal activity. The harvest begins in late spring/early summer, is interrupted during the hot summer months and starts again intensely in autumn.

Mushrooms are harvested by *comunalia* members who have access and by commercial collectors and tourists who pay for a permit. Some harvesters come from other parts of Italy (mainly the centre and north), travelling hundreds of kilometres to reach the mushroom areas. A clear distinction between the two last typologies of harvesters is not possible and, in any case, they are under the same system of payment and restrictions.

Local and national demand for mushrooms from Borgotaro has to be covered by imports from neighbouring regions of Italy and from abroad. Almost all the industrial processing activities are based on imported mushrooms and therefore market segmentation occurs in Borgotaro: fresh mushrooms for sale to final consumers and for restaurants and agro-tourism facilities mainly come from local forests, some marketed with the EC label; mushrooms used by processors and sold dried, in oil, or frozen come mainly from outside and benefit from the public recognizing that they have been processed in an area famous for quality. Thus in Borgotaro the impacts in terms of added value and employment in the mushroom industry go far beyond the activities connected with selling local *Boletus*.

Apart from the few hundred local professional mushroom collectors working three to four months a year and the tourists (36,000 permits sold in 2005), the mushroom business in Borgotaro area and surrounding areas creates employment for many people.

A total of six companies in the area (www.fungodiborgotaro.com/elenco.jsp) process and trade mushrooms fresh or frozen, dried, in oil, or as mushroom specialities. Only one enterprise, consisting of a shop and a laboratory associated with a restaurant, buys, processes and sells locally harvested mushrooms under the PGI trademark. Cleaning, sorting and processing are traditionally done by hand. They sell fresh mushrooms to consumers in the shop and prepare mushroom specialities in the laboratory (fried or cooked with meat and/or vegetables, sometimes sold frozen). Part of the production is used in the restaurant. Four people are employed permanently in the laboratory-shop and ten are employed seasonally to clean the fresh mushrooms. Another enterprise buys and sells large quantities of locally harvested mushrooms that are sold to local and external retailers. Two people are employed permanently by this company.

Two large industrial firms specialising in imported mushroom-processing (dried, under oil, frozen) employ eight and 20 people respectively. Although they mainly use imported mushrooms, they take advantage of their location as consumers appreciate mushrooms processed in Borgotaro even if they have not been harvested locally. There are also two small family firms that make and sell mushroom specialities (dried, with oil, etc.) for tourists.

Other sources of indirect employment are restaurants that prepare mushroom-based dishes and 25 family groceries in the valley that sell fruit, vegetables and fresh mushrooms (and sometimes dried and in oil).

Some processing companies have established web pages for e-business. Beside mushrooms most sell other specialities from the region like chestnuts (fresh, dry, frozen or as flour), jam or syrup of forest berries, but also other specialities obtained from farming, like olives, oil, or vegetables.

Quality issues and labelling. The consortium Fungo di Borgotaro

CERTIFICATO

Franz FISCHLER, Commissario europeo
per l'Agricoltura e lo Sviluppo rurale,
ha l'onore di certificare che la denominazione

Fungo di Borgotaro

è registrata in quanto Indicazione Geografica Protetta (IGP)
in virtù del regolamento (CE) n. 1107/96, della Commissione,
pubblicato nella Gazzetta ufficiale delle Comunità europee
L 148 del 21.6.1996 pag. 1

La registrazione di tale denominazione ne riserva l'uso
esclusivamente ai produttori situati nell'area geografica
delimitata che rispettano le condizioni di produzione
descritte nel relativo disciplinare.

Il Commissario ha il piacere di inserire tale
denominazione nell'albo delle DOP-IGP.

Fatto a Bruxelles, il 21 giugno 1996

F. Fischler

Franz FISCHLER
Membro della Commissione

Figure 6. PGI trademark

In order to take advantage of the quality of local mushroom production and boost profits for forest owners and harvesters, the *comunalia* members turned their association into a consortium (www.fungodiborgotaro.com).

In 1996 the new consortium obtained a third-party certification of origin for its *Boletus* mushrooms. In accordance with the European Commission Regulation 2081/92, the *Fungo di Borgotaro* now has a Protected Geographical Indication (PGI) trademark.

Certification is based on a standard for best management and product characteristics. There are several qualitative indicators regarding smell, impurity (external), moisture content, and surface. More than 20% of the mushroom body has to be healthy without any larva or other disorders.

Year	2000	2001	2002	2003	2004	2005
Production [tons]	0.5	2.5	0.2	2.2	3.3	21.4

Table 4. Annual production of Fungo di Borgotaro (Consorzio Comunalie Parmensi)

Mushrooms must be processed no more than a day after collection. Then they are sorted, and sand and other foreign matter is cleaned away by hand without water.

The role of the consortium has been not only to define and control product standards and quality, but also to manage promotion and communication activities, like gastronomic and trade fairs, tasting events, a web site, a local festival, training, and technical assistance to members. Great efforts are made to improve packaging, which is not only aimed at maintaining quality but also promoting the product's character as a speciality derived from local, traditionally managed forests. Only a small part of the annual production ends up as PGI mushroom due to self consumption and private selling. Of 150—200 tons produced in 2005, only 21.4 tons of PGI-labelled mushrooms have been sold, but there is a clear tendency to expand this quantity (Table 4) (Mortali 2006b). For some years the consortium has tried to extend the trademark to frozen mushrooms and processed products. Since the demand for mushrooms is much higher than production, the consortium is also trying to enlarge the PGI production area from 20,000 to 60,000 hectares. The Fungo di Borgotaro consortium is also responsible for research into improving mushroom production. It says local *Boletus* is a "spontaneous natural product obtained with the help of men". This means that *Boletus* mushrooms are not cultivated but harvested at a controlled intensity while microclimatic and other environmental conditions are influenced by forest management.

Marketing activities

PGI certification of Borgotaro mushrooms is part of a broader strategy to improve the image and attractiveness of the area. As with many other Non Timber Forest Products (NTFPs), mushrooms are perceived as the most traditional and environmentally friendly products of the rural economy

Figure 7. A tool for territorial marketing: the itinerary *La strada del Fungo Porcino di Borgotaro* to connect various products and services in the Borgotaro area (www.stradadelfungo.it in Italian and English)

and the Borgotaro *Boletus* is flagship for the territory. This is why, after the PGI certification, a complementary initiative in territorial marketing was organized in 2000: an itinerary *La strada del Fungo Porcino di Borgotaro* (www.stradadelfungo.it) which connects restaurants and agro-tourism enterprises offering dishes and specialities based on the local *Boletus*. This initiative has been partly financed through the Regional Law no. 23/2002 on itineraries offering quality products - mainly food specialities and wines. In the Borgotaro case the itinerary combines fresh and processed mushroom marketing activities with promotion of the whole territory (see Figure 7). Tourists see beautiful landscape and there are restaurants offering mushroom specialities combined with other food typical of the region, like the Prosciutto of Parma. Autumn fairs and markets attract up to 50,000 people per year and provide income to restaurants, hotels, etc. As a consequence house prices are increasing and old farm houses have been saved.

Economic value of mushroom production

Moreover all tourist activities are closely linked to the image of a green area with high production of *porcini*,[4] e.g. with uncontaminated, well-managed forests, and a valuable traditional landscape. Only 5% of mushrooms sold in the area are locally harvested PGI-marked *porcini*. Large quantities of mushrooms come from outside the consortium area in the region or are imported from eastern Europe and China.

Mushrooms are sold from the collector directly to restaurants of the region, to buyers, and brokers, and occasionally to processors. The prices rise from €7/kg from the collector to the buyer, to €13—15/kg to the broker stores, up to a maximum of €40/kg in a food specialities shop in Milan; however, for the final consumer a normal price of the Borgotaro mushroom is €15—25/kg.

The total value of mushroom production was estimated at around €2.4m in 2005, assuming an average price of €12/kg (Mortali 2006b). The price for a daily picking permit is between € 6 and €15 and for a semester between €67 and €150 (http://www.fungodiborgotaro.com/norme-locali.html).

Around 30,000-35,000 picking permits are sold for a total of € 300,000 (assuming an average of €10 each). In 2005, a bumper year, 36,000 permits were sold, producing income of €420,000, nearly all of which was returned to forest owners' associations.

From this it can be estimated that the whole income from mushroom production and selling of permits in 2005 was just over €2.8m or around €128 per hectare of forest.

Earnings from mushroom selling is not the only source of income for the local population: there are important indirect impacts on recreational and tourism activities (restaurants, shops, bed and breakfasts, hotels, etc.). Permit sales are used for improving forest management and the control of illegal collectors, as well as for maintenance of forest roads, trails, fountains, and other small-scale tourist facilities. This creates employment for local people even outside the harvesting season.

Legal and regulatory aspects

With increasing population pressure and conflicts over harvesting rights, the local authorities in 1964 established a reserved area for mushroom harvesting. A law was approved by the Emilia-Romagna region in 1996 which defines the current frame rules for mushroom harvesting (R.L. 6/1996). Harvesters who are not local residents have to buy a permit valid for a day, a week, a month, or a semester. Permits can be bought at the offices of the region, the municipalities, the consortium, or local parks. The minimum age for buying a permit is 14.

The harvester has to carry identification with the permit. Collection can take place only on Tuesday, Thursday, Saturday, and Sunday from one hour before sunrise until one our after sunset (in some areas the collection is reduced on Tuesday, Saturday, and Sunday).

4. In Italian, the word *porcini* is used to designate different top-quality edible *Boletus* species.

Up to 3kg of *Boletus* mushrooms can be collected per day per person; residents can harvest up to 5 kg per person, except species other than *Boletus*. The hat of the mushroom has to have a minimum diameter of 3 cm. The law also provides guidance on harvesting techniques. Harvesting can be done only by hand or with a knife to limit damage to the mycelium. Plastic or paper bags for the transport are not allowed.

The price of permits is set daily in a rather sophisticated system: as can be seen from Figure 8, the consortium monitors mushroom growing in each of the ten compartments in which the forest area has been subdivided. A 1:100,000 scale map has been made available to the public so that people can recognize different compartments. For each compartment special regulations and prices are defined.

Figure 8. The web page of the Fungo di Borgotaro consortium, providing information on the growing rate of the mushrooms, the type of permit, and related prices for each of the ten forest compartments. (www.fungodiborgotaro.com/default.htm)

For residents collection is free, but they have to present identification. Collectors are constantly informed (both through a web site www.fungodiborgotaro.com/default.htm and an online newsletter) about the growing rate of mushrooms in each compartment. A threshold of the number of daily permits that can be sold is defined for each compartment to keep harvesting sustainable.

A study has shown that the maximum sustainable anthropogenic disturbances of the forest is three people per hectare every ten days (Mortali 2006a).

Illegal harvesting is not a serious problem: controls are enforced not only in the forest but also in car parks and on the roads. Collectors approach the forest in private vehicle that can be easily detected and controlled.

Biodiversity: benefits and risks

Mushrooms are an essential part of forest biodiversity with very important ecological functions:

- Parasitic fungi attack old sick trees, hastening their death.
- Saprophytic fungi feed on deadwood and organic material (leaves, branches, etc), with the important function of decomposing lignin and cellulose and making them available to plants, insects, bacteria, and other organisms. Recent studies have demonstrated mutually beneficial interactions between saprophytic fungi and old-growth trees: these fungi feed on compartmentalized parts of the tree, while their presence protects old trees from parasitic fungi.
- Mycorrhizal symbioses are established between around 5,000 species of fungi and more than 90% of vascular plants. They play an important role, both in the functioning and in the structure of temperate, boreal, and tropical ecosystems (Perez-Moreno and Read 2004). The ectomycorrhizal symbiosis is established mainly between woody gymnosperms and angiosperms and basidiomycetous or ascomycetous fungi. One of the components of this symbiosis is the external mycelium, which represents one of the most fascinating living structures because, structurally and functionally, it constitutes an interphase between soil and plant components. It has been shown that through this external mycelium, plants have the ability to directly access nutrients from organic sources, otherwise unavailable to them, which include plant, animal and microbial necromass.

A balance between these three types of fungi in the forest ecosystems is crucial and indicates the healthy status and long-term survival of forests (Gómez 2006). Studies in Mediterranean forests from Extremadura and Andalusia (Spain) consider as adequate percentages: 50—66% of mycorrhyzal fungi, 40—60% of saprophytic fungi and less than 5% of parasitic fungi (Moreno and Guirado 2004).

The disappearance of old-growth forest stands is threatening important mycorrhyzal fungi: twelve species in Europe are currently considered to be threatened. Large-scale forest fires, such as those affecting cork-oak forest landscapes in Portugal and Spain in recent years, are also the cause of a decline in fungi diversity and species quantity, with negative environmental and economic impacts (Terradas 1996). Moreover, intensive timber harvesting and bad practices in mushroom collection can have a very negative impact on fungi species diversity and populations, on endemic guest-plant diversity and population, and on ecosystem functions as a whole.

An initiative such as the Borgotaro one including coppicing regimes, should consider leaving a certain surface of forest untouched to become a reserve for biodiversity and evolve as an old-growth forest stand. Also, as a way to improve fungi diversity in Mediterranean forests, it is recommended to:

Image through optical microscopy of an ectomycorrhiza: *Quercus robur* root apexes covered by mycelium from two mutualistic fungi (black or orange-red coloured), with hyphae emanating from the mantles © Lucio Montecchio

- Develop effective fire prevention mechanisms through forest management practices all year round
- Expand timber cutting periods in forest stands with high fungi values and in forest types where trees are associated with fungi species
- Keep a minimum number of trees per hectare from cutting
- Establish small fungi reserves in old-growth forest stands.

Tuber melanosporum from Mount-Ventoux (France). Wikipedia / Poppy

Yellow chanterelle (*Cantharellus lutescens*) in a Mediterranean forest in les Gavarres Protected Area (Girona, Spain). © WWF-Mediterranean / Xaviear ESCUTE

Final remarks

Data on mushroom production presented in this case study is based mainly on beech-forest management activities. Similar results in terms of mushroom productivity are obtained in chestnut forests (Mortali 2006a). The situation with deciduous oak forests is apparently similar, while information or research results about evergreen oak forests or the Mediterranean maquis is very scarce, where temperature and rain regimes are quite different. Anyway, in cork oak forests coppicing is normal practice in the production of wood for fuel and charcoal, and in very dense stands it should favour mushroom production. For highforests managed for cork production, mushroom growing must be possible due to the limited density of the trees. Only intensive grazing could limit mushroom growing as a consequence of soil disturbance. It is difficult to estimate the potential for mushroom production of Mediterranean forests, because so much is transacted informally, not being acounted for in markets. However, in Morocco it was estimated that the annual production of mushrooms was of 1,000 tons/year (Ellatifi in Merlo and Croitoru 2005), while the mushroom production of the cork-oak forests was estimated to be around 115 tons/year (Hammoudi 2002). In Tunisia, it was estimated by Daly-Hassen and Mansoura (in Merlo and Croitoru 2005) that the export quantity of mushrooms is 16 tons/year.

Mushroom exports from Tunisia are based on truffles (*Terfezia claveryi*), mainly found in Gafsa and Tataouine, and a number of mushrooms (*Cantharellus cibarius, C. lutescens, Marasmius oreades, Hydnum repandum,* and *Boletus edulis*) from the Tabarka and Ain Drahim regions. The total value of exports in 1995—8 was of about 917,818 Tunisian dinars (€550,470)[5], with the highest percentage linked to truffles. Mushroom exploitation involves about 1,120 families, representing an annual income of an average of 421 dinars (€252.5) per family. Auction costs for mushroom exploitation provide about 19,184 dinars/year (€11,506) to the forest administration over a total surface of 27,690 hectares of forest land (average data from the period 1995—8).

Mushroom exports from the cork oak forest landscapes in Kroumerie and Mogod (Tunisia) are 19,558kg a year (data from 1995—8 period), which represent 157,934 dinars (€94,723) of revenues (Bouziz and Helal 2000).

Truffles are represented in Morocco by several species belonging to genera *Delastria, Picoa, Terfezia, Tirmania,* and *Tuber*, with the common name of *Terfass*. They are all edible fungi species, in an important and very dynamic local market. They mainly grow in spring, but also in winter (*Delastria rosca, Terfezia leptoderma* and *Tuber oligaspermum*). They generally grow as mycorrhizal fungi of *Cistacea* shrub species, some of them the companions of cork-oak forests (*Tuberaria guttata*) and maritime pine (*Pinus pinaster*). The main harvesting indicator is the appearance of swollen and cracked soil around the guest plant (Khabar *et al*. 2001). The Maamora forest is one of the main truffle producing zones in Morocco: *Terfezia arenaria, T. leptoderma* and *Tuber asa* are associated with *Tuberaria guttata*; *Tuber oligospermum* and *Delastria rosea* are associated with *Pinus pinaster* var. *atlantica*.

5. Currency conversion according to www.oanda.com, 20th November 2006. 1 Tunisian DINAR = 0.60 EUR

Even in a very productive area like Borgotaro, policy-makers should recognize that mushroom harvesting is not a cure-all for the problems of depressed rural communities and of the misuse of natural resources. The large majority of direct and indirect jobs provided by this activity are seasonal and part-time. However, mushroom harvesting provides a regular source of supplementary income, aids the diversification of the rural economy, and incentivizes the active management of the landscape. Moreover, if mushroom harvesting, as in Borgotaro, is one of a basket of products associated with historical, cultural, and natural attractions, and accompanied by good customer service, it can play a lead role in sustainable rural development.

This example underlines the importance of combining the interests of all NTFP business stakeholders — from the forest owner to the processing and selling company — and creating a consortium to defend them. Their active involvement in NTFP business also guards against the unsustainability in the management of forest resources. The democratic participation of stakeholders in a business activity not only favours the growing of local entrepreneurship but also the mutual control of all the partners involved in resource management. An important lesson to be learned is that even when forest resources have an apparently low value and a marginal economic role, they can be an opportunity for local sustainable development given social capital is present - often the real limiting factor where capacity building is needed.

Authors

Prof Davide Pettenella

Professor of the Dipartimento Territorio e Sistemi Agro Forestali – University of Padova (Italy), specialised in forest economics and forest products marketing.
E-mail: davide.pettenella@unipd.it
Web: www.tesaf.unipd.it/pettenella

Ms Susanne Kloehn

Consultant on forestry and PhD student at the University of Padova (Italy).
E-mail: susikloehn@hotmail.com

Information sources and bibliography

Quoted literature and websites

Bartolozzi, L. 1988. Ricerca sui prodotti spontanei del bosco e degli altri ambienti naturali in dieci comuni della Garfagnana. In: Sorbini, M, Bartolozzi, L and R Della Casa, *Indagine sul ruolo economico dei prodotti secondari spontanei del bosco*, pp 24-54. Accademia Italiana di Scienze Forestali, Firenze.

Bonet, J A, Fischer, C R and C Colinas. 2004. The relationship between forest age and aspect on the production of sporocarps of ectomycorrhizal fungi in Pinus sylvestris forests of the central Pyrenees. *Forest Ecology and Management* 203: 157-175.

Bouziz, A and Helal, S. Etude sur le developpement des produits forestiers non ligneux en Tunisie. FAO.

Croitoru, L and Gatto, P. 2001. Una stima del valore economico totale del bosco in aree mediteranee. *Monti e Boschi* 5: 22-30.

Merlo, M and Croitoru, L. 2005. *Valuing Mediterranean Forests: Towards total economic value*. CABI Publishing. 406pp.

Farolfi, S. 1990. Ruolo economico dei prodotti secondari spontanei del bosco: un' indagine nel Casentino. *Monti e Boschi* 1.

Giovannetti, G, Zingari, P and P Terzolo. 1998. Exploitation of forest productivity through increased mushroom production. *Acta Horticola*. 457: 127-132.

Hammoudi, A. 2002. La subéraie: biodiversité et paysage. Haut Commissariat aux Eaux et Forêts et à la Lutte contre la Désertification.

Hawksworth, D L. 1992. Fungi: A neglected component of biodiversity crucial to ecosystem function and maintenance. *Canadian Biodiversity* 1: 4-10.

Hawksworth, D L. 2004. Fungal diversity and its implications for genetic resource collections. *Studies in Mycology* 50: 9-18

Khabar, L. 2001. Contribution a l'étude de la flore mycologique du Maroc les truffes marocaines (discomycètes). *Bulletin de la Société Mycologique de France* 117 (3): 213-229.

Lamb, R. 1993. More than wood - Special options on multiple use of forests. FAO Forestry Reports, no. 4.
www.fao.org/docrep/v2535e/v2535e07.htm#a%20regional%20perspective:%20the%20mediterranean

Mantau, U, Merlo, M, Sekot, W and B Welcker. 2001. *Recreational and Environmental Markets for Forest Enterprises*. CABI Publishing. 541pp.

Martínez de Aragón, J, Bonet, J A, Fischer, C R and C Colinas (in review). Productivity of ectomycorrhizal and selected edible saprotrophic fungi in pine forests of the pre-Pyrenees Montains, Spain: predictive equations for forest management of mycological resources. Forest *Ecology and Management*.

Martínez Peña, F. 2003. Producción y aprovechamiento de *Boletus edulis Bull*.; Fr. en un bosque de *Pinus sylvestris* L. Junta de Castilla y León. Consejería de Medio Ambiente.

Motali, A. 2006a. *Studio sull'influenza dell'afflusso di cercatori, dell'età e della tipologia dei boschi sulla produzione fungina all'interno del Consorzio Monte Croce di Ferro*. Consorzio Forestale Monte Croce e Monte Ferro. 12pp.

Mortali, A. 2006b. Consorzio Forestale Monte Croce e Monte Ferro. Personal communication.

Pérez-Moreno, J and Read, D J. 2004. Los hongos ectomicorrízicos, lazos vivientes que conectan y nutren a los árboles en la naturaleza. *Interciencia* 29: 5.

Regni M., 2005. L'esempio di valorizzazione del fungo di Borgataro. *Alberi e Territorio* 12: 32-4.

Websites

Borgotaro mushroom Consortium (Fungo Borgotaro): www.fungodiborgotaro.com

Centre Tecnològic Forestal de Catalunya (Spain): www.ctfc.es

Comunalie (associations of forest owners): www.comunalie.com

Comunità Montana delle Valli del Taro e Cero (association of mountain municipalities): www.cmtaroceno.pr.it/

Road: 'La strada del Fungo Porcino di Borgotaro': www.stradadelfungo.it

European Commission's web site on the marks of origin: www.ec.europa.eu/agriculture/foodqual/quali1_en.htm

A portal on the Italian wild mushrooms: www.funghiitaliani.it

An example of an enterprise marketing mushrooms in different forms (fresh, dried, cooked, etc): www.asiagofood.it

For further information on the relation men and fungi (in Spanish): www.cdeea.com/historiamic.htm

Web site Raggi Vivai. Il Tartufo. www.raggivivai.it/prodotti/tartufo/sottomenu/curiosita.asp (in Italian, English and French). 16 November 2006.

Lactarius deliciosus from a Mediterranean forest in les Gavarres Protected Area (Girona, Spain).
© WWF-Mediterranean / X. ESCUTE

Gathering Myrtle leaves in El Feidja National Park. A traditional activity for the female population of north-west Tunisia. © WWF-Canon / Michel GUNTHER

Case 4 The economic value of aromatic and edible plants in multi-purpose cork oak forest landscapes: the case of myrtle.

Context

An extraordinarily high number of wild plants in the world are of significance in household and local economies as well as international trade. About 80% of the population in developing countries use wild plants to help meet health and nutritional needs; women especially rely on them for household use and income (Vantomme 2001). The following figures give an idea of the outstanding economic value wild plants play in the global market (FAO 1995): the world trade in essential oils is of the order of €0.78 billion, including both wild and cultivated sources. From 4,000 to 6,000 medicinal plants are of commercial importance, with a total world trade of €134 million (figures from 1992). Culinary herbs and ornamental plants are other important groups of wild plants which constitute a significant component of world trade. In 1991, 50 million bulbs were exported from Turkey, mainly to the Netherlands, United Kingdom and the US (Mavi Boncuk 2006); 90% of the 75 million wild plants harvested annually in Spain are exported mainly to the US, but also to France, Germany, Canada, Japan, and Australia (Lange 1994).

The Mediterranean cork oak (*Quercus suber*) forest landscapes host a considerable number of endemic plants with cosmetic, medicinal, culinary, and ornamental properties, which contribute to household economies and livelihood security. All these plants are considered to be underutilized species, which have a small commercial value if compared to major agro-forestry products (Giuliani and Padulosi 2005). Nevertheless, in many cases the real commercial value is neglected and inadequately documented due to uncontrolled exploitation, with a negative impact on the environment and rural communities' livelihood.

As mentioned in the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (FAO 1996), many underutilized plant species have

the potential for more widespread use, and their promotion could contribute to food security, agricultural diversification, and income generation, particularly in areas where cultivation of major crops is economically marginal. The Convention on Biological Diversity (CBD) also calls for greater attention to the conservation of agro-biodiversity (including "minor species") as an integral component of biological diversity and sustainable development.

Wild-collection still plays a vital role in the local use and trade in medicinal, aromatic, culinary and ornamental plants in the Mediterranean region. In terms of volume, almost 100% of medicinal and aromatic plant material traded in Albania and Turkey is wild-collected. From the 1,200—1,300 European plant species detected in trade, at least 90% are still wild-collected. It is estimated that about 75 million plants are uprooted annually in Spain (Lange 1994).

Traditionally, wild-plant harvesting did not incorporate specific action to ensure natural resources would continue to be available in the future. Worldwide demand for medicinal, aromatic, culinary, and ornamental plants has increased considerably since 1970, creating a boom in the 1990s due to people's awareness of environmental and health issues. The resulting over-intense and uncontrolled plant harvesting in the wild has put today many plants under threat of extinction or severe genetic loss, often difficult to quantify because of a lack of information. Recent surveys of the uprooting of entire thyme plants in south-east Spain have shown significant topsoil disturbance, ecosystem damage, and species decline in areas characterised by erosion and increasing desertification (e.g. *Tymus moroderi, T. zygis* subsp. *gracilis* and *T. baeticus*) (Blanco and Breaux 1997). For most of the endangered plant species no conservation measures have been taken. Additionally, knowledge on the use of plant genetic resources by traditional societies may be lost forever (MEDUSA 2002).

A joint effort is required to ensure the survival of the useful and potentially useful wild plants of the Mediterranean region. The International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) established a network on the Identification, Conservation, and Use of Wild Plants in the Mediterranean Region called MEDUSA in 1996, to propose methods for the economic and social development of rural areas, using ecologically based management systems that will ensure the sustainable use and conservation of plant resources. This network is active in many Mediterranean countries (Greece, Turkey, Syria, Lebanon, Cyprus, Egypt, Tunisia, Algeria, Morocco, Malta, Portugal, Spain, France, and Italy), and will contribute to the implementation of the aforementioned FAO global plan of action. From a list of the 40 most useful plants of the Mediterranean region as determined by the MEDUSA survey, at least half are part of the cork oak forest landscape (e.g. *Rosmarinus officinalis, Ceratonia siliqua, Quercus suber, Pinus pinea, Myrtus communis, Arbutus unedo, Pistacia lentiscus,* and *Lavandula stoechas*).

Rock-rose (*Cystus ladanifer*)
© Pedro REGATO

Pistacia lentiscus with mature fruits from Sardinia, Italy.
Wikipedia / G. Dessì

Box 1

The International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP)

The German Federal Agency for Nature Conservation (BfN), WWF, TRAFFIC, and the IUCN are jointly developing an international standard for good practice in the sustainable wild collection of medicinal and aromatic plants (MAP). An international, interdisciplinary advisory group was formed to involve relevant stakeholders, from the conservation, social and economic development, and trade and industry sectors, in the process of developing and testing this standard. The principles and criteria proposed address ecological, social, and economic requirements for the sustainable collection of wild MAP. They include the long-term maintenance of wild MAP resources based on knowledge of species abundance, regeneration, and collection intensity; prevention of negative environmental impacts (on sensitive taxa and habitats); compliance with laws, regulations, agreements, tenure, and user rights; respect for traditional access rights of local communities; application of responsible management practices (a management plan, inventory, assessment and monitoring, transparency, participation of stakeholders, documentation); and the application of responsible business practices (market and buyer specifications, traceability of products, financial viability, training and capacity building of actors, and adequate safety and compensation for workers). The international standard is at present (2006) undergoing consultation and being updated with comments. The full process, including details of stakeholders consulted and drafts produced, can be consulted at www.floraweb.de/map-pro/

The growing demand within the very complex and dynamic market in wild plants requires an urgent response from a variety of stakeholders (governments, natural resource managers, local communities, NGOs, traders, and consumers) to reverse wild plant population decline and secure local livelihoods. The MERCATPAM initiative is an attempt to open up existing market for aromatic and medicinal plant producers and facilitate links with industrial sectors (essential oil and extract manufacturers, laboratories, agro-food industries, flavouring and essential oil manufacturers, etc.). It has been launched by the Forestry Technological Centre of Catalonia (CTFC), with the collaboration of the Catalan Association of Aromatic and Medicinal Plants Producers (www.mercatpam.com).

According to a number of international organizations dealing with Non-Timber Forest (NTFP) conservation and development needs (e.g. FAO, TRAFFIC, WWF, IUCN), efforts should focus on: trade monitoring; law enforcement; clarification of forest users' rights and access to wild plant resources; promotion of sustainable harvesting techniques and NTFP's management programmes; improvement of marketing and trade opportunities; promotion of community-based small scale enterprises and/or associations; training local actors all along the chain of production steps, from harvesting to quality control and marketing; public awareness initiatives; research in semi-domesticating or domesticating wild resources; enhancement of cultivation efforts; and certification of plant material from sustainable sources.

Myrtus communis with flowers. El Feidja National Park, Tunisia. © WWF-Mediterranean / Xavier ESCUTE

Myrtle: products and uses

Myrtle (*Myrtus sp.*) is a genus of two shrub species from the family *Myrtaceae*, native to the Mediterranean region. The Common myrtle *(Myrtus communis)*, is widespread in the lowland and warm areas surrounding the Mediterranean region. The other species, the Saharan myrtle (*M. nivellei*)[1] is restricted to the Tassili n'Ajjer mountains in southern Algeria and the Tibesti Mountains in Chad, where it occurs in small areas of sparse relict woodland in ravines, canyons, and seasonally-dry water courses.

The Common myrtle is an erect, multi-branched evergreen shrub or small tree, up to 5 metres in height, which appears all around the Mediterranean basin as a companion species in mature sclerophyllous[2] forests and woodlands and as a co-dominant species in mature maquis.[3] Myrtle grows profusely in the western Mediterranean cork oak (*Quercus suber*) forest landscapes under acid soil conditions. All plant parts are aromatic: the leaves, 3-5cm long, are ovate-lanceolate, acute, entire, coriaceous, and distinctively punctate, especially when looked at against the light, with a pleasant fragrance when crushed. The flowers have five sweet-scented white petals, and a large number of stamens. The fruit is a reddish-blue to violet berry, 0.6—1cm long, containing several seeds (Paiva 2001). Flowers are pollinated by insects and the seeds dispersed by birds, mammals and ants which feed on seed glands.

Several subspecies and varieties were described from this very variable species, but none of them is nowadays accepted by taxonomists. The species has been intensively cultivated widely since ancient times, which might explain its high variability once crop varieties became wild again. *Myrtus communis* subsp. *tarentina* (L.) Nyman, with smaller leaves (less than 2cm), is probably just an ancient cultivar which still persists in the coastal areas from eastern Spain to the Adriatic coast in the Balkans (Paiva 2001).

Box 2
Common names for myrtle and ancient traditions[4]

The Latin name *Myrtus* comes from the Old Greek *myrtos* (μύρτος) or *myrsine* (μυρσίνη) and many common names derive from it: *mirto* (Spanish, Italian, Portuguese); *murta* (Portuguese, Catalan, Sardinian); *murtra* (Catalan); *mirta* (Galician, Croatian, Serbian, Slovenian); *mirtia* = μυρτιά (modern Greek);); *myrte* (French, German); *mersin* (Turkish, also agaci) miortal (Irish Gaelic); *myrtle* (English); *myrt* = мирт (Russian); *mrdeni* =մրտենի (Armenian); *mourd* = مورد (Farsi). Spanish has another term for "myrtle" which is of Arabic origin: *Arrayán*, a medieval loan from Andalusian Arabic *ar-raihan* (الريحان), which derives from the Arabic noun *rih* (ريح), "odour". The term Raihan is still valid for "myrtle" in modern Arabic in North African countries and Malta (*rihan*), while in the eastern Mediterranean and Asian Arabic-speaking countries, it has changed its meaning to "basil". *Al-as* is the term for "myrtle" in the Classic Arabic and eastern Mediterranean Arabic-speaking countries, closely related to the Hebrew *Hadass* (הדס).
Other North-African names are: *Tarihant* (Berber); *Moqqo* for myrtle mature fruits (Jbala region, Northern Morocco); *halmus, aselmun, salmun* (Algeria) for myrtle fruits (Bellakhdar 1997).

1. This species is listed as endangered. However, some botanists are not convinced that *M. nivellei* is sufficiently distinct to be treated as a separate species.
2. The word comes from the Greek *sclero* (hard) and *phyllon* (leaf). Sclerophyllous plants generally resist dry and warm conditions well, making them successful in Mediterranean areas with rainy winters and hot dry summers.
3. A vegetation formation characterized by woody plants of low stature (1—4 metres high), impenetrable because of tough, rigid, interlacing branches, with evergreen, thick leaves.
4. From Kazer (2006) website.

Box 3
Traditions and Beliefs[5]

Myrtle was a holy plant in ancient civilizations: the Persians considered it to be sacred to the supreme god Ahura-Mazda, while the Greeks considered it to be sacred to Aphrodite. The tradition of brides wearing a crown of myrtle on their wedding day was common in Ancient Greece. Myrtle was also carried by ancient Greek colonists when settling new territories. In Muslim tradition, myrtle branches are used to wash and cover dead bodies and to place on graves the 27th day of Ramadan. Myrtle was a symbol of love and peace to the Jews and is still much prized for use in wedding bouquets. The myrtle branches and leaves are used along with other species during the Jewish holiday of Sukkot.

Also, myrtle has been used in the production of drinks since ancient times. The first mention of the black wine (vinum myrtitem or vino nero) comes from Catone in De Agricoltura and his recipe has been cited by many authors, Plinius and Moris (1840) among them. His recipe states that this wine is obtained by the immersion of dried myrtle berries in the shade in grape juice. Also, Columella in De re rustica insisted that myrtle wine was very useful against dysentery and a "weak stomach". According to this author even if the berries were mashed up, the seeds should be intact. Honey could also be added to produce wine (Coda 1998).
Columella also said that a pound of berries should be added to grape juice for every amphora of wine produced. Then the grape juice and berries should be boiled, filtered well, and put in sealed amphora.

Traditional and modern uses[6]

Edible Uses: Fruits can be eaten raw or cooked. Dried leaves and fresh fruits and flower buds are used to flavour dishes, sauces, syrups, etc. An essential oil from the leaves and twigs is used as a condiment, especially mixed with other spices. The flowers and flower buds have a sweet flavour and are used in salads. Myrtle leaves are used as a substitute of tea. In medieval Arabic Spain and the Maghreb, myrtle fruits and leaves were used to prepare syrup. In Sardinia, a digestive liquour called *mirto* is made by macerating myrtle berries or leaves in alcohol.

Medicinal uses: Herbalists distinguish between "red myrtle" (*rihan ahmer*) which are sun-dried leaves, and "green myrtle" which are leaves dried in the shade. Leaves can be used fresh or dried (infusion or powder) as a balsamic, an astringent, a haemostatic, and a tonic. Fruit juice and boiled leaves are used to strengthen and dye hair dark. A leaf infusion is also used in the treatment of conjunctivitis. Recent research has revealed a substance in the plant that has an antibiotic action. The plant is taken internally in the treatment of urinary infections, digestive problems, vaginal discharge, colds, bronchitis, sinusitis and dry coughs. Externally, the essential oil is used as deodorant, and in the treatment of acne, wounds (antiseptic), gum infections (gingivitis), haemorrhoids, and rheumatism. The fruit is carminative.[7] It is used in the treatment of dysentery, diarrhoea (also boiled "red leaves") and internal ulceration.

Cosmetic uses: An essential oil from the bark, leaves, and flowers is used in perfumery, soaps and skin-care products. A popular 16th century skin lotion known as *eau d'ange* is obtained from the flowers.

Other uses: The plant is very tolerant to regular clipping and can be grown as a hedge in gardens. Wood is used for carving and produces high quality firewood and charcoal. The foliage and wood are strongly aromatic, retaining this fragrance when dried, and very rich in tannins, once used for tanning. Domestic herbivorous animals also eat myrtle berries and shoots (Bullitta and Spanu 1976). Myrtle flowers also have important melliferous properties, contributing to a very high quality maquis, multi-flower honey.

5. Several sources: Bellakhdar (1997) Ribera and Obón (1991); Plants for a Future (2006) website.
6. Extracted from several sources: Cervelli (2004); Plants for a Future (2006) website; Rivera and Obón (1991).
7. A carminative substance helps reducing intestine motility and flatulence.

Biodiversity: benefits and risks

Mature myrtle maquis are sheltering places for rare mammals such as Barbary deer (*Cervus elaphus barbarus*), as well as an important nesting place for several important[8] bird species (e.g. Sardinian warbler *Sylvia melanocephala*, Dartford warbler *Sylvia undata*). In fact, the number of passerine species and the total number of bird species increase in mature maquis and woodlands, especially species feeding and nesting in shrubs (Santos 2000).

Myrtle berries are also important in the diets of many birds, mammals (e.g. Barbary deer, fox, weasel) and ants. Ants feed on a fleshy and edible appendage of myrtle seeds called *elaiosome*. After the passage of myrtle fruits through the digestive system of mammals and birds, the elaiosome remains intact in the seeds, and available for feeding ants. The elaiosome's removal from the seeds seems to activate germination (Ciccarelli *et al*. 2004). Actually, myrtle-seed germination is enhanced if berries are eaten and pass through the digestive system.

Myrtle also plays an important role in increasing the cork oak forest landscape's resilience against major disturbances like forest fires. In fact, myrtle and other predominant maquis species (e.g. strawberry tree *Arbutus unedo*, lentisk *Pistacea lentiscus*) are able to re-sprout from the plant stock or roots and rapidly grow after fire, preventing erosion and facilitating the ecosystem and many species recovery. Mature myrtle stands also provide shadow and fresh conditions where sensitive plant species can regenerate and grow.

Like other important plant species from cork oak forest landscapes, myrtle can have several compatible uses, which together help diversify and increase local people's revenues: essential oils, jam from berries, honey, liquor, ornamental flowers, etc. This paper will provide two cases from Tunisia and Italy, each of them focusing on a myrtle product with significant local, national, and international market values.

Box 4
Myrtle plant-nursery production techniques[9]

Myrtle plants can be produced in a plant-nursery either from seeds or from cuttings:

Seeds:

Berries must be gathered when mature (November-December). Remove the berry pulp, wash the seeds, and eliminate floating ones. Seeds can be dried (less that 10% humidity) and gathered in hermetic recipients for a number of years. Number of seeds per kilogramme of berries: 150,000—250,000
Germination is frequently high (50—80%) with no treatments. Cold stratification for 3—6 weeks may increase seed-germination ability, becoming more simultaneous in all seeds.
Sowing should take place in late autumn immediately after the berries are picked, or in spring (stratified dormant seeds). Extend seeds on a seedbed and cover with a very thin layer of light and porous substrate. Allowing sunlight through activates germination. Germination takes place in 20 days with an optimal temperature of 25ºC. Transfer seedlings to new substrate. The earlier growing stages are quite slow, and therefore shadow conditions (60%) are recommended during spring and summer.
The following year, plant them out into their permanent positions in late spring or early summer after the last frosts.

Cuttings:

The use of plants produced from cuttings of selected cultivars facilitates the standardization of final product quality. It also allows the production of vigorous plants with precocious fruitiness (after one year). Ways of increasing root growth are needed (e.g. warming the lower part of cuttings and root phyto-regulators).
Cuttings may proceed from buds or rooting parts, (7—10cm with a heel in July/August). Cuttings are potted up in the autumn and winter in a cold frame in a shaded and frost-free frame. Plant out in late spring or early autumn.

8. Selected from the 102 focal bird species which characterized important forest areas in the Mediterranean region (WWF Forest Gap Analysis Database).
9. Several sources: Garcia-Fayos et al. (2001); Plants for a Future (2006) website; Cervelli (2004).

The case of myrtle distillation in the Kroumerie and Mogod Ranges (Tunisia)

Summary table

Name of the initiative	Groupement Forestier d'Intérêt Collectif (GFIC de Gouaria)
Location	Kroumerie region, Tunisia
Surface of the initiative	800ha of myrtle in the Gouaria forest. Estimated 250ha harvested per year
Year of creation	2004
Type of exploitation and infrastructures	Craft management system: GFIC workshop, alembics, sickles, glass containers.
Number of potential workers	13 temporary workers for the recollection three temporary workers for 45 days for the distillation process
Products sold	Myrtle essential oil
Distribution process and advertising	Distribution through drug manufacturer No advertising
Certification labels	None
Initial investment	Approximately €30,000 for GFIC equipment, training and initial production
Yearly estimated revenue	Approximately €4,950 per GFIC. Net revenue of €1,117 per GFIC
Yearly estimated costs	Approximately €3,200 (including income for daily paid workers and auction costs)
Risks to sustainability	GFIC constraints in obtaining fair and competitive conditions for NTFP commercial exploitation rights for forest inhabitants' groups

Context

Non-timber forest products (NTFP) have an outstanding environmental, social, and economic value in Tunisia. In the period 1990—2001, the total value of Tunisian exports of aromatic and medicinal plants increased from €4,797,200 up to €9,222,617.[10] This represents an average of 1,160 tons per year of plant materials, from which 90% of production goes to the European market and the rest mainly to US (Ministère de l'Agriculture de la Tunisie 2006).

In terms of essential oils and flower water, the largest productions in Tunisia are extracted from neroli (*Citrus aurantium*), rosemary (*Rosmarinus officinalis*), orange (*Citrus sinensis*), and at a lower level, myrtle (*Myrtus communis*), clove (*Eugenia cariophyllata*), white artemisia (*Artemisia herba alba*), and other native species (mint, thyme, wild rose, etc.). Myrtle represented in 2001 7% of Tunisian exports or an income of €645,000 (Ministère de l'Agriculture de la Tunisie 2006).

Gathering Myrtle leaves in El Feidja National Park. A traditional activity for the female population of north-west Tunisia.

10. Exchange rate used in this paper: €1 = 1.66763 TND (24 Sept 2006 at http://oanda.com/)

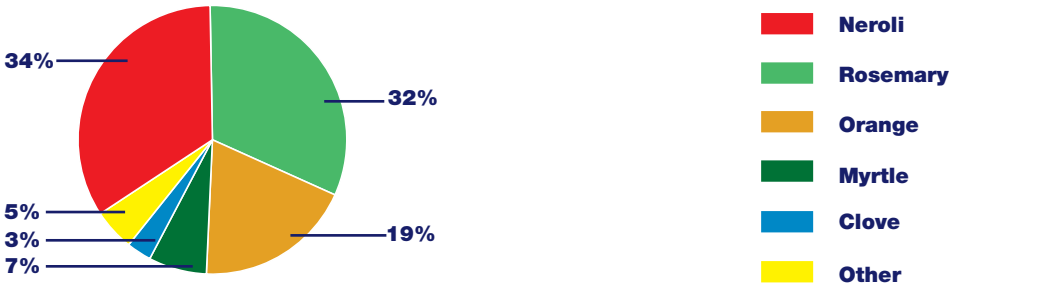


Figure 1. Percentage of essential oils and flower water extracted in Tunisia. (Ministère de l'Agriculture de la Tunisie 2006)

In the period of 1990—2001, the total value of Tunisian exports of these products has, almost incredibly, increased from €1.64 million to €44.63 million (Ministère de l'Agriculture de la Tunisie 2006). This represented a total production of 200 tons in 2001, of which 85% reached the European market.

The potential growth of medicinal and aromatic plant production in Tunisia is still high. In spite of this, wild plants and the ecosystems as a whole are facing important threats, which are similar across the Mediterranean region: over-exploitation, destructive harvesting techniques, habitat loss, and alteration and decrease in genetic diversity. It is estimated that myrtle vegetation cover in Tunisia has decreased by almost half since 1975 (from about 80,000ha to 44,250ha) (Bouziz and Helal 2003). Moreover, the trade in medicinal and aromatic plant species is largely unmonitored: a lack of information on yield sustainability and public awareness of trade and its impacts on natural vegetation mean that in many cases conservation measures only begin once it is endangered (Lange 1994).

The majority of aromatic and medicinal plant production in Tunisia comes from harvesting in the wild. With the exception of few native plant species (rosemary, thyme, etc.), aromatic and medicinal plant cultivation is limited to family orchards. In order to prevent over-exploitation and land degradation and to increase the production potential of aromatic plants, the Tunisian forestry department (Direction Générale des Forêts) has defined a set of management guidelines which are compulsory for enterprises and community groups or individuals participating in the annual public auctions selling NTFP harvesting rights in public forests. In the case of myrtle, the harvesting guidelines in Gouaria establish the following issues:

- Cutting period: every three years (the same for rosemary)
- Cutting tool: sickle (axes are forbidden)
- Size of branches: branches/buds of the year not exceeding 5mm diameter.

These harvesting guidelines can be modified in the annual call for tenders selling NTFP exploitation rights.

Box 5

Effects of biomass harvesting on wild myrtle in Sardinia

The University of Sassari (Dipartimento di Economia e Sistemi Arborei dell'Università degli Studi di Sassari) studied the effects of biomass harvesting on wild myrtle in the Mediterranean maquis. The study compared four harvesting scenarios: 1) manual harvesting of the fruits (control); 2) cutting the plant from the base; 3) cutting the plant at 80cm above the ground; and 4) cutting the branches as follows (in each plant): one third of the branches cut at the base, one third at 80cm above the ground, and one third not touched.

The results show that harvesting has effects on the production of biomass and fruits. Also, harvesting affects the protection of the soil and the proportion soil covered by myrtle/soil covered by other species. When plants have been cut at the base (scenario 2), fruits were not produced in the following year, total biomass was reduced, soil cover was reduced as well as the ratio of soil covered by myrtle/other species. The scenario 4 (mixed cutting) reduced fruit production in 60% of cases and had no effect on total biomass and on soil cover. Scenario 3 had intermediate effects between scenarios 2 and 4 (Mulas *et al*. 1999).

The common myrtle is distributed all over the Tunisian northern mountain ranges, from Cap Bon to the border with Algeria near Tabarka, becoming more abundant in the western half. In fact, the Kroumerie and Mogod cork oak landscapes host the largest populations of this aromatic plant.

Myrtle production is very variable, depending on the vegetation structure, myrtle density and growth rate in each forest/maquis stand where harvesting will take place. Plant material is collected from the wild, and the amount of myrtle brushwood gathered varies from 0.3 to 0.8 tonnes/ha. Myrtle collection is a typical gender issue, as harvesters are mainly women and girls who pursue this activity as a supplementary income, from harvesting or selling myrtle essential oil locally.

In Tunisia, all forest products belong to the state. The Tunisian forest code assigns non-commercial right of use to local communities living in forest areas for subsistence (mainly grazing, dead wood collection, and subsistence vegetable/fruit-tree crops). In exchange, local community members become responsible of eventual damages happening in the forest land where they operate, and have the obligation to participate as volunteers in forest fire extinction activities.

The right to exploit NTFP commercially is sold by the forestry administration through public auctions. NTFPs contribute up to 85% of income obtained by the sum of all local forest administrations in Tunisia. Annual public auctions for the whole surface covered by each forest product are launched by the Régie d'Exploitation Forestière (Forest Exploitation Department). Selling happens separately in each forest sector, organized by the local forest administration. In 2000, the surface of myrtle offered at auction by the forest administration was of 26,514ha (about half of the total surface in Tunisia), but only 9,145ha were finally bought. Buyers were asked to pay 4.3 Tunisian dinars (equivalent to €2.58) per hectare of myrtle.[11] These numbers give an idea of the potential of myrtle to increase local communities' revenues under sustainable management conditions and fair access rights.

Description of the initiative

During the 1990s, Tunisian forest law established an organizational mechanism, the *Groupement* Forestier d'Intérêt Collectif (GFIC), to help organise forest inhabitants and users into local associations to expand their right to participate in forest activities and open up commercial exploitation to them. In order to operate, GFICs must establish protocols with the local forest administration for the different forest activities in which they will participate. Unfortunately GFICs face a number of constraints when trying to exercise rights of use in the forest land where they live:

- Only forest products with small yields (e.g. Aleppo pine nuts, stone pine nuts) can be directly allocated by the local forest administration to GFICs without public auction
- GFICs cannot compete in public auctions with private enterprises: auction prices are too high for GFICs and they are obliged to pay the total cost in advance, as established by law (very difficult for new GFICs without savings)
- GFICs lack market know-how.

The operational mechanisms which may allow GFICs to compete with private enterprises in public auctions is still under debate. This will require changes in the rules of the game to be enshrined in law (e.g. auction prices for forest inhabitants and users organized as GFIC would be significantly lower than for outsiders; the number of NTFPs and yield levels open to direct allocation from the forest administration to GFICs may substantially increase).

A number of organizations (e.g. WWF/IPADE, GTZ, UNDP, and IUCN) are testing ways to make GFICs become real actors in the Kroumerie and Mogod sustainable forest management, and establish fair rights of use compatible with economically viable opportunities for local forest users.

With financial support from EU/SMAP (2000—3), WWF tried hard to establish a GFIC involving local people from the villages around El Feija national park in Kroumerie region. The GFIC was

11. Myrtle auction price per hectare varies significantly from year to year (e.g. 1.5 TND/ha in 1995; 2.3 TND/ha in 1996; 4.8 TND/ha in 1998; etc.)

Figure 2. Map of Tunisia and detail of the Kroumerie Mogod area

successfully established, becoming operational and self-sustainable, mainly in honey production (see box in Case 1 about products from apiculture), well organized, well accepted by local people, and empowered in terms of independence from the forest administration. GFIC members were equipped and trained in institutional development issues, honey and myrtle essential oil production, environmental issues linked to NTFP exploitation, sanitary production requirements, organic farming and marketing opportunities. Good results often depend on leaders putting in energy, imagination, enthusiasm, and courage in defending the process until it solidifies. This was the case in Feija, were the intermediary role of an NGO (WWF in this case), and the existence of one strong leader in the GFIC, helped break down walls and mistrust between local people and the forest administration, and empower GFIC members to take responsibility for the environmental impact of their production activities. But long-term sustainability will require effort on both sides:

- Awareness, involvement, and know-how from all community members, as GFIC members may change and success that is the result of one leader's efforts may not last long
- Fair and effective mechanisms (e.g. subsidies to reduce GFIC exploitation costs, etc.) to guarantee forest inhabitants right of use, competitiveness, and access to market opportunities, and empowering GFIC and/or other community-based NTFP management systems to make local people responsible for forest conservation.

The product

The leaves and flowers of myrtle contain an essential oil which can be extracted by steam distillation. Yield and quality depend on the region of production, the season of harvest, the nature of the plant material (oil yield using unselected material is 0.25—0.55%, but twice this when only fresh young leaves, flowering shoots, and twiglets are used, which also yield the highest quality oil), the method, and particularly the length of distillation. The oils most appreciated for their quality are those originating from Corsica (Bradesi *et al*. 1997). A constituent of myrtle oil is the unsaturated primary alcohol myrtenol, which has a warm woody odour and is used in perfumery and toilet preparations. The main components are normally alpha-pinene, 1.8-cineole and myrtenyl acetate, but regional variations occur.

Once myrtle branches are collected, they should be washed, drained, and stocked in places well away from air currents. The myrtle parts suitable for distillation are buds, leaves and flowers (the small branches should be removed). The distillation equipment should be kept under maximum hygienic conditions during the process. Myrtle essential oil should be kept in dark glass bottles to prevent damage from light.

Myrtle distillation in El Feidja National Park, Tunisia. © WWF-Canon / M .GUNTHER

Recycling waste material may be an important source of revenue: compost production and soap production (the water used in the distillation process keeps some essential oil and, if mixed with vegetable oil and caustic soda, produces scented myrtle soap) (Saidi and Yahia 2003).

Economic operators and production chain[12]

Myrtle essential oil production and trade can contribute to increase and diversify GFIC members' income. WWF/IPADE, with financial support from the Spanish Aid Agency (AECI), are supporting sustainable income opportunities for GFIC members resulting from a multi-purpose management plan in the cork oak and pine forests belonging to the Gouaria administrative forest sector (Kroumerie range).

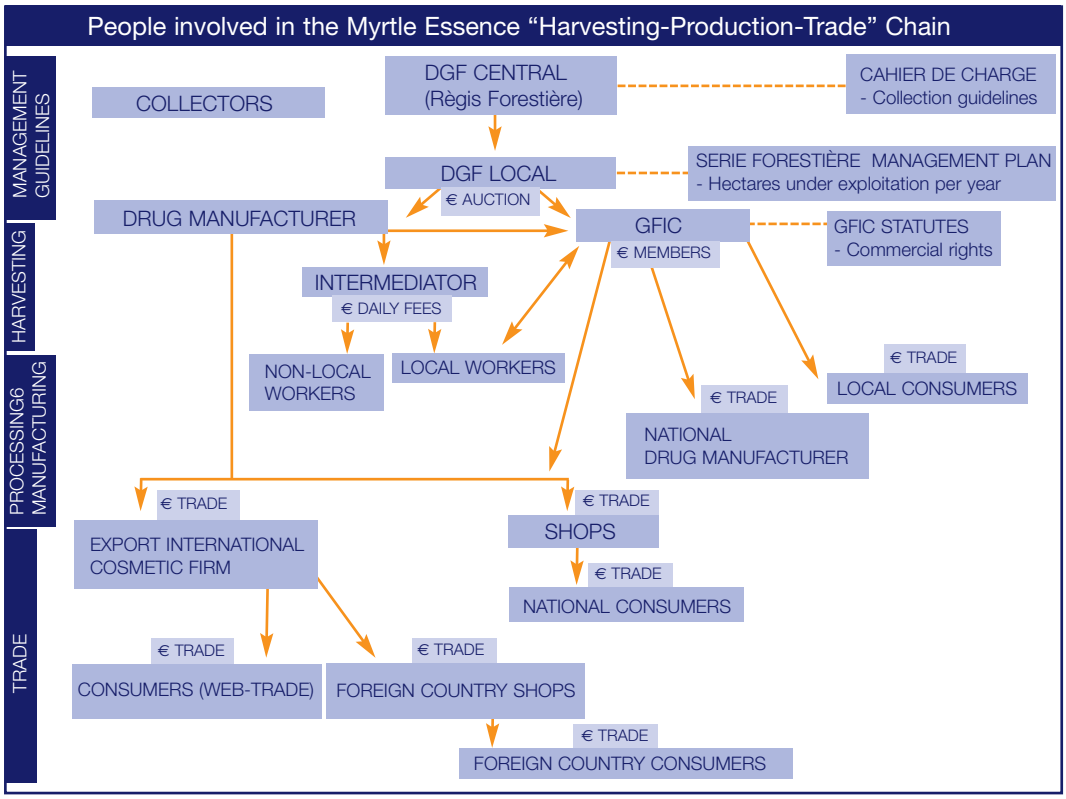


Figure 3. The chain of production of myrtle essential oil (black arrows are the current option, orange arrows the phase one option, and green arrows the phase two option).

12. Sources: Mhadbi 2003; Daly-Hassen 2002; Saidi and Yahia 2003.

The project implies changes in the current chain of production (Figure 3), in which local people act as day labourers, often competing with day workers hired by private enterprise elsewhere. Changes can be planned step by step:

- Phase one. A national cosmetic company acquires exploitation rights through public auction and sub-contracts harvesting and distillation to the Gouaria GFIC. GFIC members share savings from selling the product to the cosmetic firm and the GFIC itself will keep part of revenues to maintain and/or renew the GFIC workshop (equipment, electricity, etc.).
- Phase two. Once GFIC members are autonomous in terms of NTFP exploitation techniques and managerial and marketing skills, with a good mechanism for savings, the association can directly acquire exploitation rights and diversify product sales: locally (market places, GFIC workshop, local shops, El Feija national park centre, hotels, etc.), to national cosmetic companies or cosmetic shops, and to international cosmetic firms with fair-trade departments. In this case, part of GFIC revenues will need to cover the annual public auction costs for the forest administration. In order to become competitive with non-local private companies, the forest administration should establish incentives (e.g. lower auction costs for local inhabitants' associations, perhaps such as one dinar per hectare).

Economic value of myrtle essential oil

Myrtle extends over 800 hectares of Gouaria forest. Considering that myrtle is cut every three years, we can plan a rotation system with an annual harvest of about 250ha, with an average production of 400kg per hectare. It is estimated an average of 1.25 litres of essential oil/still (500kg of raw material), which implies a total amount of 250 litres of essential oil per year.

The exploitation of 250ha per year allows the creation of 13 temporary jobs each year with an average income of €210 per person. Distillation will require three professionals working an average of 45 days per year (with about €800 total income).

The GFIC selling price for myrtle essential oil to cosmetic enterprises could be of €19.8 /litre.[13] This makes a total revenue of €4,950, which may represent net income for the GFIC of about €1,120.[14] However, the final price paid by a European and North American consumer rises at about €120/litre (see websites selling myrtle essence oil).

Based on feasibility studies and enquiries undertaken by WWF and ODESYPANO (Office de Développement Sylvo-Pastoral du Nord Ouest, Tounisie) , a diversified local economy around a varied set of forest goods (Figure 4), may provide total income to Gouaria forest users (264 households) of about €76,000, with a net income for the Gouaria GFIC of about €18,500. This represents an average of 28% of total household income, very similar to other rural areas in Tunisia. Part of these NTFP production activities (apiculture and the different bee products; pine nuts; myrtle, lentisk,[15] and other aromatic plant essential oils; fresh and dry mushrooms) have a great potential to increase yields and number of processed products, which will result in higher incomes for local users and GFIC.

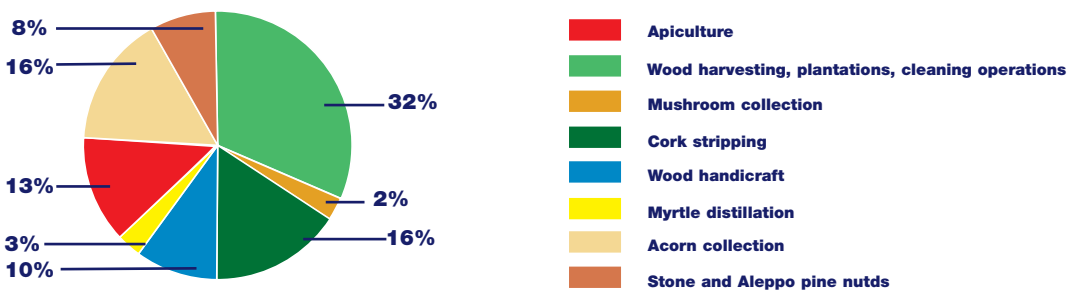


Figure 4. Percentage of income for local users derived from the different forest products in the Gouaria forest sector.

13. Data obtained from enquiries to some national cosmetic firms undertaken by ODESYPANO
14. €4,950 minus €2,730 (harvesting cost), €800 (distillation cost), €150 (auction cost), €150 (GFIC workshop maintenance) = €1,120 .
15. *Pistacia lentiscus* has a very valuable essence, much in demand in the cosmetic industry. GFIC could sell lentisk essence for about €12/litre..

Quality issues and labelling

Tunisia is exporting a number of NTFPs (e.g. cork, aromatic essentials, organic herbs) to the European market. As a response to the growing demand for organic products by European consumers the Tunisian government has developed a policy framework for organic products to comply with EU regulations. A National Commission for Organic Agriculture was established in 1999 and a certification authority (BIOCERT Tunisia) was created, connected to the Institut National de la Normalisation et de la Propriété Industrielle. Subsidies to cover 30% of the investments of organic farmers and 70% of certification costs over five years are provided by the agriculture ministry. Measures are being taken to encourage farmers to convert to organic production while remaining competitive. A Technical Centre for Organic Agriculture is being created to support training and research (Scialabba 2000).

Barbary deer (*Cervus elaphus barbaricus*), running through a field. It is the only deer species indigenous to Africa. El Feidja National Park, Tunisia.

The case of myrtle liquor production in Sardinia

Summary table

Name of the initiative	Associazione Produttori Mirto di Sardegna
Location	Sardinia (Italy)
Surface of the initiative	600,000ha of myrtle maquis in Sardinia
Year of creation	1994
Type of exploitation and infrastructures	Six small to medium family factories
Number of workers	800 seasonal pickers and an unknown number employed in processing and selling the final product
Products sold	Myrtle liquor
Distribution process and advertising	Local shops in the island. Export to other areas of Italy
Certification labels	ISO 9000 standards Mirto di Sardegna Tradizionale quality label
Initial investment	Unknown
Yearly revenue	Final market price per bottle €7.5—9.8. Approximately net revenue for producers €0.7—1.2/litre and for sellers €0.8—2.6 /litre
Yearly costs	Approximately €6—7/litre
Risks to sustainability	Over-harvesting is prevented by controlled harvesting methods and cultivation

Context

In the first half of 20th century, the medicinal and aromatic plant production sector in Italy was promoted mainly for domestic consumption and the incipient export market. More than 230 plants species were grown at that time to supply the sector. The growing demand for natural products in the 1970s significantly increased the direct (consumption) and indirect (environment, tourism) values of medicinal and aromatic plants. In spite of this, Italy has a negative balance of trade, with about 90% of consumed products being imported from abroad (Laghetti 1993).

The majority of wild plants harvested or produced in Italy go to the liquor sector (30%), followed by the pharmaceutical sector (24%), the cosmetic sector (16%), the herbalist sector (14%), the food sector (12%), the homeopathic sector (3%) and the dying sector (1%) (data from the Ministero per le Politiche Agricole e Forestali 1999). Most Italian production derives from harvesting in the wild and only a small part is cultivated: about 113 plant species over more than 3,300ha in the late 1990s (Nicola *et al*. 2004).

Description of the initiative

The production of myrtle liquor is an ancient traditional activity in Sardinia, developed by families for their own use or barter. In recent decades, Sardinian farmers showed a growing interest in diversifying their income through aromatic and medicinal-plant production. A great expansion of myrtle liquor production took place in the 1990s due to a number of important factors:

- Industrialization and the efforts of the Sardinian government to stimulate well-qualified myrtle liquor production enterprises and strengthen their production capacity through incentives (equipment, etc)

- Marketing by Sardinian enterprises to make liquor myrtle a well known and appreciated product all over the country

- Growing demand for myrtle liquor and essential oils by Italian consumers, not only as a high quality edible product but for the added value of tradition linked to ecological and cultural tourism. Today, approximately 15 small and medium private enterprises produce myrtle liquor in Sardinia,

with a total production of about 2 million litres (mainly red myrtle liquor) and a total trade value of €12 million (Sardegna Industriale 2006). In order to secure the quality of the product, six enterprises formed a producers' association in 1994 and, in collaboration with the Chamber of

Commerce of Cagliari and the University of Sassari, promoted a quality mark, Mirto di Sardegna Tradizionale (Traditional Sardinian Myrtle), which guarantees the ingredients of the ancient liquor recipe. Since 1997, the myrtle liquor market has grown by an average of 1.7% every year (the myrtle producers association is responsible of the highest increase), becoming a very promising sector in expansion. The annual wild harvesting and crop production of Sardinian myrtle berries is not enough to guarantee liquor production. Myrtle cultivation has existed since the first half of the 20th century, nowadays covering about 162ha in Sardinia. In order to cover growing market needs, the Sardinian myrtle sector is focusing on the import of myrtle berries from Morocco and Tunisia and on plantation of highly productive varieties or genotypes of myrtle, selected through research work undertaken at the University of Sassari.

Another constraint to the industry's supply of wild berries is related to fruit quality, which is highly inconsistent between years and locations. In order to optimise production in wild myrtle vegetation and avoid over-exploitation, the following issues should be carefully addressed (Mulas 2005): determination of wild myrtle yield potential and biomass harvesting sustainability; elaboration of management models for wild myrtle collection, respecting natural vegetation dynamics; and the elaboration of agro-forestry techniques for myrtle cultivation.

Myrtle cultivation systems should be developed, in order to assure both a constant supply of good quality material for the liquour industry and the preservation of natural myrtle populations. Cultivar selection is essential for its successful cultivation and has been the main goal of researchers from the University of Sassari. Seven myrtle varieties particularly suitable for being cultivated (1—1.5kg berries per plant) were identified, and more than 50ha of experimental crops have been installed, which may guarantee an average production of 1.25m kilogrammes of berries (Sardegna Industriale 2006). Organic cultivation is always recommended for these small-scale productions. Myrtle is also highly suited to restoring degraded land.

Current myrtle crops follow the same agro-forestry criteria as those used in olive-crops and vineyards.[16] The number of plants per hectare is about 3,000, in lines and 3-3.5 metres apart. In a few years myrtle plants may form continuous hedge lines, which may require pruning. The University of Sassari is testing a growing system which may be more suitable for fruit harvesting. Three to four irrigations during summer may significantly improve fruit production.

The product

Myrtle berries picked and ready to prepare myrtle liquour
Wikipedia / G. Dessì

There are two kinds of myrtle liquor depending on the process of production and the parts of the plant used. Red myrtle is produced from the berries and white myrtle is produced from fresh leaves and buds.

To prepare red myrtle liquor, myrtle berries are washed in cold water to make sure they are processed under the necessary hygienic conditions. Berries are then stocked in steel silos with pure alcohol where they may remain steeped for up to six months. In some cases, berries are slit to facilitate alcohol spreading inside them. All processing steps are carried out at low temperatures, helping maintain the intense taste of berries in the final product.

16. http://it.wikipedia.org/wiki/Myrtus_communis

The liquid is then removed from the silos and separated from the solids. The solid parts are then rinsed in water to recover the remaining alcohol from the berries, which is then added to the extracted liquid. The alcohol content of this product is not less than 50%. Before bottling, the liquid is sweetened with sugar or honey or both and brought to the desired alcohol content (not less than 30%) by adding demineralized water. As a last step, natural filters are used to render the liquor more transparent and sparkling, ready for bottling.

White myrtle liquor is prepared in a hermetically sealable container with fresh leaves and buds gathered during late spring and early summer (in at least half the container's volume), sugar and the same quantity of alcohol and water. The container is shaken strongly and then left for 10 days (not longer as the leaves' tannins may generate a bad taste or toxins). The resultant liquid is filtered and it is then ready for consumption.

Economic operators and production chain[17]

Myrtle berries are collected from early December till the end January. Professional pickers gather berries from the wild and then sell them to processors. The berries are picked from wild plants growing in more than 600,000ha of Sardinia by passing large "combs" over the branches and the berries fall into containers at the base of the plant. Great care is taken not to damage the shrub (breaking branches is illegal). Another system used for picking involves hitting the branches with a stick. After picking, cleaning operations begin. Berries are lifted up to help the wind separate berries from any waste material, such as dry leaves or twigs. This operation may be carried out in the field or in buildings equipped with powerful fans. Once they have been cleaned, the berries are put into jute sacks which enable ventilation, letting the berries transpire and keeping them dry.

Eight-hundred pickers, members of the *Flora Spontanea Association*, gather and sell about 400,000kg of berries, representing a total income of about €800,000. The collection of myrtle berries is allowed in public forest land with very few limits (e.g. avoiding damage to green biomass). Plant cutting is theoretically forbidden but occasionally pickers do it.

Box 7
The composition of myrtle berries

Mulas *et al*. (2000a) analysed the morphology, biometrics and chemistry of 12 samples of commercial myrtle berries from different locations in Sardinia. The average fresh weight of a berry was around 42.1 to 81.6mg with a percentage of 62.7% to 69.9% of dry matter. Seeds represented between 15.6% and 25.4% of the fresh fruit.
When analysing the chemical composition of the fresh pulp of mature myrtle berries (Scortichini 1986a), 9.4% corresponded to sugars (analysed by the Fehling method) and 0.5% corresponded to proteins. Vitamin C (ascorbic acid) was of 12.4 mg/g of pulp, and 0.35% corresponded to malonic acid. However, variation on this composition is possible, especially when considering fruits in different maturation states. Colouration depends on pigments like anthocians. Analysis with HPLC after extraction with methylic alcohol (Franco *et al*. 1998) found 950 to 2900mg of anthocians per kilogramme of berries. The variation in colouring also depends on the variation of the hydroalcoholic strates of the fruits and seems to be related to the ecotypes (Mulas *et al*. 1998). Flavonoids (also analysed with HPLC) found are myricetine, quercetine, kampferol and patuletine. Flavonoids are found in the skin (90%), in the pulp (8%) and in the seed (2%, mainly quercitine).

17. Sources www.it.wikipedia.org/wiki/Liquore_di_mirto; Mulas 2005; Associazione Produttori di Mirto de Sardegna 2006; Sardegna e Dintorni Nº 23, Dec 2003.

Quality issues and labelling

Myrtle liquor from Sardinia with the quality trademark Liquore Mirto di Sardegna Tradizionale from the Associazione Produttori. © X. JULIA

In 1997, the Association obtained the registration of the Liquore Mirto di Sardegna Tradizionale — Associazione Produttori (Traditional Myrtle Liquor from Sardinia — Producers Association) trademark from the Italian patent and office of the Ministry of Industry, Trade and Crafts (Rau 2005). The production requirements which secure the myrtle liquor quality standards are supervised by a technical committee, involving representatives from the industry and research institutions (University of Sassari and University of Cagliari). This trademark only identifies those bottles certified by the producers association. The association has also implemented the HACCP self-control system for the prevention of hygienic and sanitary hazards in 2000, and has obtained Quality Certification according to ISO 9000 standards. Berries must come from the Sardinian region and no flavouring and/or colouring can be used.

The Association submitted a request to the European Commission (EC) to include myrtle liquor from Sardinia in the list of alcoholic drinks recognized by the European Union. Pending EC recognition, myrtle liquor from Sardinia was added in 2000 to the list of traditional products recognized by Italian national regulations.

Figure 5. Website of the Associazione Produttori, www.produttorimirtodisardegna.it

Economic value of myrtle liquor

The economy and tree-systems department at Sassari university (Sardinia) has undertaken research about average myrtle liquor production costs and benefits obtained by small to medium enterprises. The total production cost per litre is of about €6, with the highest costs linked to salaries (€1.25), alcohol (€1.85), packaging (€0.72) and raw material/berries (€0.52). Considering a final market price per bottle of about €7.5-9.8, benefits for producers can range from €0.66 to €1.199/litre, while sellers can get €0.8—2.58/litre.

Based on this research, we may conclude that myrtle liquor producers, especially in the case of small family enterprises, have low profit margins. The main constraints linked to benefits are linked to alcohol costs, salary costs, and raw material costs. It seems that raw material costs can be substantially reduced if the enterprises grow their own myrtle plants by settling rational myrtle berry crops. The production of berries in the myrtle plantation seems to progressively increase from the fourth year to the 13th year, reaching a maximum production of 2.5kg per plant, which remains the same until the 30th year. The family enterprise would be able to recover the myrtle plantation investments costs after nine years, a bit less than one third of time to the end of the production cycle.

Myrtle crops would also help the family enterprise diversify myrtle products, for instance by producing myrtle essential oils.

Author

Dr Pedro Regato
Associate Professor at the Universidad Politécnica de Madrid (Spain). Former head of the Forest Unit at WWF-Mediterranean Programme.
E-mail: pregatopajares@yahoo.es

Information sources and bibliography

Quoted literature and websites

Associazione Produttori di Mirto de Sardegna (2006) web site: www.produttorimirtodisardegna.it

Bellakhdar, J. 1997. *La pharmacopée marocaine traditionnelle*. Ibis Press.

Blanco and Breaux. 1997. Results of a study of commercialization, exploitation and conservation of medicinal and aromatic plants in Spain. Unpublished report for Traffic Europe via Lange, D. 1998. *Europe's Medicinal and Aromatic Plants: their use, trade and conservation.*

Boelens, M H, and Jimenez, R. 1992. The chemical composition of Spanish myrtle oils. Part II. *Journal of Essential Oil Research* 4: 349-353.

Bouziz, A, and Helal, S. 2003. *Etude sur le Développement des Produits Forestiers Non Ligneux*. FAO. Available at www.fao.org/DOCREP/005/Y4496E/Y4496E16.htm

Bradesi, P et al. 1997. The chemical composition of myrtle essential oil from Corsica. *Journal of Essential Oil Research 9*.

Bullitta, P and Spanu, A. 1976. La macchia mediterranea una fonte di alimentazione per il bestiame. *L'Informatore Agrario* 31: 23571-23574.

Centre Tecnològic Forestal de Catalunya (Spain): www.ctfc.es

Cervelli, C. 2004. *Le specie arbustive della macchia mediterranea: un patrimonio da valorizzare*. Sicilia Foreste. Ed. Dipartimento Azienda Regionale Foreste Demaniali.

Ciccarelli, D et al. 2004. The role of the elaiosome in the germination of seeds of Myrtus Communis L. (Myrtaceae). *Atti Società Toscana Scienze Naturali Memorie B, 111.*

CIHEAM. International Centre for Advanced Mediterranean Agronomic Studies: www.ciheam.org

Coda, L. 1998. *Il liquore di mirto: aspetti storici e tradizione*. Caratterizzazione del liquore 'Mirto di Sardegna' tradizionale, aspetti storici, geografici, tecnico-economico-gestionali e chimico-merceologici: 12-14.

Daly-Hassen, H. 2002. Etude visant l'élaboration de plans de gestion des terroirs des GFICs de Gouairia, Feidja et Ouled Khemissa. Unpublished report GTZ-ODESYPANO-CRDA Jendouba

FAO 1995. Trade restrictions affecting international trade in non-wood forest products. Non Timber Forest Products series number 8. Forestry Department. FAO. ISBN 92-5-103767-1. Available at: www.fao.org/docrep/V9631e/V9631e04.htm

FAO 1996. Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. Available at: www.fao.org/ag/AGP/AGPS/GpaEN/gpatoc.htm

FAO 1999. Global Action Plan for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture.

Garcia-Fayos et al. 2001. *Bases ecológicas para la recolección, almacenamiento y germinación de semillas de especies de uso forestal de la Comunidad Valenciana*. Banc de Llavors Forestals. Valencia. Available at : www.cma.gva.es/contenidoHtmlArea/mostrar.aspx?idioma=C&Nodo=4355

Giuliani, A and Padulosi, S. 2005. *Enhancing the value chain for markets for traditional producers of neglected and underutilised aromatic, vegetable and fruit species in the Near East: a pilot study in Syria*. ICARDA International Conference, Syria.

ISSC-MAP. T*he International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants* at www.floraweb.de/map-pro/

Kazer, G. 2006.Gernot Kazer's spice pages: web page about myrtle common names in many different languages: www.uni-graz.at/~katzer/engl/Myrt_com.html. Consulted in November 2006.

Laghetti, G *et al*. 1993. Germplasm of medicinal and aromatic plants from Italy. I*SHS Acta Horticulturae* 344: International Symposium on Medicinal and Aromatic Plants.

Lange, D. 1994. *Europe's Medicinal and Aromatic Plants: Their Use, Trade and Conservation*. Traffic. Available at: http://www.traffic.org/plants/species-15.html

Lawrence, B M. 1990. Progress in essential oils. *Perfumer & Flavorist* 15: 63-69.

Mhadbi, F. 2003. E*tude de faisabilité de l'activité de distillation au niveau de la région du parc national d'El Feija*. Unpublished report WWF-CRDA Jendouba.
Mavi Boncuk (2006) archives at
www.mbarchives.blogspot.com/2006/08/turkish-bulb-trade-cyclamen-mirabile.html

Mazza, G. 1983. Gas chomatographic-massa investigation of the volatile components of myrtle berries (Myrtus communis L.). *Journal of Cromatography* 264: 304-311.

MEDUSA web site www.medusa.maich.gr/about/ consulted on the 12 December 2006.

MERCATPAM (2006) website www.mercatpam.com/english/index0.php.

Ministère de l'Agriculture de la Tunisie. 2006. *Résumé de l'étude sectoriel sur la culture des plantes aromatiques et médicinales*. Ministère de l'Agriculture et des Ressources Hydrauliques, Agence de Promotion des Investissements Agricoles. Available at : www.tunisie.com/APIA/aromaticplante.pdf

Ministerio per le Politiche Agricole e Forestali. 1999.

Moris, J H. 1840. *Flora Sardoa seu Historia plantarum in Sardinia et adjacentibus insulis*. Vol. II Torino.

Mulas, M, Cani, M R, and P Deidda. 1998a. Osservazioni sulla biologia per la domesticazione del Myrtus communis L. *Collana di studi : Mirto di Sardegna tradizionale, 93*.

Mulas, M, Cani, M R, Brigaglia, N and P Deidda. 1998b. Selezione varietale da popolazioni spontanee per la coltivazione di mirto e corbezzolo in Sardegna. *Frutticoltura* 3: 47.

Mulas, M, Perinu, B, and A H D Francesconi. 1999. Effetti della raccolta di biomassa da piante spontanee di mirto sulle formazioni a macchia mediterranea. *Atti della Giornata di Studio sul Mirto. Sassari, 30 giugno 1999.*

Mulas, M, Spano, D, Biscaro, S and L Parpinello. 2000. Parametri di qualità dei frutti di mirto (Myrtus communis L.) destinati all'industria dei liquori. *Atti del 4° congresso Italiano di Scienza e Tecnologia degli Alimenti. Cernobbio (CO), 16-17 settembre 1999: 451-460.*

Mulas, M *et al*. 2005. *Terza Giornata di Studio sul Mirto*. DESA Ed. Sassari.

Nicola, S *et al*. 2004. Medicinal and aromatic plants in Italy: situation and perspective for the Piedmont. I*SHS Acta Horticulturae* 629. XXVI International Horticultural Congress: The Future for Medicinal and Aromatic Plants.

Paiva, J. 2001. Género Myrtus. *Flora Ibérica Vol. XIV.* Madrid: Real Jardín Botánico, CSIC

Peana, I. 2000. A*nalisi qualitativa dei frutti prodotti da piante di mirto spontanee e coltivate*. Tesi di laurea in Scienze Agrarie presso l'Università degli Studi di Sassari: 34.

Plants for a Future (2006). Database Report at www.pfaf.org consulted in November 2006.

Rau, R. 2005. Stato del comparto industriale del mirto. In: *Terza Giornata di Studio sul Mirto*. DESA Ed. Sassari.

Rivera, D and Obón, C. 1991. *La guía de las plantas útiles y venenosas de la península Ibérica y Baleares*. Ed. Incafo.

Saidi, Y and Yahia, K. 2003. *Unpublished report of the training on distillation of aromatic plants, part of the SMAP project 'Conservation and Management of Biodiversity Hotspots : Developing a Mediterranean Network in the Mediterranean. Feija National Park, Tunisia'*. WWF-Mediterranean and Ministère de l'Agriculture et de l'Environnement et de l'Hydraulique, CRDA Jendouba, Arrondissement Forêts Jendouba.

Santos, C P. 2000. Succession of breeding birds communities after abandonment of agriculture fields in SE Portugal. *Ardeola* 47(2).

Sardegna Industriale (2006). www.SardegnaIndustriale.it consulted on the 5 October 2006.

Scialabba, N. 2000. Factors influencing organic agriculture policies with a focus on developing countries. *IFOAM 2000 Scientific Conference, Basel, Switzerland.*

Scortichini, M. 1986. Frutti minori dell'ecosistema mediterraneo. *Frutticoltura*, 48 (6/7): 37-44.

Vantomme, P. 2001. P*roduction and Trade opportunities for Non-Timber Forest Products, particularly food products for niche markets*. Expert meeting UNCTAD, Geneva.

Pistacia lentiscus with mature fruits from Sardinia, Italy.
© Wikipedia / G. Dessì

Ancient carob tree in the Algarve (Portugal) © WWF-Mediterranean / Xavier ESCUTE

Case 5 Semi-domesticated Mediterranean forest systems: the carob tree

Context

The scientific name of carob tree (*Ceratonia siliqua*) derives from the Greek *keras* (horn), and Latin *siliqua* (long pod), alluding to the hardness and shape of the pod. The common name originates from the Hebrew *kharuv*, from which are derived the Arabic *kharrub* and later *algarrobo* or *garrofero* in Spanish, *carrubo* in Italian, *caroubier* in French, *karubenbaum* in German, *alfarrobeira* in Portuguese, *charaoupi* in Greek, *charnup* in Turkish, and *garrofer* or *garrover* in Catalan. The carob is also known as St John's Bread or locust bean in reference to the presumed use of its "locusts" or beans as food by St John the Baptist, and from that derives *Johannisbrotbaum* in German (Batlle and Tous 1997).

The carob tree is an evergreen species from the *Fabaceae* family, between 5m and 15m high and with a dense and rounded crown. Leaves are pinnate, 10—20cm long, with coriaceous leaflets. There are male and female individuals, although some hermaphrodite trees may present bisexual flowers. Flowers are small and numerous, spirally arranged in long racemes, borne on the tree trunk and branches (cauliflory). The fruit is indehiscent, a thick; long, wide pod that is compressed and slightly curved. Pods have a soft inner part, consisting of a sweet and delicious edible pulp. Numerous very hard seeds are separated by this pulp. Both pulp and seeds are used in industry.

Many basic aspects of carob reproductive biology remain largely unknown. It is difficult to find trees with the three flower types (male, female, and hermaphrodite) in natural populations in the same area. For instance, the frequency of hermaphrodite forms is higher in the Balearic islands and in the east of the Iberian peninsula than in its western part. Moreover, different forms of males are described, often locally named after their anther colour. According to experience, female trees (originally female trees or grafted on to male trees) are more productive than hermaphrodites (Batlle and Tous 1997; personal experience of the case-study authors).

Detail of green carob pods in the tree. Algarve (Portugal)
© WWF-Mediterranean / Xavier ESCUTE

Detail of hermaphrodite flowers in a carob tree. Algarve (Portugal)
© WWF-Mediterranean / Xavier ESCUTE

Like other Mediterranean trees and shrubs of sub-tropical origin, the carob tree's main flowering season is in autumn (September-November). However, the time and length of flowering depends on local climate: in very hot places, full blooming has been observed in June (Leshem and Ophir 1977). Seeds are ripe mainly from September until mid-winter of the second year, after 9—10 months. The first flowers appear when carob trees are three years old, so the first pods can be collected in the fifth year. Maturity is reached at 30—40 years and adulthood at 200 years. The lifespan of this species is over 400 years.

The carob tree has been considered a species of tropical origin (Indo-Malesian flora), part of the same group with *Olea, Laurus, Myrtus*, and *Chamaerops* (Zohary 1973). Its original distribution is not clear as it has been extensively cultivated since ancient times. Hillcoat *et al*. (1980) suggested its natural range included Middle East - from Turkey to the Arabian peninsula - and the eastern half of North Africa from Egypt to Tunisia. Nevertheless, recent palaeobotanic studies demonstrate that the carob tree is also native to the western Mediterranean.The carob tree has been introduced in other regions in the world, like in the US (California and Texas), Mexico, Chile, South Africa, Pakistan, India, China, Australia, and New Zealand (Batlle and Tous 1997).

The carob tree grows spontaneously in very warm and dry conditions in coastal areas and lowlands all around the Mediterranean rim (Figure 1). It grows well in well-drained, calcareous (basic) or just poor soil, from sea level to 500 metres. It seems to tolerate salinities up to 3%. Cold stress and frost are the main limiting factor for carob-tree growth, and the reason why it is closely associated with low altitudes and coastal areas. Growth is reduced under 10ºC and some damages appear in young trees and in flowers if temperatures go below -4ºC. On the other hand, it resists temperatures over 40ºC, and hot and dry winds. It also resist drought: only 350mm of annual rainfall are required for fructification. For the fruits to mature, between 5,000 and 6,000 hours of temperatures over 9ºC are required.

Figure 1. Distribution range of carob tree (*Ceratonia siliqua*) in the Mediterranean basin. (AIDA, based on Batlle and Tous 1997).

Fig tree (*Ficus carica*) with fruits in the Algarve
© WWF-Mediterranean / Xavier ESCUTE

Olive tree with olives in the Algarve (Portugal)
© WWF-Mediterranean / Xavier ESCUTE

The traditional use of carob trees has led to a significant number of coastal areas and lowlands being converted into extensively managed agro-forestry systems with high biodiversity values. They are characterized by a mixture of open woodlands, tree orchards, pastures, and scrubland. The carob tree is mainly found either in monospecific plantations, mixed with other semi-domesticated trees (e.g. *Ficus carica, Olea europaea* and *Prunus dulcis*), scattered in evergreen oak silvo-pastoral woodlands, or as part of the high shrublands known as "maquis". Under natural conditions, the carob tree is part of evergreen sclerophyllous woodlands, characterized by the presence of wild olive tree (*Olea europaea*), holm oak (*Quercus ilex*), lentisk (*Pistacia lentiscus*), myrtle (*Myrtus communis*), kermes oak (*Quercus coccifera*), *Jasminum fruticans, Phillyrea latifolia, Rhamnus oleoides,* and *Clematis cirrhosa.*

Box 1
History

Carob fruits were used as a high-energy food for people and animals like horses, asses, or oxen, and because they could be easily stored they were especially useful when travelling long distances. To germinate, seeds need to pass through the digestive system of animals (the gastric acid weakens the outer seed cover). So it is still common to see carob trees growing where horses were tied up at the entrance to villages or near old roads in the Algarve region of Portugal.

Jewellers also used its uniform seeds as a unit of weight (200mg), the *carat*, because they stayed the same for years.

Products and services from carob trees

The three main features that distinguish domesticated carobs from their wild relatives are larger bean size, more pulp and greater sugar content (Batlle and Tous 1997). Carob pods need to be stored three months before being triturated because the seeds keep growing after the fruit is being harvested. If carob fruits are processed before, the weight in seeds is lower (AIDA 2006).

The first transformation of the carob consists on triturating the carob fruits and separating the seeds or beans from the rests of the pod. The second transformation consists on the production of flour both from the pulp and from the seeds. The carob fruits are separated into pulp (90% of the fruit) and the seed itself (10% of the fruit). The carob pulp is high in total sugar content (48—56%), mainly sucrose, glucose, fructose and maltose. Lipids consist of approximately equal proportions of saturated and unsaturated. The protein has a low digestibility because it is bound with tannins and fibre (Catarino 1993).

Carob pods waiting to be transformed in an industry in the Algarve (Portugal) © WWF-Mediterranean / Xavier ESCUTE

Carob pods triturated and separated from seeds in the Algarve (Portugal) © WWF-Mediterranean / Xavier ESCUTE

From the beans, the three parts are separated (outer layer, endosperm, embryo). The seed endosperm has a natural polysaccharide (carob beam gum) with a high viscosity in water solution over a wide range of temperature and pH (García-Ochoa and Casas 1992). The carob bean gum has very important properties for a wide range of food products: as thickening or dissolving agent in jams, sauces, baby food, and soups; as a crystallization inhibitor in ice creams, frozen food, and bread; as a binder and lubricant in sausages and bologna salami; as a gelling agent in puddings, desserts, and confectionery. Other food uses include the manufacture of soft cheeses, salad creams, and dairy products other than ice cream. One hundred kilogrammes of seeds yields an average of 35kg of pure dry gum.

Pulp is also used in making health-food products (e.g. chocolate substitute, carob syrup, laxatives and diuretics) and as a carbohydrate source for ethanol production (160g of ethanol/kg of dry legumes) (Shepperd 1974).

Product	Processing	Uses
Pod Pulp (90% of legume content)		
Kibbles	Any	Animal feed
	Milled	Human food and animal feed
	Extraction and purification	Sugar and molasses
	Fermentation and distillation	Alcohol and microbial protein production
	Extraction	Anti-diarrhoea tannins
Powder	Washing, drying, roasting and milling	Food ingredient; cacao substitute; dietary and pharmaceutical products.
Seed (10% of legume content)		
Endosperm (4% of seed content)	Grinding	Gum, as food additive, thickener, stabilizer, gelling agent, binding agent, etc. Dietary fibre. Pet food. Pharmaceutical and cosmetic ingredient.
Embryo (2% of seed content)	Grinding	Germ meal; human and animal nutrition
Coat (4% of seed content)	Extraction	Tannins for leather dying; antioxidants
Wood		
	Carving	Utensils
	Cutting	Firewood; charcoal

Table 1. Main products derived from the carob tree. (AIDA, adapted from Batlle and Tous 1997).

Carob seeds have a very high nutritional value for feeding livestock, comparable to barley and superior to oats (Bailey 1947; Coit 1962). Carob tree agro-systems also constitute important grazing, hunting, and honey production areas. Carob flowers are very rich in nectar, having an important apiculture value, especially in autumn —the flowering season— when other types of flowers are scarce (Ortiz *et al*. 1996). Carob monofloral honey is common in the eastern Mediterranean.

Carob timber is hard and has traditionally been used to make utensils, and as slow-burning charcoal. Male trees are reputed to produce high-quality wood of a prized pinkish colour. Carob trees (increasingly used in xero-gardening) also tolerate drought, pollution, and poor soil. They also require little maintenance and live for a long time.

Services provided by the carob tree are landscape provision, protection against the erosion of soil from wind and water, soil restoration, improvement after desertification, carbon absorption, and fire risk reduction —especially if cultivated in low densities. The carob tree is good for improving degraded soils: dead leaves and fruit remnants decay into soil very quickly, helping to retain water.

Economic and Social aspects

Total carob production area in the Mediterranean region is around 200,000ha (Table 2). World production of carob pods is estimated at 310,000 tonnes/year, mainly concentrated in the Iberian peninsula, Italy, Morocco, Algeria, Turkey, Greece, and Cyprus. Nowadays, it is the seeds that are the most valued, so it may be said that 10% of the weight of the seed produces 90% of the carob's economic value.

Country	Area (hectares)	% Total Production	Pod Production (1,000s of tonnes)	Seed Production (1,000s of tonnes)
Spain	82,000	41	135	12
Italy	30,000	15	45	4
Morocco[1]	25,000	12.5	26	4.8
Portugal	21,000	10.5	30	3.6
Greece	15,000	7.5	20	1.8
Cyprus	12,000	6	17	1.7
Other	15,000	7.5	37	4.1
TOTAL	200,000	100	310	32

Table 2. Carob tree (*Ceratonia siliqua*) cultivated surface and production. (Batlle and Tous 1997).

Carob cultivation in Spain mainly occurred in two periods: the 17th-century expansion of agriculture in marginal lands, and the early 19th-century conversion of vineyards affected by phylloxera into carob plantations. Carob growing in Spain is distributed across five regions: Valencia, Catalonia, the Balearic islands, Andalucía, and Murcia. Italian production is concentrated in the south, mainly Sicily, Campania and Apulia. The Portuguese growing region is mainly the Algarve with a few areas in the lower Alentejo.

Spanish and Italian production halved in the second half of 20th century, and Portuguese production fell by at least 25%. On the other hand, Moroccan production increased over the past 15 years.

1. The figure for Moroccan carob production is probably an underestimate as carob plantations have considerably increased there.

Carob plantations are usually 10% male trees and the rest female, in many cases grafted onto male stocks. Grafted trees are produced in nurseries using known female material (the most productive varieties are selected). Male trees are placed in the prevailing winds to ease pollination through anemophily (airborne pollen).

Box 2

The varieties of carob trees

Since ancient times each geographical region has developed a number of selected cultivars of carob trees. Sugar content, bean production or pod size have been the major criteria for selection. More than 90 cultivars have been named and recorded by the specialist groups and are kept at germ plasm collections in Spain, Portugal, Tunisia, the US, and Australia. Carob cultivars vary widely in colour of fruits and seeds, yield rates, season of maturity, susceptibility to pests, ease of harvest, different flowering and harvesting times, sugar and gum content and quality (Batlle and Tous 1997).

Yields of carob beans are very variable, depending on genetics (cultivar variety) and the environmental characteristics of the growing area. Average yields rarely exceed 2.5 tonnes/ha, equivalent to 22kg/tree. When irrigated, trees produce more fruits: yields of 10—17 tonnes/ha have been reported in certain irrigated areas of Cyprus and Israel. In Portugal, carob trees produce an average 60kg of fruit per tree, although climatic conditions may cause production to vary. In plantations, although yields fluctuate from one year to the next, production tends to increase up to 30 years of age.

Most processing plants are in Spain, Portugal, and Italy. However, newly established ones are operating in Morocco and Turkey. The carob sector is fairly well organized: farmers, cooperatives, kibblers, factory managers, and agro-food industries all rely on proper prices and are aware that a better organized sector would be mutually beneficial (Batlle and Tous 1997). A Carob Gum Industrial European Institute (INEC) was created in 1972 in Brussels to provide guidance on meeting EU and UN toxicological and food requirements.

The carob market is opaque and it is difficult to estimate total production per country. Family-owned orchards may process their own production and not declare it. Processing industries may buy from different producers or middlemen. Batlle and Tous (1997) estimates are included in Table 2. Robbins (1988) provides information about the total world exports of locust beam gum which has been about 12,000 tonnes/year for the period 1979-85. Spain, Italy, and Portugal are the main suppliers: annual exports are 5,000 tonnes, 3,000 tonnes and 1,500 tonnes respectively. The main importers are the UK, Germany, the US, and Japan.

Box 3

Carob plantations in southern Morocco

In Morocco, the carob tree can be more profitable than cereals and other tree crops (Sbay and Abourouh 2005). There are 23 firms doing initial processing and two working on the second and third stages. The selling price of carob pods varies greatly, from between 3—7dh/kg (0.27-0.63 euro/kg)[2] , depending on the period of the year and the region. Seeds can also be sold at a price ranging from 22—32dh/kg (2—2.87 euro/kg). Carob pods and transformed products are exported, mainly to Europe, representing 79m dirham in 2003 (€7m).

A recent initiative (2006) has been set up in Tiznit and Terensyh, southern Morocco, in order to increase employment for local people and forest cover. This area receives only 200mm of water per year and some oases can be found.

The project, sponsored by the Moroccan state and the EU, with the scientific assessment of AIDA and implementation by local development NGOs, will provide one million carob trees in five years to local communities and keep livestock in farms to reduce grazing pressure in the bush areas. Local communities will use carob pulp, argan oil, and straw to produce fodder for the animals and will produce and sell traditional cheese.

2. Exchange rate used in this paper: 1 Moroccan dirham = 0.089 Euro (8 May 2007 at http://oanda.com)

The carob economy in Portugal

At present there are more than 15,000 small farmers in Portugal producing carob as an income supplement. Carob production requires a seasonal labour force for harvesting (farmer costs are an average of four days work per hectare each year) (AIDA 2006), which takes place in the slack months of August-October. Other tasks such as tree pruning and scarification may be required only every few years. Harvesting is mainly done manually by family members and neighbours, as with almonds or olives: a big cloth or plastic sheet is laid under each tree and pods are shaken from the tree manually or with a stick. Afterwards, fruits are transported to the farm and stored in an aerated place to avoid fermentation of the pods.

In Portugal, the minimum revenue obtained by farmers is 0.40 euros per kilogramme of carob pods. In 2006, the price was 0.47 euro/kg. Around 140 small traders buy carob pods jointly with other farm products in order to reduce transportation costs. Usually, traders sell flour, fertilizers, and other products to farmers.

The whole carob industry gives work to 120 people in Portugal. The biggest industry is Danisco, employing 30 people.

Benefits to biodiversity

The fauna associated with this type of traditional agrosystem with a heterogeneous landscape pattern is very rich and varied: there is high diversity and an abundance of small mammals, many different steppe birds, important nesting areas for song birds and night raptors, and habitats for endangered reptiles such as the chameleon (*Chamaleo chamaleo*), and others.

Initiatives presented

In this Case Study, three initiatives from Portugal are presented, although differently from the previous four chapters. As carob can be considered as more of a tree crop similar to olive trees or almonds, it is difficult to find an initiative for the sustainable exploitation of carob that it is not either an intensive plantation (mostly irrigated) or a traditional farm where carob is not the most important product to be exploited (and economic data not always recorded).

In the following pages, the cases of Quinta da Figueirinha, Sociedade Agricola Herdade dos Lagos and AIDA are presented. Quinta da Figueirinha is a traditional farm in the Algarve in the process of evolution from agriculture to the provision of services to visitors: at present 80% of farm income comes from agritourism, visits centred on organic farming and land use in dry areas, and venues for scientific meetings, while only 20% comes from agriculture. The Sociedade Agricola Herdade dos Lagos, in Mértola, is a farm producing wine and olives and also with carob plantations (some hectares are irrigated) among other products. AIDA is an association based in Algarve working for the promotion and development of carob.

Chamaeleon *Chamaeleo chamaelon* in the Maamora forest (Morocco) © Michel TERRIER

The Quinta da Figuerinha

Pomar de sequeiro, the traditional agro-forestry landscape in the Algarve (Portugal) © WWF-Mediterranean / Xavier ESCUTE

Citric cultivation is increasing in the area of Algarve © WWF-Mediterranean / Xavier ESCUTE

Quinta da Figueirinha is located in the Algarve region near Silves approximately at 11km from the Atlantic coast. The landscape is dominated by tree orchards and pastures on limestone rocky substrates. The climate is dry, with annual rainfall of 600mm, 80% of it in October—April. There is extreme drought in summer.

The traditional agro-forestry landscape in the area is known as *pomar de sequeiro*—patchy, unirrigated orchards with a mixture of olive, almond, carob, and fig trees, where mechanized harvesting is not possible.

The 35-hectare farm, bought by Dr Zabel in 1988, is devoted to fruit production and processing (dry fruits, marmalades, liquours, etc.). Some irrigation schemes have been put in place to increase the coverage of citrus trees. Agritourism is becoming more and more important: two guest houses and 12 apartments for visitors have been built. Nowadays, the farm is managed by the landowner, helped by four workers and sometimes by his family (especially with tourist activities and technical support).

There are approximately 10ha of planted citrus trees (mainly orange trees), 5ha of *pomar de sequeiro* and 1ha of carob trees. The rest comprises buildings, recreational areas for visitors, and fallow areas. All the production from the farm is certified organic by Certiplanet (Portugal).

Economics of the farm

Carob production at Quinta de la Figueirinha is not the top priority, but it is an easy and secure crop as it only needs to be harvested and stored. Although carob does not need irrigation, some trees happen to grow near the irrigated areas of the farm (orange groves) where production tends to be greater.

Other products sold in the farm include organic citrics (mainly oranges), dried figs, and other dried fruits, organic vegetables, marmalades, marzipan, organic honey (millefiori and orange honey), and liquours (made of apricot, Damascus and carob). At present, olive products are of no importance for the Quinta. Products are mainly sold in the farm shop to visitors and carob and citrics are sold to regional middlemen.

Organic products sold at the farm shop in Quinta da Figueirinha: carob liquour, honey, olive oil (not produced in the Quinta), carob fruits and dried figs
© WWF-Mediterranean / Xavier ESCUTE

Agriculture represents 20% of the total income of the farm. The rest comes from services: agritourism, scientific courses on land use in dry areas, courses on ecological farming, guided tours, a restaurant, horse riding, and consulting. Labour costs are generated mainly by the provision of services. In comparison the labour costs involved in agriculture are negligible.

Promotion and marketing is done through a website and word of mouth. Adverts appear in a monthly German-language newspaper in the Algarve and two others in Germany itself.

Carob production

Workers and volunteers at the farm harvest carob fruits between September and October, spending the rest of the year on other products. Carob harvesting requires three to six weeks.

Once carob fruits are collected (the yield varies from 6 to 15 tons a year), the middleman buys the product and transports it to local processors. As the farm is certified for organic production, the carob selling price is 10—15% higher than the official one. The landowner's profits vary from 2,600 to 6,500 euros a year. The owner buys back a small quantity of pulp, once triturated and separated from the seeds (the first stage of processing), to produce the highly valued carob liquour.

Carob liquour is distilled in the farm with a fraction distiller. The pulp is fermented for up to three months and then distilled. The product of the next part of the distillation process is collected, bottled, and sold in the farm shop as organic farming carob liquour. The price is around 16 euros a litre. Liquour production has been running for five years as a trial.

Quality issues and eco-labelling

There are no special treatments involved in carob production; the pods need only be kept out of the rain. Organic certification helps to sell the product at a higher price, according to the landowner, but the costs involved in achieving certification more than offset this added return.

In the Algarve, there are three certified organic production farms. Other farms are going through the certification process at the time of writing. However, organic carob production is still not valued by the market and tends to be mixed with carobs coming from non-certified farms. It is easy for most carob producers in the area to become certified as management already meets organic standards.

Legal aspects

There is no specific legislation in Portugal related to carob production except regulations on food products. Regulations for organic production apply in Portugal as they do in other countries.

Currently, carob crop is included in the EU aid programme: actions are planned for in the Nut and Carob Production Organizations scheme (European Regulation 2159/89). An interesting initiative to

Dr Zabel, a German national settled in the Algarve, runs Quinta da Figueirinha since 1988 © WWF-Mediterranean / Xavier ESCUTE

Farm house at Quinta da Figueirinha prepared for agritourism © WWF-Mediterranean / Xavier ESCUTE

promote carob growing is the independent association AIDA, established in 1985 in the Algarve, which offers services for all interested people and institutions involved in carob production, processing, and marketing.

Improvement plans sponsored by the EU have been running in Spain and Portugal for 10 years: the study of different cultivars, for example, and ways to improve cultivation and production.

The Sociedade Agrícola Herdade dos Lagos

With a total of 1,000ha, the Sociedade Agricola Herdade dos Lagos (Mértola) mainly trades in wine and olives, and in small quantities organic carob fruits, organic almonds, honey, cereals, pasture, hunting grounds, and livestock (lambs). There are 177ha of irrigated carob plantations and 85ha unirrigated. At present, the Herdade has 12 permanent staff.

This multi-purpose exploitation began with the conversion of low-production cereal land to carob in 1997. Nowadays the first of these carob trees are in production (55ha of irrigated carob trees produced six tons of carob fruits in 2006 and were sold for €2,880). However, once the trees are mature, production is expected to reach the usual 74kg/tree. All production is certified organic by Sativa (Portugal) and sold with the help of AIDA to Portuguese processing companies that also import carob from other countries. No marketing is needed to sell carob production to processors.

Wine is sold to wholesalers and olives to the olive-oil industry. Marketing is done through www.herdadedoslagos.com and at fairs. Wine is sold by a professional salesman.

Olive tree in production in Catalunya (Spain) © WWF-Mediterranean / Xavier ESCUTE

Carob seeds once separated from the pod © WWF-Mediterranean / Xavier ESCUTE

The carob plantations were established in three phases, in 1997 and 1999, both funded by the Ruris EU scheme, and a third in 2002 funded by the Programa AGRO of the Portuguese government.

After the plantation, the major risk is frost; young trees die if they are located next to watercourses (where black frosts are likely to occur). It is also important to graft successful seedlings or plant cuttings so as to increase the number of female trees and therefore production.

The management of the Herdade stress the importance of carob trees and their fruits for livestock and game (rabbits and wild boar) and for apiculture; carob trees flower at the end of summer and autumn where the other melliferous plant species have finished flowering.

AIDA

AIDA stands for Inter-Professional Association for the Development and Valuation of Carob Production. It is a non-political *Associação interprofissional de dereito privado*, according to Portuguese law. It was established in July 1985 to promote research, experimentation, demonstration, and dissemination of ways of improving the production and marketing of carob.

AIDA logo

AIDA has worked for the promotion of the species, which is well adapted to the climatic and soil conditions of southern Portugal. Before the creation of AIDA, carob was not considered to be a very noble tree, although it generated income for small farmers.

AIDA represents members' interests in public institutions and private organisations (administration at different levels, associations of farmers, foresters, and processors, etc.); it provides technical assistance to producers, it fundraises and supervises research at universities and research centres; and works on spreading best practice and research results. For example, since 1995 some experiments are running in the experimental orchard at the Tavira Agrarian Experiment Centre owned by the Direcçao Geral de Agricultura do Algarve.

Members	Producers	Researchers	Processors	Traders	Institutions	Members of producer associations	Total
Number	133	60	14	3	8	356	574

Table 3. Members associated to AIDA. Source: AIDA.

In 1995, two technical staff were employed to implement AIDA's activities. Funding to sustain office running costs and salaries comes from EU grants, the Portuguese government and projects. AIDA is based in a small office in Loulé. AIDA provides technical assistance to producers and producer associations to sell their product to wholesalers and processors. It also collects and publishes data on carob production and prices.

Final remarks

The carob tree's characteristics — its rusticity and its ability to resist drought, the relatively low cost of management — make the species very suitable for sustainable agriculture. Production in modern carob groves may be very high (5—7tons/ha), requiring low inputs compared with most fruit trees and vegetable crops.

The carob tree is apt for restoration work in semi-arid regions and it's a good candidate preventing desertification and erosion. Given the low requirement for water and labour and the amount of litter and organic matter produced by mature trees, carobs are good soil improvers and a source of food for wild animals. Furthermore, growing carob trees may contribute to increase the resilience of sensitive forest landscapes to climate change.

Traditional agrosystems with a high biodiversity value and a high potential for improving economics linked to several products and services need to be considered an asset and valued in the context of the services they provide (landscape provision, protection against desertification, etc.). In the region of Algarve, rural tourism is increasing near the coast and more and more foreigners are settling there. Carob groves need to be maintained as part of the traditional landscape, valuable for biodiversity and adapted to the region, with strong economic potential.

Authors

Manuel Caetano
Vice-president of AIDA and former director of Danisco-Portugal.
E-mail: manuel.caetano@iol.pt

José Rosendo
Coordinator of the Regional Reforestation Commission of Algarve, Direcçao Regional de Recursos Florestais, Ministry of Agriculture, Portugal and member of AIDA.
E-mail: jrosendo@dgrf.min-agricultura.pt

Xavier Escuté
Biologist and former Capacity Building Officer for the WWF Cork Oak Landscapes Programme.
E-mail: xavi.escute@gmail.com

Information sources and bibliography

Quoted literature and websites

Bailey, L H. 1947. *Standard Encyclopaedia of Horticulture*. Macmillan Ed. New York

Batlle, I and Tous, J. 1990. El algarrobo. Ed. Mundi-Prensa. Madrid.

Batlle, I and Tous, J. 1997. Carob tree. Ceratonia siliqua L. Promoting the conservation and use of underutilised and neglected crops. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.

Catarino, F. 1993. *The carob tree: an exemplary plant*. Naturopa 73.

Coit, J E. 1962. Carob varieties. Fruit Varieties and Hort. Digest 15 (4)

Garcia-Ochoa, F, and J A Casas. 1992. *Viscosity of Locus Beam (ceratonia siliqua) Gum Solution*. J. Sci. Food Agric. 59.

Hammer, K, Knüpffer, H, Laghetti, G and P Perrino. 1992. *Seeds from the past. A Catalogue of Crop Germplasm in South Italy and Sicily*. Bari.

Hillcoat, D, Lewis G, and B Verdcourt. 1980. *A new species of Ceratonia (Cesalpinioideae) from Arabia and the Somalic Republic*. Kew Bull 35(2).

Kruse, J. 1986. *Ceratonia*. In Rudolf Mansfelds Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen) (J. Schultze-Motel, ed.). Akademie Verlag, Berlin.

Leshem, Y, and D Ophir. 1977. *Differences in endogenous levels of gibberellin activity of two deciduous tree species*. Ann.Bot 41

Martins-Loução, M A. 1985. Estudos fisiológicos e microbiológicos da associaçâo da alfarrobeira (*Ceratonia siliqua L.*) com bactérias de Rhizobiaceae. PhD Thesis, Universidade da Lisboa, Portugal.

Martins-Loução, M A. and Brito de Carvalho, J H. 1989. A cultura da alfarrobeira. Série Divulgação. Ministério da Agricultura, Pescas e Alimentação. Lisboa.

Ortiz, P, Arista, M and S. Talavera. 1996. Producción de néctar y frecuencia de polinizadores en Ceratonia siliqua L. (*Caesalpiniaceae*). Anales Jara. Bot. Madrid 54.

Robbins, S R J. 1988. Locust bean gum. pp 67-72. In *A Review of Recent Trends in Selected Markets for Water-Soluble Gums*. ODNRI Bulletin No. 2. 108 pp. London: Overseas Development Natural Resources Institute [now Natural Resources Institute, Chatham].

Shepperd, W D. 1974. *Ceratonia siliqua L*. in: Woody Plant Seed Manual. www.nsl.fs.fed.us/wpsm/

Zohary, M. 1973. *Geobotanical Foundations of the Middle East*. 2 Vol. Gustav Fisher Verlag. Stuttgart

Other sources of information

AIDA - Associação Interprofissional para o Desenvolvimento da Producção e Valorização da Alfarroba. Loteamento Industrial de Loulé, Portugal. E-mail: aida@zmail.pt . Phone: +351 89 415 151. Fax: +351 89 415 494.

Quinta da Figueirinha. Centro Privado de Investigaçao, de Demonstraçao e de Formaçao Professional para o Desenvolvimento Rural. Dr. Gerhard Zabel. Silves, Portugal. Website: www.qdf.pt . E-mail: qdf@qdf.pt . Phone +351 282 440 700. Fax: +351 282 440 709.

IRTA, Centre de Mas Bové. Dr. Joan Tous. Reus, Spain. Website: www.irta.es . Phone: +34 977 32 84 24. Fax: +34 977 34 40 55.

Detail of hermaphrodite flowers in a carob tree. Algarve (Portugal)

Recommendations for developing successful NTFP-based local economies supporting biodiversity conservation in cork oak forest landscapes

The international conventions dealing with forest conservation and management (Convention on Biological Diversity, United Nations Forum on Forests, Convention to Combat Desertification, International Tropical Timber Organisation) recognise the essential principle that the best way to ensure the maintenance of forests is to make them economically relevant to people. Non-timber forest products (NTFP) have been the focus of great attention in the last decade as natural resources with a crucial role to play in developing sustainable alternatives for forest conservation in highly diverse forest ecosystems, such as tropical and Mediterranean-type biomes.[1]

Effective conservation options mean securing key ecological components across large territorial units, which is still the case with a number of cork oak forest landscapes in the south-western Iberian peninsula, Sardinia, and North Africa[2]. To be ecologically as well as socially sustainable, natural resource exploitation in a heterogeneous landscape not only should allow people to make a living but also conserve biodiversity and secure organisms' ability to meet their requirements inside and outside protected areas (Sanderson *et al*. 2002). Whether NTFP are considered from the perspective of local livelihoods or conservation, species loss through overexploitation benefits neither local people nor conservation in the long term.

Cork oak forest landscapes provide good opportunities to meet the Convention on Biological Diversity's (CBD) objectives (conservation of biological diversity on a large scale in time and space and sustainable use of natural resources through fair and equitable sharing of benefits). NTFP potentially balance rural development and conservation through well-planned, multi-purpose management systems and sustainable trade and income generation, securing reliable and fair markets for local communities.

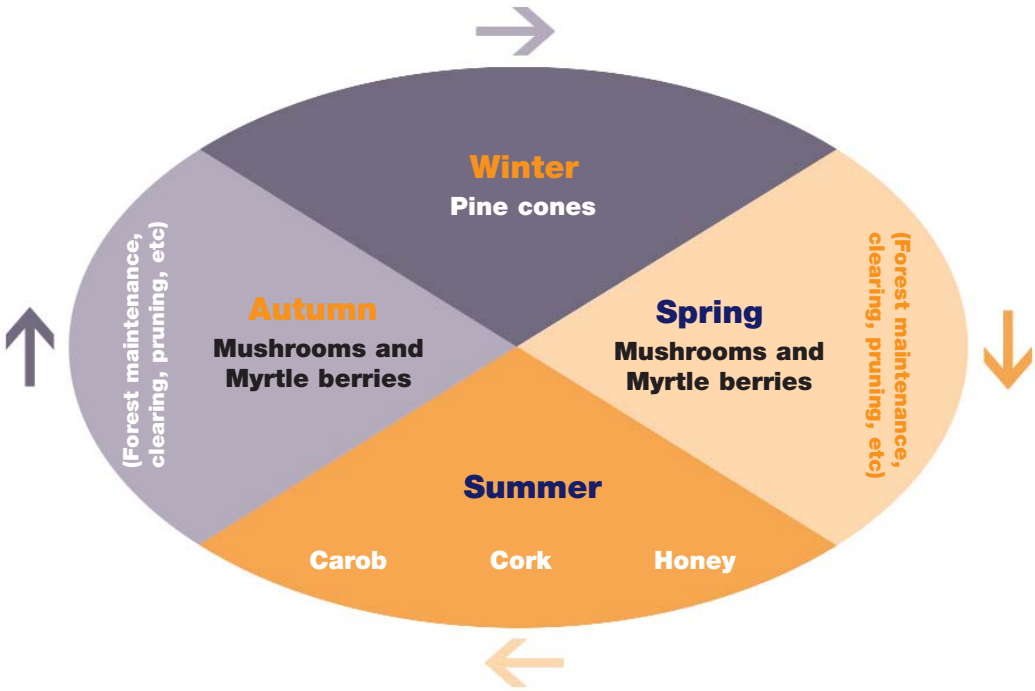


Figure 1. Harvesting periods of the different NTFPs from cork oak landscapes analysed in the case studies

1. The conservation and use of non-timber forest resources appears in more articles of the Convention on Biological Diversity (CBD) than any other component of natural resource use.
2. Functional systems where ecological and evolutionary processes are maintained, with viable habitats and species populations which are resilient to natural and human-induced disturbances.

The case studies in this book provide good examples of managing and marketing important NTFP other than cork, addressing a number of environmental, social, and economical factors influencing success. Each case study focuses on a different NTFP, which may have a predominant or a complementary economic role to cork and/or to other natural resources in a multi-purpose management system of cork oak forest landscapes. The ideal situation will be that of a forest landscape where different forest users or local associations develop economic activity around different NTFP in the same area, providing complementary employment all year round. They should also demonstrate economic viability while guaranteeing sustainable harvesting, fair and equitable sharing of benefits, and the maintenance of healthy ecosystems. Some case studies are not drawn from cork oak forest landscapes but lessons learned can easily be adapted to them as NTFPs presented are found there.

We can draw a number of lessons from these case studies which represent key steps toward integrating NTFP exploitation and management into successful cork oak forest landscape conservation projects.

1. Ecological, social and economic sustainability

1.1 Forest management plans should strive to strengthen and diversify the local economy, encouraging the efficient use of non-timber forest products and services as the best way to ensure their long-term availability.[3]

Stone pine and Aleppo pine management for cone production, particularly through tree density control and pruning, represents a good option for supporting the ecological sustainability of cork oak forest landscapes:

- It increases resilience against forest fires at both the landscape and forest unit levels, reducing biomass, and creating vertical and horizontal discontinuity between forest layers, which reduces ignition and propagation risks (Cortina 2006). In fact, more and more firebreaks are designed in critical areas as low tree-density forest patches, such as open cork oak and pine woodlands, making it easier to control vegetation growth under the canopy and having less visual and soil erosion impacts (Plana 2005).

- It allows the development of a shrub layer of valuable species for non-timber forest products (e.g. myrtle and strawberry tree). Well designed NTFP harvesting operations, such as myrtle cuttings, will also increase resilience against forest fires. Moreover, planting re-sprouting shrub species, such as myrtle and strawberry tree, will help restore degraded forest land and prevent large-scale fire impacts.

Coppice woodlands are part of the traditional management system shaping the highly diverse and mosaic-like cork oak forest landscapes. Ecologically sound coppicing not only increases the efficient use of other NTFP —like firewood and charcoal— but also helps diversify local sources of revenues and guarantee high mushroom production in the long term.

1.2 Information on the availability and growth dynamics of species from which NTFP are collected should be well known by forest managers, monitored and reported to collectors to maintain sustainable yields.

A good example is provided by the Fungo di Borgotaro initiative: the development of the management plan included a study that related mushroom growth to different management

3.This issue refers to FSC Principle 5 "Benefits from the Forest".

systems. Moreover, considering that mushroom production varies a lot depending on annual climatic variations, collectors are informed through the web about mushroom growth in each forest compartment.

1.3 Harvesting requirements adapted to site conditions appear key in most case studies.

Applying similar NTFP management systems in other cork oak landscapes requires testing and adapting harvesting techniques to environmental and social conditions. This is the case with the harvesting of myrtle for distillation in Gouaria, Tunisia. WWF and IPADE are currently testing the Forest Administration's harvesting rules, identifying effective techniques to secure production in the long term, and making myrtle harvesting compatible with, for example, the preservation of a percentage of flowers from myrtle shrub communities for honey production.

1.4 Adaptive management principles should be applied to develop ecologically sound harvesting rules.

It is necessary to monitor and, if necessary, modify a number of harvesting features, such as periodicity/seasonality, collection techniques, plant size, and amount harvested. This is because of the unpredictable climate that characterizes Mediterranean ecosystems, the irregular fructification of some Mediterranean plant species (e.g. *Pinus pinea*), and the lack of standardized harvesting methods for a significant number of NTFP.

1.5 Increasing re-sprouting and drought-tolerant native species in cork oak forest landscapes might represent a valuable option for climate change adaptation with positive environmental and social implications.

Planting species such as carob and wild olive trees and lentisk and myrtle in cork oak forest landscapes might have an important multi-purpose role: increasing revenue for local communities while preventing tree-cover loss in sensitive areas where climate change scenarios foresee cork oak decline. Massive die-back of live cork oaks has already happened in extreme droughts in Portugal, Spain, and Morocco. And many shrubs and trees providing NTFP are re-sprouting species; planting them might increase resilience against big fires and over-grazing.

1.6 A participatory monitoring system plays an important role in preventing the depletion of NTFP and the degradation of the forest system from overexploitation and illegal harvesting.

When conditions favour forest inhabitants, such as free access to mushrooms in Borgotaro, Italy, or lower auction costs in Gouaria, Tunisia, local NTFP collectors are vital in monitoring changes in NTFP yields, environmental impacts, and illegal harvesting.

1.7 Learning networks for growing and planting valuable species of NTFP may play an important role in preventing overexploitation of forest resources, restoring degraded forest land and strengthening resilience.

The growing of selected myrtle varieties has played an important economic role throughout history. Currently the harvesting of wild myrtle berries is not enough for securing production in Sardinia, and research institutions have developed good knowledge about tree nursery and planting requirements for myrtle and an important number of species providing NTFP. The development of a network for transferring production and planting know-how from Sardinia and other Mediterranean "nodes of

expertise" will help restore large areas of degraded land, such as part of the 35,000ha of myrtle scrub communities that have been degraded in Tunisia since 1975.[4]

1.8. There are economic incentives through the EU/CAP framework which can be used in Portugal, Spain, and Italy, for promoting the production and plantation of native species, providing NTFPs in cork oak forest landscapes.[5]

The existence of economic incentives is crucial for convincing landowners and other users to switch from short-turnover forest exploitation (e.g. planting fast-growing tree species, intensive grazing, and firewood collection) to a long-turnover multi-purpose forest management system. Converting degraded forest land or marginal agricultural land into environmentally sound and highly productive cork oak forest land and agro-forestry systems takes time (at least 30 years) during which landowners' and other users' lost income should be compensated. NGOs should invest significant efforts in lobbying governments, intergovernmental organizations and the private sector to identify, test, and institutionalize a number of public and private incentives, such as policy measures for sustainable rural development, payment schemes for environmental services, and carbon knowledge projects (Mansourian *et al,* 2005)

2. Governance and legislation

2.1 Establishing a legal framework for the equitable distribution of economic benefits from harvesting and marketing NTFP

Successful and sustainable NTFP-based economies require a favourable legislative framework defining:

- Access rights to forest resources;
- Preferential rights of extraction and commercial use for local communities over external actors;
- Rules governing period, size, amount, and gathering techniques adapted to each NTFP;
- Intelligence about the significance of NTFP in local economies and more transparency from the majority of the NTFP production players referred to in all case studies except honey.

The case of Borgotaro in Italy demonstrates the importance of providing free access to wild mushrooms to members of the local communities (*comunalia*), where mushrooms represent at least a significant part of revenues, especially for low income social groups. Moreover, in these circumstances, local communities lean toward careful and sustainable management of forest resources, meeting the cost of private security services.

In the case of honey there is still free access to public forest. In private forests all that is necessary is an informal agreement to make in-kind payments in product to the landowner.

Hinojos in Spain also gives preference to local associations: the municipality has established a system to purchase harvesting rights by sealed bid and only local associations can apply.

The Tunisian case is the one where major legislative and governance changes are needed to create a favourable environment for succeeding in setting up NTFP-based local economic initiatives. WWF and IPADE are currently working with the Forest Administration to test ways of establishing rights of local communities that could be the basis for new laws about NTFP. A testing exercise with GFICs is in place based on reduced auction costs.

4. For example, WWF supported the Portuguese NGO ADPM in developing a tree nursery for native plant production, many of them providing NTFPs, such as aromatic, medicinal and edible plants, run by a group of women, and providing revenues to them based on a multi-purpose activity: production and marketing of aromatic and medicinal plants; participation in forest restoration activities; environmental education activities; etc.
5. EU/CAP: The European Union Common Agricultural Policy

3. Successful NTFP enterprises

3.1 Starting small, thinking big

This is applicable to any integrated conservation and development project. In most case studies it has not been feasible to get exact data about the initial investment, but anecdotal evidence suggests first phases with low investment and a solid vision including long-term goals from the project leader. Honey provides clear lessons about the benefits of starting small. This:

- Makes it easier to master the process from the very beginning, addressing complex environmental, social and economic issues;
- Helps guarantee quality before increasing production;
- Smooths local marketing and selling in preparation for complex national and international market chains;
- Allows producers to demonstrate know-how to and gain confidence from major donors and other organisations (e.g. NTFP-related companies with fair trade schemes) which may facilitate links with larger markets in the long term.

Strong leaders with good visions are generally behind successful conservation and development initiatives. Nevertheless, as the Tunisian case study demonstrates, once a NTFP initiative becomes operational it is vital to invest in human resources and institutional development to secure the skills that guarantee the long-term success of the initiative: in the environmental, processing, administration, finance, marketing, communications, lobbying, and advocacy fields.

3.2 Consolidating local know-how through capacity building for NTFP management, processing, marketing, and entrepreneurial skills.

A strong recommendation from the honey case study, which may be seen as a sort of mandate, is the need for collectors and processors to be supervised by (preferably local) experts until they master their trade.

With new initiatives based on little experience, like the majority of NTFP-based conservation and development projects, it is extremely important to develop a learning culture. This is especially relevant considering the need for managerial adaptability in response to new data or climate change.

It must be obligatory for collectors and processors to demonstrate know-how. This is the case in Italy (the Borgotaro case study) for the truffle sector. Government, the private sector, and NGOs should provide opportunities for guaranteeing the necessary professionalism of collectors and processors. In the Tunisian case study, WWF and IPADE are working together with the Forestry Administration to train and provide certificates of expertise to cork harvesters to reduce the number of cork oak trees being killed each year (5%) as a result of bad practice.

The carob case study from Portugal provides a good example of the importance of helping local processing companies meet the necessary industrial and market standards: the establishment of an independent association (AIDA) in the Algarve region which offers services at every stage of carob production, processing and marketing, and the creation of a Carob Gum Industrial European Institute (INEC) in Brussels.

3.3 Bringing collectors and consumers closer

The key to success for NTFP-based local enterprises lies in adding value to their products: to the extent that collector organizations are involved with consumers they stand to significantly increase

revenues. They will have a good understanding of their market and be able to identify opportunities to influence it; they will also be able to react to changes in demand.

Local NTFP economic initiatives that include local processing (pine nuts, mushrooms, and honey) generate greater return for local people who manage the resource. Moreover, local processing enables the products to reach a wider market, from local markets (especially important when NTFP production happens in areas of outstanding natural beauty), direct distribution to regional markets (honey producers, for example), and international market opportunities linked to the fair trade sector, which often opens new markets for developing countries (provision of technical and marketing support to local producers, ensuring supply from sustainably managed resources, and buying directly from producers for resale in more rewarding markets) (Russo *et al.* 2003).

In almost all case studies, a key to success has been the fact that producers have developed direct links with consumers. This not only helps increase profit margins for local producers but also has an important long-term effect in raising consumer awareness about how they can contribute to social and environmental benefits by consuming these products.

3.4 Emphasizing quality products has allowed producers in all case studies to broaden their market opportunities.

In all, certification has been used as a tool to access to new market segments, even if in some cases (carob and pine nuts) it is still premature as certified and non-certified products are often mixed, preventing the real market value from being calculated. In other cases, certification has helped increase producers' profit margins.

The importance of certification is not only related to increasing profits and broadening market places but also securing environmental, social, and product quality. As a general recommendation, new community-based NTFP projects must follow certification standards (e.g. the Forest Stewardship Council or the National and International Organic Food Certification scheme), even if certification may not be seen as an objective in the short or mid-term.

The two Italian cases (myrtle liquour in Sardinia and mushroom production in Borgotaro) have invested significant efforts in creating solid producer associations or organizations (*consortia*) which helped them lobby the Italian government and the EU to create a system of controlled origin for their products, getting an EU-recognized certification label, and securing funding from major donors for enlarging their businesses.

3.5 Strategies for reducing production costs

Profit margins may not be very high when considering NTFP products individually. This is why in most case studies producers tried to keep production costs as low as possible:

- Being organized into cooperatives or associations helps reduce investment costs (e.g. a communal laboratory with equipment for honey processors of the GFIC members in Gouaria, Tunisia, or shared marketing costs for myrtle liquour or Borgotaro mushrooms).

- The carob case study provides a good example of a very well organized sector in which all actors are aware of the mutual benefits: transportation costs are shared and reduced through a sort of traditional exchange system, for example. In Tunisia, there are opportunities for the transportation of bee hives through those GFIC members with vehicles, linking livestock transhumance with honey production.

3.6 Exploring opportunities and expanding the NTFP enterprises into complementary sectors

Investing in tourism has been key to the long-term environmental and socio-economic sustainability of initiatives in most case studies. We can identify the following benefits:

- The service sector brings more economic opportunities and helps diversify sources of revenue, from local restaurants and shops offering products based on local NTFP (e.g. mushrooms and pine nuts) to accommodation and tours for visitors interested in nature linked to local NTFP (e.g. nature trails to illustrate the value and beauty of species providing NTFP) or to NTFP harvests.
- Investing in the service sector may indirectly help prevent over-exploitation of NTFP: in the carob case study, producers may have entered into overly intensive carob exploitation (e.g. gathering fruits without considering the needs for forest regeneration and for feeding wildlife), but they have taken advantage of the opportunities that the growing tourism sector offers in the Algarve region and have invested in agro-tourism. This was a critical decision as 80% of farm revenues come from tourism linked to traditional carob agro-forestry;
- The service sector provides a more stable annual income to NTFP producers, reducing risks from variable production linked to species reproduction and unpredictable environmental factors (e.g. extreme drought, late-spring frost). This is especially relevant if local associations or users base their economy on just one NTFP.
- The combined use of several forest goods and tourism services helps broaden the economy linked to NTFPs to a wider range of local actors, making the initiative more relevant to the whole society.

3.7 Improving marketing operations

As we have seen, being well organized into local or regional producer associations not only helps increase quality and reduce production costs but also provides better opportunities for effective marketing and communications strategies.

In case studies like myrtle and mushrooms, local producers have invested considerable effort in promoting not only high quality products but also all the outstanding social, cultural, emotional, aesthetic, and ecological values that make their forest landscapes unique.

The main objective is to turn NTFP into the flagship for the territory, both in terms of natural and human landscapes. In that way the region becomes very well known regionally, nationally, and internationally thanks to the reputation of the NTFP product. This has helped increase consumer demand in most cases: they do not just look for a high-quality product but for the added value of tradition and the nature linked to it. This marketing strategy has also contributed to an increase in and a strengthening of the service sector linked to the sustainable management and production of NTFP.

A good example of this type of successful promotional initiative is la Strada del Fungo di Borgotaro, which provides a good image of the environmental, social, and economic values that visitors can find and enjoy when visiting the forests of origin of highly prized Borgotaro mushrooms. Similar initiatives have worked well in supporting sustainable economic alternatives based on soft development trends in balance with conservation in southern Portugal's cork oak forest landscape: the local NGO ADPM's promotional initiative, *Mértola, Cantos e Encantos*, is based on a large conservation and development programme, building capacity of local people for NTFP management and marketing, restoration of natural and cultural landscape features (e.g. wind and water mills), and supporting the creation of a number of services (like bed and breakfasts and NTFP processing for women). A similar promotional initiative is foreseen in the WWF and IPADE conservation and development programme in the Kroumerie region (Tunisia), where the myrtle case study comes from.

Final Remarks

1. Cork oak forest landscapes have greater long-term economic value if their biodiversity is maintained by a multiple-use management system. Combining sound NTFP with tourism brings social and economic sustainability, reduces the risk of over-exploitation, and offers good opportunities for including the wider local society.

2. Local forest communities lean toward sustainable management of forests if they see direct economic benefits from harvesting and selling their products. Empowering local users' associations will consolidate a sense of ownership and responsibility among local stakeholders who monitor the health of the forest landscape, help reduce the risk of disturbance, and make the forest more economically relevant to society in general.

3. Poverty is both a root cause and a result of the depletion of natural resources and the degradation of the environment: deforestation pressures will be reduced through poverty alleviation by viable and sustainable forest management, harvesting, processing, and marketing. Addressing the root causes of the loss of biodiversity is strategically vital. Consumer awareness may pressure processors and forest owners into seeking certification and thereby securing the social, environmental, and economic factors for success in establishing long-term NTFP-based conservation and development programmes.

4. NTFP can play a key role as indicators of forest health, becoming an important educational, awareness-raising, and monitoring tool. NTFP have an extraordinary potential to raise awareness about the long-term benefits of a healthy forest landscape. In the case of apiculture, project managers can develop good economic arguments for raising awareness, achieving buy-in, and involving local stakeholders in a multi-purpose NTFP management and conservation initiative:

- Guaranteeing habitat requirements (diverse vegetation with several blooming periods) for bees helps diversify honey production and enlarge the annual production period. This could considerably increase producer revenue.
- Producers will gain better control over their grazing activities, helping secure diverse and healthy vegetation. Wildlife habitat requirements are guaranteed.
- Opportunities also arise to develop complementary NTFP production activities (like myrtle essence, which occurs just after blooming).
- A healthy bee population will also be crucial for pollinating crops in and around the forest landscape, securing a crucial economic sector at the regional and national level.

Author

Dr Pedro Regato
Associate Professor at the Universidad Politécnica de Madrid (Spain).
Former Head of the Forest Unit at WWF-Mediterranean Programme.
E-mail: pregatopajares@yahoo.es

Bibliography

Cortina, J. 2006. *Treatment of pre-existing vegetation*. In Vallejo, R. (ed.), Eufirelab, Common methodologies and tools for restoring burned areas. http://eufirelab.org

Mansourian, S, Vallauri, D and N Dudley (Eds.) (in cooperation with WWF International). 2005. Forest Restoration in Landscapes. Beyond Planting Trees. Springer, New York

Plana, E. 2005. *Developing firebreaks*. In Mansourian S. et al. (Eds.) (in cooperation with WWF International). Forest Restoration in Landscapes. Beyond Planting Trees. Springer, New York

Russo, L, Vantomme, P and S Water. 2003. *Policy guidelines for the promotion of a sustainable utilization of non-wood forest products*. Seminar Proceedings, Harvesting of Non-Wood Forest Products, FAO.

Sanderson, E W, Redfords, K H, Vedder, A, Coppolillo, P and S E Ward. 2002. A *conceptual model for conservation planning based on landscape species requirement*. Landscape and Urban Planning 58. Elsevier (ed.)

Credits

Coordination: Xavier Escuté
Supervision: Nora Berrahmouni and Christoph Stein
Scientific supervision: Pedro Regato and Nora Berrahmouni
Text editing: Alex Wynter
Layout: Oriol Soler
Translation into French: Anne Dumail
Printer: La Trebere, Madrid
Printed on FSC paper
July 2007
Cover photograph: Recently stripped cork trees in ancient forest near Algeciras, Andalucia. Spain
© WWF-Canon / Edward PARKER

Acknowledgements

This publication has been possible thanks to the contribution and commitment of many people. We would like to thank all the authors, the people working in the initiatives presented, the case studies revisors and all the involved WWF Mediterranean Programme staff.

We would like to take the opportunity here to thank the work and patience of our graphic designer Oriol Soler and of our English language editor Alex Wynter.

This publication has been possible in the framework of WWF Cork Oak Landscapes Programme funded by WWF-UK and the Spanish Aid Agency (AECI) in the framework of the IPADE managed project "*Aumento de la sostenibilidad de los medios de vida de poblaciones rurales vulnerables en Marruecos, Túnez y Mauritania*". The Government of Catalonia is giving support to the capacity building work of WWF Mediterranean Programme.

WWF is one of the world's largest and most experienced independent conservation organizations, with almost 5 million supporters and a global network active in over 96 countries.
WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:
- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.

In cooperation with:

IPADE

IPADE is a development NGO dedicated to international cooperation and education for development. Independent yet totally committed, it has since 1987 promoted sustainable development for vulnerable populations in Latin America, Africa, and Asia. To date IPADE has worked in 30 countries to raise awareness of the Millennium Development Goals and the relationship between environmental protection and the fight against poverty.

With the support of:

azahar

Government of Catalonia
Department
of the Environment and Housing

WWF

WWF Mediterranean
Programme Office
Via Po, 25/c
00198 Rome/Italy
Tel: +39 0684497227
nberrahmouni@wwfmedpo.org
www.panda.org/mediterranean

Across The Waters
Capacity Building Unit
Canuda, 37 pl.3
08002 Barcelona/Spain
Tel: +34 933056252
cstein@atw-wwf.org