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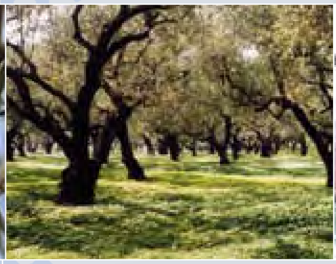

LIFE among the olives

Good practice in improving environmental performance in the olive oil sector

EUROPEAN COMMISSION

environment

EUROPEAN COMMISSION
ENVIRONMENT DIRECTORATE-GENERAL

LIFE ("The Financial Instrument for the Environment") is a programme launched by the European Commission and coordinated by the Environment Directorate-General (LIFE Units - E.3. and E.4.).

The contents of the publication "LIFE among the olives: Good practice in improving environmental performance in the olive oil sector" do not necessarily reflect the opinions of the institutions of the European Union.

Authors: Gabriella Camarsa (Technical expert), Stephen Gardner, Wendy Jones, Jon Eldridge, Tim Hudson, Edward Thorpe, Eamon O'Hara (AEIDL, Communications Team Coordinator). **Managing Editor**: Hervé Martin, European Commission, Environment DG, LIFE E.4 – BU-9, 02/1, 200 rue de la Loi, B-1049 Brussels. **LIFE Focus series coordination**: Simon Goss (LIFE Communications Coordinator), Evelyne Jussiant (DG Environment Communications Coordinator). **Technical assistance:** Audrey Thénard, Tiziana Nadalutti, Georgia Valaoras (Astrale GEIE), João Pedro Silva (AEIDL). **The following people also worked on this issue**: Federico Nogara, Santiago Urquijo-Zamora, Alexis Tsalas (Environment DG, LIFE Environment and Eco-innovation Unit), Garcia Azcarate, Panayotis Barzoukas, Fabien Santini, René L'Her, Aymeric Berling, Jose Alvarez de la Puente, Pascale Mathes, (Agriculture and Rural Development DG), Francesco Serafini (International Olive Council), Eva Corral, Benedetto Orlandi (COPA-COGECA), Domenico Mastrogiovanni (CIA), Pedro Barato (ASAJA), Theodoros Vloutis (PASEGES). **Production**: Monique Braem (AEIDL). **Graphic design**: Daniel Renders, Anita Cortés (AEIDL). **Acknowledgements**: Thanks to all LIFE project beneficiaries who contributed comments, photos and other useful material for this report. **Photos**: Unless otherwise specified; photos are from the respective projects.

Luxembourg: Office for Official Publications of the European Union, 2010

ISBN 978-92-79-14154-6
ISSN 1725-5619
doi 10.2779/8360

Printed in Belgium

Printed on recycled paper that has been awarded
the EU Ecolabel for graphic paper *(http://ec.europa.eu/ecolabel/)*

Tomas Garcia Azcarate
Head of Unit - Olive oil, horticultural products Directorate-General for Agriculture and Rural Development European Commission

Hervé Martin
Head of Unit – LIFE Environment and Eco-innovation Directorate-General for the Environment, European Commission

The olive sector is an important part of the agricultural sector in the European Union, particularly in southern countries, where it represents a significant share of the agricultural economy. The EU is also a global leader in olive production, accounting for almost 70% of total world output, and the main net exporter towards non producing areas such as North America.

In terms of area, olive farming represent 8-9% of the total agricultural land of Spain, Italy and Portugal, and 20% in Greece. More than 1.8 million agricultural holdings grow olive trees in the EU, representing 40% of the agricultural holdings in Spain and Italy, and 60% in Greece.

As with any agricultural activity, depending on its degree of intensification, olive cultivation can have both positive and negative environmental effects. However, CAP reforms in the last years have decoupled farm payments from olive production, thus withdrawing incentive for intensification and have introduced, through cross-compliance, a link between payments and certain environmental (including landscape) obligations. Increased financing for rural development policies, including agri-environmental measures, has also helped to reduce negative environmental impacts.

The LIFE programme has, and continues to play an important role in guiding this transition to a more sustainable olive sector. LIFE projects, examples of which are presented in this publication, have piloted new innovations and approaches to tackling many different environmental impacts in the olive sector. In so doing, these projects play a key role in facilitating the implementation, updating and development of Community policy and legislation in this area.

Benedetto Orlandi
President of Copa-Cogeca Working Party on Olive Oil and Table Oils

The olive-growing sector is an important source of employment and economic activity in all production regions in the EU. In addition it can have natural benefits for the environment.

Producers have made significant efforts and considerable financial investment in order to adopt new growing and processing techniques to improve product quality. These efforts have yet to pay off on the market, as low quality products persistently result in unfair competition. Furthermore, there is a lack of transparency at the consumer-end.

Olive oil must be labeled clearly to inform consumers of its intrinsic values and place of origin, whilst also providing a means of distinguishing it from poorer quality oils and/or imitations. Transparency should be facilitated by the appropriate instruments. It is only by being familiar with a product that you can appreciate it, be willing to pay the price for it and understand that it is good value for money.

Producers are increasingly aware of the importance of maintaining the environment. This publication is undoubtedly a useful means of conveying information on the impact of the sector on the environment and in bringing to light new aspects in line with the economic and environmental objectives. It will certainly help the sector to continue improving its environmental impact.

Copa (Committee of Professional Agricultural Organisations) and Cogeca (General Confederation of Agricultural Cooperatives in the EU) represent European farmers and its cooperatives. Within Copa-Cogeca the Working Party on Olive Oil and Table Olives deals with issues concerning the sector.

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Photo: pizzodisevo (doing TENS for pain)

The EU and olives: **a world leader**

Olives and olive oil are big business for the European Union, in particular those Member States with Mediterranean coastlines. Spain alone produces 36% of the world's olive oil, and the sector is a major contributor to the economies of Greece, Italy and Portugal, and is also important to Cyprus, France and Slovenia.

But the economic benefits of olive oil production, and of the production of table olives, come at a cost. Olive growing has become more intensive over the last two or three decades, and is using an increasing amount of agricultural land. Olive growing and olive oil production use considerable volumes of water in countries where this resource is scarce, and the processes used by the sector lead to significant waste, especially wastewater containing phenols and polyphenols, and solid waste in the form of an olive paste, known in Spain as *orujo*.

As awareness grows of the environmental impact of this waste, the sector thus faces considerable challenges. It must make its production processes more efficient so that less energy is consumed and there are fewer by-products, and it must manage its wastes appropriately. Wastewater should no longer be disposed of by pumping it into rivers or the sea, for example. Treatment methods and safe disposal techniques have to be found.

This is where the LIFE programme can play a part, by supporting demonstration projects that show how the sector can meet its environmental challenges. LIFE projects have shown how olive oil and table-olive producers can reduce their polluting outputs. Furthermore, a number of projects have demonstrated that good environmental practice can save money, and can even lead to new business opportunities, as production wastes are converted into saleable commodities.

This brochure assesses the important contribution of the LIFE programme to improving the environmental performance of the EU's olive and olive oil sectors. The brochure begins by examining the EU's framework of agricultural and environmental legislation that affects olive growers and olive oil producers. Olive farmers receive EU agricultural subsidies, but they must increasingly show in return that they are maintaining their land in good environmental condition. Producers of olive products, meanwhile, must comply with a range of environmental laws.

The brochure then considers olive cultivation and production of olive products separately. The second section describes olive cultivation in the EU, and provides useful data about the size and extent of the sector. The third section details how LIFE projects have helped olive growers improve their environmental performance. The fourth section describes in some detail how olive products, in particular olive oil, are processed, and considers the environmental impact of this. The fifth section gives an overview of how LIFE projects have contributed to the better environmental performance of olive oil mills and other production facilities.

LIFE projects have demonstrated how olive oil producers can reduce their polluting outputs whilst creating profitable business opportunities.

Photo: Meckert75

Throughout, the brochure highlights LIFE projects that have delivered good results – such as the Doñana Sostenible, Tirsav, Tirsav Plus, Olivewaste and EnviFriendly projects. These results, if taken up more widely by the sector, could help to significantly reduce the environmental impact of olive cultivation and olive oil production in the EU.

LIFE AND THE OLIVE SECTOR: SOME NUMBERS

Since 1992, the LIFE programme has co-financed 18 olive-related projects under the three strands of LIFE Environment, LIFE Nature and LIFE Information and Communication.

In total, eight of the olive projects, including LIFE Nature projects, have dealt with environmental impacts related to olive growing. Project themes within this portfolio include: soil erosion, water protection, improved irrigation techniques, waste management, pest control, landscape protection, conservation activities, and co-ordination with the Common Agricultural Policy (CAP) agri-environmental measures.

Another eight of the projects were LIFE Environment projects focused on reducing the environmental impact of olive oil production. The themes addressed by these projects were: wastewater treatment; waste prevention, recycling and re-use; soil protection; and production of biogas.

Figure 1: **Olive-related LIFE projects per environmental issue**

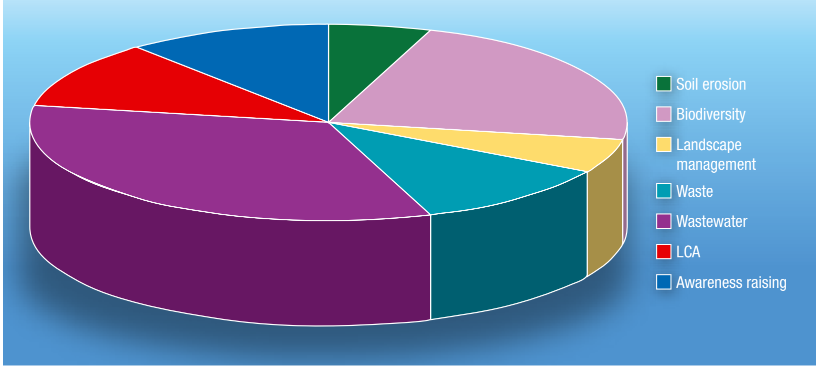
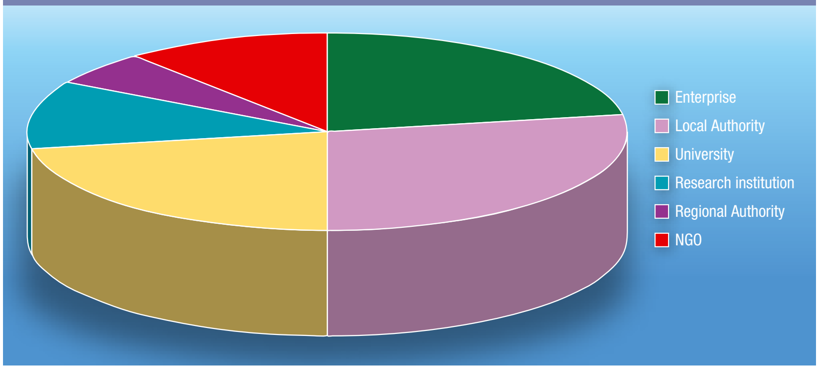


Figure 2: **Olive-related LIFE projects per type of beneficiary**



Source: LIFE project database.

The remaining two are projects co-funded under the LIFE Information and Communication strand. These projects aim at building awareness to promote sustainable olive oil production, while raising awareness amongst consumers about the importance of buying green products.

Mediterranean EU Member States have implemented the most agriculture-related LIFE projects, as would be expected given that olive farming and olive oil production are activities that belong to the Mediterranean area. The Italian share of LIFE olive-related projects has been the greatest, with six, followed by Greece with five, Spain with four, and the remaining three shared between Portugal, Germany (a project with Greece as a benefiting country) and France.

A review of LIFE beneficiaries (see figure 2) shows that one-third of all LIFE Environment olive oil project beneficiaries were local authorities (six projects), followed by companies and universities (four each) and non-governmental organisations and research institutions (two each).

Finally, 10 of the LIFE olive-related projects were technology-focused, five concentrated on methodological goals and tools, and three carried out awareness-raising activities.

GOOD PRACTICE IN THE OLIVE SECTOR

This LIFE Focus publication has been produced to improve the dissemination of environmental good practice amongst olive farmers and olive oil producers, other stakeholders and consumers. It aims to improve understanding about innovative environmental techniques from around Europe, which are available to minimise the olive sector's negative impact on the environment, while maximising the sector's positive socio-economic impact, and ensuring that production remains cost-effective. The 18 LIFE projects presented in this brochure reflect the complexity of the sector, which raises different issues for each producing Member State. Each issue needs to be tackled and addressed with specific technologies and methods that reflect the production system adopted by each country. The projects are also significant in terms of their relevance to environmental policy and legislation, and for their demonstration value and transferability.

EU legislation
and the olive sector

The environmental impact of olive cultivation and olive oil production is particularly important for the European Union because three EU countries – Spain, Italy and Greece – are by some distance the world leaders in these sectors. Particular problems include soil erosion, rising water consumption, desertification, pollution due to use of chemicals and fertilisers, damage to biodiversity, and waste generation. A number of EU policies and laws address these problems, and so, directly or indirectly, EU legislation acts on the olive oil sector in a number of ways.

THE COMMON AGRICULTURAL POLICY (CAP)

The CAP is the EU policy instrument that impacts most directly on olive producers. In fact, the CAP was one of the causes of the great expansion of olive oil production in Europe, with agricultural subsidies being previously directly coupled to the level of production (subsidy expressed in € per tonne produced). Whereas olive farming was traditionally practiced on upland terraces, with relatively low impacts in terms of use of chemicals or extraction of water, the drive to expand production led to high-density planting of olive trees on lowland plains, and the introduction of intensive farming practices, such as machine harvesting and industrial-scale processing of the olive oil.

The CAP has progressively been reformed in an attempt to counter the damaging aspects of the earlier agricultural policy. In 2003, CAP reform led to payments to olive farmers being split as follows:

Single Farm Payment – Olive producers receive a flat payment calculated on the basis of the average amount they received in production-related subsidies from 1999-2003. Olive farms smaller than 0.3 hectares receive 100% of their average production-linked payments in order to simplify aid for smaller growers, while providing a stable income support. The main aim of the single payment is to guarantee farmers more stable incomes. Farmers can decide what to produce in the knowledge that they will receive the same amount of aid, allowing them to adjust production to suit demand. For olive growers, the new direct payments began to replace the previous production-related scheme in 2005-2006.

Olive Grove Payment – A maximum 40% of the subsidy could remain linked to olive production but is intended to ensure that olive farming is done in a socially and environmentally sustainable way. Member State authorities had to identify up to five different categories of olive groves for additional support. These are chosen based on their environmental and socio-economic value, with aid per hectare fixed accordingly. The measures backed by Member States should focus on: maintenance and restoration of terraces and stone walls, maintenance and restoration of wildlife habitats and landscape features, maintenance of permanent grass, reduction of soil vulnerability by increasing organic matter content, and creation of earthworks to reduce run-off on steep slopes. The aim of this approach is to ensure olive tree maintenance and avoid the degradation of land cover and landscape. Only Spain applied this measure from 2005 to 2010. The olive grove payment has been repealed as from 2010 as part of the "Health Check" CAP Reform in late 2008.

The new rules also give EU countries some discretion to influence olive oil quality, beyond the standard regulatory regime laid down for the sector. Member States may use up to 10% of their national envelope for quality and environmental measures under activity programmes carried out by operator organisations. Italy, Greece and France have been using this facility since 2004.

CROSS-COMPLIANCE FOR OLIVE GROWERS

The CAP reform in 2003 was also the point at which the 'cross-compliance principle' became obligatory. Under this, all CAP payments received by the farmer are linked to the meeting of certain minimum requirements and standards relating to the environment and animal welfare, as well as maintaining the land in good agricultural and environmental condition. With some 2.3 million olive growers in the EU, the revised rules could potentially generate significant environmental benefits.

Specifically, cross-compliance introduces the possibility of reducing the payments in case the farmer does not respect the requirements and standards in the above-mentioned domains. In the olive sector, this mechanism can help minimise damaging practices such as excessive use of herbicides, intensive soil tillage, and illegal water extraction. The requirements include in particular observance of obligations related to the Birds and Habitats Directives, the Nitrate and Groundwater Directives and the directive on the authorisation of pesticides. Under the good agricultural and environmental requirements, farmers must also respect the national authorisation procedures for the use of water for irrigation (as from 2010), the maintenance of olive groves in good vegetative conditions and the rules about the grubbing-up of olive trees as defined by Member States.

Cross-compliance also offers biodiversity benefits. Olive groves managed in a more traditional way are notable for ground vegetation cover, and require little application of pesticides and herbicides. The revised CAP rules mean there is more emphasis on maintaining natural habitats such as copses and hedges, while birds, flora and fauna are protected.

AGRI-ENVIRONMENTAL MEASURES AND OLIVE CULTIVATION

Through agri-environmental measures, EU rural development policy supports specifically-designed farming practices that help to protect the environment and maintain the countryside. Farmers commit themselves on a voluntary basis to adopt, for a five-year minimum period, environmentally-friendly farming techniques that must go beyond the cross-compliance standards as well as minimum requirements for fertiliser and pesticide use, and other relevant mandatory requirements established by national legislation and identified in the rural development programmes. In return they receive annual payments, which compensate for the additional costs and loss of income that result from altered farming practices.

Olive yields are greatly increased through irrigation.

Photo: Kateshortforbob

ENVIRONMENTAL LEGISLATION AFFECTING OLIVE OIL PRODUCTION

The Sixth Environment Action Programme (6th EAP) is the framework for environmental policy-making in the EU for the period 2002-2012.

Under the 6th EAP, the European Commission developed seven Thematic Strategies addressing key environmental challenges. For the olive oil sector, the most relevant of these are those on pesticides and soil. Other important initiatives within the 6th EAP framework deal with waste, water and biodiversity.

SUSTAINABLE USE OF PESTICIDES

The Thematic Strategy on the sustainable use of pesticides was adopted in 2006 by the European Commission (COM (2006) 327), in order to complement existing EU pesticide rules. It is meant to cover the use phase of authorised pesticides – for example, in relation to their application by aerial spraying.

The strategy was accompanied by a proposal for a framework directive on the sustainable use of pesticides. In parallel, a proposal for a Regulation on the placing of plant protection products on the market was put forward by the Commission. The European Parliament and EU Council reached a political agreement on these two initiatives at the end of 2008, with the Parliament approving the deal in January 2009 and the Council in Sep-


Photo: José A. Gómez

Inappropriate farming practices such as mechanised tilling, use of pesticides and fertilisers can cause soil erosion.

tember 2009. Both legal acts were published on 24 November 2009[1].

The main elements of the legislation, which will affect olive growers as well as other farmers, are: a). a change in the way pesticide substances are evaluated; the creation of three EU mutual-recognition zones so that pesticides authorised by one country would be automatically considered authorised by other countries within the same zone (though individual countries would retain the right to impose national bans on particular substances); and b). introduction of rules on pesticide use, such as a general ban on aerial spraying and prohibition of pesticide use in certain places, such as near schools or in buffer zones along rivers and other water bodies.

THE SOIL THEMATIC STRATEGY

One of the main environmental issues related to olive cultivation is damage to soils. Intensified olive farming is a major cause of soil erosion, thus reducing the productive capacity of the groves and, potentially leading to other problems such as desertification and run-off of top-soil into water courses.

The main aspect of the Soil Thematic Strategy was the proposal, by the European Commission, for a Soil Framework Directive (COM (2006) 232). This would require Member States to systematically identify damaged soils and combat soil degradation. Member States would also be required to identify areas where there is a risk of erosion, landslides, loss of organic matter in soils, or compaction or salinisation of soils. Member States would then adopt risk reduction and remediation plans for affected areas, within national remediation strategies. However, Member States have so far been unable to agree on the Soil Framework Directive, with some countries believing that soil quality can be regulated at national, rather than European level. Further discussions on the potential directive are expected to take place under the Spanish Presidency of the EU during the first half of 2010.

WATER USAGE AND QUALITY

Issues related to water quality and usage are of great significance to olive growers. Olive production does not require such high inputs of water as arable crops or crops such as lettuce or tomatoes, but expansion of olive production has nevertheless led to water shortages in some areas. Some areas already suffering from depleted groundwater reserves have seen an increase in the area of land under cultivation for olives – for example, southern Spain, which is one of the world's key olive-producing areas. Sinking of non-authorised boreholes for water with which to irrigate crops compounds the problems faced by these areas.

One way in which over-consumption of water can be controlled is through water pricing. The Water Framework Directive (2000/60/EC) requires full-cost recovery to be adopted as the guiding rule for water-price setting, thereby reducing or eliminating artificial incentives to develop irrigation.

The WFD also deals with water management in the broad sense. It requires Member States to take a strategic and integrated approach to the management of all water resources and river basins. Authorities must follow a series of steps laid down in the directive, including planning of river basin districts, identification of pressures and impacts, and implementation of appropriate remedial measures. The directive also addresses water quality, with the aim by 2015 of achieving an appropriate ecological and chemical status for surface waters, as well as an acceptable chemical and quantitative status for groundwater. A body of water would be considered to have 'good chemical status' if it met all of the environmental quality standards for priority substances and certain other pollutants.

The Groundwater Directive (2006/118/EC) is a daughter directive of the Water Framework Directive, dealing with the issue of water quality. In negotiations between the European institutions, the question of the non-deterioration of groundwater quality and the relationship with EU legislation on water pollution by nitrates were key. Final agreement on the directive resulted in a level of nitrates of 50 milligrammes per litre being defined as 'good chemical status'.

Run-off of soil fertilisers and pesticides are a cause of surface water pollution.


Photo: Nikolaos Nikolaidis

1 Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides – Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC

The new groundwater rules also left untouched the earlier Nitrates Directive (91/676/EEC), which has the general objective of protecting EU waters against excessive nitrates from agricultural sources, and also plays an important role in olive grove cultivation. Nitrogen inputs in the most intensive, irrigated olive farming can reach high levels (up to 350 kilogrammes per hectare in extreme cases), and experience from arable farming suggests that a problem of groundwater pollution is likely to exist in some olive areas.

WASTEWATER AND WASTE

Wastes generated by the olive sector can be divided into solid wastes (such as olive husks or crude olive cake, a residue remaining after the first pressing of the olives) and liquid wastes (olive mill wastewater).

A number of EU laws regulate what should be done with these – and other – waste products. The over-arching principles that should be applied in managing waste are laid down in the Waste Framework Directive (2008/98/EC), which requires Member States by 2020 to recycle at least half of their household and general waste. The Waste Framework Directive, which was revised in 2008, also includes rules on hazardous waste and waste oils, which were previously covered by separate legislation. EU countries have until late 2010 to fully implement the revised Waste Framework Directive.

The revised rules also formalise a five-step previous waste management hierarchy that Member States must follow when setting out national waste management plans. According to the hierarchy waste should be dealt with first by prevention, then re-use, followed by recycling, recovery, and finally, disposal. Under the method of recovery, waste is either converted into usable forms or is incinerated so that energy is 'recovered.' Disposal, meaning landfilling in most cases, can only be done once the previous four steps have been exhausted. Member States will produce waste management plans that institute this hierarchy as they implement the revised Waste Framework Directive; these plans are likely to affect the waste management techniques used by olive oil producers, as well as other sectors. Where waste is disposed of, rules pertaining to landfilling are set out in the Landfill Directive (99/31/EC).

Photo: Nikolaos Nikolaidis

The Urban Waste Water Treatment Directive (UWWT) directive regulates liquid wastes from olive oil production.

Liquid wastes from olive oil production, meanwhile, fall under the Urban Waste Water Treatment Directive (91/271/EEC). This concerns the collection, treatment and discharge of urban wastewater and the treatment and discharge of wastewater from certain industrial sectors, including manufacture of fruit and vegetable products, under which olive oil production would fall.

BIODIVERSITY: THE BIRDS AND HABITATS DIRECTIVES

The application of techniques to increase the productivity of olive groves and of the olive oil sector in general has had a detrimental effect on wildlife, and has led to a significant loss of wildlife habitat. In Europe, biodiversity and agriculture are inherently linked. This is recognised in the 6th EAP, which highlights the importance of integrating natural heritage protection and restoration measures into agricultural and regional policy.

The EU's key biodiversity policy instruments are the Birds Directive (79/409/EEC) and the Habitats Directive (92/43/EEC). These recognise that habitat loss and degradation are the most serious threats to the conservation of wild birds and other species. The Habitats Directive established the Natura 2000 network, which consists of the Special Protection Areas (SPAs) designated under the Birds Directive and the Special Areas of Conservation (SACs) designated under the Habitats Directive. Member States are required to designate these areas, and local authorities responsible for the sites must set up environmental management plans and carry out restoration so that the sites achieve 'favourable conservation status.' Crucially, this does not mean that activities such as agriculture cannot take place in protected sites; instead, in these areas, agriculture and conservation must work side-by-side.

The Natura 2000 network is extensive. At the end of 2008, nearly 11% of the terrestrial area of the EU had been designated as SPAs (5 174 sites), while 13.3% of the terrestrial area of the EU was covered by Sites of Community Importance (SCIs) (21 633 sites). The largest olive-producing countries have more of their area covered by SCIs than the EU average. In Spain, at the end of 2008, more than 23% of the territory was designated SCI, while for Italy and Greece, the figures were 14.2% and 16.4% respectively.

This widespread designation of land as conservation territory clearly has an impact on olive growers. In these areas, environmentally-friendly farming practices and production systems that benefit biodiversity must be prioritised. Measures that can be adopted in these areas range from the maintenance of grass cover to the promotion of more rational use of agro-chemicals in order to reduce impacts on flora and fauna, and the promotion of sustainable olive-farming practices such as organic and integrated production systems.

LIFE has supported sustainable olive farming practices that benefit biodiversity, such as snakes.

Photo: R.Viti

Olive cultivation in the European Union

The European Union (EU) dominates the international olive oil market. The EU's top four producing countries – Spain, Italy, Greece and Portugal – grow more than 70% of the world's olives[1], and the EU accounts for a similar share of global olive oil production. Olive farming is an important agricultural activity in the EU's southern Member States, with around 5 million hectares harvested in 2007. Spain, with 2.47 million ha, has the largest area under cultivation, followed by Italy (1.16 million ha), Greece (0.81 million ha) and Portugal (0.38 million ha). France is smaller producer, with an area harvested of around 18 900 ha.

1 Source: Food and Agriculture Organization of the United Nations; figure relates to 2007.

The EU is also, in general, a highly productive olive producer, with yields in most cases far above the world average of 1 879 kilogrammes per hectare (kg/ha)[2]. Italy is the most productive EU country, with an average yield 2004/2007 of 3 210 kg/ha, following by Greece (2 550 kg/ha) and Spain (2 130 kg/ha). Portugal, however, lags behind the rest of the EU with yields of 670 kg/ha[3].

EU production volumes have also increased. Between 2000 and 2007, the volume of olives grown in the EU has gone from 10 185 100 tonnes to 11 385 400 tonnes, an increase of 12%[4]. In the same period, according to the IOC, world production of olive oil increased by 6% and of table olives of 60%. Increased production has been particularly notable in Spain (total olive production +25%).

2 Source: ibid.
3 Source EUROSTAT, Cronos (average 2004-2007).

Olive groves are found throughout the Mediterranean region. However, the greatest concentration of olive oil production is found in two Spanish provinces, Cordoba and Jaen in Andalusia, which account for more than a third of EU output. Plantations producing table olives (see table-olive box) account for a far smaller area than those producing olive oil. In Spain, less than 6% of the total area is devoted to table-olive production whereas the figure in Italy is less than 3%.

4 Source: ibid.

	Olives, area of production (ha)
Spain	2 470 200
Italy	1 161 300
Greece	806 600
Portugal	379 600
France	18 900
EU27	4 849 000

Source: EUROSTAT (2007).

Four main olive producing countries

The following section gives an overview of the EU's four main olive-producing countries and highlights some major tends in olive-farming systems.

SPAIN

In Spain, following the country's accession to the European Community in 1986, there were incentives under the Common Agricultural Policy (CAP) to increase production, and the number of new plantations increased steadily. These, mainly intensively-farmed plantations, have been created over large areas, particularly in provinces with a high concentration of commercially-orientated producers, such as Jaen, Cordoba, Seville, Ciudad Real, Toledo and Badajoz. According to EUROSTAT, there has been an increase of 350 000 ha of new olive plantations since 1991, bringing the total olive area in Spain to around 2.5 million ha.

From an environmental perspective this means increased use of chemical pest control, fertilisers and irrigation. Mechanical harvesting is also standard in new plantations, although most olive plantations continue to be harvested manually. In more marginal upland areas in certain provinces such as Caceres but also within the main producing provinces (in marginal and/or sloping and mountainous lands), low-input systems are still present.

Organic production is also increasing, although as elsewhere, this still accounts for only a small proportion of the total. Extremadura, the autonomous community of western Spain, has the most organic producers. Here, traditional farmers have signed up for specific agri-environment schemes providing incentives for low-input farming practices. Integrated pest control and integrated production systems have also been developed, for example in Andalusia, although also on a small scale.

GREECE

The area of olive groves in Greece has increased constantly during the last quarter century, as a result of the planting of new high-density groves, reaching an area of 800 000 ha in 2007 (+120 000 ha since 1991). Groves for olive oil have expanded in many semi-mountainous and coastal areas (mainly in Crete and the Peloponnese) and low stem varieties such as the Koroneiki – the leading oil variety of Greece – are predominant. The tendency is to intensify production through mechanisation, levelling of the land, drip irrigation and increased used of external inputs.

The mixed cultivation of olive trees with other tree or arable crops is disappearing. Olive trees are almost exclusively cultivated in single species plantations.

Spain has seen an increase in olive plantations of 350 000 ha since 1991, bringing the total area to around 2.5 million ha (EUROSTAT).

Photo: Landahlauts


Photo: Landahlauts

In 2007 Italy harvested an area of around 1.2 million ha, of which 15% had organic certification.

Old groves with large ancient trees have been replaced with new intensive plantations. More traditional plantations can be found in the smaller islands and in higher mountainous areas. They can be characterised as 'low-input' and the groves are increasingly neglected due to factors such as an ageing population, urbanisation, competition from the tourism sector for labour and harsh agro-climatic conditions, often leading to the creation of a semi-natural agro-ecosystem. This is the case for example in Corfu, Lesbos and the Aegean islands, where farms are very small. Organic farming is also a new trend and organic farming projects have been started in some of these areas. An estimated 64 000 ha are cultivated organically in Greece, mainly in Crete and the Peloponnese.

ITALY

The total olive area harvested in 2007 in Italy was approximately 1.2 million ha, representing a slight increase (+50 000 ha) compared with the area thought to exist at the start of the 1990s.

A 2000 study on olive oil production in the EU[1] found "significant differences in trends between regions" that have also changed over the years. For example, it notes a "considerable decline" in olive areas in Liguria mainly due to abandonment, and significant increases in areas in Sardinia and Puglia. In some regions, intensification has occurred with specific farming techniques, irrigation, and heavy mechanisation. In other areas easier and more productive olive varieties have been planted in place of old trees, which were dug up. However, the study's authors note that the scale of these developments in recent years is not comparable with the situation in Spain. A specific National Action Plan (*Piano Olivicolo Nazionale*) approved in 1990, intended to convert 25% of the total Italian olive-growing sector from traditional productive systems to modern systems. However, due to the lack of financial resources, the plan has been largely shelved.

Organic olive oil production is also increasing in Italy, with around 15% of the area of olive trees in Italy (approximately 167 000 ha) having organic certification, according to the International Olive Council. The trend towards organic farming is expected to continue, following the new organic farming regulation (834/2007), which promotes the continued development of sustainable cultivation systems and a variety of high-quality products.

PORTUGAL

The total olive area harvested in Portugal in 2007, was 379 600 ha. Low-input traditional olive plantations still predominate and overall, average yields are notably lower than in other Member States. However, recent years have seen the establishment of new intensive plantations with densities of 200-300 trees per ha. For example, some 15 000 ha were planted in the period 1987-96. This process has been accelerated by EU Structural Funds and private large-scale investments. By 1996, some 30 000 ha of old plantations had been removed and replaced with intensive plantations under the PEDAP programme[2], launched in 1986, to assist Portuguese agriculture in adapting to EU market conditions.

OTHER PRODUCERS

Other Member States are minor producers[3] such as Cyprus with 11 600 ha given over to olive groves, Slovenia (800 ha), France (18 900 ha) and Malta (less than 100 ha). The non-EU country with the largest area of olive groves is Tunisia (1.69 million ha), followed by candidate for EU membership Turkey, where olive groves cover an area of 815 000 ha. Another candidate country, Croatia has 25 000 ha of olive groves. Albania, Montenegro and Serbia also produce olives.

1 "The Environmental Impact of Olive oil Production in the European Union: Practical Options for Improving the Environmental Impact" (G. Beaufoy, 2000) the European Forum on Nature Conservation and Pastoralism and the Asociación para el Análisis y Reforma de la Política Agro-rural. http://ec.europa.eu/environment/agriculture/pdf/oliveoil_xs.pdf

2 Programa específico de desenvolvimento da agricultura em Portugal – Programme to modernise Portuguese agriculture

3 Source: International Olive Oil Council (December 2008); figures relate to 2006

Greece has moved towards high-density groves, reaching an area of 800 000 ha in 2007.


Photo: Federico Coppola

A diversity of olive cultivation practices

Olive-farming areas in the EU are far from homogeneous, with considerable differences between regions and countries, and in some cases even between different farms within the same area.

Olive farms range from very small (<0.5 ha) to very large (>500 ha) and from traditional, low-intensity groves to intensive, highly-mechanised plantations. Olive trees range from ancient, large-canopied specimens, cultivated by grafting onto wild olives and maintained by pruning for over 500 years, to modern dwarf varieties planted in dense lines, to be grubbed up (dug up) and replanted every 25 years. Tree densities vary from as few as 40-50 stems per hectare in some older plantations to 300-400 stems or more per hectare in the most intensive plantations.

Overall, there are three broad types of plantation:

Low-input traditional plantations are often of ancient origin and are often planted on terraces. They are managed with few or no chemical inputs and their labour input is high. Due to their particular characteristics and farming practices, such as the grazing of animals under the olive trees, these plantations have a high natural value in terms of biodiversity and landscape, and a positive environmental impact (such as controlling water run-off in upland areas). However, it can be hard to make money from these plantations, and they are thus vulnerable to abandonment.

Intensified traditional plantations share certain similarities with traditional plantations, but are managed more intensively. They use more artificial fertilisers and pesticides and more intensive weed control and soil-management techniques. They can also increase the tree density and introduce irrigation and mechanical harvesting. With more tree density, fertilisation and/or irrigation, such plantations are referred to as simply **intensive plantations**.

Super-intensive modern plantations use smaller tree varieties that are planted at high densities of 1 600-1 800 trees/ha. They are also managed under intensive and highly mechanised systems, requiring irrigation to create a humid micro-climate that increases olive tree growth, and heavy usage of certain agrochemicals such as copper sulphate, which is used at least 5-6 times per year.

Additionally, there is a growing trend for **organic plantations** managed without chemical input, and subject to the most rigorous production standards. Organic farming is increasing rapidly, though it can require higher subsidies to be competitive. It accounts for a relatively small but increasing share of EU cultivation (for examples, in Italy, around 15% of olive-growing areas have been certified as being organic). The organic tendency is expected to increase, as a result of the EU's new organic farming regulation (834/2007[1]), which promotes the continued development of this sustainable cultivation system.

The intensified traditional and modern intensive systems can present low natural value and produce negative environmental impacts. Particular problems are soil erosion, run-off into water bodies, exploitation of scarce water resources and degradation of landscapes and habitats (see the section on environmental problems).

1 http://ec.europa.eu/agriculture/organic/eu-policy/legislation_en

Grazing of animals under olive trees and other traditional farming practices are of high natural value in terms of biodiversity and landscape.

Photo: LIFE07 NAT/IT/000450

Photo: Dehaan

Although less environmentally-harmful than certain other crops, the intensified traditional and modern intensive olive-farming techniques can be associated with soil erosion, depletion of scarce water resources, pollution through over use of agrochemicals, and biodiversity loss.

Environmental issues

SOIL EROSION AND LAND DEGRADATION

Soil erosion is one of the main environmental impacts associated with intensive olive-farming. Erosion reduces the soil's productive capacity thus causing lower productivity, which in turn leads to greater use of fertilisers. It also causes the run-off of topsoil, fertilisers and herbicides, which are washed into water sources. In extreme cases, erosion may also lead to desertification or serious land degradation. Erosion is the result of the combination of many factors, such as: soil type, slope, rainfall patterns and inappropriate farming practices. An example of an inappropriate practice is mechanised tilling, which compacts the soil, exposes it to the erosive effects of rainfall and reduces the soil's organic content. The use of chemical pesticides and fertilisers can also cause the impoverishment of soil.

Changes in farming methods can help offset these problems. For example, soil erosion can be limited by maintaining grass cover during key times of the year, or by practising shallower tilling. The

Soil erosion due to intensive olive farming practices leads to an increase in the use of fertilisers, run-off of topsoil and, in extreme cases, to desertification and land degradation.

Photo: José A. Gómez

Photo: Alvesgaspar

*The olive fruit fly (*Bactrocera oleae*), the main pest of the olive tree.*

creation or repair of terraces with stone walls enables the cultivation of hillsides without excessive soil erosion, although this is labour-intensive and may require support measures.

WATER

Run-off to surface waters of soils, fertilisers and agrochemicals: Soil run-off into reservoirs due to soil erosion may pollute surface waters. Herbicides, such as Simazine, used in intensive olive plantations remain highly concentrated in the top 5-15 cm of soil and are washed into water bodies with the soil that is eroded in heavy rainfalls. Traditional olive plantations on terraces help to slow down run-off and improve water penetration. This also helps to reduce flood risk in lowland areas.

Pollution of ground water: In continuous cultivations, excessive applications of nitrogen, phosphorous fertilisers and other agrochemicals can lead to pollution of surface and groundwater with hazardous compounds.

Exploitation of water for irrigation purposes: The olive yield is greatly increased by applying water. Irrigation is especially used for table-olive varieties, where large fruit size is desirable. It is also necessary in intensive plantations with densely planted trees in order to obtain maximum production. Irrigation also enhances the effectiveness of fertilisation and pruning. Drip is the most widespread type of irrigation in intensive olive plantations and, although the quantities used per hectare are lower than for arable crops, irrigated olive plantations cover an increasingly large area, often in regions that already suffer from serious water scarcity.

The increasing demand for irrigation water leads to an indirect, negative environmental impact through the construction of new reservoirs. These are not only intended for olive cultivation, though agriculture is the main water consumer (80%). Conversely, the creation of small reservoirs or ponds can produce positive benefits for biodiversity when they are constructed to take into account the existing landscape and habitats.

FERTILISERS

In many cases, such as in continuous cultivations, farmers apply much more fertiliser than a crop really needs: ammonium nitrate, one of the most common fertilisers that contains up to 33-34% nitrogen and that, in the most irrigated and intensive plantations, can reach levels as high as 350 kg/ha, is associated with problems of run-off and eutrophication[1]. Intensive olive-farming systems also use phosphorus, boron and potassium fertilisers. The latter type is heavily used in the cultivation

1 The accumulation of nutrients (nitrates and phosphates) in a body of water. Algal blooms result and their decay removes dissolved oxygen, killing aerobic organisms such as fish.

The run-off of fertilisers from olive farms can result in the eutrophication of rivers and lakes.

Photo: LIFE07 ENV/GR/000280

Photo: LIFE07 NAT/IT/000450

Traditionally cultivated olive groves support a diversity of wildlife, including reptiles.

of the olive trees, where, particularly in high yield seasons, regular potassium fertilisation is used to maximize yield and quality.

PESTICIDES

The main pest is the olive fruit fly (*Bactrocera oleae*), while other insect pests are: the olive moth (*Prays oleae*) and the black scale insect (*Saissetia oleae*). All three occur widely on olives in the Mediterranean region, causing significant financial losses. Dimethoate or Deltamethrin insecticides have been used for many years to combat the olive fly. However, the damage caused environmentally and treatment costs are significant. More environmentally-friendly techniques such as the use of pheromone traps[2] are being tested.

BIODIVERSITY

Biodiversity tends to be high in traditionally cultivated olive groves, which provide a variety of habitats (e.g., dry stone walls, patches of natural vegetation etc) supporting a diversity of wildlife including reptiles, butterflies and other invertebrates, birds and mammals. As well as many passerine species, other nesting birds include the Hoopoe (*Upupa epops*), European roller (*Coracias garrulus*) and owls including the European scops (*Otus scops*) and little owl (*Athene noctua*) that hunt insects, lizards and small mammals. Older trees provide an abundant food supply for fauna, as they host a high density of insects along with the tree's fruit.

2 A type of insect trap that uses pheromones (e.g.hormones) to lure insects.

A low level of pesticides also encourages a rich flora and insect fauna.

Intensive farming methods introduced to increase production (in particular, the use of mechanized tilling and heavy use of insecticides and herbicides) have had a negative impact on ground flora and insect populations reducing their diversity and numbers. Certain insecticides used in olive cultivation, e.g. Dimethoate, are also blamed for a reduction of insect species, including several that help to control pest species.

The replanting of olive trees to increase olive production, which is often accompanied by clearance of natural vegetation and loss of field boundaries and dry-stone walls, has also resulted in significant loss of wildlife habitats. The expansion of olive plantations has usually taken place at the expense of natural or semi-natural woodland and other vegetation of high conservation value. New intensive olive plantations have also taken over land in areas of importance for steppe land bird communities (such as the little and great bustard and vultures) and other dependant species.

OTHER IMPACTS

Where olive plantations form a part of diverse land use systems together with pastures, arable crops, vineyards, or where vines grow between olive trees, they are an important landscape feature. However, the groves can dominate the landscape forming vast monocultures and are the only form of vegetation for most of the year, which limits landscape and habitat diversity.

In areas which have a high proportion of forest vegetation and scrub, olive plantations can provide useful firebreaks. Conversely, farmers sometimes use fire to clear invasive scrub on their land, which may actually add to the fire risk in the event of fires getting out of control.

Other impacts are the indiscriminate use of a variety of products, which has led in some cases, to an increase in plant pests due to the removal of their natural enemies. Excessive herbicide treatment has also caused die-back in the olive trees of some plantations.

Energy consumption is another less obvious environmental concern, especially for intensive olive farming with its relatively high use of mechanised soil tillage. More eco-friendly cultivation techniques are being explored such as using the branches cut down from the pruning of olive trees as an organic fertiliser, instead of the normal practice of burning. This also allows for further processing of the waste for use as biofuels.

Grubbing up (i.e. digging up) of traditional old olive plantations occurred in the 1970s and 1980s across the EU, due to a combination of abandonment and restructuring programmes. As well as the socio-economic consequences of changing cultivation trends – i.e. the expansion of new plantations and intensification of production systems, and the abandonment of traditional olive plantations – there are environmental problems affecting biodiversity and landscapes. Soil erosion for example, is intensified by abandonment or grubbing up of traditional groves, while traditional landscapes can disappear. Recent CAP reforms contain measures to address these issues, such as the retention of landscape features, including (where appropriate) banning the grubbing up of olive trees; and the maintenance of olive groves in good vegetative condition.

Socio-economic considerations

Olive trees have for centuries been a typical feature of Mediterranean landscapes, and olive oil is the base of the gastronomy of these countries. Olive oil production is a significant economic sector for the main producing countries and regions.

Olive farming is also an important part of the local rural culture and heritage. It provides an important source of employment in many rural areas. In addition, part-time olive cultivation is increasingly a rural activity combined with tourism. Continued mechanisation in more productive regions however, (in particular of harvesting and pruning) is leading to reduced labour demand. Elsewhere, in marginal areas, employment is seasonal and sometimes poorly paid, and ageing populations, emigration and other factors are leading to reduced availability of labour.

Photo: Sara Maino

Olive farming provides an important source of employment in many rural areas.

Finally, companies are increasingly recognising there are significant marketing opportunities to be gained from product innovations promoting the health, nutritional or other benefits of olive oil. To help boost profits and market share, and to meet changes in consumer preferences and the growing demand worldwide for olive oil, companies offer various speciality oils, with for example different tastes (e.g. spicy, with tomato, etc.) or functional products such as extra virgin olive oil with vitamins, or with coenzymes (antioxidants).

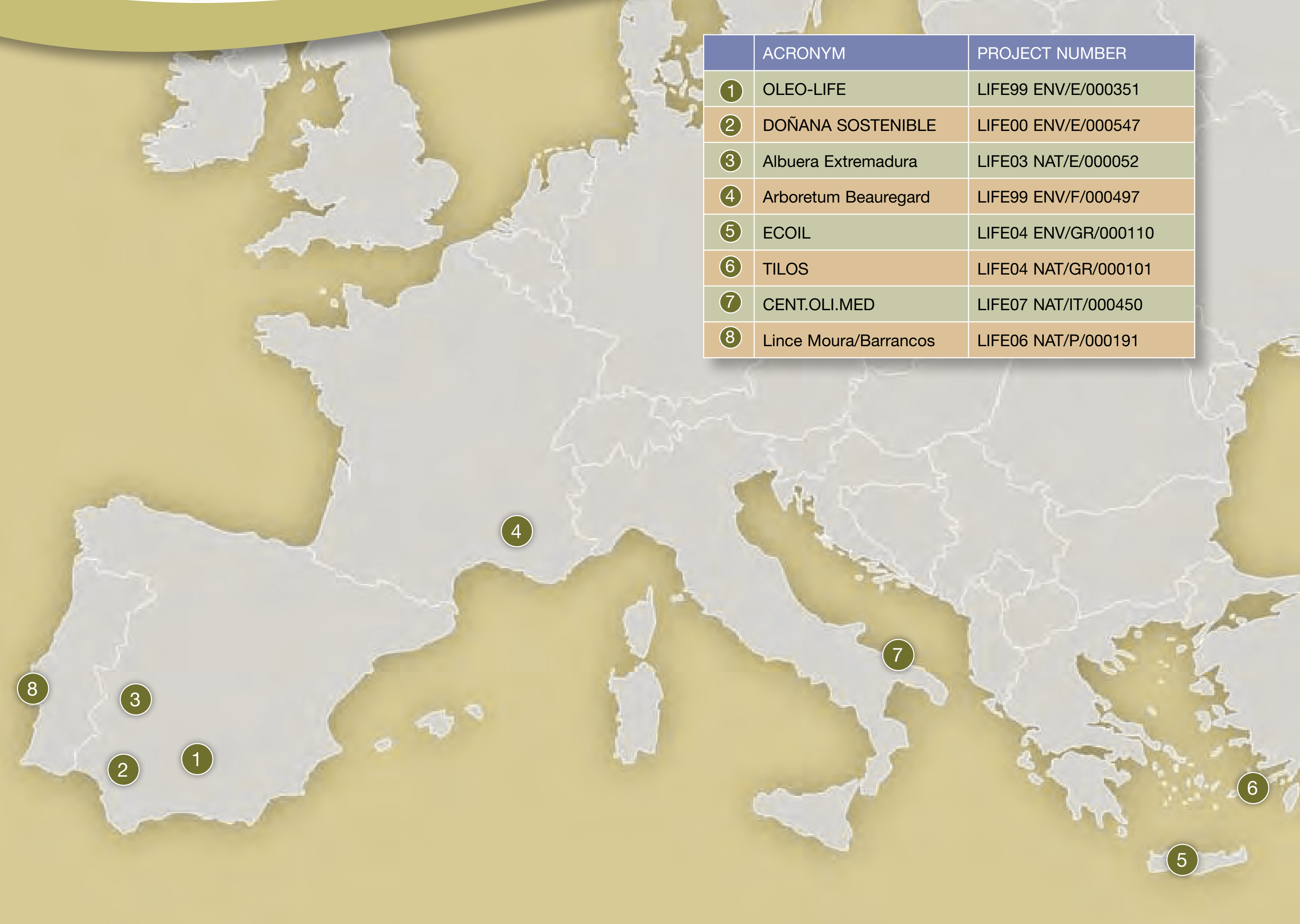
OLIVES FOR THE TABLE

Spain is the leading producer of table olives. Average annual worldwide production is around 1.76 million tonnes, of which Spain accounts for a third *(source: IOC)*. Table olives account for 22% of Spain's agri-food sector, worth around € 1 billion, and the sector creates 7 500 full-time jobs *(source: ASEMESA, the Spanish association of exporters and manufacturers of table olives)*.

The main problems associated with the production of table olives are (i) socio-economic – table-olive production is important for jobs. However, the price of table olives is very low, making production without support uneconomic for farmers; and (ii) environmental – a principal problem is associated with high water usage required for washing the table olives. As yet, there are no cost-effective techniques/ technologies for combating this negative environmental impact.

LIFE and olive cultivation

	ACRONYM	PROJECT NUMBER
1	OLEO-LIFE	LIFE99 ENV/E/000351
2	DOÑANA SOSTENIBLE	LIFE00 ENV/E/000547
3	Albuera Extremadura	LIFE03 NAT/E/000052
4	Arboretum Beauregard	LIFE99 ENV/F/000497
5	ECOIL	LIFE04 ENV/GR/000110
6	TILOS	LIFE04 NAT/GR/000101
7	CENT.OLI.MED	LIFE07 NAT/IT/000450
8	Lince Moura/Barrancos	LIFE06 NAT/P/000191



LIFE projects associated with olive cultivation have addressed major environmental issues such as soil erosion, application of agrochemicals, water usage, biodiversity loss and degradation of landscapes.


Photo: LIFE04 ENV/GR/000110

LIFE's contribution to **'greener' olive farming**

Projects have demonstrated how environmentally-friendly techniques successfully applied in one olive-growing area can be adapted for other regions, both within Europe and beyond. Such projects have worked hard to communicate their results and good practices, and thus generate interest and support among growers and policymakers. They have also demonstrated how EU policy can be effectively implemented in this sector.

SOIL EROSION AND DESERTIFICATION

As mentioned in the preceding chapter, soil erosion is one of the key negative environmental impacts of intensive olive farming. It is already a major problem in Spain, and is likely to get worse as the climate changes due to global warming. Climate change impacts in already arid areas are likely to include warmer, drier summers and longer droughts.

The Doñana Sostenible LIFE project was particularly successful in tackling the environmental impact of soil erosion in olive groves in Andalusia's Doñana national park (Parque Nacional de Doñana). EU policies clearly signal the need for an integrated approach to address erosion, and the project showed how this can be achieved. The project also succeeded in testing and promoting specific agriculture techniques in conservation, some of them

The LIFE funded ECOIL project applied the Life Cycle Analysis approach to three olive producing areas in Greece, Cyprus and Spain and identified the main environmental impacts on a site-specific basis.

Photo: LIFE04 ENV/GR/000110

Photo: LIFE04 ENV/GR/000110

The ECOIL project developed guidelines promoting eco-friendly olive cultivation techniques and good agricultural practices that are easily transferable to other areas.

going beyond the concept of good farming practices (GFP). The project's results are also relevant for the social and economic policies aimed at sustainable rural development in arid areas.

USING LIFE CYCLE ANALYSIS TO TACKLE ENVIRONMENTAL PROBLEMS

LIFE Environment projects Oleolife and ECOIL used a Life Cycle Analysis (LCA) approach to help reduce the negative environmental impacts of olive cultivation and to encourage more sustainable farming.

Using LCA, Oleolife (**LIFE99 ENV/E/000351**) examined and analysed different models of sustainable cultivation of olives in Spain – although its findings are also of value to other olive-cultivating countries. Meanwhile, ECOIL (**LIFE04 ENV/GR/000110**) applied LCA to three Mediterranean countries: Greece (the beneficiary location), Spain and Cyprus.

Both provide useful examples of good olive-farming practices. The earlier project (1999-2002) provided a series of recommendations relevant to the Spanish market in the 1990s, which have subsequently become more widely adopted both in Spain and in other Mediterranean countries, following the 2003 CAP reforms. Meanwhile, the more recent Greek project (2004-2006), has developed site-specific guidelines for improvements in both olive cultivation and processing.

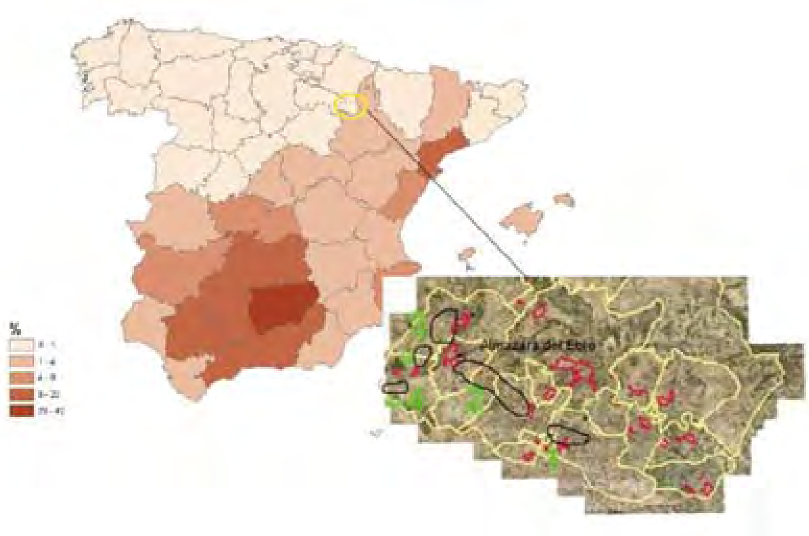


Photo: LIFE04 ENV/GR/000110

LIFE CYCLE ANALYSIS PROMOTES SUSTAINABLE CULTIVATION

Until recently, olive production was considered one of the least environmentally-harmful agricultural activities in the Mediterranean region. Nevertheless, as a result of the industrialisation of olive cropping, especially in Spain, significant impacts on human and natural environments are apparent, such as rural depopulation, and loss of biodiversity and cultural heritage. Olive production in Spain plays a pivotal role in protecting natural resources and preserving the traditional landscape, as well as being a significant economic sector and providing employment to stabilise rural populations and preserve their cultural heritage.

The main objective of Oleolife was to use an LCA approach to categorise different olive-cultivation methods in Spain according to their environmental impact, and to explore these in a wider context taking into account socio-economic and cultural considerations. By carrying out a wide programme of communication activities directed at stakeholders (such as olive farmers, politicians, industry and academics) the idea was to create support for future sustainable development.

Different farming practices were assessed in three key Spanish olive-producing regions: Baeza in the province of Jaen, Reus in Tarragona, and Mora in Toledo. A systems-based LCA approach was developed that differentiated between the different cultivation methods used:

- intensive – no soil and biological resource conservation with heavy chemical input;
- conventional – partial soil and biological resource conservation with variable chemical input; and
- ecological – total soil and biological resource conservation with no chemical input

These three types were further categorised according to the more and less-productive areas where they are located i.e. plains and mountains. Indicators were identified for these production systems examining socio-economic, environmental and cultural factors.

KEY RESULTS

As expected, ecological systems were found to be good from environmental, social and cultural viewpoints. However, they are still marginal, accounting for only 2% of Spanish production[1], provide little economic income and depend on subsidies.

Intensive systems in lowlands and plains are not sustainable. Nevertheless, as these systems account for the greatest proportion of olive-cropped lands, their overall impact is important. Significantly, the project highlighted the fact that at that time, the income generated was mainly due to the CAP production-based payments. However, this is changing as CAP reforms have progressively de-coupled payments to farmers from production, thus encouraging less intensive practices.

Conventional systems had a similar profile to intensive systems. Although their environmental impact per hectare is high, conventional systems account for a limited part of olive-cropped land in Spain. The application of vegetative cover was found to improve environmental performance, but it was not sufficient to make the system sustainable.

Intensive systems on steeply-sloped land were found to have the most negative impact on the environment and to generate few jobs and little income. On the other hand, the project concluded they are usually characterised by a desirable cultural profile that should be preserved, possibly by applying more sustainable systems.

LIFE CYCLE ANALYSIS FOR CULTIVATION AND PROCESSING

ECOIL applied the LCA approach to sites in three Mediterranean olive-producing areas: Voukolies in Greece; Lythrodontas in Cyprus; and Navarra in Spain. In each of these areas, the environmental impacts were assessed throughout the lifecycle (i.e. from cultivation through to processing) and the weakest points from the environmental point of view were identified on a site-specific basis.

The research suggested eco-friendly techniques that could produce short, medium, or long-term benefits and identified the most appropriate techniques for olive cultivation. The main environmental problems were found to be related to poor soil management, the burning of the waste generated from the pruning of the trees, and the use of pesticides and fertilisers.

Among the main outcomes, the project developed guidelines for the improvement of olive cultivation and processing, and concluded that the application of good agricultural practices in the cultivation of olive trees, such as irrigation and the use of biocides, would lead to reductions in the relative cost for farmers and to enhanced protection of the environment and public health.

The guidelines promote eco-friendly cultivation techniques such as activities for preparing the site for plantation (the uprooting of other trees and bushes, levelling the soil, construction of terraces, soil analysis to determine the amounts of phosphate and potassium fertilizers and suggestion of maximum amounts) a large reduction in the use of pesticides and minimisation of the use of fertilisers; and suggest using the branches pruned from olive trees as an organic fertiliser, instead of the normal practice of burning. This allows for further exploitation of the waste, which provides secondary products, and when implemented has proven to be very profitable.

Finally, transferability of the lessons learned by the project is high since the processing of olive oil is common throughout the Mediterranean region and the majority of producers are small and privately-owned companies. The project's findings can be applied to Malta, Lebanon, and North Africa, other sites in Greece, Cyprus, Italy and Spain. Moreover, the methodology can also be applied to other production processes, such as fruit and vegetable canning, juice, and seed oil and corn oil production.

The results of the Life Cycle Analysis were applied in the area of Navarra in Spain.

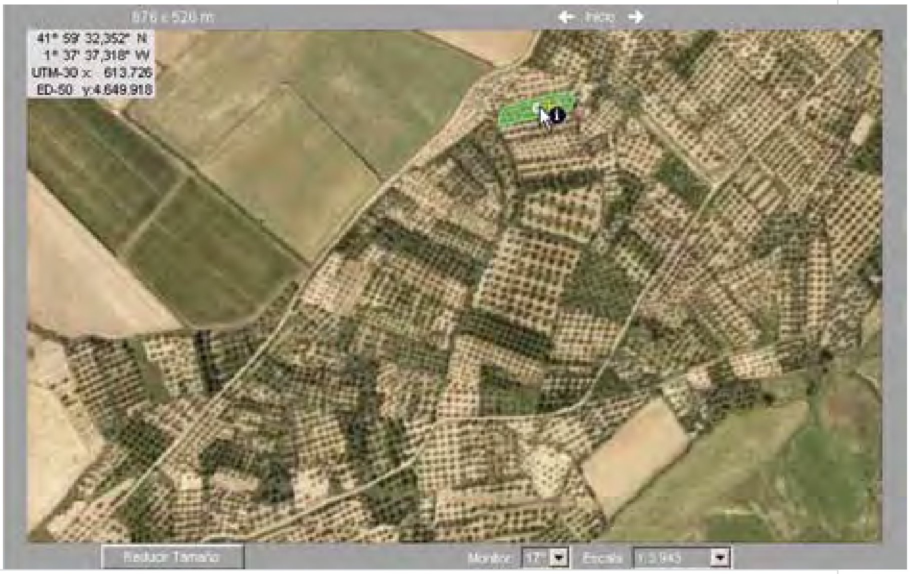


Photo: LIFE04 ENV/GR/000110

1 Project data 2002.

Combating soil erosion among olive groves in Andalusia

The Doñana Sostenible LIFE Environment project was particularly successful in tackling the negative environmental impacts from soil erosion among olive plantations in Andalusia's Doñana national park (*Parque Nacional de Doñana*). The project was also successful in testing and promoting conservation farming techniques.

The Doñana national park is one of Spain's main natural heritage reserves, hosting unique European wildlife including the endangered Iberian Lynx and colourful colonies of migrating flamingoes. Agriculture plays a significant role in supporting both the local economy and the quality of natural resources in the Doñana catchment area, where olive groves and other orchard crops are cultivated on a large-scale. Farming in this part of Andalusia has intensified over the years and this has been linked to soil erosion, leading to increased sedimentation, fertiliser run-off and pesticide pollution, particularly in the Guadiamar river basin, which feeds much of the national park's wetland areas.

Farming organisations have acknowledged their role in tackling these issues and have harnessed LIFE support to establish new soil conservation methods. The project was implemented by Seville's young farmers' association (ASAJA).

Activities started in 2001, with the investigation of soil management techniques to improve the Guadiamar river catchment's conservation status. The project adopted a participatory approach, starting with an inclusive soil-mapping exercise, followed by wide-ranging farm trials of different ground-cover methods.

The Doñana Sostenible project improved the conservation state of the Guadiamar River by reducing soil erosion through the use of soil conservation techniques on olive farms.

Thirty-three demonstration farms were selected for the project's trials, covering 320 ha of agricultural land. The pilot sites were chosen for their high susceptibility to erosion and also to ensure a good representation of the area's common soil types. More than 80% of plots were olive-tree plantations, but a number of fruit crops were also included in the trials including citrus, plum and peach trees.

Dedicated conservation techniques were identified for each soil type and common methods involved: applying fertiliser to help maintain nutrient balances; leaving a strip of live vegetation to allow plants to complete seed production cycles; and encouraging grass cover due to its strong anti-erosion qualities.

LIFE investments were estimated to have prevented 345 000 tonnes of soil erosion.

IMPRESSIVE RESULTS

The results were impressive, with erosion being reduced for the majority of test sites and the vegetation cover shown to be beneficial for pest control. Farmers were particularly pleased with the works on difficult sloping areas where considerable improvements in the overall soil structures were noted.

In total, the LIFE investments were estimated as preventing 345 000 tonnes of soil erosion, converting to approximately ten cm of soil across 230 ha of farm land, and representing a significant reduction of sediment pressure on the Guadiamar river. The associated improvements in water quality from diminished agri-chemical run-offs were further increased by the soils' enhanced retention capacity. This also had a positive effect on local landscape quality and biodiversity, with analysis confirming greater species diversity among insects, earthworms and soil micro-organisms.

SUSTAINABLE OUTCOMES

Such benefits should increase over time as more farms adopt the new sustainable soil management techniques. Encouragingly, a visit by an external LIFE monitoring team at the end of 2007 showed an estimated 90% of farmers in the target area had by then taken up the new soil-management methods. This achievement has been attributed to a mix of factors including:

- Soil-conservation techniques were cost effective and did not affect productivity;
- The project was led by local farming groups which were respected within the agricultural sector; and
- Project staff worked closely with agriculture stakeholders and prioritised awareness-raising to improve understanding of the project among more than 5 000 farmers and agri-technicians

The project identified conservation techniques for each soil type, such as the maintenance of vegetation cover due to its anti-erosion quality.

More than 5 000 farmers participated in the project's dissemination activities and 300 ha. of demonstration plots with sustainable soil management techniques were implemented.

Furthermore, some of the farmers who participated in the project are now members of an association that promotes integrated production and promotes olive quality (APAMAD: *Asociación de Productores de Aceituna de Mesa del Area de Doñana*). They use a mix of ecological and traditional techniques.

GOOD PRACTICES

The good practices most widely adopted included the maintenance of vegetation cover throughout the year among the olive groves, with pruning waste left on site. These practices have now become fairly widespread in the area because the benefits are direct, at little extra cost. The tests carried out were referenced in a geographic information system that helped to monitor the development of the techniques implemented.

Manuals and other information materials were produced and are still available on www.forodelolivar.com.

The project's participatory approach has already being replicated in a later LIFE project Sustainable Wetlands (**LIFE04 ENV/ES/000269**) that promoted sustainable soil conservation among farmers in other important Spanish wetland sites.

ECONOMIC BENEFITS

The various techniques and practices studied by the project were economically viable and most were shown to lead to direct cost savings, hence increasing farms' profitability. Some techniques require upfront investment (such as new machinery or personnel training) but this was shown to be recoverable within a few years. ASAJA estimates that the cost reduction can reach about €30 per ha, provided the techniques are correctly applied.

EU POLICIES

The European Commission has supported an integrated approach to address soil erosion, and the project shows how this can be achieved. The project has implications for the future development of soil protection policies in the EU (Sixth Environment Action Programme and the Thematic Strategy for Soil Protection), and for water quality and management measures (Water Framework Directive, 2000/60/EC). Importantly, the techniques developed by the project are in line with the Water Framework Directive, even though this was not published at the start of the project.

CONCLUSIONS

The major success of the project has been to raise awareness among the local population and farmers of the importance of conserving natural resources and landscape. A significant change in the attitudes of the whole production and agricultural sector in the project area (arable land surrounding the Doñana national park) was noted during the course of the project and after. The project has been a driving force for the use of sustainable practices in the area.

Indirectly, LIFE also provided some solutions for adaptation to climate change in areas likely to suffer severely in the near future.

The Doñana national park hosts unique European wildlife, including the endangered Iberian Lynx.

Project Number: LIFE00 ENV/E/000547

Title: Design and Application of a Sustainable Soil Management Model for Orchard Crops in the Doñana National Park Area

Beneficiary: Asociación de Jóvenes Agricultores de Sevilla (ASAJA-Sevilla)

Total Budget: €790 000

LIFE Contribution: €395 000

Period: Jul-2001 to Jun-2004

Website: www.asajasev.es

Contact: José Fernando Robles Del Salto

Email: life@asajasev.es

Photo: LIFE07 NAT/IT/000450

LIFE preserving **biodiversity**

High nature value farmlands, including ancient olive groves in the Mediterranean region, can play a crucial role in the protection of biodiversity. A number of LIFE projects have developed and tested new approaches to identifying, assessing, protecting and enhancing the biodiversity of olive growing areas.

The high biodiversity value of ancient olive groves is related to the genetic reservoir of the ancient trees and their associated species. A prolonged system of extensive production has allowed a wide range of animal and plant species to flourish. Some bird species use the trunks of the trees for nesting. The work to characterise high nature value farmlands among traditional olive groves, as well as assessing its condition and the threats to it, is at an early stage of development throughout the EU but the main threats to high nature value farmlands biodiversity have been identified as changes in farming practices – the adoption of intensive systems and abandonment of less economically viable low-input traditional plantations. Ancient large-canopied trees are also increasingly uprooted for ornamental purposes. Coupled with this is limited knowledge of the environmental value and cultural heritage of ancient olive groves. Other important threats include:

- groundwater pollution, for example from the use of copper and other heavy metals in chemical fertilisers, which are also responsible for damage to soil-borne micro organisms;
- removal of hedges e.g. the disappearance of myrtle hedgerow (*Myrtus communis*), dry walls and other small-scale structural elements (see the section below on traditional landscapes) that provide important shelter for many species;
- pest control: studies show that the treatment of olive trees with Dimethoate (widely used to guard against olive fly (*Bractrocera oleae*) may cause a considerable reduction in the

number of insects. Similarly, the use of growth regulators such as Fenoxycarb is attributed to a serious decline in 'useful' insects such as ladybirds (*Coccinellidae*) and lacewings (*Neuroptera*).

LIFE RESPONSES

An ongoing Italian LIFE Nature project, CENT.OLI.MED (**LIFE07 NAT/IT/000450**), run by the Mediterranean Agronomic Institute of Bari (the Italian seat of CIHEAM – *Centre International de Hautes Etudes Agronomiques Méditerranéennes*) is seeking to identify and assess the biodiversity in ancient olive groves. The project is using this information as the basis for drawing-up and implementing guidelines for ancient olive-grove management, with the overall aim of conserving and enhancing biodiversity. Concrete actions are taking place in Apulia (Italy) and Crete. These actions include the restoration of dry-stone walls, the planting of Mediterranean shrubs, propagation of typical species of Mediterranean grassland, and the conservation and propagation of important tree genetic material. Moreover an extensive GIS-based inventory of ancient olive trees, including a detailed description of trunk sizes, shapes, heights and other morphological and environmental characteristics, has been put in place and is available on the project website.

Photo: E.V. Perrino

*The CENT.OLI.MED project found 308 plant species characteristic of habitats within low-input olive orchards. An example is the Lady Orchid (*orchis purpurea*).*

A RICH BIODIVERSITY

CENT.OLI.MED has already shown that in the target olive groves in Apulia, in the spring-summer period alone, 26 animal species were detected (three mammals, 19 birds, four reptiles), and 308 plant species were found. Some plant species are characteristic of specific habitats within low-input olive orchards. Such species include *Stipa austroitalica*, an EU protected species (Annex I of the Habitat Directive 92/43 CEE), *Triticum uniaristatum*, a threatened species (EN) at regional and national level, *Helianthemum jonium, Asyneuma limonifolium. subsp. limonifolium, Crepis corymbosa, Orchis palustris*, threatened species (EN) at regional and national level and the rare *Epilobium parviflorum*.

The LIFE Nature CENT.OLI.MED project is assessing biodiversity in ancient olive groves, and will use this information to draw-up guidelines for ancient olive grove management.

Photo: LIFE07 NAT/IT/000450

The project team is also working to spread awareness about the conservation value of these ancient olive groves via its website (www.lifecentolimed.iamb.it) and an information campaign featuring on-site notice boards, workshops and technical and non-technical publications in both Italian and Greek.

A HAVEN FOR ENDANGERED SPECIES

Other LIFE Nature projects have indirectly supported biodiversity improvements, with specific actions targeting olive-growing areas carried out as part of broader conservation measures. For example, the 2006-2009 Lince Moura/Barrancos project (**LIFE06 NAT/P/000191**) in Portugal worked to restore and maintain key areas and connective habitat corridors for the critically endangered Iberian lynx (*Lynx pardinus*) within the Moura/Barrancos Natura 2000 site. Works to aid the recovery of natural and semi-natural Mediterranean vegetation favoured by the lynx have included the planting of native species, such as wild olive trees, and the promotion of natural regeneration. The project also successfully campaigned to prevent the conversion of 4 000 ha of traditional olive plantations into intensive and super-intensive groves.

Similarly, a Greek LIFE Nature project named after its location – the island of Tilos, a special protection area (SPA) under the Birds Directive – introduced the planting of wild olive (*oleaster silvestris*) in small plantations, as part of efforts to increase prey availability for two endangered raptors: Bonelli's eagle (*Hieraaetus fasciatus*); and Eleonora's falcon (*Falco eleonorae*). TILOS (**LIFE04 NAT/GR/000101**) focused in particular on invertebrates (insects), bird (partridges), reptiles (lizards) and (micro) mammal populations.

Another project, Albuera Extremadura (**LIFE03 NAT/E/000052**) worked with olive farmers to restore the natural habitats of the Albuera wetland in southern Spain. The site is an important stopover point for migrating birds, which use it for breeding and wintering. The project reported noticeable results in terms of biodiversity enhancement of the targeted habitat type; Mediterranean temporary ponds (listed as a priority habitat by the Habitats Directive). A key outcome was a shift of attitude among the local olive farmers, who now recognise that profitable exploitation is compatible with wildlife conservation.

PRESERVING A TRADITIONAL LANDSCAPE

As mentioned in the preceding section, there are considerable differences in the Mediterranean olive-growing areas, in both type of plantation and olive-farming system used; and these have varying impacts on both habitat and species diversity and on landscape value.

As with other farming systems, olive groves make a more substantial contribution to biodiversity when they co-exist with other land-use practices, such as arable crop farming, other tree crops or forests, or when they are supported by structural elements such as hedges and stone wall terraces. Traditionally, terraces with supporting walls were constructed on sloping land, which also helped to prevent soil erosion. In some regions, an expansion of olive plantations in intensively-managed areas has taken place at the expense of natural woodland and other vegetation – to the detriment of both natural and landscape value.

The French LIFE Environment project Arboretum Beauregard (**LIFE99 ENV/F/000497**) investigated the importance of preserving a traditional landscape, with its associated biodiversity. Located in the Provence-Alpes-Côte d'Azur region, in southern France, the 1999-2002 project targeted the restoration of damaged natural habitats – riverbank woods, hedges and related habitats along the banks of the Ouvèze river, to avoid the risk of flash flooding. The site is situated at the northern limit of the natural distribution area of the olive tree, an area that has suffered considerably from climatic and economic problems, causing the progressive disappearance of olive groves and of traditional terrace cultivation. Another aim therefore, was to restore the diversity of past, native tree species and vegetation. For example, from a once-diverse range of olive-tree varieties only three species remained at the beginning of the project.

Working with the *Conservatoire Botanique national Méditerranéen de Porquerolles* – a national conservatory and botanical garden located in the Port-Cros national park – the project has planted an olive grove for research purposes, with the 35 olive-tree varieties grown in France, including 15 species of high economic value. The aim is to demonstrate the advantages of using wild native species. Parts of the area's traditional terraces were also restored. Importantly, a "National chart for the preservation of the genetic resources of olive trees" has been agreed upon regionally. Moreover, the project helped raise awareness among the local population about the different olive varieties, and of the economic opportunities for promoting their premium olive oils.

The LIFE funded Arboretum Beauregard project helped to preserve the landscape of the Provence-Alpes-Côte d'Azur region, by reintroducing 35 olive tree varieties and restoring the area's traditional terraces.

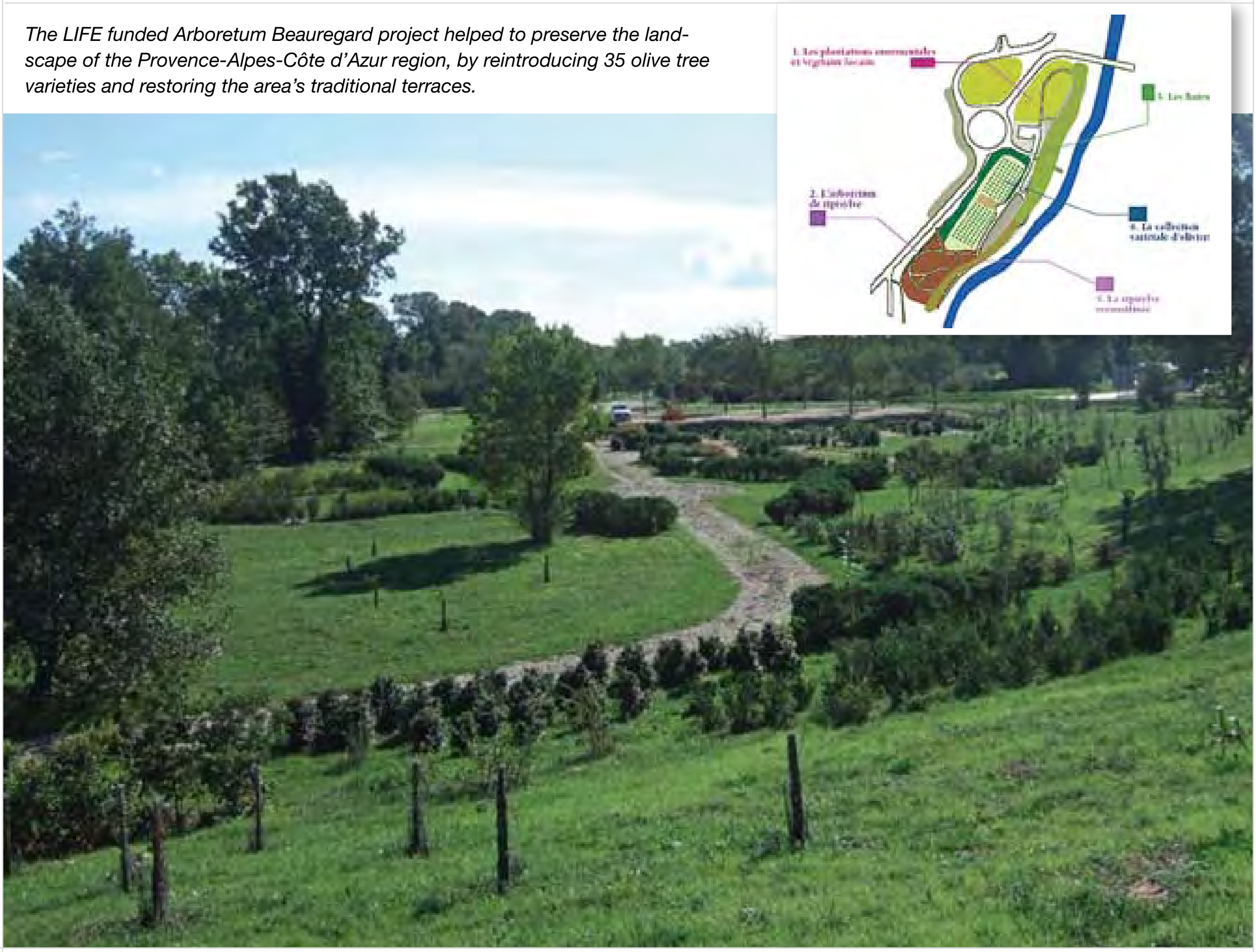


Photo: LIFE99 ENV/F/000497

Olive Oil production

Much of the EU's olive harvest is processed into olive oil. The EU is also an importer of olive oil for blending from countries such as Morocco and Tunisia. During the first six months of 2009, EU countries imported around 80 000 tonnes of olive oil per month, according to International Olive Council data[1]. Different methods are used to extract oil from the olives and these processes create large volumes of liquid and solid waste. The waste streams remain highly hazardous to Europe's environment and present a number of treatment challenges for EU olive oil producers.

Society's increasing interest in healthy lifestyles and nutritional food has contributed to the resurgence of Europe's olive oil trade. Olive oils continue to grow in popularity with EU consumers, and olive oil production represents an important component of many regional economies in southern Europe, where the olive oil industries are estimated to provide employment for around 800 000 people, either directly or indirectly, mostly in small or medium-sized enterprises.

Much of Europe's olive oil is produced in Spain, Portugal, Italy and Greece. Other major producers in the region include

Figure 1: **Total EU annual olive oil production (tonnes)**

Data source: International Olive Council (figures for 2007/09 are provisional and exclude data for Romania and Bulgaria)

1 Olive products market report summary, No. 33 July-September 2009, available at http://www.internationaloliveoil.org/

Turkey, Tunisia and Morocco, and Balkan countries. Between them, all these countries supply some 90% of the global olive oil market.

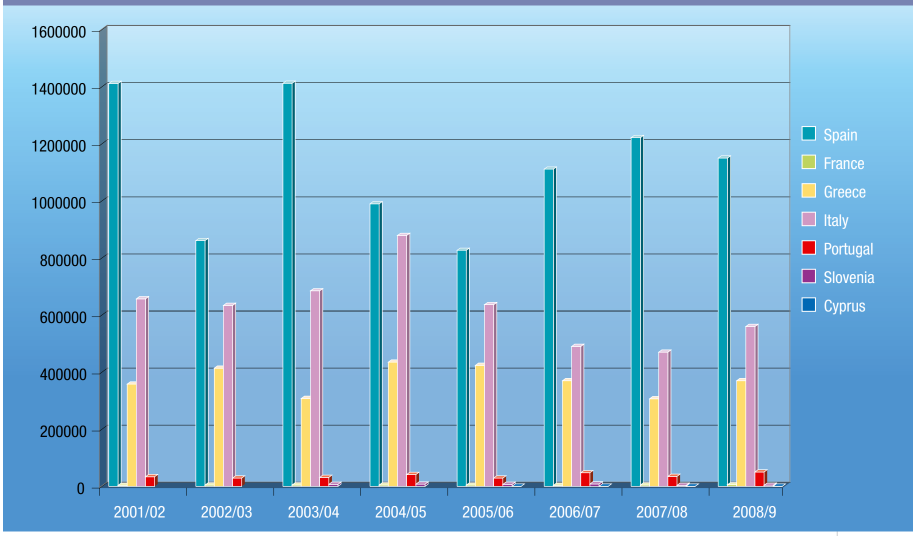
Figures 1 and 2 show production trends for the main EU olive oil producers between 2001 and 2009.

Analysis of Figure 1 reveals a relatively consistent annual production rate in the EU, mostly above two million tonnes of olive oil per year. Supplies peaked early on in the decade and are now climbing steadily back towards their former high points. Trends reflect a combination of market demands, climatic conditions and harvest factors.

Data from Eurostat indicates that olive oil accounts for around a fifth of the EU's vegetable-oil production and only about 60% of olive oil is consumed in the EU producer countries. The remainder is sold to other Member States or exported, primarily across the Atlantic. Figure 2 shows the volume of olive oil production for key EU producer countries.

Reviewing the International Olive Oil Council data from Figure 2 clearly shows that Spain is the EU's largest olive oil producer, recently producing more than double the amount of oil of its main rivals, Italy and Greece. Output figures from Portugal, France, Cyprus and Slovenia also indicate established olive oil industries in these Member States.

Figure 2: **EU Member States annual olive oil production (tonnes)**



Data source: International Olive Council (figures for 2007/09 are provisional).

EU QUALITY STANDARDS

All of these Member States produce the full range of olive oil grades. The EU has established quality standards that help define the grades and inform consumers. These are set out in Regulation (EC) 1019/2002, which introduced marketing requirements for olive oil sold in the EU, particularly in terms of labelling information. The Regulation differentiates between 'virgin oils' and 'refined oils' and focuses attention on ensuring the authenticity of olive oils.

Virgin olive oils are categorised as oils from the fruit of the olive tree obtained solely by mechanical or other physical means under conditions that do not lead to alteration in the oil. The olives should not have undergone any treatments other than washing, decanting, centrifugation or filtration. Solvents, chemical or bio-chemical agents cannot be used during virgin olive oil production processes and virgin oil should not contain any mixture of other oil types.

Virgin olive oils are classified by oleic acidity as follows:

- 'Extra virgin olive oil' – defined as virgin olive oil with a maximum free acidity, in terms of oleic acid, of 0.8 g per 100 g;
- 'Virgin olive oil' – classified as virgin olive oil with a maximum free acidity, in terms of oleic acid, of 2 g per 100 g; and
- 'Lampante olive oil' – characterised as virgin olive oil with a free acidity, in terms of oleic acid, of more than 2g per 100 g.

The latter Lampante oils are usually unsuitable for human consumption due to their high acidity, unattractive colour or abnormal aroma. Refining and chemical treatments can help eliminate these problems and a number of classifications exist to define different non-virgin olive oils. These include:

- 'Olive oil' - obtained by blending refined

A high quality olive oil is also obtained by continuously adding fresh water to the washing process resulting in water consumption in modern plants of about 800lt/hr.

Photo: Giancarlo Dessì

Photo: Giancarlo Dessì


Photo: pizzodisevo (doing TENS for pain)

The three-phase and two-phase processes, although similar in their oil yield significantly differ in the amount and composition of the different by-product fractions that they generate.

olive oil and virgin olive oil having a free acidity content expressed as oleic acid, of not more than 1 g per 100 g;

- 'Crude olive-pomace oil' - obtained from olive pomace by treatment with solvents or by physical means; and
- 'Refined olive-pomace oil' - obtained by refining crude olive-pomace oil, having a free acidity content expressed as oleic acid, of not more than 0.3 g per 100 g.

QUALITY FACTORS

Generally speaking, the first pressing tends to produce oil with the highest quality and olives that undergo a second or third pressing are likely to produce oils that decrease in quality with each pressing.

Oil quality is also influenced by timing. The olive-harvest date is critical in order to achieve the highest quality oil. The harvest usually takes place in late autumn when the olives have reached their optimum level of maturity and oil levels are deemed to be peaking. In addition, olives should ideally be processed relatively soon after harvesting, usually within 48 hours. Storage times need to be long enough to allow the olives to become warm, so that they release their oil easily, but short enough to avoid detrimental effects caused by fermentation during the olives' natural degradation.

EXTRACTION PROCESSES

Another key determinant of oil quality is the type of production process used. Methods for extracting and processing oil from raw olives vary. They range from niche artisan approaches and traditional techniques to large scale commercial systems that apply high-tech industrial manufacturing processes. The basic steps involved in all of these processing methods are however similar. The first stage involves grinding or crushing the olives (often including the stones). This crushed olive paste (referred to as 'pomace') is then pressed to produce a liquid substance, which is finally separated into oil, water and solid elements.

Different techniques are used to crush, press and separate the oils. The main manufacturing processes favoured by EU olive oil mills can be grouped into three methodological approaches. These are:

- Traditional methods – combining stone milling and mechanical-pressing techniques;
- The two-phase decanter process – based on a horizontal centrifuge system used to separate and extract oils; and
- The three-phase decanter process – also based on horizontal centrifuge technology and involving an additional vertical centrifuge phase.

On average, these techniques can produce around 200 kg of oil from one tonne of processed olives. This equates to approximately 1 litre of oil from around 2 000 olives.

CONSUMER AWARENESS

Olive oil is covered by the EU schemes to promote and protect names of quality agricultural products. These include the protected designation of origin (PDO) and the protected geographical indication (PGI). The PDO covers agricultural products and foodstuffs which are produced, processed and prepared in a given geographical area using recognised know-how. The PGI covers agricultural products and foodstuffs closely linked to the geographical area. At least one of the stages of production, processing or preparation takes place in the area. Olive oil produced from certified-organic olive plantations can be labelled as such, on the basis that it conforms with national organic labelling rules, or with the EU's Regulation (EC) No 834/2007 on organic production and labelling of organic products.

Olive oil is covered by the EU schemes to promote and protect names of quality agricultural products, which include the protected designation of origin (PDO) and the protected geographical indication (PGI).


Photo: pizzodisevo (doing TENS for pain)

Photo: pizzodisevo (doing TENS for pain)

Olive oil **production methods**

Three different processes are used today for olive oil production. These systems are similar regarding their oil yield, but they differ significantly in the amount and the composition of the different by-product fractions.

TRADITIONAL TECHNIQUES

Traditional processing approaches use the same type of classic techniques that have been applied for centuries. Traditional methodologies are known as 'discontinuous' systems, due to their stop-and-start nature that results in individual batches of oil, rather than a continuous supply.

Traditional methods begin with olives being cleared of any leaves or twigs. Clean olives are washed in cold water and dried prior to being crushed into a smooth pomace paste using stone milling equipment. The resulting olive pomace is then spread out on to natural fibre mats which are stacked, sometimes up to 50 layers high, in a vertical press to extract what is known as the first 'cold pressing' of oil. The mats are pressed together, using relatively little pressure, to squeeze out the oily liquid which contains a mixture of oil and water. This liquid is later left to decant, as the oil floats to the top due to density differences. Batches of oil are traditionally left unfiltered, as filtering can remove many beneficial nutrients.

Photo: pizzodisevo (doing TENS for pain)

MODERN METHODS

More modern approaches to the manufacture of olive oil have continually evolved and technology is now well advanced. Large-scale production plants operate continuous shifts during harvest periods applying fully mechanised systems to crush olives, extract oil and package the products. Recent developments have concentrated on improving the equipment used for separating olive oil from the remnant components, and the latest advances include new types of centrifuge systems.

Crushed and milled olive pomace is spun at high speed in a rotating decanter and the oil, being lighter,

Photo: Gabriella Camarsa

The 3-phase decanter system produces 1200 kg of wastewater and 500 kg of solid waste for every 1000 kg of olives.

moves towards collection points close to the rotation axis, whereas the heavier pomace and vegetable water are spun to the outer edge of the decanter.

Advantages of these continuous production systems include:

- High production capacity, which avoids having to stockpile olives during batch production and therefore allows a continuous supply of fresher olives to be used which increases the oil's quality; and
- Improved performance, cleanliness and hygiene from the highly mechanised technology which is carefully designed to comply with international sanitation standards.

TWO-PHASE VS. THREE-PHASE PROCESSING

Three-phase decanter processes were the industry standard for many years. These involve an initial decanting phase which cleans, washes and grinds the olives into a pomace. The beaten olive paste is then made more fluid, by adding one litre of water per kilogramme of paste. The liquid paste is spun, during the second decanting phase, in a horizontal centrifuge that separates solids from the oily liquid. A third and final decantation phase uses a vertical centrifuge to separate the olive oil from the fruit vegetable water.

Recent innovations have led to the introduction of a new two-phase centrifuge process which uses a horizontally-mounted centrifuge for primary separation of the olive oil fraction from the vegetable solid material and water solution. The process is virtually the same as the three-phase approach, with the difference that instead of adding new water for the horizontal centrifugation, vegetable water is recycled in a closed loop system.

Recycling of vegetable water increases the levels of polyphenols in oils and so strengthens their biotic capacity as natural protectors against oxidation. Closed loop two-phase processing systems also help to reduce the environmental footprint from olive mills by minimising water consumption and reducing wastewater. However, the two-phase process does produce the '*alperujo*' wet pomace, which is discussed in more detail below.

POMACE OIL PROCESSING

Two methods are used to extract pomace oil, a by-product of olive oil processing. Pomace oil obtained from two-phase processing, with a moisture content close to 70%, is physically extracted by centrifugation. The process also produces a residual water solution of high commercial value due to the presence of mineral salts, sugars and polyphenols.

To extract pomace oil from the traditional and three-phase production methods, solvents are used. The pomace is mixed with the solvent hexane, that dissolves any residual oil. The exhausted pomace is then separated from the oil and hexane solution (called miscella) by filtration. Any hexane residues in the solid pomace are removed by a 'desolventiser', which evaporates the solvent, which is captured for re-use. The oil and hexane solution is distilled, allowing the hexane to be recovered and re-used, whilst the solvent-free oil goes through further processing such as refining.

Although the traditional pressing process is more ecological, it can only be run in batches and this is not always feasible for the main producing countries.

Photo: pizzodisevo (doing TENS for pain)

Environmental impacts

Each of the different olive oil production methods creates different amounts and types of by-products, all of which are potentially hazardous to Europe's environment.

Waste material generated by the two-phase method of olive oil extraction is termed '*alperujo*'. This Spanish name is derived from an amalgamation of the technical terms '*alpechin*' and '*orujo*', which refer respectively to wastewater and solid material from olive mills using traditional and three-phase processes. Solid wastes from olive oil mills are also referred to as 'olive cake' and liquid waste streams are termed olive-mill wastewater.

BOD and COD

BOD stands for biological oxygen demand, and refers to the oxygen absorbed by micro-organisms in water rich in organic matter (such as olive-mill wastewater). COD refers to chemical oxygen demand, meaning the amount of oxygen consumed when organic matter in water is chemically oxidised into inorganic end products.

OLIVE-MILL WASTEWATER

Traditional olive oil processing methods are estimated to produce between 400 and 600 litres of *alpechin* for each tonne of processed olives. Olive-mill wastewater levels from three-phase processes are much higher, producing between 800 and 1000 litres of olive-mill wastewater for each tonne of processed olives. Virtually no wastewater is produced by the two-phase process, although its *alperujo* waste streams tend to have high liquid contents which remain costly to treat.

In total, some 4.6 million tonnes of olive-mill wastewater are estimated to be produced each year at the European level and much of this is essentially water (80-83%). Organic compounds (mainly phenols, polyphenols and tannins) account for a further 15-18% of wastewater content, and inorganic elements (such as potassium salts and phosphates) make up the remaining 2%. These proportions can vary depending on factors related to climatic and soil conditions, farm man-

Lipids in the olive mill wastewater produce an impenetrable film on the surface of rivers that blocks out sunlight and oxygen to microorganisms in the water thus reducing plant growth.

Photo: LIFE07 ENV/GR/000280


Photo: LIFE05 ENV/GR/000245

Olive mill wastewater polluting charges are high with levels of BOD 5 and COD of between 20 000 and 35 000 milligrammes per litre.

agement, harvesting methods and oil extraction processes.

The presence of proteins, minerals and polysaccharides in *alpechin* means that olive-mill wastewater has potential for use as a fertiliser and in irrigation. However, re-use opportunities are restricted by the abundance of phenolic compounds that are both antimicrobial and phytotoxic. These phenols are difficult to purify and do not respond well to conventional degradation using bacterial-based techniques.

Olive oil mills' polluting charges are therefore significant revealing levels of both BOD 5 (biological oxygen demand in 5 days) and COD (chemical oxygen demand) at between 20 000 and 35 000 milligrammes per litre. This represents a notably large organic matter load compared to standard municipal wastewater, which exhibit levels of between 400 and 800 milligrams per litre. Anaerobic digestion of *alpechin* results in only 80 to 90 % COD removal and this treatment remains insufficient to permit olive-mill wastewater effluent to be discharged back into the environment.

Discharging unsafe olive-mill wastewater back into natural water systems can result in a rapid rise of microorganism numbers. These microorganisms consume large amounts of dissolved oxygen in the water and so reduce the share available for other living organisms. This could quickly offset the equilibrium of an entire ecosystem.

Anaerobic fermentation of olive mill wastewater emits methane and hydrogen sulphide creating unpleasant and far reaching odours.


Photo: LIFE04 ENV/IT/000409


Photo: LIFE05 ENV/GR/000245

Further concerns are caused by the high concentrations of phosphorus in olive-mill wastewater, since if released into water courses this can encourage and accelerate the growth of algae. Knock-on impacts include eutrophication which can destroy the ecological balance in both ground and surface water systems. Phosphorous remains difficult to degrade and tends to be dispersed only in small amounts via deposits through food chains (plant - invertebrates – fish – birds etc). The presence of large quantities of phosphorous nutrients in olive-mill wastewater provides a medium for pathogens to multiply and infect waters. This can have severe consequences to local aquatic life, as well as humans and animals that come into contact with the water.

Several other environmental problems can be caused by olive-mill wastewater. These include:

- Lipids in the olive-mill wastewater producing an impenetrable film on the surface of rivers, their banks and surrounding farmland. This film blocks out sunlight and oxygen from microorganisms in the water, leading to reduced plant growth in the river bank soils and in turn soil erosion;
- Acids, minerals and organics in the olive-mill wastewater can adversely affect the 'cat-ion exchange capacity' (CEC) of soils. CEC is used as a measure of soil fertility and refers to a soil's capacity to exchange cat-ions (positively charged ions) between the soil and the soil solution; and
- Unpleasant and far reaching odours can be created by fermentation of the olive-mill wastewater discharged in the natural environment, which emits methane and other pungent gases, such as hydrogen sulphide.

TREATING *ALPECHIN*

A number of options exist to help reduce the environment impact of olive-mill wastewater. Treatment priorities focus on eliminating organic components and reducing the overall mass of the waste. These include: aerobic treatment, anaerobic treatment, precipitation/flocculation, adsorption, filtration, wet oxidation, evaporation; and electrolysis.

LIFE projects have been at the forefront of cost-effective and highly innovative treatment processes of OMWW and solid wastes.

Aerobic, anaerobic and combinations of these two treatment processes produce useful results. Anaerobic processes degrade much of the *alpechin* resulting in minimal volumes of sludge, which can then be further treated by aerobic processes. The overall process is considered efficient in terms of emission controls and energy inputs, but requires dedicated costly facilities that are only required for a relatively short period during harvest times.

TREATING *ALPERUJO*

Treating *alperujo* presents similar problems for the EU's olive oil producers. *Alperujo* is formed during the two-phase process and contains a mix of olive pulp, olive stone (around 30%) and olive-vegetation water (around 70%).

Alperujo is commonly sent to seed oil factories for further chemical and heat processing to obtain secondary extractions of refined olive oil products. Transporting the *alperujo* to secondary processing plants presents environmental risks because untreated *alperujo* has a high pollutant potential, comparable with *alpechin*, due to its significant content of fat, sugars, organic acids, poly-alcohols, pectins, polyphenols and minerals.

Many of these hazardous compounds remain present in the waste materials produced following the secondary refining phases. This waste therefore needs to be properly treated in order to minimise its environment impact.

TREATMENT OPTIONS

Key challenges involved in treating wastes from the two-phase, as well as three-phase and traditional olive oil production techniques, centre around identifying suitable chemical and biological agents capable of converting the *alperujo* and *alpechin* wastes into compounds or constituents with better biodegradable potential. The availability of specialised treatments plants and precision technologies can greatly assist this process.

Dried solid pomace waste is sometimes mixed with the olive leaves and fed to animals such as pigs.

However, cost factors are crucial to the success of such treatments and the seasonal nature of olive oil production, compounded by the small size of some extraction plants, present particular problems that need to be overcome.

Other useful treatment outcomes can be achieved by investigating alternative uses for olive oil wastes. These include composting, livestock fodder and harnessing the organic content as a fuel source for biogas plants. Benefits can also be gained by defining pollution parameters and safety standards involved in dispersing wastes on cultivated fields for irrigation and mulch purposes. Great care is required in this process to protect the quality of local soils and water resources, as well as the biodiversity and habitats that they support.

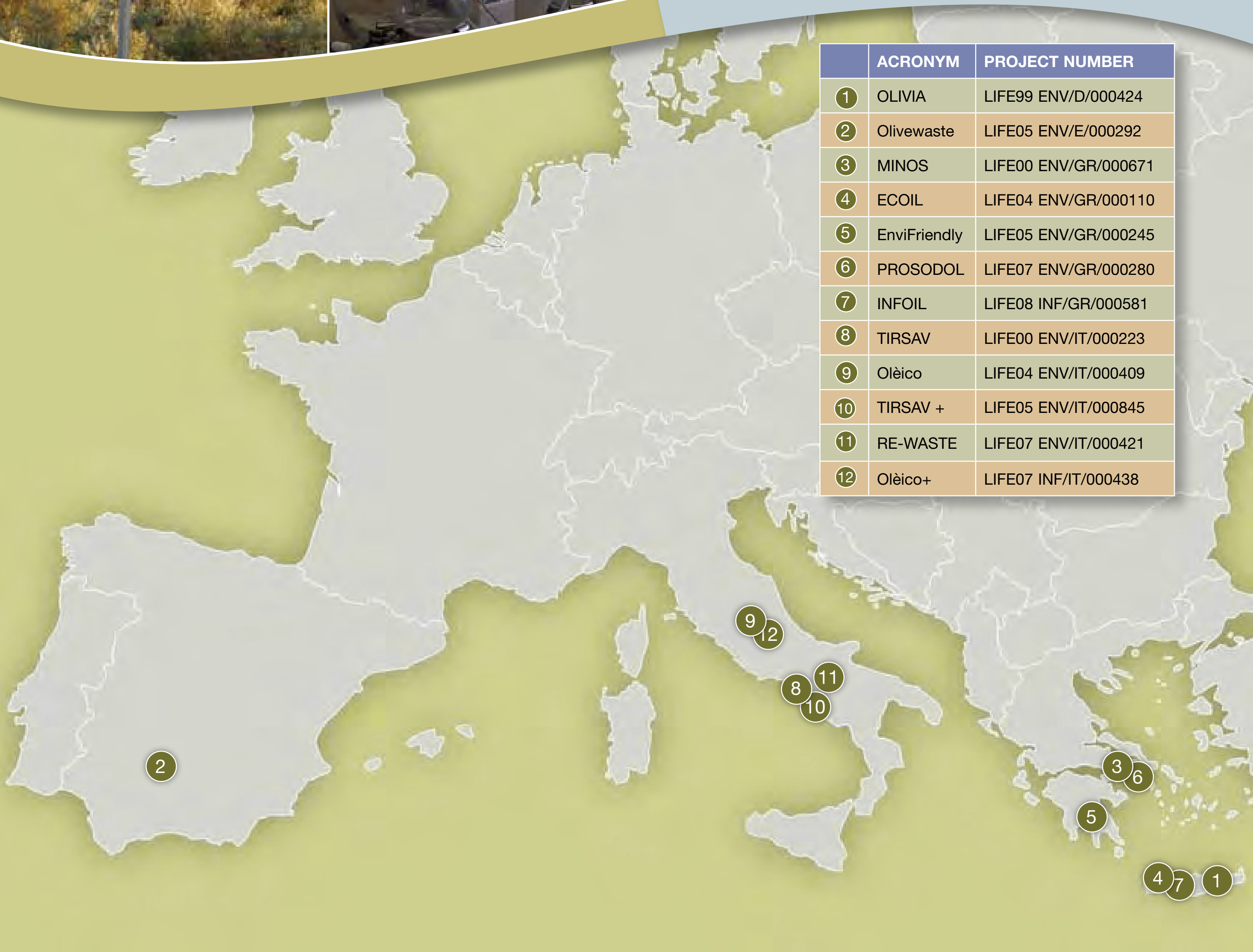
GOOD PRACTICE

LIFE projects have been at the forefront of pioneering new technologies and approaches to reducing the environmental impacts of olive oil production processes. These good practices help the EU industry to implement environmental impact assessment guidelines relating to olive oil production processes that encourage:

- Effective management of wastewater and solid waste at olive oil production and oil-refining stages;
- Reducing odour emissions; and
- Optimum consumption of water and energy during olive oil production and refining stages.

LIFE's work in such areas also has important socio-economic benefits for many local communities in southern Member States. These relate primarily to safeguarding essential employment as new developments support producers' efforts to comply with environmental legislative and policy frameworks covering: prevention and minimisation of industrial pollution; waste recovery, re-use and recycling; as well as Industrial Pollution Prevention and Control (IPPC); and Integrated Product Policy (IPP).

LIFE and olive oil production



	ACRONYM	PROJECT NUMBER
1	OLIVIA	LIFE99 ENV/D/000424
2	Olivewaste	LIFE05 ENV/E/000292
3	MINOS	LIFE00 ENV/GR/000671
4	ECOIL	LIFE04 ENV/GR/000110
5	EnviFriendly	LIFE05 ENV/GR/000245
6	PROSODOL	LIFE07 ENV/GR/000280
7	INFOIL	LIFE08 INF/GR/000581
8	TIRSAV	LIFE00 ENV/IT/000223
9	Olèico	LIFE04 ENV/IT/000409
10	TIRSAV +	LIFE05 ENV/IT/000845
11	RE-WASTE	LIFE07 ENV/IT/000421
12	Olèico+	LIFE07 INF/IT/000438

LIFE reducing the environmental impact of olive oil production

LIFE projects dealing with the environmental problems associated with the production of olive oil have focused in particular on wastewater and pomace disposal, and water usage. Projects have demonstrated innovative new processes that reduce pollution and waste, and are also more energy- and cost-efficient. Such projects have attracted interest within the sector and from policymakers. They have also demonstrated how EU policies can be effectively implemented.

OLIVE-MILL WASTEWATER

The most common aspect of olive oil production pollution that LIFE projects have addressed is olive-mill wastewater. One early project, OLIVIA (**LIFE99 ENV/D/000424**), developed a biological anaerobic technological process allowing recovery from olive-mill wastewater of biogas with high calorific value and solid residues that can be used for agricultural purposes. The technology, devised by Aquatec in Dresden, Germany, was implemented in Crete by oil-pressing company AFOI Boudourakis.

SLUDGE RECOVERY FOR BIOGAS AND FERTILISER PRODUCTION

The project was a step towards reaching the objectives of Article 7 (e) of the Sixth Environment Action Programme (2001-2010), which concerns water quality and sustainable water use. The pre-treatment stage piloted by OLIVIA separates the wastewater into dissolved and non-dissolved constituents thus reducing the organic load by 40-60%. It then undergoes anaerobic treatment where up to 95% of the constituents are removed from the wastewater and converted into biogas. As a result, the water can be safely used for irrigation, used in industrial processes or treated in municipal facilities as common wastewater. The system's two other outputs – sludge and biogas – have commercial potential. After sedimentation, the sludge is stabilised aerobically, solar-dried and then mixed with nitrogen and potassium to produce a potassium fertiliser. One cubic metre of olive-mill wastewater produces 40-60 kg of fertiliser.

The sludge can also be converted to biogas in the methane stage; one cubic metre of olive-mill wastewater sludge yields energy equivalent to 140-200 kW/h, providing a viable source of energy for the larger plants. To break even economically, the mill would need to produce 1 200 tonnes of olive oil a year. Applying the technology would increase the price of olive oil by 3%. However, the integration of the treatment system in existing installations such as communal purification plants or composting installations would produce greater operating-cost efficiencies.

For small olive oil mills, cost factors are an important consideration. Traditional methods of treating the olive-mill wastewater are not effective due to the presence of high levels of polyphenols, which make treatment difficult. Also, aside from the high capital cost of purchasing such equipment, the treatment plants also have high operational and maintenance costs that are not compensated for by the production of by-products with low commercial value. The cheapest option is to discharge olive-mill wastewater into nearby water bodies, with a detrimental effect on water and soil quality. More precisely, 58% of the olive mills pump their wastewater into streams, 11.5% into the sea, and 19.5% onto the land. The wastewater is not easily biodegradable and has high concentrations of polyphenolic compounds that strongly affect the soil. Through leaching, wastewater can also reach and contaminate underground water. It also contains large quantities of other compounds, which though not toxic, can alter the equilibrium of the soil with continuous disposal.

Photo: LIFE07 ENV/IT/000421

The Olivia and RE-WASTE projects developed wastewater treatment plants with the aim of producing biogas and of recovering polyphenols.

RECOVERY OF POLYPHENOLS FOR THE PHARMACEUTICAL AND FOOD INDUSTRIES

A project carried out in Crete, the MINOS LIFE project (**LIFE 2000 ENV/GR000671**) developed a method for recovering the polyphenols, which can be used by the pharmaceutical, cosmetic and food industries. A pilot plant was constructed for the integrated treatment of olive-mill wastewater and for the recovery of the polyphenols. At the plant, the wastewater is treated with absorbent resins and organic solvents before undergoing a thermal treatment that delivers the polyphenols. As end products, the olive-mill wastewater treatment plant produced clean water that is suitable for disposal in water bodies, for irrigation purposes and for re-use in the LIFE-funded plant. Other end products include polyphenols (around 98% end up in the wastewater) and sludge that, after further filtration, is composted along with the olive leaves that are rejected as solid waste from the mills.

The economic value of these organic substances – they are rich in anti-oxidants, which can be used to prevent colon and breast cancer, and have antibacterial and antiviral properties – make the recovery process an attractive alternative to discharging. The system was optimised at a pilot scale, but for full-scale viability, mills would need to co-operate with one another and install a central unit. As well as offering commercial profit, such central units could create new employment opportunities.

MINOS also demonstrated how the requirements of the Water Framework Directive can be fulfilled. An important result of the project was the reduction of water consumption through recycling. In common with the OLIVIA project, MINOS has a high demonstration value and can be easily transferred to other areas where there is a preponderance of small-scale mills.

POPLAR TREES AND PHYTOREMEDIATION

The Olèico project (**LIFE04 ENV/IT/000409**) helped implement Article 12 of the Urban Wastewater Treatment Directive, which states that treated wastewater should be reused whenever appropriate. At a pilot plant, the project constructed a 200m^2 waterproofed phytoremediation basin into which waste effluent was fed by a pressurised piping system from the adjacent olive mill, thus eliminating transportation costs. The toxic and organic substances present in the olive-mill wastewater are degraded through phytoremediation by 24 poplar trees and 10 cypresses planted above the basin. The trees absorb the water and remaining phytoremediated water evaporates. All pollutants in the effluents were successfully degraded and no negative impacts on soil or water were detected. A plant of these dimensions is able to treat about 60 m^3/year of olive-mill wastewater. Moreover, it eliminates the use of chemical reagents and does not need specialised manpower for it to operate.

The patented process proved so effective that the Italian environment ministry authorised the construction of a full-scale plant based on the demonstrated characteristics. The plant is already up and running, and another 30 organisations have expressed interest in introducing similar systems. The system is cost-effective: the initial outlay (digging the pit, waterproofing, purchase of poplars, etc.) of €50 000 will be paid for in six years by wastewater treatment savings. Furthermore, olive oil production costs are reduced by the drop in costs linked to wastewater treatment. Another economic benefit is the possibility of selling 10 tonnes/ha of woody biomass that is produced every year. Finally, since no sludge is produced, the Olèico plant also fulfils the requirements of EU legislation regarding waste prevention.

RECOVERING RAW MATERIALS FROM OLIVE MILL WASTEWATER

The ongoing RE-WASTE project (**LIFE07 ENV/IT/000421**) aims to implement an integrated prototype plant for cost-effectively or profitably reusing olive-mill wastewater. Many plants face high costs because olive mill wastewater treatment processes are expensive, and because costs may be incurred for wastewater transportation to treatment plants. Wastewater treatment is often outsourced because the process for olive mills to obtain authorisation for their own treatment facilities can be complex and long. Through the treatment process adopted by the RE-WASTE project, antioxidants and biogas will be produced, as a consequence the olive-mill wastewater will no longer be classified as waste under the national law 152/2006, but as a by-product. The plant will thus no longer

The Olèico project constructed a 200m^2 phytoremediatian basin that is able to treat 60 m^3/yr of olive mill wastewater.

Photo: LIFE04 ENV/IT/000409

need to obtain waste disposal authorisation, and extraction of valuable products from the by-product will be possible.

The pilot plant combines different technologies: membrane filtration (a clean technology that operates without the addition of chemicals and with low energy consumption and simple operating systems), adsorption and anaerobic digestion. This system will be able to recover substantial volumes of purified water (60-70%) that can be reused in the production process.

In recognising that the natural extracts of olive-mill wastewater can be useful to the food, pharmaceutical, cosmetic and animal feed industries, the project is addressing the revised Waste Framework Directive (2008/98/EC). The project also demonstrates how the amount of generated waste can be reduced, disposal prevented and waste recovered, thereby fulfilling legislation on waste prevention.

In order to make the proposed process economically viable, the RE-WASTE project needs to find ways to market the by-products. Biogas, produced through the anaerobic digestion of the concentrates obtained after the first two filtration steps, is an economically viable resource, but for the extracts rich in polyphenols and flavonoids, it is necessary to establish a trading process in order to obtain economic benefits. RE-WASTE plans to produce antioxidant extracts for the pharmaceutical and cosmetic sectors or for the formulation of novel foods, as these compounds are antioxidant, anti-inflammatory, anti-atherogenic, anti-viral and anti-carcinogenic. Finally, the project will evaluate the possibility of using the developed technology to treat other agro-industrial wastes in order to eliminate pollution and recover valuable substances.

IMPROVING SOIL QUALITY WITH OLIVE OIL WASTE

The ongoing PROSODOL (**LIFE07 ENV GR 000280**) project is working to develop and implement protective/remedial technologies that can be used to remove or significantly limit the presence of pollutants in soils and water bodies affected by the wastes from olive oil mills. The project is testing bioremediation and the use of low-cost porous materials as soil additives, ahead of drawing up a management plan for ensuring soil quality, the preservation of biodiversity and the protection of water bodies in affected and non-affected areas. It will also assess pre-treatment of wastes using abundant, low cost, harmless materials (such as coarse limestone, metallic iron and poor lignite), which are mostly considered by-products/wastes of industrial operations. Pre-treatments make it easier for the toxic load to be recovered by acidic washing and precipitation before final disposal in landfills or use in secondary applications.

The knowledge gained from these tests – obtained from the implemented pilot soil and water quality monitoring systems – will be used to achieve the central objective of the project, which is to define the tools and measures necessary to identify areas at risk of pollution and already-contaminated sites. The project facilitates the implementation of the Soil Thematic Strategy, suitable for the entire Mediterranean region, by providing authorities with the scientific, technological and methodological know-how to identify, study and register the suspected contaminated sites. Integrated technologies for the improvement and remediation of polluted soils will be practical tools for authorities that are planning medium- and long-term conservation measures. Moreover, the project will promote the sharing of best practices, the improvement of knowledge and the exchange of information.

The PROSODOL project is testing bioremediation and the use of soil additives to remove or significantly limit the presence of pollutants in soils and water bodies affected by the wastes from olive oil mills.

Photo: LIFE07 ENV/GR/000280

The Ecoil project (LIFE04 ENV/GR/000110) used a Life Cycle Analysis (LCA) instrument to determine the environmental impact of olive oil production, with the aim of proposing best practices for sustainable production of olive oil. The LCA assessment was implemented in Cyprus, Greece and Spain, producing in each country, site specific data that can be used to determine environmental impacts.

Best practice guidelines for sustainable production

Such information was then used to develop guidelines for improving the entire olive oil production cycle. These focused on the optimum consumption of water during olive oil production, optimum consumption of energy, water saving during the oil-refining stages, odour emissions, wastewater management, solid waste management at olive oil production and oil-refining stages and general good practice. Suggested practices included the use of organic solid waste for the production of compost for agricultural purposes, and the switch to the application of two-phase centrifugal olive mills. As a follow up to the project, an LCA comparative study has been conducted by the beneficiary using the project methodology and project results as well as all the produced recommendations. The implementation of the two-phase oil system led to a more than 25% reduction in soil pollution from lead and zinc, and in BOD (biological oxygen demand) and COD (chemical oxygen demand) in liquid wastes.

Guidelines and know-how are highly transferable to other Mediterranean countries. As a result, the project is relevant for many EU policy goals, such as waste prevention through recovery/re-use and recycling, integrated pollution prevention and control, and integrated product policy. Additionally, the outcome of the project is in accordance with the targets set by the European Environmental Technologies Action Plan, which focuses on the development and marketing of new environmental technologies.

Furthermore, the Ecoil project has proposed policy developments to facilitate the eco-production of olive oil. It recommends that governments should allocate a small amount of funds from EU sources for supporting the development of necessary infrastructure. A policy motivating the implementation of sustainable practices in olive oil production would reduce the environmental burden linked to the oil production. The tools to develop such a policy could include:

- Development of a strategic plan (national, regional or local) for the management of wastewater from olive oil production, describing specific targets and actions to be taken;
- Co-funding of necessary infrastructure from EU funds. The infrastructure could include either construction of wastewater treatment plants or the substitution of thee-phase systems with two-phase systems;

Photo: LIFE04 ENV/GR/000110

- Tax benefits following implementation of environmental practices;
- Funding of research and pilot projects for wastewater management (three-phase systems) or the management of humid by-products (two-phase systems);
- Imposition of environmental taxes;
- Strict control and monitoring of the performance of the olive oil mills, with fines for performance below certain standards;
- Establishment of financial incentives for the implementation of environmental management systems and eco-label products.

Finally, awareness raising and training of olive-mill workers has significantly improved environmental performance. A new LIFE project proposal – a follow up of the ECOIL project – which focuses on these aspects, received funding this year. The INFOIL project (**LIFE08 INF/GR/000581**) foresees the development of a complete set of dissemination and educational activities aimed at the highest number of stakeholders across Greece, including visitors and tourists. The two projects share the common vision of promoting the sustainable production of olive oil.

CHANGING THE BEHAVIOUR OF OLIVE OIL PRODUCERS

ISRIM (*Istituto Superiore di Ricerca e Formazione sui Materiali Speciali per Tecnologie Avanzate*) is carrying out a second LIFE project, Olèico+ (**LIFE07 INF/IT/000438**) that addresses the issue of legislative compliance by organising awareness-raising campaigns and selecting the best technologies developed to treat olive-mill wastewater. Moreover, the project will collect and compare environmental legislation regulating olive-waste management at EU level, national (Italian) level and in other EU olive oil producing countries such as Greece, Spain and Portugal. A survay to evaluate the feasibility and assess the practicality of the legislation will be distributed to associations, co-operatives and private companies. From the responses, the project will conduct a cost-benefit analysis of the best technologies used.

Olèico+ aims to achieve the following results:

- An analysis of the legislative frameworks in force, with the aim of defining the best technology for each kind of production, in relation to size, location and infrastructure;
- Increased environmental awareness among stakeholders and a demonstrable interest in utilising the proposed technologies;
- At least six olive-mill owners/co-operatives planning to convert their disposal practice from land spreading or lagooning to one of the proposed eco-friendly technologies;
- A draft proposal submitted to the EU regional office indicating the eco-friendly technologies identified after the awareness-raising campaign.

Photo: LIFE07 INF/IT/000438

The Olèico+ project will focus on legislative compliance by organising awareness-raising campaigns and by selecting the best technologies developed to treat olive-mill wastewater.

Olèico+ highlights a common theme running through the majority of LIFE projects that focus on olive oil production: compliance with legislation can be enhanced through raising awareness and the application of new technological processes that not only reduce the environmental impact of production but offer economic benefits. Such cost savings are clearly demonstrated in the reduction of water consumption by recycling wastewater (the MINOS and RE-Waste projects are good examples). Treating waste products as a resource offers another commercial advantage for mill owners.

LIFE projects have also identified gaps in policy and obstacles that impede full implementation of existing legislation. It should be noted, however, that olive oil production is carried out in different ways in different countries due to variations in the typology of plants and the size of the mills. As a result, best-available techniques vary and LIFE projects, such as Olèico+, which is comparing the feasibility of these technologies, have an important role to play in informing legislation as well as demonstrating how it can be best implemented.

The Ecoil project has proposed policy developments to facilitate the eco-production of olive oil.

Photo: LIFE04 ENV/GR/000110

The two TIRSAV projects, carried out in the Cilento national park in Campania, Italy, are demonstrating the possibility of using olive oil production waste products to produce a high-quality fertiliser. The second project is addressing the cost implications for small-scale producers and is planning a centralised recycling plant.

Transforming **waste into a high-quality fertiliser**

The major waste problem faced by smaller olive mills is the production of fresh olive pomace. This by-product is typically sent to pomace plants for further chemical extraction: a procedure that is highly polluting whilst producing very low-quality olive oil. Furthermore, the two-phase continuous production decanters produce a moister version of this waste that, due to the high level of water present in it, hinders chemical residual-oil extraction (for further information see the section in the preceding chapter about two-phase and three-phase decanter processes). Hence its disposal has become a common problem. Controlled agronomic use of these by-products is allowed, though handling problems occur, such as percolation during transportation and odour emissions during spreading after long storage periods.

The first TIRSAV project, which was launched in 2000, patented a new technological process for re-use of olive-mill wastewater and organic residues – the pomace waste. The project developed a co-blending strategy that combines olive-mill wastewater, fresh olive pomace and other natural organic wastes (straw, pruning residues, sawdust) to produce a non-percolating and non bad-smelling olive-mill waste mixture for use on agricultural land. In tests, the organically rich mixture performs as well as nitrogen-enriched fertilisers, offering a viable means of by-product disposal that has a lower environmental impact. The compost, packaged in sacks, is also easy to transport and store. It is also compliant with environmental legislation on a national and EU level.

Prototypes were constructed to demonstrate the suitability of the system for both the two- and three-phase continuous centrifugal extraction oil presses and for all types of waste produced by these two processes (wastewater and the virgin pomace). The TIRSAV process solves this problem by turning the virgin pomace in the oil mill or consortium plant into organic substrates that can be used on the land. The same applies for the vegetable liquids produced by the three-phase system. The positive result of this project is shown by the fact that the technology can be adopted by any type of olive mill (2 and 3-phase olive oil extraction processes), and it is thus transferable to all countries that produce olive oil, regardless of the system that they use.

In spite of the potential cost advantages of implementing the TIRSAV system, small-scale olive farmers, who make up a large proportion of olive oil producers in Italy, are reluctant or unable to invest in expensive new equipment. The beneficiary, the Cilento national park (Ente Parco

The TIRSAV project developed a co-blending technology that combines olive-mill wastewater, fresh olive pomace and other natural organic wastes such as straw, to produce a non-percolating fertiliser mixture.

The TIRSAV project promoted the idea of developing an international law on the treatment and recycling of olive oil waste.

Nazionale del Cilento e Vallo di Diano), therefore decided to carry out a follow-up project to address this. One way to circumvent the problem of cost is to transport the waste to a central recycling plant. A plant that is being built as part of the follow-up project will be owned by the national park, but such a centralised plant could be owned by an association of mills. The second project is also promoting the need for common regulation across Europe.

The production of fertilisers using such waste products requires the use of bacteria to stabilise the mixture. The process will take several weeks – at the new plant, effluent is stored in containers for 15 days to allow this bacterial reaction to occur before it is cooled on a special fabric layer for a further 15 days – and the beneficiary in partnership with the department of engineering at the University of L'Aquila is conducting research into the most efficient means of achieving this microbiological breakdown and the most effective bacteria to use. The best solution will be tested at the new plant.

The project organisers say, however, that legislative requirements have restricted the design and working regime of the new plant. Under Italian legislation, olive-mill wastewater is currently considered a special waste product, and not a by-product, as in other EU countries. As a result, it's treatment is subject to a higher level of regulation. Through the project, the organisers aim to show the value of such wastewater. "Legislation should reflect that wastewater can be treated to produce a new product," said Antonio Feola, project manager. "If products going into the plant were no longer considered waste, then this process could be simplified and therefore made more cost efficient. For example, we wouldn't have to weigh wastewater coming in."

For these reasons, the working regime and treatment capacity of the plant has been reduced in order to treat a maximum of 12 000 t/yr of olive oil effluents instead of 36 500 t/yr. However, the technology could be used to treat greater waste volumes in those countries that consider the effluents as by-products.

The new plant aims to demonstrate the economic benefit of recycling. It will produce a "high-quality product that can be sold at a high price, which would pay for the running costs of the plant," according to Feola. A cost-benefit analysis conducted during the first project showed that considerable increases in profits can be obtained through only slight variations in the price of the compost. The plant will also minimise energy costs by using solar power and the biomass potential of olive stones.

The TIRSAV projects have generated interest at international and national level (with the Italian Ministry of the Environment providing €2.5 million in co-financing). The first TIRSAV project promoted the idea of developing an international law on the treatment and recycling of olive oil waste. Furthermore, the International Olive Oil Council is interested in implementing similar projects in Morocco, Syria and Tunisia.

Project Number: LIFE05 ENV/IT/000845

Title: New technologies for husks and wastewater recycling plus

Beneficiary: Ente Parco Nazionale del Cilento e Vallo di Diano

Total Budget: €5 454 264

LIFE Contribution: €944 208

Period: Oct-2005 to Mar-2011

Website: www.tirsavplus.eu/

Contact: Antonio Feola

Email: feolant@tiscali.it

Project Number: LIFE00 ENV/IT/000223

Title: New technologies for husks and wastewater recycling

Beneficiary: Ente Parco Nazionale del Cilento e Vallo di Diano

Total Budget: €1 075 000

LIFE Contribution: €299 000

Period: Sept-2001 to Oct-2004

Website: www.tirsavplus.eu/

Contact: Antonio Feola

Email: feolant@tiscali.it

The production of fertilisers requires the use of bacteria for microbiological breakdown of the waste before undergoing substrate maturation.

Spain's Olivewaste LIFE Environment project demonstrated a fully-integrated system for obtaining useful by-products at all stages of olive oil production and waste treatment. The project both reduced the environmental damage caused by the sector, and showed where economic benefits could be achieved.

Olivewaste: **from three phases to two and back again**

While olive oil is a healthy part of European diets, waste produced during its production can be a serious problem when it enters rivers, groundwater and soil. Typically, less than 25% of the mass of olives is converted into virgin olive oil. Dealing with the remaining 75% is therefore an important environmental and economic concern for olive oil producing countries.

Since the early 1970s, olive oil mills have used centrifuge technology in secondary oil extraction. When these techniques were first introduced, the industry favoured the three-phase decanter. This added water to the mass of crushed olives emerging from the primary extraction and separated it into the following three phases: virgin olive oil, vegetation water, and olive cake.

The olive cake was passed on to companies that extracted lower quality *orujo* oil. However, the addition of water in the process meant that many polyphenols were washed out of the virgin oil, leaving vegetation water as phytotoxic waste. There was no particular management approach to this waste, increasing the likelihood of its uncontrolled disposal into the natural environment.

Most Spanish mills now use a two-phase decanter process for the secondary extraction to avoid the vegetation water problem (see the section on olive oil production for more details). The two-phase process separates the mass into virgin

The Olivewaste project developed an innovative integrated system based on a three-phase decanter system for the treatment of the vegetation water and olive cake.

olive oil and *alperujo*, a dense liquid residue. The *alperujo* can be sent to *orujo*-oil extraction plants, thus solving the waste-management problem for the olive oil mills.

However, use of the two-phase process simply displaces the waste-management problem onto the *orujo*-oil extraction plants. The *alperujo* contains more polyphenols, and subsequent processing requires large amounts of energy, produces high levels of the pollutant benzopyrene and still leaves substantial waste. Some extraction companies may even refuse to accept *alperujo* for treatment.

AN INTEGRATED TREATMENT PROCESS

CARTIF, a technology research centre based in Valladolid, Spain, had been exploring concepts for reducing the environmental impact of olive oil production. CARTIF technical expert Jorge Lopez explains: "We believed we could build an integrated process with a return to the three-phase decanter in the secondary extraction stage that not only avoided environmental damage, but also provided economic incentives for doing so."

The process reintroduces the three-phase decanter into an overall system, thus providing treatment stages for the two types of waste produced: the vegetation water and the olive cake. It generates useful by-products in the form of fertilisers and water, and reduces transport and energy costs in the system as a whole.

CARTIF, supported by LIFE, built a small-scale industrial plant in Baena (Córdoba) to demonstrate this process. The system was piloted over two olive harvests, allowing adjustments and improvements to be made.

One of the greatest challenges to the success of the project was administrative. Julio González, CARTIF managing director, recalls: "Our first major problem was obtaining the planning permission to build the plant. Once this was received, we had to work quickly to catch up with the project timetable."

ECONOMIC AND ENVIRONMENTAL BENEFITS

Taking into account the whole process, the main environmental and economic benefits come from the fact that the different phases are easier to treat separately. All the olive mass and water entering the system is used in some way. The reduced water content of the olive cake produced by the three-phase decanter reduces its volume and thus storage and transport costs. Furthermore, *orujo*-oil extraction companies only need to use around half the energy to extract the same amount of *orujo* oil. The process produces negligible amounts of benzopyrene, and the leftover solids can be used as biomass for energy production, or composted to produce fertiliser.

However, Olivewaste's main innovation was the treatment process for the vegetation water emerging from the three-phase decanter. It undergoes accelerated separation of its solid particles, which are sent for composting. The remaining liquid is pumped into an evaporation and concentration system, where over 80% of the water is removed. Both the compost and the concentrated liquid can be used as fertiliser. The removed water can be collected and is clean enough to be reintroduced into public water supplies.

The pilot project also showed that the whole system could be energy self-sufficient. A small amount of power was generated from olive biomass – particularly the stones and husks. Significant power was also obtained from solar panels in the factory roof. Since olive trees grow in hot countries, this is a particularly interesting aspect. As Julio González highlights: "In a full-scale industrial plant, there should be the possibility of selling additional power produced by the panels to the electricity grid."

The potential for widespread introduction of the system demonstrated by the Olivewaste project seems high, with few technical obstacles to replacing the two-phase decanter process with a three-phase one. Although there are additional treatment costs for oil mills compared to simply passing *alperujo* on to others to deal with, the beneficiary is confident that these would be more than offset by the potential economic value of the by-products, and by reduced transport costs.

A major chanllege will be the ability to convince production companies of the overall economic advantages of the new process. The project team has already presented the system to olive oil producers from Greece, Italy, Jordan, Syria and Lebanon. The project also points to the possibility of stricter regulation, for example that concerning pomace oil extraction companies.

CARTIF technical expert Jorge Lopez, demonstrates how energy is generated from the olive biomass.

Project Number: LIFE05 ENV/E/000292

Title: Processing plant for the integral treatment and valorization of the waste generated during the olive oil production process

Beneficiary: CARTIF – Technology Centre

Total Budget: €4 900 000

LIFE Contribution: €1 060 000

Period: Dec-2005 to Dec-2009

Website: www.tirsavplus.eu/

Contact: Jorge Lopez Simon

Email: jorlop@cartif.es

EnviFriendly, a Greek LIFE project, demonstrated low-cost techniques for treating olive-mill wastewater and wastewater from the washing of table olives. It successfully integrated the techniques into the watershed management plan for the Evrotas river basin and its coastal zone.

Reducing olive mill wastewater discharge into Greek river basins

The Evrotas river basin in south western Greece is threatened by flooding, degradation of surface and groundwater caused by point and non-point pollution, and by droughts that devastate fish populations.

Pollutants enter the river basin from the area's 168 olive mills, 91 of which are located in the Evrotas river catchment area. These mills produce both olive oil (around 20 400 tonnes annually) and table olives. They generate approximately 60 000 m³ of wastewater each year, 57 000 tonnes of wet waste, and 6 300 tonnes of phenolic compounds. Most mills are family-owned and small, and the area lacks a centralised waste treatment facility. Consequently, olive-mill wastewater is disposed of directly into the Evrotas river.

The project team devised and implemented three cost-effective olive-mill wastewater techniques that could be easily adopted by olive mills, as follows:

1. Phytoremediation with subsurface disposal of olive-mill waste

At the Kokkolis olive mill, the project used a poplar tree plantation to phytoremediate olive-mill wastewater. The mill filtered its wastewater, separating suspended solids from the liquid phase. Whilst the solid waste was composted or mixed with olive leaves and fed to animals. The filtered wastewater was transported to a storage tank.

To test the phytoremediation potential, the project planted 300 poplars on an area of one-tenth of a hectare. The wastewater was released at intervals from the storage tank and distributed among the poplars using a technique known as subsurface disposal. This involved pumping the wastewater through a network of pipes buried at a depth of 40cm. During the winter, the distributed wastewater remains just above the groundwater table close to the poplars' roots. When the poplars start to grow in the spring, they use the olive-mill wastewater, while degrading it naturally.

The plantation soil was monitored, and organic compounds were found to accumulate 80 cm below the surface. However organic matter derived from wastewater was not found deeper in the soil. Groundwater reservoirs were also monitored to ensure that pollutants did not enter.

A number of olive-mill owners expressed interest in this approach, and some partnerships to develop the technique have been established. Mill owners have been attracted by low costs – the EnviFriendly project paid only €1 000 for the 300 poplars – and by the business opportunity offered by the future harvesting of the poplars and sale of their wood.

2. Lime treatment of olive-mill wastewater prior to spreading on cornfields

The second test approach took place at an olive mill producing approximately 500 tonnes/yr of olive oil and about 3 000 m³/yr of olive-mill wastewater. The wastewater was transported to tanks and treated with lime, which facilitates the separation of suspended solids. This solid waste was recovered, partially composted and used as a fertiliser for maize.

The project tested the phytotoxicity of the solid waste, which was found to be significant only during the first year of cultivation. During the second year, the organic compounds were degraded naturally and maize yields increased by 25%. The recovered wastewater, meanwhile,

The Kokkolis olive mill used a poplar plantation of 300 trees to phytoremediate olive-mill wastewater.

Photo: Gabriella Camarsa

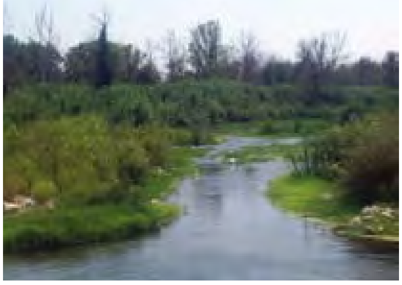


Photo: Gabriella Camarsa

The Evrotas river basin will achieve by 2015 the "good ecological status" objectives foreseen by the WFD thanks to LIFE funding.

was stored in open lagoons, mixed with clean water and used to irrigate the crops during the summer. The mill owner benefited economically by selling the grain thus produced, or by using it to feed animals.

3. Electrolysis of wastewater from washing of table olives

The third approach tested by the project dealt with table-olive washing. Table olives go through a fermentation process to improve the taste and reduce micro-organisms. Brine is used for this and the olives are then washed, resulting in wastewater with a high biological oxygen demand (BOD), or oxygen requirement for breaking down organic matter. This wastewater is the cause of high levels of pollution if disposed of in water bodies, and modifies the organic composition of soil if spread on the ground. The washing process requires 1.2 litres of freshwater for every kilogramme of table olives.

To treat the wastewater, a production plant owned by Euroamericana S.A. put in place an electrolytic technique. The brine solution underwent electrolysis, which generates oxidants that degrade the pollutants in the wastewater. The wastewater was then transported to evaporation tanks. The project found that this technique halved the BOD content.

Euroamericana S.A. developed a prototype that uses electrolysis for the degradation of pollutants in the brine solution derived from washing of table olives.

ENVIFRIENDLY PROPOSED 10 TREATMENT TECHNOLOGIES

FOR A SINGLE OLIVE MILL

- Evaporation ponds
- Storage and irrigation during the summer
- Surface disposal in olive groves and natural restoration: wastewater is spread on the ground between olive trees so it percolates only into the first 10-20 cm of the soil where there are aerobic conditions. There it degrades naturally
- Subsurface disposal and phytoremediation without groundwater protection – the Kokkolis mill case study
- Subsurface disposal and phytoremediation with groundwater protection – also studied by the LIFE Olèico project

FOR A GROUP OF OLIVE MILLS

- Phytoremediation – a wastewater collection system, use of a decanter to obtain the 1% of oil, and phytoremediation following principles established by EnviFriendly or Olèico
- Evaporation pond and odour-control using lime
- Filtration using wood chips and resins
- Anaerobic digestion
- Odour-control with electrolytic treatment (as demonstrated by EnviFriendly)

ENVIFRIENDLY'S WIDER IMPACT

All of the techniques tested by the project proved effective, with the results being wastewater that could be used for agriculture, thus reducing water depletion, and less pollution entering the Evrotas river. Based on the pilots, Lakonia prefecture established a list of 10 'EnviFriendly' techniques (see box). The prefecture said that it would, in futur, grant annual permits to olive oil mill owners only if they adopt one of these techniques to control wastewater. The prefecture further committed to defining limits of pollutants that can be legally discharged in water bodies, in line with efforts to implement the Water Framework Directive. The project also established a Local Development Observatory, which has become the region's water management centre, responsible for the implementation of the Water Framework Directive.

The project's findings offer environmental benefits for Greece and other Mediterranean countries. Due to the communication activities carried out by the project, many other olive oil producing areas have expressed interest in joining the EnviFriendly initiative. Because the techniques explored by EnviFriendly are cost-effective, they do not have an impact on the price of olive oil. In fact, they offer benefits to mill owners through improved relationships with the public due to a reduction in the odours produced by the incorrect disposal of wastewater into the Evrotas river and its tributaries.

EnviFriendly has also contributed to Greece's first Integrated Water Resources Management Plan. The Central Water Agency of Greece's Environment Ministry nominated the Evrotas basin to the EU Pilot River Basin (PRB)-Agriculture network. The Lakonia prefecture states confidently that the Evrotas river basin will achieve by 2015 the "good ecological status" objectives foreseen by the Water Framework Directive.

Project Number: LIFE05 ENV/GR/000245

Title: Environmental Friendly Technologies for Rural Development

Beneficiary: Prefecture of Laconia

Total Budget: €2 194 000

LIFE Contribution: €1 096 000

Period: Dec-2005 to May-2009

Website: www.envifriendly.tuc.gr

Contact: Dimitros Liakakos

Email: grafeio.symvoulou@lakonia.gr

Photo: Nikolaos Nikolaidis

LIFE: leading the way towards a greener olive sector

The LIFE programme has supported projects dealing with the environmental impacts of both olive cultivation and olive oil processing. Both of these areas have been through significant changes in the last two decades. In addition, attitudes towards the environment and legislative frameworks have undergone major revision. Olive growers and processors have therefore had to adjust to new approaches and adapt to new ideas. LIFE projects have played an important role in guiding this process.

LIFE AND OLIVE FARMING

The LIFE ECOIL project, for example, through the implementation of life-cycle analysis at different sites, has identified the main environmental impacts of modern olive cultivation. These environmental impacts, which arise from the use of herbicides and pesticides, fertilisers, and from water exploitation for irrigation purposes include: the contamination of surface and underground water bodies; eutrophication; soil erosion and desertification; and loss of biodiversity and landscape degradation, which is mainly caused by intensive cultivation.

Future projects could capitalise on the work of projects such as ECOIL by working more on the implementation in practice of techniques and technologies to mitigate these impacts. Few LIFE projects so far have focused on devising farming practices that can do this. Nevertheless, reforms of the Common Agricultural Policy since 2003 provide a framework for more environmentally-friendly farming through cross-compliance and agri-environmental measures, which are relevant for olive growers as much as for other farmers. Future projects could focus on assessing what implementation of such measures has achieved, what gaps remain, and what farming techniques would be most effective for the more extensive integration of environmental policies into the agricultural sector.

The LIFE funding strands – Environmental Policy and Governance and Information and Communication – therefore have a role to play. Raising awareness, especially among smallholders, is important, but intensive cultivators should also be targeted with information about farming techniques that minimise negative environmental impacts. In particular, there should be greater understanding that these techniques can be economically-viable, and even profitable.

LIFE AND OLIVE OIL PRODUCTION

The main environmental impacts of olive oil processing are the production of wastewater and *alperujo* (wet solid waste). These waste products are characterised by high toxicity, meaning that they need to be treated, and should not be disposed of untreated in the environment where they can cause negative impacts to soil and underground or surface water bodies.

A steady evolution can be seen in the LIFE projects that have tackled this, from development of simple wastewater treatment facilities with relatively high investment costs, to more integrated treatment plants (such as the RE-WASTE project), incorporating a membrane filtration wastewater treatment system, the end product of which is purified water that can be reused in the production process or to irrigate crops. This system also recovers polyphenols – a marketable by-product – from olive waste, which can be used for the production of biogas.

LIFE projects have thus led to the introduction of more advanced technologies, which are also low-cost and low-maintenance, and which can be adapted to the particular requirements of different olive oil producing regions. Where industrialised production predominates, such as in Spain, the biggest olive oil producer, there is scope for investment in the more expensive water treatment facilities. Where production is still done on a more traditional basis, and by smaller-scale producers, such as in Greece and parts of Italy, low-cost methods can be applied. Adoption of greener technologies and methods can be greatly boosted by local authorities, who can require their implementation as a condition of granting permits to producers.

In the late 1980s and early 1990s, the two-phase, rather than three-phase, decanter system was seen as the best approach to reducing the negative environmental impact of olive oil production. These systems reduced water consumption and produced less wastewater. However, the two-phase approach leads to greater production of *alperujo*, which contains toxic substance and must itself be treated before disposal to prevent negative environmental impacts. The Olivewaste project revisited the three-phase approach, but integrated it within a pilot plant with the capacity to re-use all of the by-products. The project found that any costs related to the reintroduction of a three-phase system could be offset by the economic value of by-products and by reduced transport costs related to the external treatment of *alperujo*.

LIFE funding has helped promote an environmental consciousness among olive growers and olive oil producers throughout the EU.

Photo: pizzodisevo (doing TENS for pain)

For the future, more needs to be done to enable small olive mills to adopt cost-effective treatment methods and facilities. New approaches must also take into account the seasonality of olive oil processing, which means that mills do not operate continuously. The involvement of local authorities, and the formation of consortia by producers, can help with the roll-out of better facilities.

LIFE projects can show local authorities the way in this respect, by improving their management planning and governance approaches towards the olive oil sector. There is scope for projects to work on building environmental concerns into operations such as permit issuance, granting of subsidies for environmental improvements, strategic planning (national, regional or local), establishing tax benefits for implementation of environmental practices, inspection and monitoring of olive oil mills, and implementation of eco-labeling schemes.

LIFE Information and Communication projects, meanwhile, will have an important role to play. LIFE projects in the last decade or so have shown the way towards more environmentally-friendly olive oil production, but awareness of the new techniques needs to be spread so that greener approaches are taken up more widely. On-going assessment of the implementation of legislation can also take place, to identify policy gaps.

Ingraining an environmental consciousness in olive growers and olive oil producers has become even more important because of climate change. Although the sector has seen a marked increase in demand for its products, global warming presents a severe external challenge to its future development. Better environmental approaches, which will help offset the negative impacts of climate change, can be LIFE's legacy to the sector.

Statements from National Associations

ITALY: CIA

Domenico Mastrogiovanni, Head of the "Olive oil and wine" section

The LIFE programme's objectives continue to be valid, but should be strengthened by improving the synergy of the various actions being undertaken. This must be done to address climate change, to ensure sustainable land use, and to minimise the risk that chemicals pose to the environment and human health.

Projects to disseminate information or promote innovation in line with EU objectives are well suited to the olive-growing sector. These should aim to share knowledge and understanding, and provide information on new technology to improve growing methods. Environmental concerns within the sector can be addressed by adopting new techniques, whereby the by-products from the processing stage are reused, thus having a positive impact both on incomes and the environment.

Future projects should emphasise in particular the provision of information, using meetings, seminars and workshops to convey the results.

The challenge for this sector is to remain productive, both economically and environmentally. This can happen if access is granted to new technology and if a balanced use of land is maintained.

GREECE: PASEGES

Theodoros Vloutis, Head of the "Olive oil" section

The LIFE programme will continue to help the olive-growing sector to overcome the difficulties it faces, such as climate change and the need for sustainable growth. Combined action must be taken to ensure sustainable land-use and reduced use of chemicals, while maintaining producers' incomes.

The olive-growing sector must take action to share information, knowledge and understanding, and to provide information on improved sustainable growing methods. Certain problems must be addressed, such as improving soil management, better use of water and the efficient treatment of industrial residues from the processing stage.

The objective must be to protect the environment as well as producers' incomes. This can be achieved by promoting innovation and embracing new technology to help ensure sustainable growth.

SPAIN: ASAJA

Pedro Barato, National President

Olive growing has to overcome the serious problems that are currently threatening its survival. Matters such as the cost of labour, the excessive fragmentation of supply as opposed to the concentration of demand and price volatility, all pose serious threats to the competitiveness of growers. At the same time, it is crucial to respond correctly to environmental challenges, and to boost the beneficial effects of olive growing on the environment.

Improving soil management, making efficient use of water and plant protection products and minimising the negative impact of treating industrial residues from olive processing must be combined with initiatives that promote the important role of olive groves in capturing greenhouse gases, preserving biodiversity and supplying biomass for energy production.

Integrated production has proved to be the production system that can contribute the most towards improving the environment when principally used in the most intensive production areas. Organic production, for its part, is easier to implement on the most traditional farms, which use few inputs but obtain lower yields and lower profitability.

If we are capable of providing a response to these questions in the immediate future, we will be able to assure the survival of a thousand-year old tradition that is part of Europe's cultural legacy.

International Olive Council: **future perspectives**

The International Olive Council, is an intergovernmental organisation established in 1959 under the auspices of the UN, contributing to policymaking issues and tackling present and future challenges in the olive sector.

The growing interest in environmental issues is heavily impacting on the policies implemented by national and international organisations alike. The International Olive Council (IOC) is no exception, having incorporated these issues into the agenda of its action programmes in a move to respond better to society's concern over environmental protection and conservation. In fact, one of the major innovations written into the 2005 International Agreement on Olive Oil and Table Olives has been to include environmental questions among the general objectives of the Organisation and to convert them into a major linchpin of IOC action in the area of international technical cooperation.

Economic development in agriculture must ensure environmental compatibility by opting for an agricultural model that makes careful use of natural resources and which protects the global ecosystem and generates economic prosperity and balanced social development. All economic development must necessarily take into account every aspect of environmental compatibility by opting for an economically sustainable and self-compatible agricultural model. Starting from the principle that our land capital is an exhaustible resource, we are duty-bound to do everything we can to conserve it and to use it properly, and to pass it down in good condition to future generations, so guaranteeing them the same quality of life handed down to us by our predecessors. A new concept of sustainable development has thus evolved, which can be readily summed up as "development that meets the needs of the present without compromising the capacity of future generations to respond to their needs".

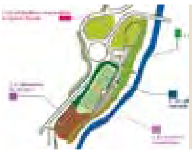
The IOC strives to ensure that olive growing is practised in an eco-friendly manner to prevent any risk of pollution or inadequate use of natural resources. Modern olive growing has to go by new principles and innovative low-impact technologies if it wishes to find solutions to the problems inherent in the entire production chain. Land use systems must therefore be made more rational to allow the olive tree to perform all its functions to the full while making good use of the available natural resources and satisfying consumers.

Examples of completed or ongoing environmental projects drawn up by the IOC include a programme known as Irrigaolivo for the development and dissemination of sustainable irrigation management in olive growing and a project for the recycling of olive oil mill wastewater and olive pomace, aimed at putting forward a rational solution to the problem of the disposal of the effluent generated by olive oil production, notably by reusing the wastewater and olive pomace as fertilisers on agricultural land under grass or tree crops. Another example of related work is the code of good practice published by the IOC for the sustainable development of olive orchards in areas characterised by fragile ecosystems.

Photo: Nikolaos Nikolaidis

OLIVE CULTIVATION

Oleo-Life
Oleo-Life
LIFE99 ENV/E/000351 http://www.aemo.es/proyectos/detalle_proyecto.php



Arboretum Beauregard
Arboretum de Beauregard- the local plants at service for the restoration of the usual nature
LIFE99 ENV/F/000497 www.vaucluse.fr/1053-l-arboretum-departemental-de-beauregard.htm

ECOIL
Life Cycle Assessment (LCA) as a decision support tool (DST) for the eco-production of olive oil
LIFE04 ENV/GR/000110 www.ecoil.tuc.gr/

CENT.OLI.MED
Identification and conservation of the high nature value of ancient olive groves in the Mediterranean region
LIFE07 NAT/IT/000450 www.lifecentolimed.iamb.it/

Lince Moura/Barrancos
Recovery of Iberian Lynx habitat in Moura/Barrancos Site
LIFE06 NAT/P/000191 http://projectos.lpn.pt/index2.php?id_projecto=14

TILOS
Conservation management of an Island SPA
LIFE04 NAT/GR/000101 www.tilos-park.org.gr/tiloslife/

Albuera Extremadura
Conservation and management of the SPA for Birds site of Community interest wetland “La Albuera” in Extremadura
LIFE03 NAT/E/000052 www.xtr.extremambiente.es/albuera/Paginas/index.html

Doñana Sostenible
Design and Application of a Sustainable Soil Management Model for Orchard Crops in the Doñana National Park Area
LIFE00 ENV/E/000547 www.asajasev.es

OLIVE OIL PRODUCTION

OLIVIA
Innovative demonstration facility for the treatment of waste water from olive oil presses (OMW) with material and energetic utilization of the residues
LIFE99 ENV/D/000424 www.aquatec-engineering.com/

MINOS
Process development for an integrated olive oil mill waste management recovering natural antioxidants and producing organic fertilizer
LIFE00 ENV/GR/000671 www.pharm.uoa.gr/minos/minos2-146.htm

OLIVE OIL PRODUCTION

ECOIL
Life Cycle Assessment (LCA) as a decision support tool (DST) for the eco-production of olive oil
LIFE04 ENV/GR/000110 — www.ecoil.tuc.gr/

Olèico
A new application of phytodepuration as a treatment for the olive mill waste water disposal
LIFE04 ENV/IT/000409 — www.lifeoleico.it/

RE-WASTE
Recovery, recycling, resource. Valorisation of olive mill effluents by recovering high added value bio-products
LIFE07 ENV/IT/000421 — www.re-wasteproject.it

PROSODOL
Stategies to improve and protect soil quality from the disposal of olive mills' wastes in the Mediterranean region
LIFE07 ENV/GR/000280 — www.prosodol.gr/?q=node/527

Olèico+
European awareness raising campaign for an environmentally sustainable olive mill waste management
LIFE07 INF/IT/000438 — www.lifeoleicoplus.it

INFOIL
Promoting sustainable production and consumption patterns: the example of olive oil
LIFE08 INF/GR/000581

TIRSAV
New technologies for husks and waste waters recycling
LIFE00 ENV/IT/000223 — www.tirsavplus.eu/

TIRSAV+
New technologies for husks and waste water recycling plus
LIFE05 ENV/IT/000845 — www.tirsavplus.eu/

Olivewaste
Processing plant for the integral treatment and valorisation of the wasted generated during the olive oil production process
LIFE05 ENV/E/000292 — www.life-olivewaste.cartif.com/?q=description

EnviFriendly
Environmental Friendly Technologies for Rural Development
LIFE05 ENV/GR/000245 — www.envifriendly.tuc.gr/en/news.php

Available LIFE publications

LIFE-Focus brochures

Getting more from less: LIFE and sustainable production in the EU (2009 - 40pp. - ISBN 978-92-79-12231-6 - ISSN 1725-5619)

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Other publications

Environment Policy & Governance Projects 2008 compilation (2009, 107pp. – ISBN 978-92-79-13424-1)

Information & Communications Projects 2008 compilation (2009, 21pp. – ISBN 978-92-79-13425-8)

Nature & Biodiversity Projects 2008 compilation (2009, 87pp. – ISBN 978-92-79-13426-5)

Best LIFE Environment projects 2008-2009 (2009, 32pp.-ISBN 978-92-79-13109-7 ISSN 1725-5619)

Environment Policy & Governance and Information & Communications Projects 2007 compilation (2009, 92 pp.-ISBN 978-92-79-12256-9)

Nature & Biodiversity Projects 2007 compilation (2009, 67 pp. – ISBN 978-92-79-12257-6)

A number of LIFE publications are available on the LIFE website:
http://ec.europa.eu/environment/life/publications/lifepublications/index.htm

A number of printed copies of certain LIFE publications are available and can be ordered free-of-charge at:
http://ec.europa.eu/environment/life/publications/order.htm

The programme

LIFE+ "**L**'**I**nstrument **F**inancier pour l'**E**nvironnement" / The financial instrument for the environment

Period covered (LIFE+) 2007-2013.

EU funding available approximately EUR 2,143 million

Type of intervention at least 78% of the budget is for co-financing actions in favour of the environment (LIFE+ projects) in the Member States of the European Union and in certain non-EU countries.

LIFE+ projects

> **LIFE+ Nature projects** improve the conservation status of endangered species and natural habitats. They support the implementation of the Birds and Habitats Directives and the Natura 2000 network.
> **LIFE+ Biodiversity projects** improve biodiversity in the EU. They contribute to the implementation of the objectives of the Commission Communication, "*Halting the loss of Biodiversity by 2010 – and beyond*" (COM (2006) 216 final).
> **LIFE+ Environment Policy and Governance projects** contribute to the development and demonstration of innovative policy approaches, technologies, methods and instruments in support of European environmental policy and legislation.
> **LIFE+ Information and Communication projects** are communication and awareness raising campaigns related to the implementation, updating and development of European environmental policy and legislation, including the prevention of forest fires and training for forest fire agents.

Further information further information on LIFE and LIFE+ is available at http://ec.europa.eu/life.

How to apply for LIFE+ funding The European Commission organises annual calls for proposals. Full details are available at http://ec.europa.eu/environment/life/funding/lifeplus.htm

Contact

European Commission – Directorate-General for the Environment
LIFE Unit – BU-9 02/1 – B-1049 Brussels – Internet: http://ec.europa.eu/life

Life Focus / LIFE among the olives: Good practice in improving environmental performance in the olive oil sector

Luxembourg: Office for Official Publications of the European Union

2010 - 56p - 21 x 29.7 cm
ISBN 978-92-79-14154-6
ISSN 1725-5619
doi 10.2779/8360

KH-80-09-979-EN-C

Publications Office

ISSN 1725-5619

ISBN 978-92-79-14154-6