LIFE III

focus




LIFE on the farm

Supporting environmentally sustainable agriculture in Europe

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 Unit - E.4).

The content of the publication "LIFE on the farm: Supporting environmentally sustainable agriculture in Europe" does not necessarily reflect the opinions of the institutions of the European Union.

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Luxembourg: Office for Official Publications of the European Communities, 2008

ISBN 978-92-79-08976-3
ISSN 1725-5619
doi: 10.2779/99640

Printed in Belgium

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

Foreword

Michael Hamell

Agriculture is essential to everybody, everyday, everywhere. It provides us with food and biomaterial, rural employment and even renewable energy. Furthermore, it plays an important role in maintaining the rural landscape and semi-natural habitats. However, agricultural practices do exert significant pressures on Europe's natural environment and on natural resources.

The European Union (EU) is aware of these pressures and remains fully committed to reducing the environmental impact of agricultural activity. This has been demonstrated by the EU's efforts during the last couple of decades to 'green' its Common Agricultural Policy (CAP) and by many important pieces of environmental legislation covering soil, water, air and biodiversity, to name just a few, that are either directly or indirectly related to the farming sector.

In view of the future challenges facing agriculture, resulting not only from stricter environmental standards but also from the rapidly changing global marketplace, this new publication, "LIFE on the farm: Supporting environmentally sustainable agriculture in Europe" comes as a timely opportunity to take stock of some recent LIFE-funded innovations in sustainable agriculture. It also coincides with the ongoing CAP 'health check' and the preparations for the EU budget review in 2009.

Complementing the earlier LIFE-Focus publication "LIFE and agri-environment supporting Natura 2000", the latest edition covers a broader range of innovative solutions to help enhance agriculture's influence on the environment. It aims to illustrate the point that, as Mariann Fischer Boel, the Commissioner responsible for Agriculture and Rural Development stated earlier this year, agriculture versus environmental protection is not a 'zero-sum game'.

This LIFE-Focus brochure highlights again the fact that the innovative projects co-financed by the European Commission's LIFE programme since 1992 can produce mutual benefits and synergies for the environment as well as for a wide range of beneficiaries. By doing so, it is relevant not only to environmental experts and conservationists, but will also serve as a valuable source of information for many different environmental stakeholders, particularly the various industries that comprise Europe's agricultural sector.

Featuring 20 project case studies from 11 different countries and co-funded under all three LIFE programme strands, this publication offers a wide variety of practical examples on how to deal with present and future environmental challenges in the agricultural sector. In addition to emphasising the value of knowledge transfer and best practice, the projects also present highly pertinent examples of sustainable agriculture, where natural resources are managed in a holistic manner to ensure that their benefits are also available for future generations.

Michael Hamell
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Achieving sustainable agriculture in Europe

Agriculture is the single biggest user of land in the EU and farmland covers 41% of the EU-25's landmass. Agri-industries create essential services for society including the production of food, energy and jobs. Europe's bio-economy[1] for example, has an estimated annual turnover of more than €1,500 billion and employs 22 million people. Furthermore, farming has been and still remains the most important influence in shaping Europe's rural landscape, as well as being a major determinant of biodiversity in the EU.

Low input systems and extensive farming methods, such as environmentally sensitive livestock grazing or traditionally managed orchard plantations, are all closely associated with popular cultural landscapes and high nature value farmland. At the same time however, intensive farming can exert significant environmental pressures through the consumption of water, the use of toxic substances, the production of waste, and negative effects on the quality of soils, water and air. Besides these concerns, the decline of important habitats and species, and the loss of landscape diversity can, in some cases, be attributed to inappropriate agricultural practices or insensitive land-use.

In 2006, agriculture was responsible for some 50% of water use in southern Europe and nearly half of the total nitrogen pollution found in the EU-15's rivers. In 2002 it was responsible for around 10% of total greenhouse gas emissions in EU-15 and data from 2001 indicate that 15 million tonnes of commercial fertilisers (nitrogen, phosphate and potash) were consumed by agriculture in the EU-15. These figures highlight some of the problems of modern farm production systems, which can also pose serious risks to the quality of Europe's soils. Soil erosion is a very real problem in many areas and it is estimated that soil loss from water run-off alone can amount to more than two tonnes per hectare each year.

1 Here understood as the broad field of agriculture, forestry, fisheries, aquaculture, bio-based handling of resources and rural development.

The most severe concerns arise on the more intensively managed land, such as in horticulture and arable farming, lowland dairying and intensive livestock systems, where the impact of toxic substances can be particularly acute. Local geography, crop type, farm structure and the regional socio-economic situation also influence the scope and scale of stress that agriculture can exert on Europe's environment. In addition, new issues have emerged in the last few years that farmers now need to deal with. These include greater market volatility for agricultural commodities, increasing globalisation of markets, on-going technological advances, and rapidly increasing food demands, all of which can contribute to further farm intensification. Other recent developments involve responding to climate change or new pressures regarding water quality and bio-energy, as well as issues linked to managing the environmental uncertainties associated with genetically modified organisms in agriculture.

Reconciling commercial agriculture and environmental conservation

This complex relationship between agriculture and the environment requires a two-pronged approach. Firstly, there is a clear need to encourage farmers to continue to play a leading role in the maintenance of the countryside and the environment. Secondly, the importance of respecting environmental concerns needs to be stressed within agricultural policy and practice, which should aim to promote holistic sustainability.

LIFE05 ENV/DK/000145

Agricultural dominates much of Europe's landscape

The European Union has set itself a strategic objective to achieve "sustainable agriculture", which aims to capture an effective balance between commercial agriculture and environmental conservation. Practically speaking, this translates into a number of key challenges for Europe's agricultural sector. These challenges are interrelated and include: providing high quality products and services; ensuring food safety and animal welfare; meeting consumer preferences; making positive environmental contributions; and maintaining quality jobs and international competiveness throughout the agricultural industry's supply chain.

Meeting these challenges remains an on-going task for EU agriculture policy, which continues to evolve, enhancing its ability to reconcile economic, social and environmental aspects in order to secure and safeguard sustainable benefits for Europe's farmers, its environment and society in general.

EU policy and legislation

Environmental priorities feature prominently in agriculture-related EU policy and legislation, which include a mixture of dedicated farm support instruments and other broader strategic guidelines that remain relevant to the EU agriculture sector and its stakeholders.

Europe's agricultural policy makers acknowledge the need to design strategic approaches capable of promoting farm profitability whilst avoiding actions that damage natural resources. A wide range of agricultural and environmental legislation exists to put these requirements into practice, including instruments within the Common Agricultural Policy (CAP) apparatus that regulate EU farm activity and play a vital role in supporting environmentally sensitive production practices.

LIFE00 NAT/EE/007083

European legislation helps to reduce negative impacts from intensive farming techniques

Common Agricultural Policy (CAP)

The CAP is Europe's main driver of activity within the Community's agricultural sector and has made considerable progress in safeguarding Europe's food supply since it was introduced in the early 1960s. Significant progress has also been made in mainstreaming environmental objectives and targets within the CAP, to reflect society's changing values over the years. 1992 saw one of the first important milestones for sustainable agriculture when efforts were made to start 'greening' the CAP by establishing the **Agri-Environment Regulation** (2078/92/EEC) and by introducing **Extensification Premiums** paid to beef producers.

These developments were built on during a far reaching CAP reform agreement in 1999, known as Agenda 2000, which entailed a further shift from price support to direct payments, thereby removing incentives for intensification of farm production processes. **Agenda 2000** also diversified the CAP into two new "pillars", separating agricultural support between market and income policy in the "first pillar" and sustainable development of rural areas in the "second pillar". The latter was designed to support non-market objectives of the CAP, notably the social and environmental dimension of sustainable agriculture.

Although the first pillar was never intended to act as a direct environmental support instrument, it has had major positive impacts on farmland environments and associated biodiversity, mainly due to its **Cross-Compliance** device. This instrument obliges farmers who receive CAP direct payments to respect certain statutory management standards in the field of public, animal and plant health, as well as to comply with minimum requirements of good agricultural and environmental conditions defined by the Member States. Cross-Compliance policy was first introduced in 1999 and soon afterwards became compulsory during the 2003 CAP reforms, which fixed the device as an explicit condition for farmers seeking benefits from market support under CAP's first pillar.

Most of the CAP's main measures that help protect the environment are however found in the second pillar. These measures include: mandatory agri-environment schemes; compensatory allowances for less favoured areas and Natura 2000 sites; optional training programmes; and advisory services for farmers that promote environmentally sensitive management methods. All of these measures are linked to the obligation for Member States to set out codes of good agricultural and environmental conditions (GAEC) and Cross-Compliance.

Agri-environment measures are available to EU farmers and

represent both an incentive payment to carry out environmentally sensitive management practices, as well as a compensation payment to offset commercial losses that might occur as a result of the revised approaches. CAP support under these measures is only granted when farmers commit to at least five years of controlled agricultural production methods that go beyond **good farming practice**. Agri-environment measures were introduced during the 1999 CAP reforms and since then they have become recognised as one of the EU's principal policy tools for promoting sustainable agriculture. All Member States are committed to these measures, which remain core elements of national authorities' Rural Development Plans.

CAP reform in 1999 also reinforced the compensatory allowances for **less favoured areas (LFAs)**. LFA payments had already been in place for a quarter of a century and were strengthened to support the continuation of farming in areas where natural handicaps cause lower agricultural productivity and threaten farm viability. They play an important role in maintaining landscapes, habitats and local environmental qualities that depend on farming in more marginal areas, such as mountains.

Environmental agendas were further harmonised following the **2003 CAP reform**, which saw new or amended measures being launched to promote the protection of farmed environments in both CAP pillars. Key developments included: the decoupling of most direct aid payments from production; the aforementioned Cross-Compliance obligation; financial support for the implementation of requirements resulting from the Birds and Habitats Directives in Natura 2000 areas; and the introduction of the Modulation concept. Modulation allows Member States to move funds from the first to the second pillar with the aim of building a more diversified, dynamic and environmentally friendly rural economy in Europe.

These types of environmental incentives demonstrate the EU's dedication to achieving its sustainable development objectives. In addition, a wide variety of key mainstream EU policy initiatives also exist that help integrate environmental objectives in agri-activity.

Environmental legislation

Europe's main binding framework for multi-sectoral environment policy-making is the **Sixth Environmental Action Programme** (6th EAP). It covers the period up until 2012 and promotes full integration of environmental protection requirements into all EU policies and operations. One of the 6th EAP's core objectives refers to the protection of soil from erosion or pollution. This goal was extrapolated further in the Communication "Towards a thematic strategy for soil protection", adopted by the Commission in September 2006.

A proposal for a **Soil Framework Directive** is currently under discussion by the European Parliament and the European Council. If agreed, this would enable Member States to adopt measures tailored to their own local needs, as regards agricultural practices and other policy areas affecting soil quality.

Water quality is another core component of the 6th EAP and agricultural practices remain important influencing factors on water quality in many parts of Europe. Issues linked to nitrate pollution from farm fertilisers are a common concern for Member States, which are required to monitor and control environmental standards in compliance with EU Directives covering nitrates and water quality. The **Nitrates Directive** (91/676/EC) has the general objective of protecting Community

Livestock farming has a significant influence on the quality of Europe's environment

LIFE00 NAT/EE/007083

waters against excessive nitrates from agricultural sources and the **Water Framework Directive** (WFD) sets clear guidelines on European water policy for the decade ahead.

By 2015 the WFD expects to achieve an appropriate ecological and chemical status for surface water, as well as an acceptable chemical and quantitative status for groundwater. In addition, it contains provisions on water pricing policies and a list of high risk substances which present a significant threat to, or via, the aquatic environment. A **Groundwater Directive** was also agreed in 2006 to support the aims of the WFD.

Climate change presents a relatively new challenge for farmers in Europe, both in terms of adaptation and mitigation. Emissions of greenhouse gases have been confirmed as the critical cause of anthropogenic climate change and agriculture, like all other European industries, is required by law to observe the emission ceilings for a range of gases, including: sulphur, nitrogen oxides, ammonia and non-methane volatile compounds set out in the EU's **National Emission Ceilings Directive** (NECD). Although no specific targets relating to agriculture are mentioned in the NECD, its ammonia target is widely understood to represent an obligation for the agricultural sector to reduce its discharges, since these are estimated to comprise more than 90% of the total ammonia emissions in Europe. A number of options are available to reduce emissions, including opportunities to harness the gas for alternative fuel production, as also foreseen in the **Landfill Directive** for methane and other landfill gases.

Emissions from fossil fuels represent one of the largest sources of greenhouse gases globally, as well as other polluting gases. As such, the EU presented an important **package of measures on renewable energies and climate change** in early 2008, which incorporates a specific communication on carbon capture

Environmental legislation

All of these environmental controls make important contributions to conserving Europe's natural environment and biodiversity. Indeed, the maintenance of biodiversity forms a priority objective in most EU environmental legislation and policies. Biodiversity has been shown to be highly dependent on agriculture and biodiversity goals are enshrined in the 6th EAP, which highlights the importance of integrating natural heritage protection and restoration measures within agricultural and regional policy.

Issues such as global warming pose important challenges for EU farmers

LIFE03 ENV/S/000596

and storage, as well as targets for biofuels. The Communication **"20 20 by 2020 - Europe's climate change opportunity"** also stresses the need for a new EU framework with national commitments covering emissions not covered by the Emissions Trading System, such as those produced by agriculture.

Other relevant policy work in this area includes the EU's proposal for a **Thematic Strategy on Air Pollution** that establishes interim objectives for air pollution in the EU and proposes appropriate measures for achieving them. It is closely linked to the Commission's thinking regarding a future **Directive on Ambient Air Quality** along with an impending **Directive for Acceptable Emissions** that would set controls on agricultural and forestry tractor engines in order to reduce atmospheric pollution.

Photo: Nora Schiessler

Traditional farming practices play important roles in shaping cultural landscapes

Terrestrial pollution has been attributed to a wide range of different factors across Europe and pesticides emerge as a prominent pollutant due to the high toxicity of some substances. The **Thematic Strategy on the Sustainable Use of Pesticides** covers pesticides' full life-cycle in an attempt to reduce their impacts on human health and the environment. It includes objectives to achieve more sustainable levels of pesticide use and promotes a significant overall reduction in risks by adopting pesticide practices that are more consistent with the actual level of threats posed by pests. To this end, in July 2006 the Commission proposed a **Directive establishing a Framework to achieve a sustainable use of pesticides**, which is expected to be adopted soon.

Two other relevant pieces of generic pesticide legislation are **Directive 79/117/EEC** concerning prohibited products and control of residue limits in food and feedstuffs and **Directive 91/414**, concerning the placing on the market of plant protection products. Similarly, a **Regulation for Fertilisers** (2003/2003/EC) also defines the provisions relating to the placing of fertilisers on the market and **the Regulation on organic production of agricultural products** includes dedicated measures to minimise the application of toxic farm substances.

Agricultural stakeholders further need to consider the I**ntegrated Pollution Prevention and Control Directive**, the EU's **Strategic Environmental Assessment Directive**, the **Environmental Impact Assessment Directive** and waste recycling policies such as the **Sewage Sludge Directive**, the **Incineration Directive**, **Urban Wastewater Directive** and the **Waste Framework Directive**.

The **EU Habitat and Birds Directives** also define specific legal requirements for biodiversity protection and the interaction between biodiversity and agriculture is dealt with in detail by the **Biodiversity Action Plan for Agriculture 2001**. This action plan harnesses the policy instruments established or confirmed by the Agenda 2000 CAP reforms to prioritise environmentally-friendly farming practices and production systems that benefit biodiversity. Additional support is awarded to the promotion of measures regarding genetic resources and sustainable farming activities in biodiversity-rich areas, such as those with Natura 2000 designations.

This review of EU policies and legislation affecting Europe's agricultural sector reveals a clear desire to achieve an effective equilibrium between commercial productivity and essential environmental considerations. A wide range of strategic tools are available to promote sustainable agricultural practices, including the EU's LIFE programme.

LIFE on the farm: Demonstrating good environmental practice

EU policy provides an important opportunity to improve environmental management in the farming sector and the European Commission's LIFE (Financial Instrument for the Environment) programme supports these efforts by co-funding demonstration projects that deliver real benefits for European farmers, agriculture's stakeholders and the environment.

LIFE02 TCY/CRO/000014

LIFE projects have funded an interesting variety of beneficial farm activities

Europe's agricultural sector is no stranger to change and farmers have become well acquainted with altering their operations to reflect the evolving expectations that emerge from customers, funders and policy makers. A key challenge currently facing the industry is to identify sustainable solutions to macro issues, including: climate change; environmental impacts and pressures on natural resources; globalisation and increasing competition; demographic changes; and advances in science and technology regarding crop and livestock productivity.

Tackling these challenges while still ensuring an appropriate balance between socio-economic and environmental factors will require innovative approaches by all stakeholders in the agricultural sector. Innovation remains central to the sector's ability to move forward within a framework of sustainable development, which supports farmers' capacity to develop new products and specialist operations whilst also mitigating negative environmental impacts. Promoting such innovation through demonstration is an effective way of mainstreaming sustainable approaches in modern European farming methods.

DG Environment's LIFE programme has played an important role in promoting environmental priorities by financing projects that demonstrate holistic solutions for complex and interlinked farming problems and show how new opportunities for European agriculture can be best applied in practice. LIFE seeks to bridge the gap between R&D and large-scale application, whilst also assisting in the process of disseminating good practices and validating pioneering approaches and technologies that improve environmental management.

An important characteristic and one of the main advantages of LIFE projects is the fact that they are delivered at a local level. This ensures that the projects provide valuable information and relevant experiences regarding

LIFE02 NAT/GR/008494

Information dissemination plays an important role in LIFE project objectives

uptake of environmental measures by farmers and other agri-interests from across Europe.

More than 160 agriculture-related LIFE-Environment projects

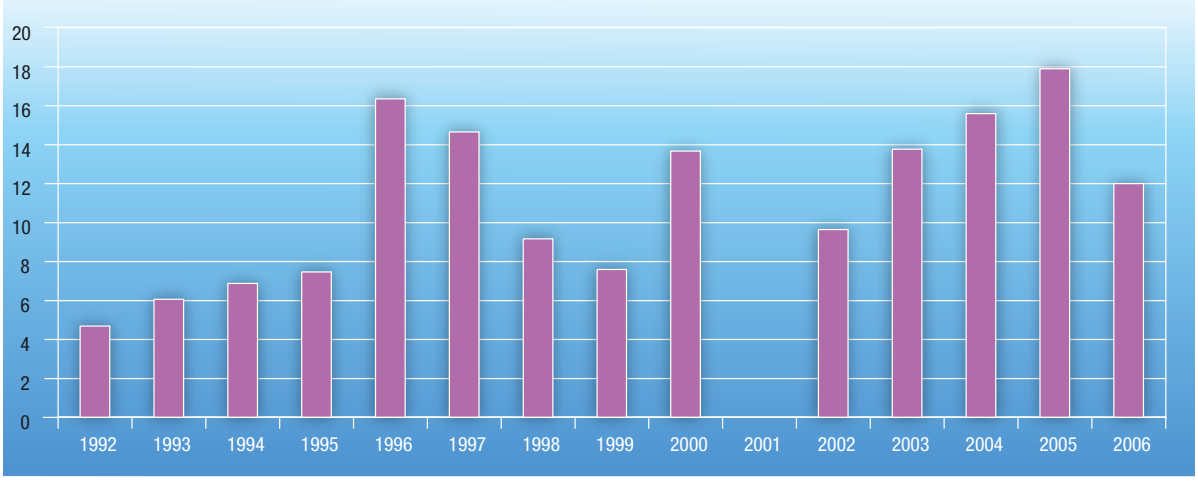
Since 1992, LIFE has co-financed more than 160 agriculture-related projects under its LIFE-Environment component. In total, 11% of all LIFE-Environment projects have dealt specifically with agricultural issues and numerous LIFE-Nature and LIFE-Third Country projects have complemented these efforts. Project themes within LIFE's agricultural portfolio include: soil and water protection; improved irrigation techniques; the effects of animal husbandry; pest control; waste management; landscape protection; conservation activities; and coordination with CAP agro-environmental measures.

LIFE's support for these agriculture-related activities has stayed relatively stable during the different programming periods, which highlights the sector's bearing on nature conservation and sustainable management of Europe's environment. The farming sector's significance to Europe's environment is further demonstrated by, for example, a significant increase in LIFE-Environment agriculture-related projects following CAP reforms in 1999 and 2003 (14% in 2000 and 16% in 2004), thereby acknowledging the increasing emphasis on agri-environmental measures. In addition, relatively high percentages of LIFE projects dealt with agriculture during the launch years of LIFE II and LIFE III.

Figure 1 illustrates LIFE's commitment to supporting innovation and environmental management activity in Europe's agricultural sector since 1992.

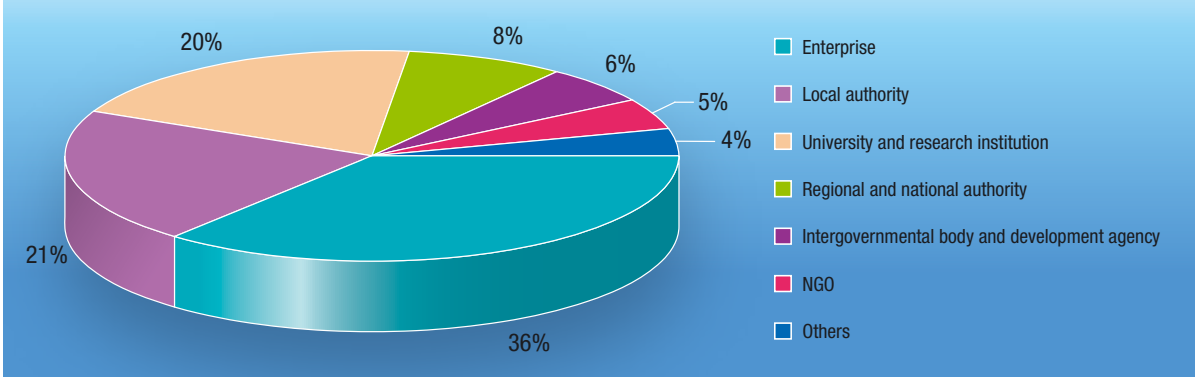
Further analysis of data on LIFE allocations reveals the fact that Mediterranean Member States have implemented the most agriculture-related LIFE projects, with Spain (53), France (23), Italy (22) and Greece (10) all topping the LIFE league for farm related projects. Northern and eastern European countries also fare well when looking at the proportion of country projects dealing with agriculture. Whilst Spain (27%) is again highest, it is followed by Finland (17%), Estonia

Figure 1: **Percentage of agriculture-related LIFE-Environment projects per type of beneficiary**



Since 1992, more than 160 agriculture-related LIFE-Environment projects have received funding. (Note that a cumulative budget covered 2000 and 2001.)

Figure 2: **Percentage of agriculture-related LIFE-Environment projects per type of beneficiary**



(14%), France (14%), Denmark (12%) and Sweden (11%).

A review of LIFE-Environment beneficiaries (see figure 2) shows that more than one-third of all LIFE-Environment agricultural project beneficiaries were enterprises (36%), followed by local authorities and university or research institutions (about 20% each). These encouraging figures highlight the private sector's interest in sustainable agriculture and demonstrate a healthy balance of commitment between private and public entities regarding endeavours to improve the integration of environmental matters within European agricultural practices.

Half of all agriculture-related LIFE-Environment projects were technology-focused, 43% concentrated on methodological goals and tools, whilst 7% targeted awareness-raising activities. These trends closely mirror the general distribution of approaches by LIFE-Environment projects in other sectors (as shown in figures 3 and 4).

Disseminating results

Lessons learnt from the LIFE programme confirm the benefits of knowledge transfer as well as the need to improve dissemination of environmental best practice. The importance of these two facts was also acknowledged by speakers and participants at the 2007 conference "Towards future challenges of agricultural research in Europe", where delegates stressed the need for both improved distribution of knowledge in the agriculture sector, as well as more awareness-raising on new approaches that generate sustainable benefits for farmers and society alike.

This LIFE-Focus brochure has been produced to contribute to the environmental knowledge transfer process for farmers and other stakeholders in the agricultural sector. By focusing on environmental issues it aims to improve understanding about best environmental practice techniques from around Europe that are available to the agricultural sector. It features examples of effective agriculture-related LIFE projects that have succeeded in minimising a wide range of environmental pressures from agriculture whilst still maximising its positive external outputs. The 14 LIFE-Environment, five LIFE-Nature and one LIFE-TCY projects presented in the brochure have been selected on the basis of: their innovative approaches; the sustainability of the outcomes; their relevance to environmental policy and legislation; and their demonstration value and transferability.

Eleven different countries are covered by the brochure and this represents only a small sample of the many successful projects within LIFE's agricultural portfolio. Other exciting agriculture-related activities can be found on the LIFE programme's website in the project database at: http://ec.europa.eu/environment/life/project/Projects/index.cfm, or in the website's thematic pages on soil, land-use and agriculture at http://ec.europa.eu/environment/life/themes/soil/index.htm.

Figure 3: **LIFE-Environment projects by approach**

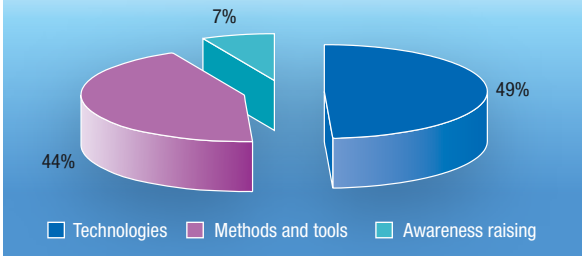
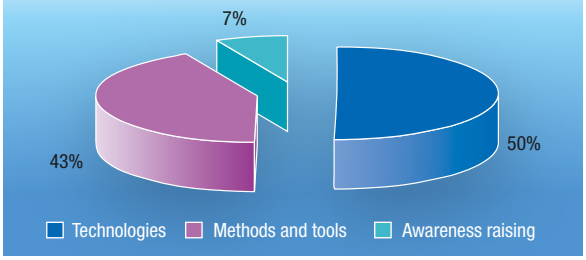


Figure 4: **Agriculture-related LIFE-Environment projects by approach**



Water quality and sustainable consumption

The quality and quantity of Europe's water supplies are inextricably linked with European agriculture. For example, as much as 30% of total water use in the EU relates to crop irrigation, a figure that increases to around 50% in southern Europe.

Irrigation is an essential activity that helps to guarantee the availability of food and farm products, but it can also contribute to exerting excessive stress on subterranean aquifers as well as aggravating soil erosion, increasing soil salinity and altering pre-existing semi-natural habitats. Other issues concerning water quality and agriculture include the risk of contamination from pesticides and fertilisers, with nitrates causing one of the biggest challenges.

Drinking water, surface water and groundwater are all protected by the Water Framework Directive (WFD) and the Nitrates Directive. The CAP also provides support to improve the state of irrigation infrastructure and protect water quality via specific controls and incentives in respect of pesticides and nitrates.

Further support to Europe's water resources has been delivered through the LIFE programme, which has helped agricultural beneficiaries to run projects that produce a wide range of benefits in terms of water quality and resource management in Europe. These projects include innovative actions and partnership proposals that have succeeded in: implementing the WFD; demonstrating new management techniques for water irrigation; rehabilitating and protecting aquatic ecosystems; diversifying farm production into organic practices; developing codes of conduct for good agricultural practices in order to reduce point source and diffuse pollution; and reducing the impacts of pesticide and nitrate contamination in surface and ground waters.

Optimizagua: An optimised irrigation system to rationalise water use

BEST PROJECTS AWARD 2007-2008

This Spanish LIFE project used latest technologies to develop a simple and cost-effective method for reducing water use in agriculture and in green public spaces such as parks, by watering only as much as necessary and at the most effective times.

Watering crops only when needed generates significant resource savings

Water scarcity is an increasingly pressing concern across the EU and particularly in water stressed countries in the South. Agriculture is an extremely water-intensive sector, using around 70% of all European water supplies and, as such, presents both a target for criticism, but also great potential for water saving.

The San Valero Foundation in Zaragoza, Spain realised that a key issue was not just the water needs of agriculture, but the fact that watering often exceeded these needs. The Foundation was convinced that optimising water consumption could offer significant water savings with no adverse effects on agricultural production.

Many farmers were watering more than they needed to for fear of not watering enough, including when it rained. As Nieves Zubalez, from the foundation, pointed out, many were also "watering their fields in sunny or windy conditions when much of the water would not reach the targeted soil". So existing watering methods were both excessive and inefficient.

The project manager, Cesar Romero, explains that "we knew that science had developed an understanding of the water requirements of different plants and that the technology was available to measure humidity in soil and the optimum times to water, but that nobody had thought to combine this technology into an integrated system for rationalising water use".

Optimised watering

The foundation made a successful LIFE project application to demonstrate a system for providing the optimum,– and therefore rationalised – amount of water for different types of land use and different plants. It aimed to establish prototypes of the system to operate in a variety or rural and urban settings to establish the possible water savings from rationalised watering in different contexts.

Several leading-edge technologies were combined during the demonstra-

tion project. A set of highly-sensitive sensors was used to measure soil humidity, air temperature, wind speed and rainfall. Modern radio, GPRS and Internet technologies were also used in the system to enable communication between the sensors, the watering system and the people in charge.

Humidity sensors were placed at different depths in the targeted soil. Readings from these gave, often for the first time, extremely accurate information on the water contained within the soil. These readings not only provide a warning when the soil needs watering, but as Romero points out, "they highlight when there is sufficient soil humidity at the required depth so that watering can be avoided and even reveal where underground leaks, invisible on the surface, have occurred".

The water-saving potential is increased because the growing scientific knowledge of plant physiology has given invaluable information on the optimum amount of water needed for each plant. It has even shown that under-watering plants can sometimes be beneficial to the end cultivated product. Whilst under-watering is a risky business when relying on guesswork or experience alone, the exactness of the Optimizagua data makes this a real possibility.

Whilst the soil humidity sensors provide information on how much to water different plants, the climatic sensors provide information on when the watering should take place. Windy conditions result in water being blown away from its target area, whilst sunny and hot conditions mean that much water evaporates before it can penetrate the soil. Watering in both circumstances is highly inefficient and haphazard, whilst watering when it is raining or snowing is generally ineffective.

An integrated, automated system

The readings provided by the various sensors at each site are transmitted to a central 'concentrator station'. This collects the data and sends them to a 'management and control station' via GPRS. Once collated on a server, the data are then used by software programmed by the client to determine watering.

The client can establish the parameters in which watering is to take place and the system will automatically water as necessary according to the parameters and the received data. A park keeper at a project site in Zaragoza highlighted that, "the best time to water is between 6am and 8am, as the ground is the most receptive to water and the temperatures are low. The Optimizagua system means that I no longer have to compromise between watering at a time that suits the park and a time that suits me!"

The system can also be programmed to trigger a variety of alarms requiring action by the client, sent either via the Internet or mobile phone. Whilst the system is highly automated, it does not replace the need for an overseeing role. In this sense, it does not constitute a threat to jobs, but allows workers to get the optimum benefit from their watering and dedicate more time to other associated activities.

The project manager recalled that although the technology worked well from the very beginning, there were also some unexpected surprises: "The concentrator stations are in exposed

Various watering programmes can be applied during different conditions

locations in the fields and one was hit by lightning. We realised we had to install lightning conductors on each one". A particularly cold snap one night also made them realise that it was important to set wide temperature parameters so as not to disturb the computer programme.

Impressive water saving

The project tested the implementation of the Optimizagua system in a variety of situations, including corn and wheat fields in Soria, cornfields in Monte Julia, two public parks in Zaragoza and the private gardens of a residential estate in Logroño. Each system was programmed according to the specific requirements of the land being watered.

All the various sites used a control zone to compare with the Optimizagua zone and overall, the Optimizagua sites used 54% less water. The project demon-

The methodology was tested in a number of settings

Urban areas were also included in the project objectives

strated water saving of more than 60% in public parks, over 50% for private lawns and around 40% for wheat and corn fields. During the project, a total saving of over 22,000m^2 of water was achieved on a total area of only 4 ha.

During a 235-day cycle in the wheat fields of Soria, 1,426 m^3 of water was used on the control area, whilst only 874 m^3 was watered on the equivalent-sized project area. Six-month cycles in the cornfields of Soria and Monte Julia both saw water savings of around 42% in the project sites compared with the control areas.

Alongside the efforts to rationalise the watering of different soils, the project also developed a complementary system to ensure that rainwater was used wherever possible before making use of the mains water supply. This approach reduces demand for drinking water, which is often used unnecessarily for watering activities, whilst also reducing the costs of watering by using a freely available source.

Park areas benefited from the LIFE support

At an agricultural site in Monte Julia, rainwater was collected from the roofs of nearby buildings and from the run-off from nearby slopes into a 10,000 litre underground water storage tank especially installed by the project. An automated watering control system for the crop fields was installed together with a system for filtering and pumping the stored water to the watering system.

The water savings are even more impressive when the use of rainwater is taken into account. Despite the exceptionally dry conditions experienced during the project implementation, the use of mains supply water was reduced by nearly 50% on both the cornfields of Monte Julia and the wheatfields of Soria. The importance of rainwater to reducing demand on the mains water supply is likely to be even greater during years – or in areas – with more rain.

Life beyond LIFE

The benefits of the project will extend into different areas and into the future. The experiences of the LIFE project have already been used as the evidence base to strengthen local and regional legislation around Zaragoza. These now require optimised irrigation and rainwater collection systems, along the lines demonstrated by Optimizagua.

The project's excellent results have also led to real interest from both the public and private sectors to implement the methodology. The San Valero Foundation is furthermore able to reassure them that the initial investment necessary to install the system can be offset within two years from the water savings alone. The project's transferability is thus very high.

Zaragoza's City Councillor for the environment, Lola Campos, recently confirmed that "Zaragoza has already started to introduce the Optimizagua methodology into local parks, a new eco-area in the city, two natural peri-urban zones and green areas alongside the river". The project will have a

The project attracted good media coverage

deservedly high profile during the 2008 Expo in Zaragoza on the theme of Water and Sustainable Development: (www.expozaragoza2008.es).

A public organisation providing watering services to farmers (the Montes Negros Comunidad de Regantes) has committed to making the initial investment to install the system and the methodology is even to be implemented in the Dominican Republic, through a contact of the foundation.

Finally, the project offers potential for further environmental benefits beyond saving water. Cesar Romero concludes that "energy savings were not the focus of this project, but not only does Optimizagua use renewable sources of energy itself, but less irrigation also requires less pumping of water, which is often powered by diesel". The full environmental benefits of this impressive LIFE project are likely to extend and increase well into the future.

Project Number:
LIFE03 ENV/E/000164

Title: Demonstration of water saving for watering uses through the experimentation of artificial intelligence integrated in traditional systems of water control

Beneficiary: Fundacion San Valero

Period: Oct-2003 to Sep-2006

Total Budget: € 1,452,000

LIFE Contribution: € 692,000

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Odense River Management Plan: Leading the way in WFD implementation

This Danish LIFE project demonstrated that it is possible to prepare a cost-effective Programme of Measures for agriculture based on the WFD methodology and to incorporate these into a River Basin Management Plan. It achieved this via a pilot plan for the Odense river basin.

Photo: Jan Kofod Winther

Odense Fjord received a dedicated package of LIFE funding to improve water quality and wildlife habitats

Agricultural activities often cause high levels of nutrients to be released into local water bodies by leaching or soil erosion. Where this occurs, it negatively impacts upon natural ecosystems and affects biodiversity. Such consequences of agricultural activity represent a major impediment to the achievement of good ecological status in all EU water bodies by 2015.

Accordingly, agricultural nutrient pressure has been targeted as a key area of concern for the EU Water Framework Directive's (WFD's) Common Implementation Strategy. Amongst the activities foreseen by the strategy are the development of guidelines on technical issues and their testing and demonstration in Pilot River Basins.

Led by the Environmental Centre Odense of the Danish Ministry of the Environment, this LIFE project aimed to implement the methodology laid down in the WFD in the Odense river basin, which covers around 1,050 km^2, of which 68% is used for agricultural purposes. The project sought to demonstrate the development of a cost-effective programme of measures to reduce levels of nitrogen and phosphorous in the basin.

The project team carried out a baseline study analysing the development of agriculture, horticulture and forestry in the Odense Fjord catchment considering the natural resources available, structural changes in the sector, changing demand and socio-economic importance. They also examined the links between the EU's Common Agricultural Policy and the implementation of the WFD in a further report.

An assessment was made of nutrient pressure from agriculture and its impact, showing the risks of failing to meet the WFD objectives by 2015 of 88% for rivers, 92% for groundwater and 100% for coastal waters.

To limit these threats, the project's first output was a balanced Programme of Measures to ensure that the water bodies and terrestrial ecosystems comply with their environmental objectives. These measures included the environmental optimization of crop production and set aside of farmland to reduce nitrogen and phosphorus losses from agricultural activities into water bodies.

To support the cost-effective implementation of this programme, the project commissioned the Danish Institute of Agricultural Science (DIAS) to create a modelling tool to establish nutrient balances at the level of individual farms.

A second output was the first European Pilot River Basin Management Plan (RBMP) with a special focus on agricultural and environmental problems. Produced via an open process in dialogue with different stakeholders, the plan is to be used as an example by the Danish Ministry of Environment and Danish municipalities in their management of the Odense River basin. The plan includes as an example a complete monitoring programme.

The LIFE project showed that it is feasible to apply the WFD approach to the agricultural sector and has provided a guiding example for all other river basins in Europe. The project presented its methodology and Plan at national and international events, including a national conference and European meetings of water management authorities.

Examples of natural and modified waterways on farmland in the Odense catchment area

Photo: Jan Kofod Winther

The Fjord experiences numerous pressures around its River Odense outlet

Project Number:
LIFE05 ENV/DK/000145

Title: Odense Pilot River Basin Agricultural Programme of Measures

Beneficiary: Danish Ministry of the Environment, Environmental Centre Odense

Period: Jan-2005 to Jun-2007

Total Budget: € 514,000

LIFE Contribution: € 202,000 (maximum)

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Agri-Peron: Promoting best agriculture practice in reducing nitrate pollution of water bodies

Water quality in France's Peron river catchment area has been protected by a LIFE project that responded to bottom-up demands from local famers for new codes of best agricultural practice that have proved to be effective in reducing risks of water pollution from phytosanitary products by 90%.

Arable farms are major land users in the Peron river area

The use of crop-protection products presents a number of environmental challenges. Nitrate-based fertilisers and pesticides in particular pollute waters and harm biodiversity in surrounding areas.

The Chamber of Agriculture of Aisne, which acts as an interface between farmers, administrators and economic actors, sought to improve farming approaches to crop-protection products in the Peron River basin, with the aim of reducing nitrate contamination of the environment and improving the water quality in the river's catchment area.

Through the LIFE project "Agri-Peron", the Chamber aimed to develop tools to make farmers aware of practices designed for sustainable development, restoring and preserving the quality of the natural environment whilst guaranteeing the economic viability of 76 participating farmers.

The project started by carrying out an inventory of environmental pressures in the Peron catchment area. It examined the quality of both surface and groundwater and the extent to which related EU legislation such as the EU Nitrates Directive, Water Framework Directive, and the Directive on the sustainable use of plant production products was being respected, particularly in farming activities. The inventory identified areas of point source and diffuse

pollution from pesticides and fertilisers and their origins in the agricultural sector.

Based on this inventory, the project defined and promoted codes of best agricultural practice. Optimal methodologies and techniques were specified, including the installation of appropriate agricultural equipment and the use of scientific tools to reduce pollution.

Planning agricultural changes

A particularly innovative part of the project involved specifying plans for revised agricultural practices on individual farms. These plans set out carefully considered changes in farming methods that were agreed with the farmers themselves. Training actions were also carried out to raise awareness of best practices in the farming community and to help it implement such practices.

Thanks to the project, 'nitrate traps' were installed on 50% of land affected by nitrate infiltration and 70% of the places identified as being at risk of high-level infiltration were adapted to reduce this danger. Levels of nitrate were reduced by 40 units for rape fields and 10 units for wheat, amounting to reductions of 20-30%.

Nitrate levels were monitored on different crops during the inventory phase

It is estimated that the risks of pollution linked to the use of phytosanitary products was reduced by 90%. Initial testing showed improvements in water quality and it is expected that the project will lead to a revival of biodiversity in the Péron basin in the medium-term.

The project is an interesting example of how to implement the requirements of EU directives concerning water basin management. It is noteworthy in its approach to involving the farming community in identifying best agricultural practices to minimise pollution from pesticides and fertilisers.

The project was perceived as an innovation by a large number of farmers in the area, including those who had already tried other methods of controlled fertiliser and pesticide application and it was frequently visited by farmers' representatives from outside of the project.

Information on the project was disseminated on a European scale to highlight the efficiency of applying best agricultural practices and the resulting environmental benefits.

Water quality has benefited from the LIFE project support

Project Number:
LIFE04 ENV/FR/000319

Title: Development and implementation of codes of good agricultural practices to reduce point source and diffuse pollutions in the Peron catchments area

Beneficiary: Chamber of Agriculture of Aisne

Period: Sep-2004 to Sep-2007

Total Budget: € 655,000

LIFE Contribution:
€ 328,000 (maximum)

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Soil protection

Soil quality is widely acknowledged by farmers, soils scientists and other environmental stakeholders as one of the key components for sustainable land use in Europe. Nevertheless, soil quality across the continent continues to suffer from a host of different hazards. These include soil contamination, organic matter decline, salinisation and landslides from erosion. Environmental impacts of soil erosion pose particular problems and are often associated with pollution, habitat loss or structural damage to landscapes and human infrastructure. Furthermore, soil erosion also has a major effect on agricultural systems, due to the loss of soil nutrients, organic matter, seeds, trace elements, invertebrates and microbial populations, as well as an overall decline in soil depth and water retention capacity.

Such threats to European soil quality have led to the European Union establishing a dedicated theme for soil quality within its 6th Environment Action Programme. A first step was a European Commission Communication on Soil Protection in April 2002. In September 2006, the Commission published its proposal for a Soil Thematic Strategy, including a Soil Framework Directive.

A number of different LIFE projects have worked in partnership with local farmers to successfully demonstrate ways of confronting soil challenges and promoting soil conservation techniques in order to improve European soil quality. Examples include: sustainable fertiliser regimes; innovative composting techniques; conservation-oriented arable land management systems; and training activities for farmers on ways to prevent soil erosion.

Petrignano: Controlling surplus nitrate inputs on Italian farms

Nitrate balances in the soils of central Umbria have experienced a marked improvement following the intervention of a successful LIFE-Environment project which encouraged farmers to reduce fertiliser inputs.

The environment of Umbria in central Italy is world famous for its unspoilt beauty and peaceful tranquility. Traditional agriculture provides the backdrop for such idyllic imagery but recent trends in farming practices have started to offset the balance in key environmental elements and legislation has now been introduced to help conserve Umbria's valuable natural resource base. This legislation includes regulations to improve water quality, which has been adversely affected by nitrate contaminants leaching from local soils.

Nitrogen run-off on agricultural land remains one of the major sources of nitrate pollution in ground waters and this problem is particularly acute in the Petrignano area of central Umbria because of specific groundwater conditions. The area depends on a large alluvial aquifer for its main supply of both drinking water and industrial water but flows in this type of subterranean aquifer are very slow, which means that nitrate contamination can be difficult to rectify.

Concerns regarding high levels of soil nitrates in the Petrignano area led to it being the first area in Umbria classified as a Vulnerable Zone under the Nitrates Directive (91/676 EEC). This classification encouraged the regional government's environmental protection agency, Agenzia Regionale per la Protezione Ambientale (ARPA - Umbria), to apply for LIFE support in order to help local farmers control surplus levels of nitrogen leachate in arable soils.

LIFE field trials tracked nitrate levels to identify appropriate fertiliser regimes for local crops

Alternative agri-management

The core objective of the LIFE project was to identify and implement alternative agronomic techniques for soil management in Petrignano which minimised nitrate impacts on the local groundwater reserves.

ARPA was aware of the importance of participatory approaches when working with agricultural issues and so efforts were made to secure LIFE partners from the local farming community. Three agricultural associations supported the project team and their cooperation became critical, both in terms of providing access to a large number of farmers but also in achieving high levels of commitment to the project activities from the agricultural sector.

Farmers were closely involved during the project design stage, during which an integrated programme of soil management activities was prepared to firstly identify viable options for curbing nitrogen inputs and then disseminate the results to relevant stakeholders.

Research trials

Ambitious project targets were set to reflect the Vulnerable Zone status and these provided a strong impetus for the LIFE team's work load, which focussed much of its attention on analysing the productivity effects on different crops following controlled reductions of nitrogen inputs. A wide variety of field experiments were carried out to investigate soil leaching from artificial fertilisers, green manures and natural nitrogen fixing by leguminous species.

Eighteen demonstration plots were established covering over 160 has

of mostly wheat and maize crops. Barley, sunflower, tobacco, sorghum and sugar beet were also included and control sites were selected on neighbouring land to provide comparative data for crop productivity.

Each trial site was divided into three sections that were subjected to different regimes of nitrogen inputs, fertiliser distribution and irrigation methods. ARPA used the official Code of Good Farming Practice as a baseline for recommended fertiliser use and then researched the effects on crops of reducing nitrogen inputs by factors of 30%, 40% and 50%.

Leachate levels were tracked using a standardised system of monitoring instruments established by agro-environmental specialists from Perugia University who provided scientific support to the LIFE team. Piezometers were placed at three different depths throughout the trial sites in order to clarify the exact movement of water transporting the nitrates and also to allow sampling at important points. These small diameter underground well sensors were designed to avoid interference with the agricultural activity taking place above and were supplemented by a network of lysimeters that collected surface level data on water movement as it evaporated from soils and plant foliage.

Lysimeters and piezometers were sampled on a monthly basis during the LIFE project and water tables were checked bi-annually at 30 wells in the local monitoring network. Data from the instruments were used to determine an appropriate Nitrogen Balance for each site based on the comparison between nitrogen that entered and left the soil. The aim was to identify a neutral balance, since persistent surpluses indicate potential environmental pollution and persistent deficits in Nitrate Balances indicate potential sustainability problems for agricultural productivity.

Equivalent productivity was achieved from fewer fertilisers

Surplus savings

Results from the four-year LIFE project clearly demonstrated that Petrignano's farmers could make significant savings on the levels of nitrogen fertilisers that had been applied previously. Surplus nitrogen inputs were identified all over the field trials which confirmed that equivalent productivity levels were still possible in some areas even when fertiliser levels were reduced substantially. On average, optimal results were obtained for most crops and areas from 30% reductions in fertiliser.

Such noteworthy findings have been well received by the LIFE project partners, with farmers gaining economic savings from reduced fertiliser costs and ARPA Umbria noting decreasing trends in data on nitrate levels leached from local soil.

Life after LIFE

Results from the LIFE project have been incorporated within a Regional Action Plan for the Nitrates Vulnerable Zone encompassing more than 4,000 ha of the Petrignano area and 77,000 ha in the wider Umbria region. The Action Plan includes new mandatory measures for farmers to submit self-regulatory monitoring data on fertiliser inputs. In early 2008, more than two years after the project's end, some 3,100 farmers, equivalent to nearly 60% of Vulnerable Zone farms, are providing activity reports for the Regional Information System database, which equips the local environmental authorities with a highly effective strategic tool for managing water quality.

ARPA believes that LIFE's investment in the Petrignano project has catalysed the farmers' support for these new technological approaches and provided the region with a new confidence to move forwards, expand low impact agronomic activities and achieve sustainable nitrate balances within Umbria's important farm soils.

Project Number:
LIFE00 ENV/IT/000019

Title: Integrated management systems of the Petrignano area: new models against the nitrates pollution

Beneficiary: Agenzia Regionale per la Protezione Ambientale ARPA Umbria

Period: Sep-2001 to Sep-2005

Total Budget: € 1,127,000

LIFE Contribution: € 413,000

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Doñana Sostenible: Successful soil conservation in Spanish orchards

Farmers in Andalucía's Doñana National Park joined forces to implement a pioneering package of soil conservation techniques, helping to align local agricultural production systems with those of internationally important ecosystems.

The Parque Nacional de Doñana is one of Spain's main natural heritage reserves, hosting a variety of 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 quality of natural resources in the Doñana catchment area, where olive groves and other orchard crops are produced on a large-scale basis.

Coverage of arboreal crops in this part of Andalucía has gradually intensified over the years, as have productivity techniques. These developments have been linked to increases in sedimentation, fertiliser runoff 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 harnessed LIFE support to establish new soil conservation methods that strengthen the environmental sustainability of local agricultural systems.

Collaborative conservation

Seville's young farmers association, Asociación de Jóvenes Agricultores de Sevilla (ASAJA) managed this pioneering LIFE-Environment project that involved strong cooperation from other agricultural interests and the Andalucía Regional Government.

Activities started in 2001 with the aim of investigating soil management techniques to improve the Guadiamar river catchment's conservation status.

Different types of cover crops were planted on the project's demonstration plots

The project adopted a participatory approach, starting with an inclusive soil mapping exercise, which was followed by wide-ranging farm trials of different ground cover methods. The results of these pilot schemes were then disseminated throughout the region as well as further afield.

Soil status mapping

Initial work focussed on mapping different soil types and undertaking an inventory of orchard coverage in the surrounding area. Soil scientists sampled 80 soil profiles, examining agricultural properties such as texture, permeability, apparent density, total porosity and hydric retention capacity. More than 2,400 tests were completed during this process and the results were then collated with findings from a further 500 chemical tests that provided data on soil fertility levels.

A GIS was used to map the soil analysis data on a 1:20,000 scale. Five different soils types were classified across 54 subclasses of agricultural land. Additional GIS information on climate, geology, physiography and gradient was also programmed in order to provide the LIFE project team with an effective tool for identifying areas that were particularly vulnerable to erosion. These areas were then prioritised for inclusion in the farm trials.

Soil conservation crops

The use of vegetation cover is a well known treatment for soil erosion problems, since root and foliage systems help strengthen soil structures and contribute to water retention. The project team based its field trials on this basic premise and focussed efforts on identifying which types of vegetation provided the best soil erosion protection for different soil characteristics.

Thirty-three demonstration farms were selected for the project's trials, which covered close to 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. Most of the pilot sites concentrated on olive production but a number of other arboreal crops were also included in the LIFE trials such as citrus, plum and peach trees.

Each site was carefully assessed to determine the most appropriate form of ground cover and management technique. Spontaneous vegetation was favoured due to its ease of control and minimal competition with the main crop. Sown ground cover was also tested and plant species were selected based on their ease of use, coverage, biomass contributions and capacity to support soil stability. Rye, barley, lupin, vicia, cruciferae and polygonaceae were all noted as successful species within the vegetation trials, which were established in strips between the trees covering up to 60% of the interlineal area.

Test strips of ground cover were prepared at the beginning of autumn and then harvested in March, which was judged early enough to avoid competition with harvest crops but late enough to produce sufficient soil biomass.

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.

Results from the trials were impressive, with erosion being reduced on the majority of test sites and the vegetation cover was also highlighted as 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 to prevent 345,000 tonnes of soil erosion, which converts to approximately ten centimetres of soil across 230 ha of farm land and represents 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 provided by the new vegetation cover. This also had a positive effect on local landscape quality and biodiversity, with analysis confirming higher species diversity among insects, earthworms and soil micro-organisms.

Sustainable outcomes

These outcomes were welcomed by the farming community and National Park authorities who consider that the LIFE work has made useful contributions to preventing soil erosion and water contamination around Doñana.

Such benefits are expected to increase over time as more farms adopt the new soil conservation techniques that continue to be applied several years after the LIFE funding finished. As a visit by an external LIFE monitoring team in autumn 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 credited to a mix of success factors including the following:

- soil conservation techniques were cost effective and did not affect productivity;
- the project was led by local farming groups who 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 over 5,000 farmers and agri-technicians.

LIFE partners' work identified important sustainability lessons of relevance to other orchard growing areas in Europe

ASAJA believes that these key lessons can be applied successfully in most of Europe's orchard-growing areas. Their participatory approach is already being replicated in a new LIFE Environment project promoting sustainable soil conservation among farmers in other important Spanish wetland sites.

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: € 379,000

Period: Jul-2001 to Jun-2004

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SOWAP: Transnational approaches to managing European soil quality

Less intensive approaches to soil tilling have been shown to generate a variety of useful economic and environmental benefits in a LIFE project which demonstrated that extensive alternatives exist to intensive ploughing methods.

Conservation agriculture refers to modern farming methods that minimise negative impacts on biodiversity, as well as water, air and soil quality. The concept involves a complex interaction of different land management techniques. Although a lot of information is known in theory about conservation agriculture, only a limited amount of this knowledge is actually applied on European farms. A LIFE-Environment project aimed to bridge this gap by demonstrating less intensive, conservation tillage techniques for farmers in Belgium, Hungary, UK and the Czech Republic.

The LIFE project SOWAP (SOil and WAter Protection) was implemented as a collaborative project between partners from agri-industry, NGOs, academic institutions and farmers to investigate and demonstrate the benefits of conservation tillage techniques. SOWAP staff were tasked with identifying best practice approaches to soil management that maximised economic benefits for farmers and minimised negative impacts for society. Tests included assessing commercial factors related to different soil tillage techniques and monitoring biodiversity indicators to analyse effects on birds, aquatic invertebrates and earthworms.

Different conservation tillage techniques were tested on SOWAP's pilot plots during the LIFE project

Practical soil solutions

Trials were established on 48 demonstration plots, covering 18 farms in three different countries, allowing direct comparison between different land management techniques including zero-till, non-inversion tillage, mouldboard (or inversion tillage) and fallow. Farmer's workshops and open days were organised at all sites to promote zero-till techniques and non-inversion tillage, as well as to discuss the pros and cons of conservation agriculture.

Hundreds of farmers visited the LIFE-funded demonstration sites and received first hand knowledge about the benefits from these applied technologies. The SOWAP project concluded that conservation tillage could reduce soil erosion by up to 98% and that soil structure and function were improved with higher levels of soil carbon, nitrogen and soil moisture. Farmers visiting the sites were also shown that conservation tillage could reduce water run-off by as much as 90%.

Important biodiversity benefits were recorded, with earthworm activity in particular being enhanced. This is significant since worms act as natural indicators of soil quality and their presence results in knock-on improvements for the conservation status of other species further up the food chain.

The economic viability of conservation tillage practices was assessed by SOWAP and this demonstrated that the practices could reduce soil management costs by up to 70%. However, this decrease in overhead did not always translate into increased profits when crop yields were also reduced. These key findings from SOWAP's project work demonstrate the difficulties that farmers face in trying to balance the various requirements of their production systems and support the case for agri-environmental measures targeting conservation tillage techniques.

Confidence among the SOWAP partners remains high regarding the results generated by their rewarding LIFE project and they continue to promote the soil quality benefits of conservation agriculture to European famers.

Project Number:
LIFE03 ENV/UK/000617

Title: Soil and Surface water protection using conservation tillage in northern and central Europe

Beneficiary: Syngenta UK

Total Budget: € 3,624,000

LIFE Contribution: € 1,782,000 (maximum)

Period: Jun-2003 to Aug-2006

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Farming and biodiversity

Relationships between farm practices and the diversity of natural resources are complex and long in the making. This is evidenced by the fact that many valuable habitats in Europe are maintained by traditional extensive farming methods and an estimated 50% of all species in Europe rely on these types of agricultural systems for their survival. Conversely, other agricultural techniques can be highly harmful to Europe's biodiversity. These include: the destruction and fragmentation of semi-natural habitats from mechanical and intensive land-use treatments; detrimental food chain effects from pesticides; water consumption for irrigation; and loss of crop varieties or livestock breeds.

The EU has introduced several measures, including the 2001 Biodiversity Action Plan for Agriculture, to help stabilise and strengthen the existing conservation status of agricultural biodiversity in Europe and reduce the potentially harmful impacts of farming.

LIFE projects have made an important contribution to the implementation of this plan, particularly LIFE-Nature projects, through their work in implementing the EU Birds and Habitats Directives and establishing the Natura 2000 network. Important project activities in these areas include: restoring habitats; testing agri-environment measures; and introducing dedicated land-use techniques such as extensive mowing and grazing regimes. Other environmentally positive approaches have also been progressed by LIFE under the common objective of securing a harmonious and sustainable relationship between agricultural land-users and European biodiversity.

Habitats-Birds: Domestic livestock herds help to conserve unique habitats in Hungary

Cattle, pigs, goats and sheep have proved to be the key to conserving unique puszta steppe habitats in Hungary's Hortobágy National Park, where traditional agricultural techniques co-funded by LIFE have restored wetland areas for endangered bird species such as the Black-tailed Godwit and Glossy Ibis.

Traditional livestock breeds, including the Hungarian Grey and Flecked cattle, helped to restore and maintain important wetland habitats in the Hortobágy National Park

Agriculture has shaped the Hortobágy National Park area for many centuries and resulted in a distinctive steppe habitat, known as Puszta, which supports a notable number of important European bird species. This part of eastern Hungary includes some of the region's oldest wetlands where traditional grazing patterns prevailed up until the end of World War II before local farming techniques were dramatically altered during the Soviet era.

Considerable pressures were exerted on the Puszta by collective farming approaches and the application of intensive food production methods. Land was disconnected from the Tisza river and drained for cultivation. Marshes and alkali lakes were converted into fish ponds and vast rice fields were created across the area's grassland meadows.

These changes had a huge impact on the area's habitats, with alien crop species being introduced in uniform systems, natural rivers transformed into structured channels and ancient grazing systems destroyed as mechanical mowing replaced indigenous livestock breeds. Overhead power pylons were constructed and some parts of the Puszta were even used as a bombing range by military aircraft.

Such pressures continued on the Hortobágy environment for almost 50 years up until the fall of the iron curtain during 1989's Autumn of Nations. Interest in establishing conservation measures at Hortobágy had been growing since the early 1970s and the new independent government was keen to pass legislation to designate Hortobágy as a National Park with special recognition for its historic habitats.

National Park managers and local environmental groups in Hortobágy were aware of the benefits of reversing intensive agricultural trends and applied for LIFE-Nature assistance to help restore traditional balances within the Park's farmland ecosystem.

Habitat husbandry

Four years' worth of LIFE support was awarded to the Hortobágy Environmental Association (HEA) for a partnership project with local farmers and National Park authorities that aimed

to revive pre-war habitats by reintroducing farming systems based on the traditional husbandry methods. A long-term management plan was drawn up to boost the area's conservation value. This plan emphasised a return of local livestock breeds to graze Puszta land under natural conditions.

Traditional domestic farm breeds were carefully selected and purchased, including Hungarian Grey and Flecked cattle, Mangalica pigs, Racka sheep and indigenous goats. Famers were provided with contracts to rear the livestock using extensive methods and additional land was also leased to cultivate winter fodder. This was considered important because it enabled the animals to be kept on site all year-round, thereby maintaining the high grazing pressure that was vital for the required vegetation structure on restored grasslands.

Restoration work on the Puszta started with a comprehensive programme of LIFE investments to remove sluice gates, dam drainage channels and clear shrubbery, which culminated in the creation of over 200 ha of low-lying shallow wetland habitat on the alkali steppe. Fencing was provided to control grazing patterns within the wetland area and new, vernacular-sensitive pastoral constructions were built to help improve the commercial viability of traditional husbandry systems. These included the installation of a Y shaped windbreak, thatched shelters and sweep wells which had previously been typical features on the Hortobágy landscape.

LIFE assisted local Black-tailed Godwit populations

Photo: János Oláh

Natural land managers

More than 1,000 domestic farm animals were reintroduced and successfully reared during the LIFE project, which provided an important educational service for farmers in the National Park area. A broad range of different practical land management skills were developed and disseminated during the project regarding organic management systems and environmentally sensitive agriculture, both of which receive increasing attention and incentives from the EU's Common Agricultural Policy and so provide diversification opportunities for Hungarian farmers.

Useful environmental benefits and agricultural knowledge were gained from working livestock in mixed breeds and mixed types across the project area, since different animals carried out different land management functions. For example, Mangalica woolly pigs were noted to be particularly important in maintaining wetland habitats by naturally controlling reed and marsh species with their rooting and wallowing, which helps to sustain open patches in wetland zones.

Heavy beef breeds, such as the distinctive Great grey cattle, proved to be highly effective in achieving desired grazing intensity on the project's meadows and other animals, including the Racka sheep, were shown to provide equally important grazing functions on the wetland shores, creating short-grass swards, bare dry habitats and islands that are considered essential for management of shore bird habitats.

Goats were used to manage weed patches as well as tall vegetation that appeared on draining banks. Horses grazed the flooded meadows whereas donkeys, unlike other domestic livestock, demonstrated their preference for grazing on perennial shrubs.

Sustainable future

All of these lessons continue to be applied in the National Park, where LIFE support has created a sustainable blend of economic and environmental benefits. New jobs were created for the farming community and considerable awareness was raised regarding the cost-effectiveness of organic production systems.

Breeding densities for a large number of different bird species were monitored carefully alongside each grazing pattern with results revealing significant correlations between traditional techniques and species' conservation status. Black-tailed Godwits, endangered both in Hungary and in Europe, now breed in the LIFE project area, which has also become an important foraging habitat for Spoonbills and Glossy Ibises, both of which are listed in Annex 1 of the Birds Directive.

HEA notes that the wetland shore area alone is now regularly hosting more than 16,500 birds and all of the project's partners look forward to these numbers increasing in future years as the legacy from LIFE's agricultural inputs is reinforced to safeguard a sustainable future for the wildlife and livestock in Hungary's Hortobágy National Park.

Project Number:
LIFE02 NAT/H/008638

Title: Habitat management of Hortobágy eco-region for bird protection

Beneficiary: Hortobágy Environmental Association

Total Budget: € 830,000

LIFE Contribution: € 543,000

Period: Jul-2002 to Jun-2006

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La Serena: Shift in compensation payments demonstrates compatibility of farming and conservation practices

Comparative analysis carried out on alternative land use models in Spain's La Serena grasslands highlights the potential conservation benefits and economic viability of controlled crop cultivation, livestock husbandry and game hunting.

Located in Extremadura, south-west of Madrid, La Serena is one of the Iberian Peninsula's largest anthropogenic grassland areas where the natural environment and local land use systems unite to maintain a unique array of high conservation value habitats and rare bird species. Lesser kestrels, great bustards and little bustards have all prospered in La Serena's semi-natural sub-steppe pastures of grasses and annuals which evolved over time in harmony with the region's agrarian society.

The long-term conservation of these important EU birds and habitats, included in the Natura 2000 network, has, however, been compromised in recent years by modern-day agrarian methods. Concerns have been raised regarding excessive exploitation of local land resources through overgrazing, intensive irrigation and hunting pressure, which have all accumulated to exert a hefty stress on La Serena's natural environment.

Several LIFE proposals have been responding to these concerns, including a particularly interesting alternative agriculture approach by local estate owners, which sought to examine long-term solutions for the region's farmers, flora and fauna alike.

Eco-farms

Partners in LIFE's La Serena project included the Spanish partner of BirdLife International, Sociedad Española de Ornitología (SEO/BirdLife), regional authorities and the agricultural sector, represented by four local estate owners. The LIFE partnership's main objective was testing different methods of environmentally friendly farming in order to identify a sustainable land management model that was appropriate for La Serena's specific conditions.

Two estates were selected to examine alternative models of farming and hunting and another two estates were included in the LIFE-Nature project to act as control sites, where the impacts of conventional farming practices were monitored. Several variables were tracked throughout the four-year project on all four estates including biodiversity indicators measuring bird populations and financial appraisals following the farms' commercial performance. Data from the monitoring programmes were intended to com-

La Serena's distinctive grassland environment hosts a rich variety of flora and fauna

pare the estates' economic and ecological viability.

Good relations had been established with one of the test sites, "Miraflores" estate, through previous co-operation work on eco-farming practices. This helped facilitate the signing of a four-year management agreement with the estate owner. LIFE contracts were also signed for experimental work at the other test site, "La Pavorosa" estate, where agreements were made with the estate leaseholder, rather than land owner, since this allowed more direct management of the estate's land and also directly involved local farmers. Management agreements on the "Miraflores" estate covered 368 ha and "La Pavorosa" provided a larger test area of 600 ha.

Alternative management model

A common management framework was developed for both test sites that deliberately focused on environmental objectives by adopting alternative approaches to the conventional control farms. The framework involved the following features:

Hunting was limited to three days a month and regional government support was enlisted to help raise awareness regarding the new restrictions, which also involved strengthening prosecution powers against poachers. Only five hunters a day were permitted on the estates during the open days and bans were placed on all game other than red-legged partridge.

Farming practices were altered to improve nesting and feeding habitats for kestrels and bustards. Considerably less than half of the normal estate area was cultivated commercially and this land was split between cereal and legume crop rotations. No armoured seeds were used and agrichemicals were discouraged, particularly pesticides commonly used to control locust populations.

An alternative farming calendar was introduced to respect the biological cycles of important bird species. Cereal harvests were delayed until after 20th June, ploughing was only allowed between 1st October and 1st March and preparation of legumes and peas for consumption was timed to start after 20th July.

New livestock measures were also tested, including carefully controlling sheep densities on the uncultivated land. Grazing pressure was set at between one-and-a-half and two sheep per hectare to achieve the desired ground cover result, which was further assisted by fencing certain areas to direct the natural mowers.

Farmers were encouraged to diversify into added value products that could bolster farm incomes and brand the area as a destination for eco-tourists. These investments continue to pay off with the popularity of local organic cheeses and expansion of birdwatching tourism.

Biodiversity benefits

Despite some operational difficulties caused by uncharacteristic weather patterns, the overall project outcomes have shown that alternative farm methods can produce significant biodiversity benefits for La Serena. Comparisons between the test sites and control farms highlighted a clear set of achievements, including:

- regeneration of valuable steppe grassland pasture;
- diversification of feeding and reproduction habitats;
- increase in trophic foodchain resources; and
- improvement in the general habitat quality.

These positive project results validate the applied methodology and prove that the management model is well designed for involving local farmers in the long-term conservation of La Serena's steppe habitats. Motivation and momentum appears strong among other farmers in the area for adopting similar approaches, with some producers already starting to sow leguminous crops as an alternative to cereal monocultures.

Hunting restrictions were introduced to protect local birdlife populations

LIFE's pilot work has thus demonstrated that, with suitable support schemes, farmers can be encouraged to practice sustainable agriculture. Efforts are now underway to convert the LIFE approach into new compensation schemes, via the Common Agricultural Policy's agri-environmental measures and rural development funds. Adoption of such financial incentives in the La Serena region will radically improve the compatibility of agriculture and nature conservation and in turn help maintain the area's unique array of priority habitats and rare bird species for many years to come.

Project Number:
LIFE00 NAT/E/007327

Title: Habitat management model for La Serena– Sierra de Tiros SPA (Extremadura, Spain)

Beneficiary: Sociedad Española de Ornitología (SEO/BirdLife)

Total Budget: € 736,000

LIFE Contribution: € 467,000

Period: Jan-2001 to Dec-2004

Website:
www.seo.org/media/docs/Life%20Serena%20(Inglés).pdf

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Limestone Country: Native cattle breeds boost biodiversity

Reintroduction of native upland cattle on the limestone grasslands of northern England has reversed negative impacts of sheep grazing and supported the reestablishment of semi-natural habitats and wild flowers.

Photo: English Nature

Dramatic limestone pavement landscape at Scales Moor in the Yorkshire Dales National Park, part of the Ingleborough Limestone complex SAC

Livestock farming methods have moulded the landscapes of Limestone Country in Britain's Yorkshire Dales National Park, creating a rich mix of biodiversity that has received international recognition via SAC designations. Over the past 40 years, many of the cattle breeds that traditionally grazed the SAC's high limestone pastures have been replaced with sheep. This shift in farm livestock systems was driven by agricultural subsidies and is thought to have contributed to a reduction in the variety of local plant life. Sheep are very selective about what they eat and rarer plants began to disappear in some over-grazed grassland areas whereas taller, completely ungrazed areas emerged elsewhere on less palatable parts of the limestone pasture.

A partnership of nature conservation and farming interests within the SAC was formed to reduce these pressures and achieve a grazing balance that allowed all the plant life in Limestone Country to flourish. The partnership was led by Yorkshire Dales National Park Authority, which secured LIFE-Nature support to help boost biodiversity levels on two particularly important limestone complexes. There conservation measures were implemented to reverse sheep intensification trends and re-introduce native cattle breeds in order to revitalise ecological integrity.

Native nature managers

LIFE funding helped farmers to develop comprehensive conservation plans for nearly 2,000 ha of grazing land on

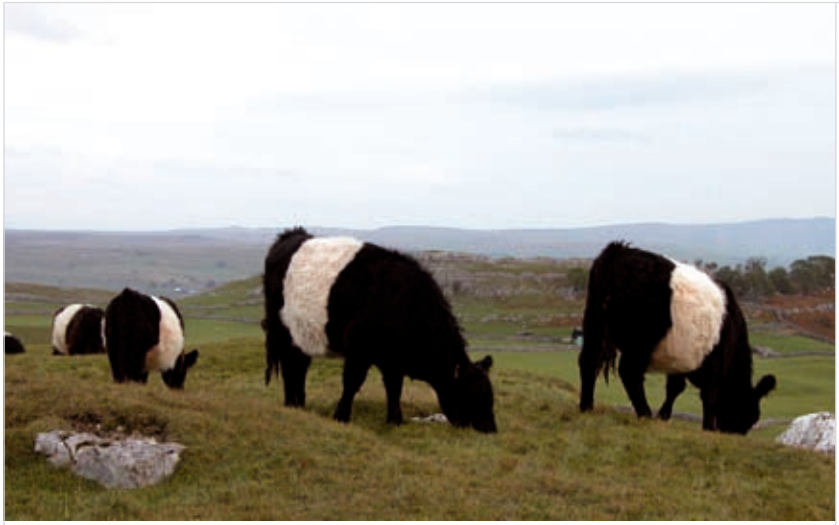

Photo: Robert Goodison

Belted Galloway Cattle grazing in the project area have helped to restore upland plant habitats

the limestone complexes. The management plans identified revised husbandry methods and suggested the type of livestock breeds that should be reared. Native upland cattle, such as Beef Shorthorn, Galloway and Blue Grey were proposed since they are less selective grazers than sheep and are generally hardier than most popular modern breeds.

Herds of these hardy beef breeds were then introduced by 18 farmers who participated in the LIFE project and received support for work involved in converting production systems to ensure that the new cattle could be properly looked after. Active conservation measures, controlling rabbits, shrub and evasive weeds, were introduced on over 1,000 ha and a parallel research programme was also carried out. Biological surveys were accompanied by financial reviews to analyse the wildlife benefits that were created by different cattle systems and assess the results on farm businesses. Findings from the monitoring work were disseminated during a series of demonstration events, including an International Workshop in June 2006.

Hardy beef breeds provide natural land management functions in all conditions

Photo: YDNPA

Long-term legacies

One of the long-term aims of the project was to help local farmers develop viable financial livelihoods from their new hardy beef breeds, since this would help sustain the environmental benefits from traditional grazing systems. By working with local auction markets, butchers and restaurants the project has helped the LIFE-funded farmers to start developing specialist markets for their Limestone Country-branded beef. This has succeeded in attracting premium prices over intensively produce beef, by using niche marketing techniques such as "box schemes".

This economic legacy from the LIFE project is expected to be further fortified by its political results, which have helped to effect a change in British government policy regarding the inclusion of traditional cattle breeds for conservation purposes within agri-environment schemes. Such important LIFE developments mean that more Limestone Country farmers in future will be able to receive regular support for conservation activities that help restore important limestone areas designated under the EU Habitats Directive[1].

1 See Ireland's BurrenLIFE project (LIFE04 NAT/IE/000125), which also applies extensive livestock faming practices for conservation outputs in important limestone habitats.

Project Number:
LIFE02 NAT/UK/008539

Title: Yorkshire Dales Limestone Country Project

Beneficiary: Yorkshire Dales National Park Authority

Total Budget: € 1,884,000

LIFE Contribution: € 739,000 (maximum)

Period: Jun-2002 to Mar-2007

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Wadden Sea Estuary: LIFE funding acts as catalyst for Danish farm diversification strategy

Farmers from a coastal region in Denmark have devised an innovative win-win programme of agri-environmental measures that used LIFE funds to pump prime long-term diversification agreements resulting in new conservation benefits for Natura 2000 sites.

The Wadden Sea's low-laying coastal environment received dedicated LIFE support from local farmers

The Atlantic salt meadows and estuarine environment of western Jutland's Varde river valley have been designated as Natura 2000 sites and host some of Denmark's last remaining wildlife habitats where tide and flood dynamics function naturally, uncontrolled by the dike systems that dominate lower parts of the Danish coastline. The area also hosts a large farming community that has recently adapted its production systems to help strengthen the river valley's conservation status as a wildlife haven.

The shift in local agricultural strategies was led by Varde Farmers Union (VFU) and followed a crash in prices for the area's mainstay crop of grass pellets. This loss of income created considerable concern among VFU members who, since conventional diversification options were few and far between, risked losing their land and livelihoods. Farmers considered various options and the most promising prospects were judged to lay in agri-environmental schemes. Their assessment was influenced by the presence of neighbouring Natura 2000 sites and advice from Ministry of Environment staff who suggested the land was ideally suited for wetland wildlife habitat that could be managed using traditional extensive mowing and grazing methods.

Conservation investments

LIFE-Nature support was identified as an appropriate vehicle to carry out the pump-priming work involved in preparing grass-pellet fields for suit-

able wetland conditions. VFU negotiated an agreement with the Ministry of Agriculture for a 20-year package of financial assistance in line with EC Regulation 2078192 on agri-environment subsidies.

Subsidies were provided subject to farmers adopting low-input management plans that reversed previous reliance on pesticides and fertiliser and encouraged river valley fields to revert back to a more natural, wetter state. LIFE assistance was deployed to develop the management plans for individual farms and also invest in physical works to facilitate an optimal wetland environment. Works included removing sluice gates and blocking ditches. By the end of the project, in 2002, nearly 2,500 ha of land was being managed under natural hydrological conditions. At the same time, over 250 farmers had gained long-term security for themselves and the rural communities that they support.

These economic benefits have been further boosted by an upturn in the number of tourists who have started visiting the area to enjoy the traditional meadow landscapes and watch the wildlife, which has increased as a result of the revised farming systems. For example, new livestock grazing methods and a ban on mowing before late June have improved breeding sites for priority species such as the Corncrake which, current monitoring trends indicate, is making a comeback after 30 years of absence.

Water levels are monitored to maintain appropriate hydrological conditions in the wetland habitats

Other flora and fauna are also thriving in the new natural conditions and LIFE's symbiotic support has successfully secured sustainable conditions for the long-term survival of both farmers and wildlife in Denmark's Varde valley. In addition, the Wadden Sea area is expected to be designated part of the new Danish National Park network in 2009 and this will further support the conservation measures established by LIFE funds.

VFU members have achieved a classic win-win situation through their LIFE project's initial award of € 1.7 million, which will lever a total of € 20 million in agri-environment payments for local farmers up until 2022. These in turn have guaranteed a 20-year conservation commitment for local wildlife and provided a beneficial boost to the natural value of Danish Natura 2000 designations. Such accomplishments hold substantial scope and interest for replication in other areas of Europe where agri-environmental measures might represent viable options for farm diversification programmes.

Agro-environment payments ensure the sustainability of extensive farm techniques and associated biodiversity benefits

Project Number:
LIFE99 NAT/DK/006456

Title: Wadden Sea Estuary, nature and environment improvement project

Beneficiary: Danish Ministry of Environment

Total Budget: € 1,739,000

LIFE Contribution: € 713,000

Period: Jan-1999 to Dec-2002

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http://www.skovognatur.dk/English/

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Tetrax: Legume crop rotation supports healthy habitats for endangered bird species

A four year programme of LIFE support for Portuguese farmers has helped establish new environmentally sensitive land management approaches which sustain traditional mosaic production methods and associated habitats for Europe's Little Bustard populations.

Portugal's membership of the European Union in 1986 has had a major influence on the country's rural environment with the Common Agricultural Policy (CAP) apparatus introducing new land-use trends such as farm intensification and forestation. These rural development practices continue to unfold across the country and replace traditional farm management practices with modern methods which improve productivity but can also have a detrimental effect on local ecosystems.

This has been the case in parts of Portugal's Alentejo region which has experienced a decline in conventional approaches to crop cultivation and the subsequent mosaic habitats formed by long-rotations of fallow land, extensive dry cereals and then sown pasture. Environmentalists in the region recognised the implications from these trends on local flora and fauna and applied for LIFE support to help conserve sufficient farm land habitat for local wildlife, particularly the Little Bustard which is endangered and listed in EU Birds Directive Annex.

LIFE funded crop rotation methods proved popular with Little Bustards in the Alentejo region

Photo: Juan Martín Simón

Pilot actions

LIFE project partners included the Portuguese Society for the Study of Birds, the State Nature Conservation Agency and a local farmers union who, between them, prepared a four year "Tetrax" project to pilot different actions aimed at improving the conservation status of Little Bustards. Agriculture formed the main focus of LIFE funded activities which involved determining a land management system capable of providing continuous food supplies and a suitable nesting habitat for the local Bustard population, as well as supporting viable farm incomes.

Forty five local farmers were contracted to carry out over 120 separate trials targeting a total area of 3241 hectares. Rotation schemes were tested by applying 23 different crop varieties to recreate traditional habitat structures from mosaics of dry legumes, dry cereals, permanent pasture and fallow land.

Successful outcomes

Legumes were carefully selected for their bird feed properties and LIFE staff noted effective results from alfalfa, silage-pea, and chick-pea. Fallow land was shown to provide safe places for birds to nest and overall the maintenance of mosaic habitats was considered a highly successful mechanism for supporting the conservation status of Little Bustards.

Findings from the LIFE project were disseminated widely and discussed by regional government departments. An Action Plan for conserving Little Bustards in Alentejo was also produced during the LIFE project, which all stakeholders agree provides positive contributions to Portugal's CAP goals regarding environmentally sensitive farming systems.

Tetrax partners are currently lobbying for their innovative and effective land management methodology to be incorporated within new agri-environmental support schemes financed by CAP apparatus. The success of their lobbying is expected to help safeguard long term sustainable benefits for local populations of both farmers and Little Bustards.

Project Number:
LIFE02 NAT/P/008476

Title: Project Tetrax - the conservation of Little Bustard in Alentejo

Beneficiary: Sociedade Portuguesa para o Estudo das Aves (Portuguese Society for the Study of Birds)

Total Budget: € 967,000

LIFE Contribution: € 720,000 (maximum)

Period: Oct-2002 to Dec-2006

Website: www.spea.pt/ms_sisao/

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EMAS and LCA in agriculture

Quality assurance schemes are now commonplace in all European industries and a number of these schemes are also available to the agricultural sector. One quality standard that is becoming more popular with EU farmers is the Eco-Management and Audit Scheme (EMAS*), which promotes quality approaches to environmental performance. EMAS represents a new era in farm management whereby environmental standards are established and managed and eco-performances are improved on a continuous basis. EMAS farmers commit to the voluntary process because they themselves see the advantages in taking responsibility and initiative for long-term sustainability. The EMAS logo, which recognises registered organisations, can also be used as a marketing tool to advertise their environmental credentials.

An important part of EMAS's sustainability tool-kit is the life cycle assessment (LCA), which involves the evaluation of a product system's "environmental footprint" throughout all stages of its life cycle. LCA represents a rapidly emerging family of tools and techniques designed to improve environmental management and contribute to long term sustainable development goals. Fundamentally, it is a tool to support decision-makers, but it can also help to ensure that a company's commercial choices are based on environmentally sound judgements.

Under the LIFE programme, numerous projects have demonstrated ways to efficiently and effectively introduce EMAS and LCA as tools to support the generation of mutual benefits for agriculture and the environment. Examples include the development of an integrated environmental management system for farm cooperatives and the promotion of EMAS in agricultural smallholdings. Specific LCA applications have also been supported in viniculture and the olive-oil production sector.

* 761/2001/EC

DIONYSOS: Wine, waste and business opportunities

Two Universities from Athens have used LIFE-funded LCA research to demonstrate new economically viable techniques for processing wastes from winemaking industries that also allow recovery of high added value natural polyphenols for use in a variety of applications.

BEST OF THE BEST 2007-2008

Although Greece is one of the smaller European wine producers, its wine is well known internationally. Greece is one of the oldest wine-producing regions worldwide and the origin of hundreds of indigenous, unique grapes. The nation's 400 mostly small to medium-sized wineries, use approximately 500,000 tonnes of grapes to produce 400 million litres of wine annually.

Driven by a personal passion, Serkos Haroutounian, professor of chemistry at the renowned Agricultural University of Athens (AUA) initiated a study some years ago examining the numerous varieties of different Greek wines. Although pleased with the quality and interesting characteristics of the grapes and wines, he and his colleagues were shocked to learn that the waste produced by Greek wineries was not dealt with in an environmentally friendly way. The study inadvertently revealed that most of the 120,000 tonnes of grape pomace (around 17% of the total grape weight) and 800 million litres of sludgy wastewater generated annually during the vinification process were discarded on to open fields without any prior treatment. This waste is mainly composed of organic molecules such as lipids, sugars, polyphenols and tannins, some of which have significant negative environmental consequences if released untreated in large volumes, such as takes place post vinification. Plant growth can be negatively affected, drinking water quality risks being degraded and fragile aquatic animal species can all be threatened by the antimicrobial and phytotoxic characteristics of the wine waste products' biodegradation processes.

Lack of environmental awareness and strict regulations limiting the amount of new alcohol that can be produced from the wine wastes are assumed to be among the reasons for this non-sustainable waste disposal method. Another important factor relates to the structure of the Greek wine industry, which is made up of mainly small to medium-sized enterprises that cannot afford to implement expensive waste management procedures.

By-products from wine grapes were found to contain useful chemical extracts that could extend the grapes' commercial life cycle

Research trials based their analysis on grape pomace from Greek wine cooperatives

A LIFE project is born

Professor Haroutounian and his colleague Leandros Skaltsounis from the University of Athens (UOA) decided that a solution needed to be found to the wine waste issue. Together they applied for LIFE funding to undertake life cycle analysis (LCA) research on winery waste in order to help develop new economically viable approaches that promoted integrated management of wastes from the wine industry. Their DIONYSOS project has succeeded in this goal by demonstrating methods for treating grape pomace that are both technically and financially attractive, whilst also helping to reduce environmental impacts during waste management stages of the wine production life cycle.

The key concept of the LIFE proposal revolved around the aim of recovering substances from the grape pomace that held important biological properties. Recent scientific studies have indicated that particular polyphenols contained in grapes are of high interest, since they exhibit remarkable biological activities, mainly as antioxidants. Due to these characteristics they are attractive for numerous applications in the pharmaceutical, cosmetics and food industries.

Prokopios Magiatis, assistant professor at UOA's School of Pharmacy and member of the core LIFE project team, states that "the heart of the whole process" was to extract and recover the polyphenols in a financially viable and easy way. Although the final solution seems to be easy, it took in fact about two years of intensive research until the LIFE project team succeeded in finding suitable adsorbance resins capable of capturing the polyphenols from winery waste in their pilot prototype plant.

DIONYSOS in action

Primary treatment plants were constructed at two wineries. These included a cooperative winery at Tyrnavos, producing mostly white grapes and the Ktima Kyrianniy winery at Naoussa, growing red grapes. In addition, a central polyphenol recovery unit was installed at the UOA and a new composting facility, incorporating aerobic and anaerobic processing, was set up at AUA.

With the help of the primary treatment plants the wineries were able to process their solid waste and wastewater on site. This involved the collection of grape pomace, which was then air-dried and pulverized. The powder was extracted using ethanol within a mechanical stirring process. The extract produced from this process was then dissolved in water, filtered and passed through a series of specialised adsorbent resins located in simple columned tanks. The only effluents here were mostly water and a limited amount of ethanol. The water effluent contains mainly sugars, which were not considered hazardous or valuable and so were disposed of.

The next part of the re-use process involved moving the columns filled with adsorbent resins to the central polyphenol recovery unit at UOA for further regeneration-treatment. Here the ethanol fraction, containing the majority of the polyphenols, was processed, resulting in the collection of polyphenols and in the evaporation of the ethanol, which can also be collected and recycled. The regenerated columns were then returned to wineries for re-use.

Project results provide alternative uses for fermented grapes and offer useful waste minimisation benefits

This method allows the polyphenols contained in grape pomace to be completely recovered. Figures from the LIFE project demonstrated that 1,000 kg of grapes result in 100 kg of grape pomace, from which 1 kg of polyphenolic enriched extract can be produced. Furthermore, the polyphenol extract gained can be further processed to separate individual polyphenols, such as *trans-resveratrol*, a highly antioxidant and bioactive substance with high commercial value, estimated by LIFE staff at some 1,100 €/g. FCPC chromatography was used to produce 1 g of resveratrol from 1 kg of DIONYSOS extract during the project tests.

Possible applications

Based on this technology, the LIFE project team tested and demonstrated a wide range of applications for wine wastes in order to encourage stakeholders from the wine-making industry and other investors to take up and implement the same type of approaches. A variety of different uses were examined in order to maximise outputs from the full life cycle of wine production inputs. These included the following types of products:

Medicines – A clinical study conducted during DIONYSOS in UOA's cardiology clinic on 30 male patients with coronary heart disease showed that the extract of polyphenolic compounds from red grapes significantly improved the endothelial function of the patients. These results could reflect the favourable effects of red wine on the cardiovascular system, commonly known as 'the French paradox'. One dose of the LIFE project's polyphenol extract corresponded to the consumption of 1 kg of grapes based on the concentration of trans-resveratrol. Professor Skaltsounis noted, with a smile, that this consumption level of polyphenol exceeds "even an average Mediterranean-type diet". He and his colleagues in the project team believe that it would be interesting to consider the production of health supplements containing polyphenols from red grapes, provided that their beneficial effect is confirmed by larger and long-term medical studies.

Beauty products – Beauty products based on grape seeds have recently become important lifestyle products. As such, anti-allergic tests were conducted by American laboratories on cream prepared with DIONYSOS polyphenolic extract and these found no evidence of any adverse side effects. The LIFE team was particularly pleased with these findings, since it opens the door for a wide range of added-value beauty products that can be branded with green credentials for domestic, international and tourist markets.

Animal food and organic fertilise – Solid waste left over from the DIONYSOS treatment process were found to contain organic molecules with high nutritional value that could be further converted into natural, non-polluting, organic fertiliser by using specialised composting techniques. The DIONYSOS composting system involved two open-vessel and two closed-vessel composting units that were equipped with a control system for the waste humidity content. Mature compost was then created via mechanical aeration in open "wind-rows". Two wineries are currently using this process to convert a large portion of their grape pomace into organic fertilizer, which is being used in their vineyards.

Remnant wine wastes were also found to offer possibilities as animal feed. The project team conducted digestion experiments with 16 goats and 16 sheep in order to test whether the DIONYSOS milk possessed biofunctional nutrient properties. In this regard, the assessment of the most active constituents of milk lipids, Conjugated Linoleic Acid (CLA) and Trans-Vaccenic Acid (TVA), has indicated that the use of the treated wine waste as livestock fodder can increase TVA and CLA concentrations by up to 50%.

Dairy products and other food supplements – The DIONYSOS team collaborated with a large Greek dairy company to investigate the possibility of incorporating polyphenolic extract in yoghurt production processes. This resulted in 200 kg of yoghurt being produced by combining milk with the polyphenolic extract, in order to enhance the bioactive characteristics of yoghurt. The tests proved successful and the product's commercial characteristics, taste and stability, were mostly favourable. Thus, the dairy company is seriously considering implementing new products using the grape

Various components were extracted and analysed during the LCA research

Processed grape pomace was found to have high nutrient value as a livestock fodder

Large volumes of winery waste are often dumped on open land without any form of environmental treatment. Dionysos could help change this

waste additive. This important market feedback highlights wider commercial opportunities for DIONYSOS investors in terms of selling polyphenols as food supplements, either in the form of an extract-mixture or as an isolated product, such as trans-resveratrol.

Drawing a conclusion

The LIFE project staff estimate that the cost of establishing a central plant for polyphenol recovery, capable of treating 2,500 kg of winery wastes per day, is approximately € 1,100,000, with an operational cost per month of around € 53,000. Output calculations indicate that the total depreciation of such a plant's equipment costs can be achieved within a nine-year period. This is based on achieving polyphenol concentrations of between 7-10 g/kg depending inter alia on grape variety, climate and soil conditions as well as a market price for the final polyphenolic extract of around 0.5-1 €/g. These figures include assumptions regarding a full operational period of six months per year, because of the wine collection period. Increased profits were considered possible if the plant could be fully operative over 12 months, extracting other substances of pharmaceutical interest from olives or herbs.

An investment of this scale is feasible when applied to a centralised polyphenol recovery unit which will process the waste of small wineries within a wider geographical area. Since the cost of each primary treatment plant does not exceed € 25,000, the LIFE team believes this model also represents a viable waste management system for individual wineries. The beneficiaries are keen to stress the point that these waste treatment plants could provide important rural employment and encourage the establishment of various added-value production processes, as well as the development of new state-of-the-art technologies.

These opportunities were highlighted during the project's dissemination activities, which proved to be very successful in raising awareness about the wine waste problems and solutions. Two wineries that did not participate in the project have already started to implement the waste management concepts and Professor Haroutounian and his colleagues are still invited to deliver presentations about the DIONYSOS process all over Greece.

"Our job has been done", says Prokopios Magiatis. "Now we hope that more people will apply our demonstrated approach". Haroutounian explains that "To produce and sell only the phenolic raw material is unlikely to be attractive enough on its own for investors. It is important that people process the raw material in order to produce added-value products from the individual polyphenols such as resveratrol. With beauty products and pills to use as human food supplements, investors could really make money and this would help treat the huge amount of wine industry waste in an economically viable way."

"Working on the LIFE project and achieving these results was great. Such a project becomes like a child, for whom you care much and that you love", says Haroutounian, before adding: "If I have another good idea, I might apply again for LIFE funding". Dionysos, the god of wine and pleasure, would be happy to hear that.

Project Number:
LIFE03 ENV/GR/000223

Title: DIONYSOS - Development of an economically viable process for the integrated management via utilization of winemaking industry waste; production of high added value natural products and organic fertilizer

Beneficiary: Agricultural University of Athens

Period: Oct-2003 to Dec-2006

Total Budget: € 1,310,000

LIFE Contribution: € 641,000 (maximum)

Website:
www.pharm.uoa.gr/dionysos/index.htm

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EMAS Farming: Improving small holdings' environmental standards

LIFE-funded farmers from the Pyrenean foothills have used collaborative approaches and an EMAS methodology to help improve understanding and implementation of pro-active pollution controls, create new environmental support jobs and achieve sustainable cost efficiencies.

Spain's Aragon region is characterised by mountain landscapes, medieval villages and a patchwork of small-scale farm holdings operating mixed livestock and crop productions systems. Over 90% of Aragon's micro-companies are traditional family farms, where static business attitudes often prevail and innovation remains relatively low. A local NGO, Fundación San Valero (FSV), which specialises in providing capacity building support across Aragon, identified a common concern among the region's smallholders about the costs involved in complying with environmental controls.

An ambitious LIFE project was launched to address these two issues and the outcomes succeeded in demonstrating that environmental quality standards are as relevant to smallholders as they are to larger scale agricultural businesses. FSV's LIFE project examined an adapted version of the conventional EMAS model and considered it effective in allowing a gradual, systematic approach to enhanced environmental management that could be delivered through a collaborative methodology in order to create cost savings.

Ecodiagnosis and environmental improvements

More than 100 small holders participated in the project's different development phases, which began with a detailed survey of environmental conditions, farm attitudes and key issues. Results from this "ecodiagnosis" exercise confirmed a list of common problems and provided a mechanism to classify different farms in terms of their individual needs.

Farmers from small businesses were concerned about covering the costs of environmental standards

Three main issues emerged that the LIFE team agreed an adapted EMAS methodology could focus its attention on. These were a general capacity-building campaign on environmental awareness and improved management of dangerous waste containers carrying phytosanitary and zoosanitary products. Each topic was tackled by a dedicated set of measures that were established by the LIFE project in cooperation with Aragon's smallholders. Tangible outcomes from the process included new environmentally sensitive procedures for managing zoosanitary containers being adopted by 11 farms. Capacity-building activities led to the establishment of a Rural Foundation and an on-going programme of farm training in environmental standards that helped to integrate the EMAS approach within a large number of agricultural businesses. Central collection and cleaning points were set up to improve the management of containers and, as with the training programme, these activities created important new rural employment opportunities. In total, 12 new jobs were created as a direct result of the LIFE project's activities.

Cost savings of 32% were generated through cost sharing between 16 small farms at the centralised container cleaning points, where farmers were able to decontaminate their product container waste at an affordable price. This model proved itself to be popular with the farmers and productive for their EMAS qualifications since it significantly reduced the risks of pollution episodes from pesticide, fertiliser or manure spillage. Site-specific Best Available Technologies (BAT) were also prepared and Good Practices (GP), which further contributed to the EMAS standards. Nearly 1,800 BATs and GPs were implemented and tested during the three-year project.

FSV believe that their LIFE-funded EMAS work has succeeded in combining improved environmental quality standards with new job creation in rural areas and as a result the project has made a significant difference in changing local farmers' behaviour regarding pro-active pollution control measures.

Project Number:
LIFE00 ENV/E/000387

Title: Innovative approach for the participation of the farming sector in EMAS and the experimentation of new formulas to create specialized employment formulas

Beneficiary: Fundación San Valero

Period: Oct-2001 to Sep-2004

Total Budget: € 651,000

LIFE Contribution: € 322,000 (maximum)

Website:
www.life-emasfarming.org

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ECOIL: Environmentally efficient olive oil production

Olive oil producers from three Mediterranean countries have benefitted from new life cycle assessment methodologies that have been designed with LIFE support to help improve eco-cultivation, eco-production and eco-processing standards in olive oil systems with the intention of minimising waste, energy and pollutant hazards.

LIFE support helped confirm life cycle factors capable of improving environmental sustainability for Europe's olive producers

Olive oil production constitutes one of the main traditional agricultural practices for many Mediterranean countries and olive oil products are well known for their positive health properties. These high value commodities can however come at a high environment cost when weaknesses arise in production techniques regarding waste, energy and water. An innovative LIFE project has helped to reduce these weaknesses by designing effective life cycle assessment (LCA) procedures that have been applied productively in three different Mediterranean pilot areas.

The ECOIL LIFE project was managed by Greece's Technical University of Crete (TUC), which was aware that LCA applications had never been applied in a methodical manner to olive oil production in the Mediterranean area. TUC had worked with LCA approaches in other agricultural systems and was keen to introduce the concepts to olive oil producers in order to help the industry improve commercial performance and reduce environmental impacts.

Eco coefficients

ECOIL focused on developing and implementing an appropriate LCA methodology that could be applied on a practical basis to the full cycle of oil production ranging from tree cultivation, to waste management and marketing, and adapted to different production systems. Project partners and pilot areas were identified from Lythrodontas in Cyprus, Voukolies in Crete and Navarra in northern Spain. Each of these areas was then subjected to a methodological assessment of local production systems and environmental characteristics covering parameters such as tree varieties, cultivation practices, quantities of olive oil produced, olive milling processes, waste management practices and energy inputs.

Data from all three assessment exercises were then used to produce a life cycle inventory, customised for each pilot area, which allowed the LIFE team to determine site-specific material flows and various coefficients, as well as defining the exact boundaries of the LCA systems. An innovative piece of software was also designed to manage and test the LCA methodologies that resulted in a set of new decision support tools to help farmers improve a wide range of environmental and commercial factors. These included: planting processes; soil management

Environmental impacts were carefully assessed including evaluation of water use, waste management systems and energy consumption during oil extraction

techniques; fertiliser, herbicide and pesticide use; pruning methods and residue control; harvesting; and transportation to processing units. Other aspects of the olive oil life cycle were incorporated with special attention being paid to the processing practices in terms of electricity and water use, storage procedures and packaging.

Eco communication

TUC was aware that the success of its new LCA methodology was dependent on its acceptance by the olive oil community and so a carefully designed communication strategy was prepared, targeting both policy makers and producers, to disseminate the project's findings and promote this new best practice approach. Training events were delivered for a large network of stakeholders involved in the olive oil life cycle such as farmers, municipal authorities, transporters, and owners and operators of olive oil mills. This capacity-building programme was also augmented by a policy document featuring recommendations on key topics including: the use of clean technologies; promotion of eco-production and eco-cultivation methods; modifications of production stages and principles of integrated production policy; as well as specific suggestions for the application of market-based instruments.

Outcomes from the project have been well received by the different stakeholders, with producers in each project area showing interest in the LCA approach. Long term impacts from the LIFE investments are anticipated to include improvements in the environmental performance of olive oil mills from more informed, needs-based approaches to resource use and better management of the waste products, particularly wastewater effluents. Other environmental benefits predicted within the olive oil production cycle include more carefully controlled irrigation and insecticide practices as well as improved efficiencies in product transportation.

Advice and guidance generated during the LIFE project was disseminated in three different Member States

Project Number:
LIFE04 ENV/GR/000110

Title: Life Cycle Assessment (LCA) as a decision support tool (DST) for the eco-production of olive oil

Beneficiary: Technical University of Crete, Department of Production Engineering and Management

Period: Oct-2003 to Dec-2006

Total Budget: € 839,000

LIFE Contribution: € 419,000 (maximum)

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Sustainable management of farm waste

Environmental impacts from agriculture can be considered on a spectrum that stretches from intensive production systems, with significant environmental pressures, to extensive farming approaches with a considerably lower environmental impact. Livestock is associated with both ends of this farming spectrum and intensive livestock farming often results in harmful environmental impacts. These problems can be exacerbated where they coincide with weaker policy standards and poor waste management procedures.

Water pollution is a common problem associated with intensive livestock production, as is biodiversity loss and the prevalence of hot spots of nutrient loading. Furthermore, livestock are responsible for substantial amounts of gaseous emissions, with 94% of total EU-15 ammonia emissions and about 50% of total methane emissions being linked to animal husbandry.

Community legislation and environmental incentives have been introduced to help agro-industries deal safely with animal by-products. An interesting mix of LIFE-funded initiatives has been active in this important area. It includes projects that have: applied energy efficient technologies to the combustion of animal by-products; used abattoir waste to produce biogas, electricity and fertilisers; combined pig manure flushing technology with a membrane bio-reactor to treat liquid manure; processed duck slurry waste into fertiliser pellets; and used insects to decompose manure and transform it into high quality fertiliser. Each of these LIFE-funded projects represents good environmental practice and highlights the opportunities that are now available to Europe's agricultural sector to ensure the sustainable management of livestock waste.

Zero Nuisance Piggeries: Holistic approaches to manure management

This French LIFE project demonstrated an improved management of pig manure using innovative integrated technology solutions that combine new flushing tools and a membrane bio-reactor to treat liquid manure with a compost system for the treatment of solid manure. This new universal management strategy has been effective in reducing pollution problems and improving the well-being of farm workers.

Manure is a natural farm waste product created by all livestock husbandry systems and manure management remains an increasingly important task for Europe's agricultural sector as livestock farming methods continue to intensify, producing more waste. Management provides a mechanism to control negative environmental impacts such as excessive nutrient enrichment of soils and water, pathogenic hazards and emissions of odour-causing compounds or greenhouse gases.

Waste manure streams from Europe's pig production industries are particularly susceptible to these problems, since much of the EU's swine husbandry systems involve relatively intensive approaches to pork production and these frequently create high volumes of manure. Most of this waste is usually stored in the piggeries until it can be applied as fertilizer to farmland but this practice tends to increase the risk of environmental problems mentioned above.

A number of different processes exist to treat pig manure. LIFE-Environment support was awarded to help establish a new holistic approach that improves all aspects of waste stream management from piggeries, including air, liquid and solid waste as well as working conditions for farm employees. This innovative "Zero Nuisance Piggeries" (ZNP) project was developed and tested in France's Brittany region.

The LIFE project's innovative technology provided an effective waste management process and created welfare benefits for the pigs

Manure management demands

Nearly a third of all French pig farms are located in Brittany. Here, up to 7,000 different production units rear half of the country's swine herds and generate more than 10 million tonnes of pig manure annually. "It was this large demand for effective manure management measures that was identified as a potential opportunity by Veolia Environment", explains the ZNP's project manager from Anjou Recherche, Juan-Carlos Ochoa. "Our intention was to develop cleaner technologies with generic relevance across Europe's livestock sector".

Veolia Environment is a large multinational company with a long history of supporting technological innovations and its specialist water research subsidiary, Anjou Recherche, developed the ZNP project in a LIFE partnership that combined knowledge, technologies and experience in order to produce a new integrated process for managing pig manure.

The core idea of this holistic approach was to incorporate existing techniques into a single system for pig slurry management. This involved:

- applying flushing techniques to clear the fresh manure on a regular basis throughout the day to prevent anaerobic decomposition of the manure within the building and hence the major source of odour nuisance;
- using centrifuge systems to separate liquid and solid waste products within the manure for subsequent treatment;
- biologically treating the waste products using membrane filtration; and

- creating an effective composting regime for the centrifuge manure residues.

Waste water was retained within these integrated processes and reused for slurry flushing. This reduced pressures on water resources, decreased pollution risks and minimised water bills.

Testing piggery parameters

Two years were allocated for testing and demonstrating ZNP's new integrated solutions. This involved establishing a prototype plant at an experimental station in Guernevez, near Brest. A control pigsty was used to provide benchmark data against the LIFE project's performance.

During the project, five groups of 72 pigs were examined at each site and analysis was undertaken on different ZNP constituents in order to optimize the prototype's operations. Each of ZNP's four constituent technologies was carefully monitored by the LIFE team. The tests were performed during the 120-day fattening period, when the pigs gain weight from 30 kg up to 120 kg and create around 360 litres of slurry per day (5L/day/pig x 72 pigs).

Testing started with the flushing system to identify the most favourable volumes and frequency of flushing. This concluded that 2,400 litres of water (400 litres, six times a day for three minutes) was required to achieve the best results.

The flushed manure was then passed to ZNP's pre-treatment station, which separates liquid and solid manure components as well as nitrogen and phosphorus compounds. Many different tests were carried out on the centrifuge machinery to assess the optimal rotation speed and flow rate of manure. Final choices for these key parameters were agreed, at 4,500 rotations per minute, to facilitate an efficient separation.

ZNP's prototype facility for treating livestock manure

The next stage of the holistic process involved the use of a membrane bioreactor to reduce the liquid manure's organic and nitrogen content in order to limit nitrogen release and avoid atmospheric pollution. Results from these membrane parameter tests were especially important since this part of the holistic process involves the removal of harmful pathogens and allows treated water to be recycled for re-use in the flushing system. "A key parameter was the membrane", explains Ochoa. "We were very pleased by its performance, especially the easy maintenance, which helps to extend the equipment's utility and cost effectiveness."

LIFE staff also carried out various experiments on the composting process. The centrifuge system produced about 700 kg per week of solid manure, which was then mixed with 35 kg of straw. It was judged to reach aerobic degradation after seven days and to generate as much as 80% of mature compost, with sanitary and biological characteristics satisfying Standard AFNOR UF44A-N7, by the end of an eight week degradation cycle.

Preparations for the project confirmed the importance of monitoring gaseous emissions from the prototype. This involved recording nitrogen compounds (NH_3+ and N_2O), and volatile fatty acids (VFA), which are both associated with strong-smelling emissions. Scientific instruments were set up to track and compare these emissions against the control site.

Impressive results

Findings from the four integrated tasks have demonstrated that ZNP's prototype technology is highly productive and relatively simple to install. As such it offers good transferable benefits for a range of European livestock producers.

ZNP project manager Juan Ochoa is delighted with the wide range of benefits that the technology offers and particularly with its capacity to greatly reduce environment pollution from piggeries. Results regarding pollution risks are indeed impressive, with ZNP technology providing 100% elimination of suspended solids and around 95% elimination of total chemical oxygen demand (COD). Nitrogen is almost wholly transformed into nitrates (by 94%) and subsequently denitrified.

The analyses undertaken on emissions also confirm the improvements that can be gained from the LIFE-financed technology, with important increases in air quality. Compared with the control pig units, the ZNP system reduced the outflow of ammonia and nitrous oxide by up to 70%. Attributed to the new flushing system, this offers considerable benefits for the well-being of both farm workers and livestock. Additional advantages from reduced ammonia emissions include mitigating greenhouse gases and atmospheric pollution. In fact, ZNP staff predict that widespread use of the new holistic treatment technology in France could reduce national ammonia emissions from pig production, currently around 60,000 tonnes, by approximately 18,000 tonnes a year. Other important benefits include the reduction in water consumption linked to the integral recycling system, which provides savings of up to 40% compared with conventional systems.

Optimisation and commercialisation

No adverse effects were identified regarding pig health or productivity and ZNP continues to analyse these important factors during its on-going, after-LIFE work. Ochoa is keen to emphasise the sustainability of the ZNP partnership's investments. "We are very glad to now have the French Institute for Pig and Pork Industry on board. With them, we will continue fine-tuning the ZNP technology to make it even more compact and easy to operate. For 2008, tests with three new pig groups are planned". This work will include: clarification of air mass balance, compost and antibiotic parameters; optimisation of the flushing periods regarding livestock rest times; a solution to the accumulation of non biodegradable COD fractions within the reused water; external validation of the technology; as well as further evaluation of economic cost-benefits from the new technology.

Early data indicate a first total cost of manure treatment through the ZNP experimental system of between 15-19/m^3, excluding governmental subsidy. The prototype version of this new technology is deemed to be more expensive than traditional methods (which cost around 10-11 €/m^3) but these costs are expected to be reduced significantly by technical adaptations in future commercialised versions.

The beneficiary has a positive outlook on ZNP's future. "For us, this LIFE project was not just a demonstration project. One-and-a-half years after the project's end we are still continuing to further develop it. It is Veolia's goal to commercialise the ZNP technology soon", says Ochoa. "The company is firmly committed to present an effective, successful market application to its customers". ZNP technology's main client group for the commercial version is expected to be intensive piggeries and large swine producers or cooperatives, since the system is anticipated to be particularly effective in reducing environmental hazards on medium- or large-scale holdings or in centralised manure treatment centres.

A good level of interest in ZNP techniques has already been shown by visitors to the demonstration site. These include poultry producers, who view the integrated manure treatment process as offering useful benefits for their waste management challenges. Veolia Water is also considering developing the LIFE-funded work further by planning to build a new version of the system in Denmark.

These international outcomes will help ensure that the environmental benefits from ZNP's holistic approach extend across Europe and by doing so, fulfil the LIFE partners' strategic objectives of developing innovative technology that can help improve the sustainable management of farm waste throughout the EU.

Open days helped raise awareness about the technology's potential use in other livestock sectors

Project Number:
LIFE04 ENV/FR/000337

Title: Zero Nuisance Piggeries.

Beneficiary: Veolia Environnement Recherche & Developpment

Period: Dec-2004 to Nov-2006

Total Budget: € 890,000

LIFE Contribution: € 237,000 (maximum)

Website:
www.zeronuisancepiggeries.com

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Biomal: Energy savings and health safety benefits from livestock by-products

A progressive LIFE project in southern Sweden has successfully demonstrated a new concept for safe handling and combustion of animal by-products that is environmentally sensitive, economically sustainable and energy efficient.

Some 16 million tonnes of animal by-products are produced, rendered and destroyed in Europe annually. Stringent EU legislation, introduced following the BSE epidemic, stipulates that all animal rest products from slaughterhouses together with animal carcasses have to be destroyed by combustion. It is extremely important that this destruction process is performed properly and Swedish companies have used LIFE-Environment funds to construct a ground-breaking new facility that safely converts animal by-products into biofuel. The fuel is called Biomal which is burnt to create renewable energy in local heat and power plants.

The new Biomal production plant was developed by specialist companies, Konvex and S.E.P. Scandinavian Energy Project, on the outskirts of Karlskoga in southern Sweden, adjacent to the city's main landfill site. The aim of the facility was to provide a cost effective alternative to conventional methods of handling animal by-products, which traditionally involves a complex and energy consuming procedure to produce animal fat and meat and bone meal (MBM).

Easy, cheap and efficient

The novel Biomal project approach has proved to be easier, cheaper, more energy effective and environmentally favourable than standard disposal approaches, the reason being that the energy intensive processing of raw material into fat and MBM is removed. Biomal's less complicated technology involves simply crushing and grinding

The Biomal plants' simple and effective approach holds strong demonstration value for other Member States

raw material, which is then pumped through a closed piping system into a fluidised bed boiler where it is combusted together with a base fuel such as wood chips, peat or municipal waste. Thus, energy is recovered from the animal by-products by producing renewable heat and electricity and the net outcome of energy is considerably increased.

Konvex's processing plant became fully operational in November 2006 and produces 85,000 tonnes of Biomal fuel annually for use in four heat and power plants at Karlskoga, Uddevalla, Perstorp and Ängelholm. The LIFE beneficiary estimates that the plant's own energy demands represent only 13% of conventional rendering requirements and other environmental benefits have been achieved with air emissions being controlled at levels well below their permitted maximum. Furthermore, effluent discharges are reduced by up to 94% since most wastewater is collected and re-circulated within the Biomal plant.

Biomal has been shown to have a heating value comparable with ordinary wood chips and other important outcomes from the LIFE project include:

- elimination of risks regarding BSE-infection or other diseases;
- safe transportation of the Biomal fuel to the end users in bulk vehicles;
- up to 40% reduction of nitrogen oxides formation by mixing with other fuels, and
- much lower operational and investment costs compared with standard rendering processes. For example, construction of the Biomal plant cost about € 8 million, whereas a rendering plant of the same capacity would cost more than twice as much.

LIFE's support for this important aspect of Europe's agri-industry was appreciated by both environmentalists and local officials. They acknowledged the EU support as a crucial factor in helping to introduce this innovative technology that safely addresses hazardous waste and provides a renewable fossil fuel replacement, whilst also generating economic and energy savings for business.

Project Number:
LIFE04 ENV/SE/000774

Title: Demonstration of a new concept for a safe, environmental advantageous, economical sustainable and energy effective system for handling animal by-products in Europe

Beneficiary: Konvex AB

Period: Jan-2004 to Mar-2007

Total Budget: € 8,144,000

LIFE Contribution: € 1,240,000 (maximum)

Website: www.biomal.com

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PIGWASTEMAN: Strengthening strategic pig farm waste management

International cooperation and knowledge transfer in the field of pig manure technology and related policy has helped Cyprus to fulfill its environmental obligations as a new Member State of the European Union.

All EU Member States are committed to providing high standards of environmental protection for their citizens and society as a whole. A comprehensive set of EU laws has been designed to maintain these high standards which new Member States are required to conform with during their transition processes. Cyprus joined the EU in 2004 since when significant headway has been made with strengthening State level controls for environmental standards. LIFE-Third Country (TCY) support has assisted this progress by helping national authorities to develop new strategic tools for managing the island's pig manure.

LIFE-TCY funds were awarded in the run up to Cyprus becoming a Member State and provided an important boost to the government's Agriculture Research Institute (ARI), where staff had identified a need for new policy tools to comply with EU requirements for pig waste. Pig production on the island was increasing but national authorities lacked adequate information about the extent of production on a country-wide basis, or sufficient knowledge concerning the level of environmental risk in specific districts.

European cooperation

A package of measures was prepared and implemented by the LIFE-TCY project to address these concerns. It included extremely useful international cooperation with experts from Greece, Italy and Denmark, who collaborated with their Cypriot colleagues, including Ministry of Agriculture staff, by exchanging good practices and refining these to suit local conditions.

European collaboration proved to be particularly beneficial during the production of policies concerning Best Available Techniques (BAT) for the treatment of waste and waste water from pig farms. The latter has a high biological oxygen demand and so poses a serious threat to the survival of wildlife in natural water courses if it is not properly dealt with. Such pollution risks have fortunately now been reduced due to the worked progress by LIFE partners who identified a BAT list for different sized pig farms.

The BAT list assessed various parameters including nitrogen vulnerability, odour problems, land scarcity, agricultural reuse of sludge and general economic viability in order to clarify optimum waste management technologies for Cypriot pig producers. Analysis covered treatment methods for liquid and solid manures which highlighted the potential benefits from a centralised biogas plant and aerobic treatment for liquid waste.

Several other important policy tools were also developed by the project including a new piece of GIS software that helps land-use planners forecast the impact of pig waste on local surface and ground waters. This Water Resources Vulnerability Tool, mapping all ground and surface waters and their vulnerability, is already used by the Ministry of Agriculture to facilitate decision making with regard to issuing livestock permits. The tool's wider effectiveness has since also been recognised by other public bodies with mandates extending from geological surveys to water quality.

EU experts join forces to develop Cypriot waste strategies

ARI's project concluded in 2006, by which time Cyprus was a fully fledged Member State with, thanks to LIFE, a strong set of environmental policy tools for piggeries that were aligned with EU requirements and capable of selecting appropriate waste management techniques, as well as assessing environmental risks. Constructive collaboration between European colleagues was noted as a key factor for this project's success and a useful factor that demonstrates the power of partnership for similar policy-oriented LIFE projects.

Project Number:
LIFE03 TCY/CY/000021

Title: Guidelines to the Cyprus Competent Authorities for Policy Formulation for Sustainable Management of Pig-farming Wastes in Compliance with EU Practice

Beneficiary: Agricultural Research Institute

Period: Dec-2004 to Nov-2006

Total Budget: € 563,000

LIFE Contribution: € 377,000 (maximum)

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Processing agricultural products

European consumers, as elsewhere in the world, are becoming increasingly concerned about the quality of food and other agricultural products. A 2007 Eurobarometer Survey on the CAP, for instance, indicates that over 40% of citizens think that food safety and quality should be one of the CAP's main priorities. This consumer trend is reflected in consumer spending, which has enormous implications for farmers, growers and the wider agri-food industry.

The EU has an important role to play in both facilitating these consumer demands and helping the agricultural sector to take advantage of the opportunities that they present. A focus on quality and adding value invariably translates into improved revenue and society has shown itself to be willing to pay a premium for quality farm products, especially those that can be marketed as having strong environmental credentials. Various incentive schemes are available to encourage EU farmers to produce high quality, eco-friendly products with lower pollutant potential, minimised waste impacts, guaranteed food safety and high standards of animal welfare or plant health.

Numerous LIFE projects have also made important contributions to helping Europe's agri-food industry adapt to these new and mutually beneficial market trends. Successful examples include projects that: reduce energy consumption, odours and air pollution; introduce organic waste recycling techniques; produce commercial biogas, electricity and fertilisers from treated abattoir waste; and develop a new vacuum-packaging process for rice that reduces pesticide use and greenhouse gas emissions. All of these LIFE successes demonstrate the commercial benefits of adopting environmentally sensitive approaches to processing agricultural products.

Stiim: Improving traditional seed treatment techniques to replace pesticides

BEST PROJECTS AWARD 2005-2006

The Swedish LIFE project, Stiim, implemented a technologically enhanced version of traditional thermal techniques for removing pathogens from cereal seeds. It demonstrated that modern thermal techniques can be effective and efficient in ensuring that seeds are disease-free without the use of pesticides.

Chemical pesticides are used to treat seeds to protect crops from seed-borne diseases. However, these pesticides can cause significant environmental problems, including contamination of soil, groundwater and hazards to seed-eating birds. They affect people employed in the seed industry and farming, whilst leftover seeds must be treated as chemical waste.

Large volumes of seeds can easily be decontaminated by the Stiim technology

It was estimated that in 2001, Sweden alone accounted for 68.9 tonnes of chemical seed dressing pesticides used on cereal crops, while in Europe as a whole the quantity is approximately 2,000 tonnes annually. This demand is driven by the fact that seed-borne diseases cause serious problems for farmers by reducing both the yield and quality of the final harvested product.

Organic farming in particular creates a large demand for effective methods of seed-borne pathogen control and yet, access to practical, useful and effective alternatives to pesticides has been limited.

Learning from the past

Researchers from Acanova AB (now Seedgard AB), a Swedish company specialising in supporting innovations for the agriculture and forestry sectors, worked with colleagues from the Swedish University of Agricultural Sciences to respond to this demand for pesticide-free seeds. Aiming to produce cereal seed free from undesired additives and environmentally sustainable in line with the EU's thematic strategy on the sustainable use of pesticides, they looked back to traditional methods to find ideas for a non-chemical treatment system.

Supposedly 'old-fashioned' techniques placed seeds in baths of hot water to kill off pathogens with low heat resistance. The major disadvantages of such a thermal process, however, were that it was laborious, time-consuming, energy-intensive, had low capacity and suffered from low precision, often giving insufficient disinfection or reduced germinability.

The researchers devised a thermal seed treatment process using hot humid air as a heating medium and fluid bed technology to ensure even exposure of thick seed layers. Small-scale testing of this system in several countries of Scandinavia and central Europe produced promising results, but a larger scale demonstration was necessary.

The LIFE project Stiim linked up these researchers with Svenska Lantmännen (SvL) - a co-operative of Swedish farmers and leader in the Swedish seed market. Together, they sought to develop a full-scale demonstration of the thermal process, which they called ThermoSeed, to be used commercially.

Firstly, they constructed an intermediary system to process cereal seeds in carefully controlled conditions using a combination of steam and heat to remove the pathogens from the seeds. The project team assembled a large variety of components from several manufacturers, including treatment and cooling devices, sensing systems, system control

software, power supply and seed transportation equipment. They ran the system under commercial conditions and tested both the treatment parameters and the mechanical characteristics of the process. The seeds were evaluated by sampling, testing, and quality control. Based on this work, a full-scale processing system was developed and installed. It has operated in Skara, Sweden since September 2005 with a treatment capacity exceeding 200 tonnes of cereal seeds per day.

The ThermoSeed methodology is based on the fact that seed-borne pathogens are more sensitive to heat than the seed itself and Thermoseed's approach dramatically improves on traditional techniques through the outstanding precision provided by state-of-the-art expertise in fields such as modern process engineering, seed biology and seed processing technology.

The treatment process developed is a clean and effective production method with low energy consumption and low carbon footprint. It maximises disinfection rates without the inefficiency of the traditional methods. Since it does not use any chemicals, one treatment plant can reduce the use of chemical seed treatment by some 2.5 tonnes of the active ingredients per year, which is close to 4% of the use of these chemicals in Sweden.

No gloves are required for the LIFE funded ThermoSeeds which offer farmers important protection against chemical risks

The benefits

The environment benefits of this process are clear. Immediate benefits include an end to the exposure of farmers to the chemicals and the removal of pollutants affecting wildlife, water and soil. Furthermore, as a farmer in Central Sweden, Jan Cederholm, explains, "It is a great advantage not having to use the chemically treated seed, both for the environment and for the fact that leftover seed can be used for other purposes, for example as feed for the animals".

In addition to its environmental benefits, ThermoSeed proved to be competitive with chemical seed treatment with regard to both treatment effectiveness and cost. The method was approved by the Swedish Seed Testing and Certification Institute (now a part of the Swedish Board of Agriculture) as an equivalently effective alternative to chemical seed dressing of cereal seed.

As an effective technique that reduces the use of chemicals in agriculture, the methodology is attractive for both conventional and organic farming in all countries. The LIFE project was able to successfully demonstrate that the application was ready for the commercial market.

Director of the Seed Department at the Swedish Farmers' Supply and Crop Marketing Association, Bertil Hult, also explained how important ThermoSeed is for consumers. "We have to offer our highly demanding customers continuously improved products at a competitive price. We are under increasing pressure concerning economy, quality, care for the environment and labour environment. ThermoSeed is outstanding in all these areas".

The new technology has been validated by Sweden's national seed authorities

LIFE after LIFE

Since the end of the project, the partners have been actively promoting further applications of the system, particularly to a larger variety of seeds than originally tested. Though the new technique is not yet adjusted for all cereal types, it has been shown to be highly effective for barley, wheat, oats and rice seeds. Testing on other seed types, such as vegetable seeds, has also been promising, although adjustment of the operational and control parameters to different seed characteristics still needs to be completed.

Project Number:
LIFE03 ENV/S/000600

Title: System for Thermal Seed Treatment – an Integrated Approach to Implementation and Management in the EU Seed Industry

Beneficiary: Svenska Lantmännen ek.för

Period: Jan-2003 to Jun-2005

Total Budget: € 1,349,000

LIFE Contribution: € 250,000

Website: www.thermoseed.se

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Odour Scrubber: Reducing energy consumption in rape seed oil production

This innovative German LIFE project created a closed-loop heat-exchange system to reduce energy consumption in the processing of rape seeds to oil. It reduced overall energy consumption in the pilot plant by nearly 4% and contributed to a reduction in odour emissions.

In 2006, the total EU-25 production of rape seeds was 16 million tonnes, mainly processed to produce vegetable oil. Standard production mills for rape seed oil require significant amounts of energy, firstly to dry the seeds and then to heat them for pressing. They also release substantial quantities of vapour containing glucosinolate, resulting in significant local odour pollution.

Cargill, a large international processor and distributor of agricultural and food products, sought to re-channel wasted heat back into the rape seed production process to reduce the overall energy demand. It also aimed to condense most of the vapour and glucosinolate, which cause the odour problems, into a collection tank, resulting in reduced air pollution.

The project successfully established a full-scale plant based on a counter-flow heat exchanger to recover and re-use heat given off from the processing of rape seed. In the cyclical process, hot water is used to heat plates over which cold rape seed is passed to pre-heat it (from 15 to 55 °C). The cooler water that emerges from this process (outflow water at 55°C compared to 75°C at the inflow) is sprayed onto the vapours rising from the seed. Having been reheated by the vapours (from 55 to 75°C) the water is then channelled back to the plates and the cycle starts again.

This recovery of previously wasted heat reduces the energy required for heating at the drying stage by 20%. This lowers the overall energy consumption of the oil mill by 3-4%. These energy savings amount to approximately 90 MJ/tonne of rape seed. For the beneficiary, which processes 300,000 tonnes of rape seed each year at its site in Mainz, the energy savings amount to 27 TJ/yr. This equates to savings of around € 350,000 per year on heating oil.

Additional benefits of the system include improvements in the processing parameters, such as better flakeability of the seed. The quality of the final product was fully maintained during the implementation of the innovative system.

Using a scrubber to spray cooler water emerging from the seed-heating process onto the odorous vapours helped condense the vapours. However, it did not remove enough of the odour components (glucosinolates) from the vapours, so the beneficiary added a separate oxidising device ("Airox") to treat the exhaust air after the scrubber. This resulted in an odour reduction of 60%.

The project was economically efficient making it very transferable to other processes. Two other sites within the Cargill Group have already set up similar plants and the supplier of the equipment, Bulkflow, has implemented some 200 similar heat exchangers in other branches to heat or cool bulky goods.

Cargill's heat exchanger plant demonstrates good practice in energy use and pollution control

Project Number:
LIFE04 ENV/DE/000051

Title: Demonstration of a closed circuit system resulting in a substantial odour emission reduction and energy saving during oilseed pressing

Beneficiary: Cargill GmbH

Period: Dec-2003 to Nov-2006

Total Budget: € 1,159,000

LIFE Contribution: € 213,000 (maximum)

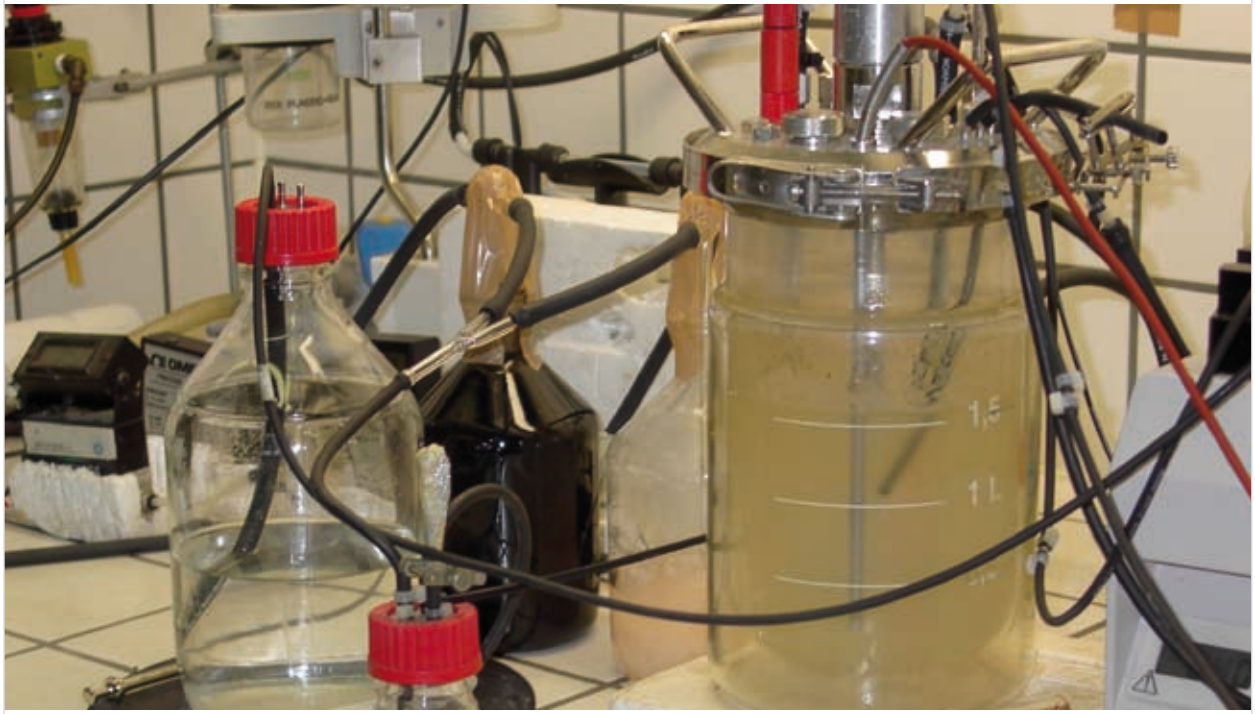
Beneficiary's website:
http://www.cargill.de/

Contact: Thomas Rau

Email: Thomas_Rau@cargill.com

SoNatura: Using BAT to reduce industrial gas emissions from the cork and leather industries

The Portuguese SoNatura LIFE project successfully demonstrated the application of Vapour Phase Bioreactors as a Best Available Technology (BAT) for air pollution control in the leather and cork industry segments of agro-non-food industries.



Microbiotic components were tested in the LIFE project's laboratory to provide data for industrial scale treatments

The leather and cork industries produce significant emissions of Volatile Organic Carbons (VOCs), which form potent greenhouse gases in the stratosphere. These are given off particularly when spray-painting machines apply solvent-based products, such as pigments, dyes and lacquers to leather, and from the mixing of granulated cork with solvent-based resins.

According to several Best Available Technology Reference (BREF) reports, Vapour Phase Bioreactors (VPBs) are a BAT to control industrial gas emissions. They are a natural and cost-effective treatment using microbial cultures to degrade VOCs and odours through oxidative biodegradation into water and carbon dioxide. They can be used to meet EU legal requirements on emissions reductions.

SoNatura aimed to anticipate future stricter emissions legislation affecting the cork and leather industries by promoting the application of VPBs in the treatment of gaseous emissions from agro-non-food industries. It sought to develop a demonstration project in two specific companies: Granotec (cork) and Marsipel (leather).

The LIFE project, which was coordinated by the Escola Superior de Biotecnologia da Universidade Católica Portuguesa, developed laboratory-scale characterisations of the treatment processes of the industries' gaseous emissions. Researchers identified the main VOCs present and developed enriched microbial cultures to degrade them. Analytical methods of monitoring the disappearance of the VOCs were established and the treatment of the emissions using VPB was tested.

Following optimisation of the laboratory process, a mathematical model was used to scale up the VPB design to pilot-scale for the respective companies to put into

operation on their industrial sites. Monitoring at the inlets and outlets showed average treatment efficiencies higher than 50%, with most emissions being under the currently established legal limit (< 50 mg/Nm^3).

In the Marsipel case study, the VPB showed removal efficiencies of or very close to 100% for the majority of the target pollutants when the total inlet concentrations were under 500 mg/m^3. The production process also proved to be dynamic in the face of different-sized batches of leather products, able to stop for recalibration without the need for significant maintenance work.

At Granotec, the treatment efficiency for the VOC, toluene, when exposed to inlet concentrations of 85 mg/m^3, was around 70%. Additionally, the VPB was exposed to a 15-day starvation period and did not require re-inoculation to restart the treatment process.

At both sites, the surrounding air quality was found to have improved and, given that they operate at ambient temperatures and pressures, the operational costs were low. This helps increase the potential transferability of the project and, accordingly, SoNatura carried out significant dissemination operations to raise awareness in specific sectors of the benefits of VPBs.

Finally, the project contributed to strengthening the links between the university and industrial partners, all of which indicated their interest in continuing to explore the feasibility of widening VPB application to other sectors and emission sources and improving the efficiency of the treatment when faced with higher organic loads.

The Vapour Phase Bioreactor at Granotec performed well during the LIFE trials

Highly successful results were achieved from Marsipel test plant

Project Number:
LIFE03 ENV/P/000521

Title: Vapour Phase Bioreactors for Agro-non-Food Industries

Beneficiary: Escola Superior de Biotecnologia – Universidade Católica Portuguesa

Period: Sep-2003 to Dec-2005

Total Budget: € 465,000

LIFE Contribution: € 202,000

Website: www.esb.ucp.pt/sonatura

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Further agriculture-related LIFE projects

The table below presents some of the numerous past and current LIFE projects focussing on agriculture. For more information on individual projects, visit the online LIFE database at: http://ec.europa.eu/environment/life/project/Projects/index.cfm or the section 'LIFE by theme: Soil, land-use and agriculture' at: http://ec.europa.eu/environment/life/themes/soil/index.htm.

Start	Country	Number	Acronym	Title
Quality and balanced use of water				
2006	France	LIFE06 ENV/F/000133	ArtWET	Mitigation of agricultural nonpoint-source pesticide pollution and phytoremediation in artificial wetland
2005	Denmark	LIFE05 ENV/DK/000155	AGWAPLAN	Integrated Protection of Surface and Groundwater in Agricultural Regions
2005	Spain	LIFE05 ENV/E/000289	FERTIGREEN	Sustainable management of water reducing environmental impact using new fertirigation methods
2005	Spain	LIFE05 ENV/E/000313	gEa	Excellence in irrigation water management
2005	United Kingdom	LIFE05 ENV/UK/000137	NITRABAR	Remediation of agricultural diffuse nitrate polluted waters though the implementation of a permeable …
2005	Italy	LIFE05 ENV/IT/000845	TIRSAV PLUS	New technologies for husks and waste water recycling plus
2005	Belgium	LIFE05 ENV/B/000510	TOPPS	Train the operators to prevent pollution from point sources
2005	Germany	LIFE05 ENV/D/000182	WAgriCo	Water Resources Management in Cooperation with Argriculture. Compilation and Implementation of Integrative
2005	France	LIFE05 ENV/F/000058	AWARE	Reducing pesticide-related water pollution by improving crop protection practices: The use of embedd ICT
2005	The Netherlands	LIFE05 ENV/NL/000021	CEPE	Reduction of pest control impact of horticulture on ground and surface water through a system of constant
2004	Italy	LIFE04 ENV/IT/000454	OptiMa-N	Optimisation of nitrogen management for groundwater quality improvement and conservation
2002	Spain	LIFE02 ENV/E/000210	HAGAR	Tools of self-management for water irrigable in the overused hydric systems
2000	Finland	LIFE00 ENV/FIN/000668	Innowa (KarjaanjokiLIFE)	Integrated river basin management - a network for optimized water management, rehabilitation and protection of aquatic ecosystems in Karjaanjoki area
2000	Italy	LIFE00 ENV/IT/000223	Tirsav	New technologies for husks and waste waters recycling
Soil protection				
2005	Spain	LIFE05 ENV/E/000288	ALMOND PRO-SOIL	Soil protection in Mediterraanean areas with increased soil erosion rate through cultivation of new
2004	Spain	LIFE04 ENV/ES/000263	BIOSOIL	Project to demonstrate the feasibility of compost bioremediation technology for the reclamation of brownfields
2004	Spain	LIFE04 ENV/ES/000269	Humedales Sostenibles	Integrated management of agriculture in the surroundings of community importance wetlands
2003	Latvia	LIFE03 ENV/LV/000448	Bio Waste	Treatment of Biodegradable Organic Municipal Waste Using Composting Technologies
2003	Italy	LIFE03 ENV/IT/000377	BIO.CO.AGRI	Biodegradable coverages for sustainable agriculture
2003	Italy	LIFE03 ENV/IT/000321	FREEPCB	Elimination of PCBs from the Food Chain through Bioremediation of agricultural superficies
2003	Italy	LIFE03 ENV/IT/000366	SLID	Shallow Landslides Investigation Device: a tool to assess land susceptibility to shallow landslides for agricultural and urban planning in rural areas
2002	Italy	LIFE02 ENV/IT/000089	fertiLIFE	Sustainable fertilisation of an intensive horticultural basin through an innovative management system of the local vegetal waste bio-mass utilising an existing composting plant and supporting a permanent info-structure
Land-use and biodiversity preservation				
2003	Finland	LIFE03 NAT/FIN/000039	Gulf of Finland	Management of wetlands along the Gulf of Finland migratory flyway
2003	Austria	LIFE03 NAT/A/000009	WACHAU	WACHAU

Start	Country	Number	Acronym	Title
2003	Austria	LIFE03 NAT/A/000010	WEIDMOOS	Habitat management in the SPA Weidmoos
2002	Italy	LIFE02 NAT/IT/008574	Alpe Veglia	Alpe Veglia and Alpe Devero: actions of conservation of mountain grasslands and peatlands
2002	Spain	LIFE02 ENV/E/000200	GALLECS	Demonstration project on land use and environmental management of the physical planning in Gallecs as a biological and stable connector in the fringe space of Barcelona metropolitan area
2002	Hungary	LIFE02 NAT/H/008634	Hortobagy Steppes	Restoration of pannonic steppes, marshes of Hortobágy National Park
2002	Denmark	LIFE02 NAT/DK/008588	IMAGE	Improving status of coastal lagoon Tryggelev Nor, Denmark - IMAGE
2002	Finland	LIFE02 NAT/FIN/008465	Simojoki	Restoration and protection of the River Simojoki
2002	Germany	LIFE02 NAT/D/008461	Trockenrasen Deutschland R-Pf	Restoration and conservation of xeric grasslands in Germany (Rheinland-Pfalz)
2002	Germany	LIFE02 NAT/D/008456	Westliche Dümmerniederung	Re-wetting of the Western Dümmer fen area
2000	Sweden	LIFE00 NAT/S/007117	Öland	Coastal Meadows and Wetlands in the Agricultural Landscape of Öland
2000	Denmark	LIFE00 NAT/DK/007116	Skjern River	Restoration of habitats and wildlife of the Skjern River
EMAS and LCA in agriculture				
2003	Portugal	LIFE03 ENV/P/000501	EMAS@School ✪	Environmental Management and Audit Scheme implementation at a complex school
2003	Spain	LIFE03 ENV/E/000085	SYNERGY	Quality and respect for environment
2002	Spain	LIFE02 ENV/E/000180	TRAMA	Integrated reduction of environmental impact in Agricultural economic systems
Sustainable management of farm waste				
2006	Spain	LIFE06 ENV/E/000044	ES-WAMAR	Environmentally-friendly management of swime waste based on innovative thechnology: a demonstration
2006	Sweden	LIFE06 ENV/S/000517	BIOAGRO	Innovative method for reduction of emissions of green house gases and waste from the agriculture sector
2004	Hungary	LIFE04 ENV/HU/000372	ECOFILTER	Modern and environmental friendly composting methods of agricultural waste
2003	Ireland	LIFE03 ENV/IRL/000312	Duck Slurry	Development of a Processing Plant for Recycling of Duck Slurry
2002	Spain	LIFE02 ENV/E/000187	ENERWASTE ✪	Implementation of an AD facility at a Spanish slaughterhouse for a sustainably closed energy and waste
2000	Portugal	LIFE00 ENV/P/000829	PIGS	Pig-Farm Integrated Management Project
Processing agricultural products				
2006	Italy	LIFE06 ENV/IT/000266	Seq-Cure	Integrated systems to enhance sequestration of carbon, producing energy crops by using organic residues
2004	Spain	LIFE04 ENV/ES/000184	ECORICE	Sustainable management of the rice straw
2002	Spain	LIFE02 ENV/E/000255	ENVACIO	Demonstration title of the progressive elimination of Methyl Bromide in the processed rice fumigation, due to the substitution of the vacuum packed rice, minimised the environmental impact and the emission of gases into the atmosphere
2000	Spain	LIFE00 ENV/E/000555	BIOCOMPOST	Demonstration Plant for composting municipal sewage sludges and rice straw, and evaluation the agronomic
2000	Italy	LIFE00 ENV/IT/000191	LIFE PROSIT	Planning and restoring of Cinque Terre costal traditional agricultural landscape
2000	Spain	LIFE00 ENV/E/000402	MicroValdorba ✪	Development and implementation of an integrated system for the sustainable management of wild fungus-producing forest ecosystems in Valdorva, Navarra
2000	Spain	LIFE00 ENV/E/000483	PPB-Colrec	Environmentally collection and recycling of pesticide plastic bottles using advance oxidation process

✪ 'Best Projects' award

Available LIFE publications

LIFE-Focus brochures

A number of LIFE publications are available on the LIFE website:

LIFE and endangered plants: Conserving Europe's threatened flora (2007 - 52 pp. - ISBN 978-92-79-08815-5) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/plants.pdf*

LIFE and Europe's wetlands: Restoring a vital ecosystem (2007 - 68 pp. - ISBN 978-92-79-07617-6) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/wetlands.pdf*

LIFE and waste recycling: Innovative waste management options in Europe (2007 - 60 pp. - ISBN 978-92-79-07397-7) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/recycling.pdf*

LIFE and Europe's rivers: Protecting and improving our water resources (2007 – 52pp. ISBN 978-92-79-05543-0 - ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/rivers.pdf*

LIFE and Energy: Innovative solutions for sustainable and efficient energy in Europe (2007 – 64pp. ISBN 978 92-79-04969-9 - ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/energy_lr.pdf*

LIFE and the marine environment (2006 – 54pp. ISBN 92-79-03447-2- ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/marine_lr.pdf*

LIFE and European forests (2006 - 68pp. ISBN 92-79-02255-5 - ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/forest_lr.pdf*

LIFE in the City: Innovative solutions for Europe's urban environment (2006, 64pp. - ISBN 92-79-02254-7 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/urban_lr.pdf*

Integrated management of Natura 2000 sites (2005 - 48 pp. – ISBN 92-79-00388-7) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/managingnatura_lr.pdf*

LIFE, Natura 2000 and the military (2005 - 86 pp. – ISBN 92-894-9213-9 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/military_en.pdf*

LIFE for birds: 25 years of the Birds Directive: the contribution of LIFE-Nature projects (2004 - 48 pp. – ISBN 92-894-7452-1 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/birds_en.pdf*

The air we breathe: LIFE and the European Union clean air policy (2004 - 32 pp. – ISBN 92-894-7899-3 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/lifeair_hr.pdf*

LIFE-Nature: communicating with stakeholders and the general public – Best practice examples for Natura 2000 (2004 - 72 pp. – ISBN 92-894-7898-5 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/natcommunicat_lr.pdf*

A cleaner, greener Europe: LIFE and the European Union waste policy (2004 - 28 pp. – ISBN 92-894-6018-0 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/waste_en.pdf*

Industrial pollution, European solutions: clean technologies – LIFE and the Directive on integrated pollution prevention and control (IPPC Directive) (2003 - 32 pp. – ISBN 92-894-6020-2 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/cleantech_en.pdf*

LIFE and agri-environment supporting Natura 2000 - Experience from the LIFE programme (2003 - 72 pp. – ISBN 92-894-6023-7 – ISSN N° 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/agrienvironment_en.pdf*

Other publications

Best LIFE-Environment Projects 2006-2007 (2007, 44 pp.-ISBN 978-92-79-06699-3 ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/bestprojectsdocuments/bestenv07.pdf*

LIFE-Third Countries 1992-2006 (2007, 64 pp. – ISBN 978-92-79-05694-9 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/TCY_lr.pdf*

Best LIFE-Environment Projects 2005-2006 (2006, 40 pp. ISBN 92-79-02123-0) *http://ec.europa.eu/environment/life/publications/lifepublications/bestprojects/documents/bestenv06_lr.pdf*

LIFE-Environment 1992-2004 "Demonstrating excellence in environmental innovation" (2005, 124 pp. – ISBN 92-894-7699-3 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/lifeenv92_04.pdf*

LIFE-Environment Projects 2006 compilation (2006, 56 pp.-ISBN 92-79-02786-7) *http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/envcompilation06.pdf*

LIFE-Nature Projects 2006 compilation (2006, 67 pp. – ISBN 92-79-02788-3) *http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/natcompilation06.pdf*

LIFE-Third Countries Projects 2006 compilation (2006, 20 pp. – ISBN 92-79-02787-5) *http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/tcycompilation06.pdf*

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 III) 2000-2006.

EU funding available approximately EUR 945 million.

Type of intervention co-financing actions in favour of the environment (LIFE projects) in the Member States of the European Union, in associated candidate countries and in certain third countries bordering the Mediterranean and the Baltic Sea.

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 Environment projects** contribute to the development of innovative and integrated techniques or methods to support environmental progress.
> **LIFE Third Countries projects** support environmental capacity building and initiatives in non-EU countries bordering the Mediterranean and the Baltic Sea.

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 on the farm: Supporting environmentally sustainable agriculture in Europe
Luxembourg: Office for Official Publications of the European Communities

2008 - 60p - 21 x 29.7 cm
ISBN 978-92-79-08976-3
ISSN 1725-5619
doi: 10.2779/99640

KH-AJ-08-001-EN-C

Publications Office
Publications.europa.eu

ISSN 1725-5619

ISBN 978-92-79-08976-3
9 789279 089763