FOOD & BIODIVERSITY

Implementation of biodiversity measures

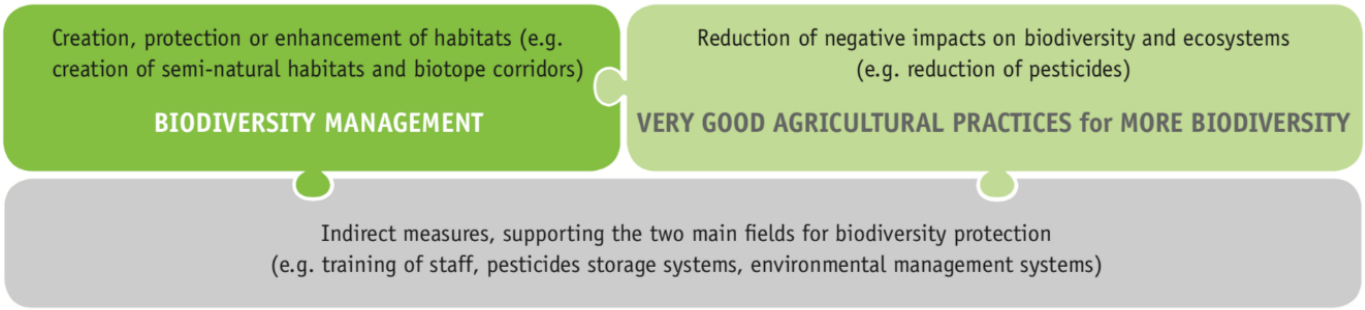
Experience in olive pilot farms in Spain

Content

1. Introduction

The LIFE Food & Biodiversity project supports food standards and food companies to develop efficient biodiversity measures and to implement them in their pool of criteria or sourcing guidelines.

In this paper on the Spanish olive pilots in the LIFE Project, we provide information on our experiences gained in the olive pilot projects in Spain in terms of implementation of recommended biodiversity measures. All pilots within the project were subject to a specific biodiversity consultation and measures were put in place that are based on the two pillars for biodiversity-friendly agriculture: Biodiversity Management and Very Good Agricultural Practices (figure below).



This publication targets agents who assess the implementation of requirements regarding cultivation methods (standard advisors, cooperatives, suppliers). We wish to communicate the challenges we experienced in our pilot projects and point out the observed benefits of the measures, as well as the pitfalls and related cost. This may be taken as a guide to avoid similar pitfalls and to enhance the benefit for biodiversity.

2. The Pilot Projects

Within the LIFE Food & Biodiversity project, "Recommendations to improve biodiversity protection in policy and criteria of food standards and sourcing requirements of food companies and retailers" were published. This Guideline includes a catalogue of measures to enhance biodiversity, out of which farmers may chose actions to enhance their farming practices. All of the measures were tested over the years by different stakeholders in different projects and proved their benefits for biodiversity.

In total 19 different measures to enhance on-farm biodiversity were tested in olive pilot farms. In Spain 3 different Olive cooperatives or Standards have developed Biodiversity Action Plans to enhance biodiversity: Al Alma del Olivo (1 pilot farm organic; 300 has) Cooperative Viver (10 olive pilot farms; 10,83 ha) Cooperative La Peraleña (8 olive pilot farms in organic farming; 12,75 has)

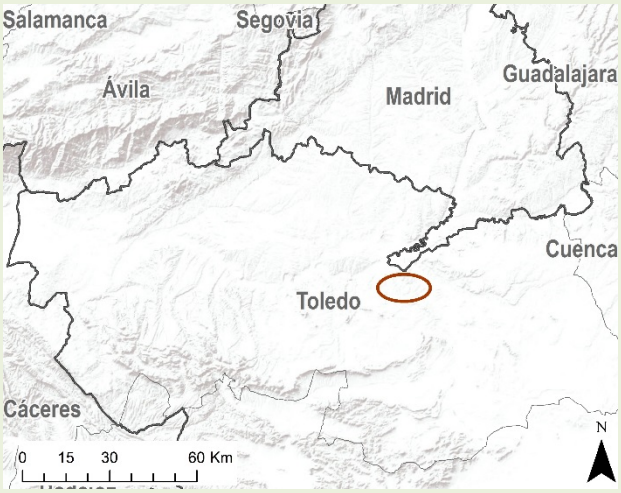
The farms assessed can be grouped in the so-called "traditional olive groves" and "modern olive groves". In the first case, tree density is lower, trees can be very old and yields are sometimes lower. In modern plantations, the system is adapted for a more efficient management and higher yields. No intensive olive plantations (super high density, in hedgerow) have been analysed. Viver farms benefit from deficit irrigation and conventional farming, Al Alma del Olivo is an organic farm and irrigated, and La Peraleña is rainfed, and have both organic and conventional production.

The aim of this publication is to give an overview about the actions taken, the lessons learned, the benefits for biodiversity and the challenges faced during their implementation. In this document, we focus on a few measures that were applied by a higher number of farmers and we describe them in detail, including costs and effort.

Measures to enhance on-farm biodiversity
Agrobiodiversity
Use of adapted traditional varieties
IPM Integrated pest management
Pest monitoring
Olive fruit fly control, following IPM approach
Mechanical weeding & grazing for weeding
Soil and fertilization
Reduced tillage
Regular application of organic substances, (incl. incorporation of pruning into soils, olive mill compost applications etc.)
Sown or spontaneous soil covers (green manure, biodiversity, soil, pest management)
Water
Decision-support tools for irrigation
Landscape management
Diversification of land use
Landscape elements:
Hedgerows & grass fields margins
Solitary trees
Stone- and deadwood piles
Dry stone walls
Support to wild fauna (incl. water ponds, nesting aids for birds and bats, nesting aids for wild bees)
Riparian strips along water bodies
Farm management
Crop management advisory supported by farm register books and monitoring
Integrated management
Organic management

Al Alma del Olivo

Al Alma del Olivo is an olive farm with 202 ha devoted to organic production of olive oil, with its own mill; it is a family company dedicated to the production and marketing of Extra Virgin Olive Oil. The farm is surrounded by several Natura 2000 network sites, between platforms, corridors and depressions of the Algodor and Cigüela Rivers. The farm area is included within the zone corresponding to the recovery plan of the Iberian imperial eagle (*Aquila adalberti*) and the recovery plans of the Bonelli's eagle (*Aquila fasciata*). Al Alma grows three varieties of olive trees: Cornicabra, Picual and Hojiblanca. There are different degrees of implantation; from old olive trees to more recent plantations carried out in 2013. The entire farm is under the standard of organic farming. There is a great commitment to improve, enhance and invest in biodiversity through the development and improvement of new ecological infrastructures (such as green covers, hedges, stone piles and water ponds) and improving agronomic methods, such as the mill compost to fertilize the soil, between others.



Cooperativa de Viver

The Cooperativa de Viver was created more than 20 years ago by merging different olive mills spread in the municipality with the aim of producing high-quality olive oils and obtaining fair revenues for farmers. The plots included in the project contribute to a premium extra virgin olive oil produced by the cooperative under the brand “Lágrima”, which is based on a local olive variety called “Serrana”. The cooperative established an agronomic protocol around Lágrima for obtaining the maximum quality including agronomic measures and specific processing requirements. This project was regarded as a good opportunity for strengthening Lágrima standard with biodiversity measures.

The results obtained show that biodiversity should be considered a promising and low-hanging fruit for Cooperativa de Viver. This is due, on the one hand, to the fact that Viver environment is especially rich in biodiversity and traditional olive groves are naturally inserted in the landscape. On the other hand, the cooperative relies on technical staff (agronomic and processing) that decided to bet for quality (to its full extent) and accurate control on all the agronomic actions. For example, treatments, irrigation and other agronomic practices are known, compiled and consistent with integrated production protocols.

La Peraleña

"La Peraleña" is a cooperative with 150 members and its own mill for the production of organic extra virgin olive oils. It was founded in 1955 by farmers from Perales de Tajuña (Tajuña Valley Region, Madrid). The pilot farms assessed in the project includes about 12 hectares of productive olive groves. These are mostly thousand-year-old trees and planted in a traditional way so that each tree can enjoy up to 120 m2 of land to provide their precious fruits in the most sustainable way. They are managed all under a rain-fed regime and under the Quality figure of organic farming. The whole exploitation is located in the surroundings of the ZEC ES3110006 "Vegas, slopes and páramos of the Southeast of Madrid" (Special Conservation Area, Natura 2000 Network). The harvest is done manually by using a traditional technique called “vireo”, which is beating the branches with long sticks. There is a significant surface of different ecological infrastructures such as linear hedges, permanent ponds and streams.

2.1. Sown or spontaneous soil covers

When cover crops are **sown**, farmers establish a specific plant community and therefore have more chances to control the role they will play. For example, the so-called **green manures**, sown for improving nutrient content, will be mostly based on leguminous species. **Catch crops**, sown for retaining nitrogen and avoiding its leaching, will prioritize species with a steady growth during the period targeted and good efficiency for up taking nutrients. When the desired effect is getting rid of soil-borne diseases, Brassicaceae family plants will be sown. More information on soil covers can be found in the Action Factsheets for advisors, auditors or quality managers, which describe the measures in detail and give insights in their correct management and implementation.

Soil cover in olive pilot farms of Viver

The implementation (Al Alma: 2017/18: 10 ha sown | 2018/19: 6 ha sown + 6 ha spontaneous | 2019/20 all the UAA (202 ha) spontaneus cover .) (La Peraleña: 2017/2019 1,5 m radio of ties of spontaneous wild plants under olive trees | 2018/2019: 1 ha of soil covers by spontaneous wild plants. 1 plot of sowing seeds to avoid erosion in a plot with a steep slope)

Soil covers were sown during the first year in Al Alma at the beginning of December with a density of 40 kg/ha of seeds (including leguminous species, grasses and cress (Fam. *Brassicacea*). The second year the sowing was made by the end of October. It's advisable to make the sowing operations when the soil is in optimal conditions, which under Mediterranean conditions means soil moisture. It also should be balanced with an appropriate seed density according to the soil potential. The covers are mown at beginning or mid spring, before water competition with olive trees begins and in order to allow the selection of beneficial species of shorten cycles against weeds. It's advisable that the mix of seeds includes native species to favor a future auto-sowing.

Spontaneous soil cover in olive pilot farms of Al Alma

Soil covered by native wild plants are feasible in plots where the bank of seeds remains in the soil. The cover composition can improve after a few years if managed properly: for example, mowing in mid spring can favor species with shorter cycles and narrow leaves. In some plots in Al Alma, wild covers are re-planted with leguminous species, as they disappear progressively. In the last year, the entire farm of Al Alma has been left un-ploughed to favor spontaneous vegetation cover. In La Peraleña mowing is done for favoring legumes and in order to select some preferred plants. In Viver, some plots are covered naturally with native flora. Covers are mown twice or three times a year depending on the weather conditions. Grinded branches from pruning are also left on the soil and contribute to covering the soil. When water is available, covers can last almost all the season. When the irrigation is not possible or the season is especially dry, covers are removed with a light tilling. All these experiences demonstrate that at least winter covers, sown or wild, are technically feasible and deliver significant agronomic and environmental benefits. Proper cover management, different from year to year and from farm to farm, is the main limitation for a wide implementation.

2.1.1. Benefits and experiences

Soil green covers reduce water erosion; contribute to enrich soil organic matter contents and carbon sequestration. Furthermore, farmers benefit from enhanced soil fertility besides improved biological pest control since covers help to break weed cycles reducing the need of using herbicides.

For example, one farmer experienced that in plots where cover crops were sown, after intense rainfall, the loss of soil was less intense than in plots with bare soil and even more, yields were the same in both cases.

Spontaneous cover in Al Alma del Olivo (November 2019).

Farmer´s concerns

1. Water competition with olive trees
2. Not always easy to implement, necessary to explore the best option for each farm system, type of soil and agro-climatic conditions to decide the best species to sow, densities, appropriate time, termination, technique for removing it, etc.
3. Cost of sowing

Costs

The cost of implementing cover crops go from a few euros per hectare in the case of spontaneous cover crops (related to fuel expenses related with the works for terminating the covers) to about 80€/ha for simple sown covers (with few species or common ones like vetches) and to several hundred euros if very precise seed mixtures are selected

2.1.2. Auditing Tips

The auditor can check the following quality aspects of cover soils:

- Number of days/year with agricultural soil covered by vegetation that is not the main crop.
- Structural diversity of the cover cover crops (not just a grass community) depending on agroclimatic conditions
- High diversity of plant species
- Natural, autochthonous seeding mixtures should be used
- Soil should be left bare the minimum amount of time, mown in Spring (beginning or middle depending on the agroclimatic conditions)

2.1.3. Lessons learned and recommendations

Wild cover crops grow during the autumn and winter time. They sprout with the first summer rainfall and are usually terminated in spring. The moment for removing the cover crops depends on the water availability (early spring in rainfed olive groves, permanent in some irrigated farms) and hydric competence with olive trees. It is highly recommended to use reliable methods for estimating hydric competition for maximizing the cover crop lifespan and its benefits. This entails a close relationship with local technician and advisory systems for understanding at what time of the year, according to weather conditions, the evapotranspiration levels become crucial. Whether the cover is sown or wild, there is no reason for not having soil covers during the winter. This time of the year is critical in terms of erosion and nutrient leaching, and the conditions for having a soil cover are excellent. When the covers are sown, the species used shall be native and adapted to the soil, micro climatic conditions and the desired function. It can include grasses, leguminous species, Brassicaceae species, cereals, etc. Short cycle species and a reduced soil work during the crop season will promote the existence of a seed bank that will naturally flourish every autumn, although regular sowing is recommended. The termination of cover crops can be done in several ways. The use of herbicides, an option quite spread, is not recommended. Mowing is a good option but it is usually preferred by farmers that want to establish permanent cover crops, as plants tend to re-grow during the spring and need further mowing. In rainfed olive groves, cover crops are usually terminated by a reduced tillage that incorporates plants and improves water infiltration of spring rainfall.

2.1.4. Quick Note

Sown or spontaneous covers have a notable positive effect on biodiversity, especially on soil microbiota and consequently for invertebrates and bird populations.

In general, Soil covers can be described as follows:

Cost	**Benefit for biodiversity**	**complexity of implementation and management**
€ €		

„Cost“ relates to the monetary and time expenses caused by the measure.

“Benefit for Biodiversity” symbolizes the positive effect of a measure for biodiversity.

“Complexity of implementation and management” describes the amount of work related to the implementation and the maintenance of a measure.

This scale is meant to compare the different actions with each other regardless of the area on which the actions are usually applied

2.2. Use of adapted traditional varieties:

Almost all the Mediterranean regions in Europe have their own olive varieties. They were selected over the centuries by farmers for being adapted to local conditions (soil, water needs, temperatures…), for yielding a reasonable amount of high-quality fruits and for having a good aptitude for their end use (raw olives, olive oil). The use of native varieties is also a good strategy for getting differentiated in the markets from other olive producers, but also for diversifying production within a region. Varieties, even in the same region, can have very different aptitudes for oil making. Finally, adapted varieties to local conditions shall be considered as the best insurance against climate change, as genetic diversity within crops is the basis for any improvement, being naturally or human. More information on the advantages of Agro-Biodiversity can be found in the Biodiversity Knowledge Pool.

Cooperativa de Viver & Serrana variety, a success love-story

Back in the 90s, when local varieties were not still a trend in olive oil sector, Cooperativa de Viver decided to make its best bet until now: producing extra virgin olive oil with the native olive variety called Serrana. This variety is restricted to a few municipalities in Espadán mountains (Castellón, Spain). By this time, and still now, most cooperatives and farmers mix all the varieties. The personality of the varieties gets therefore diluted and this heritage lost over time. A poor selection of olives has also a tremendous impact of the olive oil produced. For example, including olives with fruit fly damages, using fruits harvested from the soil, leaving olives for hours until milled or harvesting them much too ripened will result in defects on the oil and will decrease the quality from "extra virgin" to lower categories. The decision was clear: it was not just a matter of using the native variety but to make the best out of it.

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The result is called "Lágrima" (from Spanish, tear): an extra virgin olive oil which has deserved several International and National Awards and that is used by the best chefs in the region. But the success comes also from another part: despite the reluctance shown by some farmers at the beginning, Lágrima production allows a fair and better revenue to farmers. If you want to know the secret, just note down: 100% Serrana, green olives barely ripening, close advisory and good agri-environmental management, selection of plots and fruits, 4 hours from harvesting to olive milling, just mechanical extraction in cool conditions… and tones of passion. As quality is a wide concept, Cooperativa de Viver went further in terms of sustainability. They calculated some years ago their carbon footprint and are now reducing GHG emissions. The have also joined the LIFE Food & Biodiversity project to better understand Lágrima contribution to biodiversity.

2.2.1. Benefits and experiences

Native varieties are adapted to local conditions and this generally means a better agronomic performance according the hydric conditions, type of soils, temperatures, etc. in which trees grow. Genetic variability is also important in terms of pest and diseases' sensitivity. For example, some varieties are known for their resistance to *Verticillium* while others have shown to be resistant to *Cycloconium* and other pests. Finally, different olive varieties, even in the same region, can have very different chemical and organoleptic profiles (polyphenols, oleic acid, etc.). This is very important not only for obtaining different flavors, but also for specializing in different end uses (for example, olive varieties rich in polyphenols produce oils with a longer shelf life, while varieties rich in oleic acid are best suited for being used at high temperatures).

Farmer´s concerns... and potential solutions

1. Native varieties are less productive than some varieties
   Not always true. In most cases, crop management is more important for maximizing yields than the varietal component. In case it is true, just make it work for you: use it as a claim for attracting consumers that look for scarce and high-quality products.
2. Consumers are used to other well-known, even famous, varieties
   Yes, but they are also willing to discover new flavours and the olive oil market has shown to be very dynamic in that sense.
3. Changing the variety is a long-term investment and means less benefits in the short term
   Consider it for new plantations, or graft the varieties you planted that do not work well. Most varieties reach their maximum yield in a few years.
4. In the olive mill, all the varieties are mixed, so why growing something different?
   Hire an expert and learn about the properties your native variety has, you may be surprised. Convince the company managers or the cooperative members that using your local variety can be an advantage in the market. If it is possible, mill separately at least part of the different varieties. If you are not satisfied, you can always make a coupage afterwards.

2.2.2. Auditing Tips

The auditor can check the following quality aspects regarding the native olive varieties:

- The native character of the variety is supported by reliable documents (e.g. Regional Strategy for Phytogenetic Diversity; National/Regional catalogues of native variety).
- The surface occupied by the native variety is significant in the sourcing area.
- The native variety supply volume is consistent with the planted surface.
- If there is a claim regarding the use of native varieties for olive oil production, a reliable traceability system can support it.

2.2.3. Lessons learned and recommendations

The Mediterranean basin is the most important area for olive oil production accounting for 75% of the World production. Spain, Italy and Greece are the three countries in which EU production is concentrated. However, there is a growing olive oil industry in the North of Africa that will be very soon the most important competitor for EU production. The combination of modern plantations (much more efficient than the traditional olive groves) and low salaries, result into very low production costs, even for high-quality olive oil (extra virgin olive oil). Varietal differentiation (along with high nature value production systems and high-quality oil production methods) is a tool that EU olive growers cannot ignore. Producers may need the help of researchers and authorities to characterize their native varieties, its peculiarities and aptitudes, and also to recover them. There are a lot of examples that demonstrate that betting for local varieties help to better position olive oil in the market and obtaining fair revenues for producers.

2.2.4. Quick Note

The experiences gained in the olive pilot farms show positive experiences for the farmers and companies differentiating their production in terms of native varieties:

Cost **Benefit for biodiversity** **complexity of implementation and management**

„Cost“ relates to the monetary and time expenses caused by the measure.

“Benefit for Biodiversity” symbolizes the positive effect of a measure for biodiversity.

“Complexity of implementation and management” describes the amount of work related to the implementation and the maintenance of a measure.

This scale is meant to compare the different actions with each other regardless of the area on which the actions are usually applied (e.g. dead wood is piled on a few m², whereas a flower strip is sown on a few ha).

2.3. Integrated pest management applied to the olive fruit fly

The olive fruit fly (*Bactrocera oleae*, formerly known as *Dacus oleae*) is the most important pest in olive plantations. It is a fly that has co-evolved with wild olive trees and then with cultivated ones, and therefore is perfectly adapted to the conditions in which olive trees grow and to the crop cycle. *Bactrocera* has an impact both in quantity and quality of the olives. Some damaged fruits fall into the ground resulting in a loss of yield, but the affected olives that do not fall have reduced aptitudes for high-quality olive oil making. The fight against the olive fruit fly concentrates most of the efforts of olive farmers, as its incidence is usually much higher than any other pest. Another important point is that the rest of the pests and diseases can be controlled using low toxicity products, being the fruit fly treatments in most cases the most important barrier for becoming organic.

The general principle of Integrated Pest Management (IPM) should guide the actions taken on a farm for fighting any pest. The principles consist out of a few basic requirements, which any farmer should follow: prevention, setting economic thresholds, monitoring, preference of non-chemical over chemical methods, preference of selective over wide action substances, and evaluation. Unfortunately, pest management is still widely done on a calendar basis, that is, scheduling treatments along the year without understanding the pest population, the incidence of natural enemies or the real damage the pest is producing. More information on the Integrated Pest Management can be found in the Biodiversity Knowledge Pool. In the case of the olive fruit fly, promising options are gradually incorporated into farms that would entail a very significant benefits for biodiversity.


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Bactrocera oleae is small brownish fly (4-5 mm long) that can be easily identified for having a conspicuous yellow triangle in its back. Females lay their eggs under the olive skin in June and larvae begin to feed on the fruit when the olive stones harden. As summer approaches, the life cycle of the fly is accelerated due to warm temperatures and several generations can overlap. As a result, in early autumn, almost all the stages of the olive fruit fly (eggs, larvae and adults) can be found in the olive groves. When larvae are completely developed, they fall into the ground, they are transformed into pupae and metamorphize to become adult flies.

2.3.1. Benefits and experiences

Parasitoids naturally occurring in olive groves (for example, from genera *Opius* and *Pnigalio*) can contribute to the olive fly control. Some plants like the false yellowhead (*Dittrichia viscosa*) and probably other accompanying plants host these natural enemies. Ants have also been reported to feed on *Bactrocera* pupae on the ground. In short, keeping a rich environment is determinant for enhancing biological control.

The traditional treatment in conventional olive groves consist of 2-3 wide-spectrum pesticide applications, which result in a massive impact on the pest but also on natural enemies, surrounding biodiversity and induce long-term pest resistance. In the last years, traps with attractants (diamonic phosphate) have been used in combination with the pesticide classic treatments, as traps cannot substitute chemical treatments. However, new and promising techniques are appearing. They combine traps and treatments, both using low toxicity products and very reduced surface/application area. The new traps use also attractants (more stable in time than the traditional ones), but the trap taps, which are clear and used by flies to escape, include very small doses of a low toxicity substance (lambda cihalotrin, accepted in organic agriculture) that kill the insects. Therefore, the traps combine massive attraction and death. The trap density for controlling olive fly populations would be very high, and costly, so these new traps are combined with the so-called "patch" or "bait" treatment, which consist on spraying the south face of the trees (1-2 m^2) with a hydrolysed proteins (attractant) and again a low-toxicity pesticide (e.g. spinosad 0,024%) also accepted in organic agriculture. In summary, there the surface treated is 75% smaller than in conventional treatments, they are more effective for being selective and locally applied, and the products used have low toxicity compared to the pesticides used.

Farmer´s concerns

- increasing pressure from olive fruit fly
- treatment cost is higher in low-toxicity options (although hidden costs are often disregarded)
- weather-dependent effectiveness in trap-attraction systems or bait applications

Costs

Advanced trap systems: about 3€/trap with densities of 40 traps per hectare

Bait spraying: about 18€/ha

2.3.2. Auditing Tips

The auditor can check the following quality aspects for a more sustainable approach to olive fruit fly control:

- The ecological infrastructures in the olive grove and surrounding areas are considered a key aspect in pest control and well-maintained, so natural enemies can contribute to the olive fly control.
- There is a monitoring protocol for assessing the olive fly populations. Thresholds for treatments are established and the decision of treating is consistent with the monitoring results and thresholds.
- Low impact treatments (or a combination of them) are prioritised. Low impact is characterized by: the use of selective methods (selective trapping) so there is no impact on natural enemies and the surrounding biodiversity, spot applications of toxic substances so the area treated is significantly reduced, and the use of low-toxicity products.

2.3.3. Lessons learned and recommendations

Chemical treatments for controlling the olive fruit fly is the most important barrier for most olive growers to become organic. Other diseases have no significant impact on the yield or olive quality, and other problems such as fungal infections can be reasonably controlled by using substances accepted in organic agriculture. Although low-toxicity solutions are far from being widely implemented, there is an interesting opportunity for a more sustainable olive production and for certifying organically the resulting olive oil. As mentioned, this would help to better position high-quality olive oils in a market increasingly dominated by emerging producers from areas with looser environmental and social requirements.

Cooperativa de Viver has tested during the LIFE Food & Biodiversity fruit fly control using the above-mentioned methods. The results obtained in one-year test cannot be significant, as olive fruit fly populations change from year to year due to natural cycles, weather conditions, etc. In the pilot experience, plots using conventional treatment (2 to 3 applications of dimethoate; 0.4 kg of active matter of high toxicity and wide spectrum) was compared to two alternative solutions: 1) attractant and death traps in high density (40 traps/ha) and 2) a combination of these traps (same density) and bait spraying (only in south face). The benefit in decreasing pesticide pressure is double: it is estimated that in average the amount of pesticide would reduce up to 1,000 times and the toxicity of the products change from high and to low toxicity (being the latter accepted in organic agriculture). Additionally, in the trap and death alternative, this small amount of low toxicity is enclosed in a trap, reducing to the maximum the possibility of reaching wildlife. Unfortunately the costs per treatment is inversely proportional to the environmental impact, being the conventional cost (only product, no fuel or time included) about 6€/ha while the two alternative options are about 100€/ha.

2.3.4. Quick Note

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Cost **Benefit for biodiversity** **complexity of implementation and management**

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This scale is meant to compare the different actions with each other regardless of the area on which the actions are usually applied (e.g. dead wood is piled on a few m², whereas a flower strip is sown on a few ha).

2.4. Landscape elements:

Semi-natural habitats and specific landscape elements can host a high diversity of animals and plants, being therefore important to promote biodiversity. Because they provide refuge and food for a variety of organisms, a well-designed farm in terms of semi-natural habitats and landscape elements, can mitigate the impacts of agricultural activities on biodiversity, but also support agricultural production through ecosystem services. Examples of semi-natural habitat range from large ecosystem patches, such as scrubland, permanent grasslands, or fallow land, to vegetated banks associated with stone walls or more specific landscape elements such as hedges, buffer stripes, fallow land and flower strips; other examples include single trees (living and dead) in cropland, and reforested areas; there can also be semi-natural habitats associeted with water elements, like water plots (streams, ditches, ponds) or water margins (riparian galleries). More information on Landscape elements and seminatural habitats can be found in the Action Factsheets for advisors, auditors or quality managers, which describe the measures in detail and give insights in their correct management and implementation.

Landscape elements in olive groves: stone piles, dry-stone walls, feeders and drinkers for rabbits and partridges

The implementation (The three olive pilot farms, Al Alma, La Peraleña and Viver, have implemented different landscape elements; all the plots analyzed from Cooperativa de Viver).

- **Stone or deadwood piles:** Surfaces of about 15 m2 and 1 m of height. Piles are maintained and not overgrown with vegetation. Ideally 5 m2 are recommended. The most suitable position is in a sunny spot, wind-protected and undisturbed sites. 80 % of the stones should have a size of 20–40 cm, the rest may be finer or coarser. It is important to use rocks which origin from that area
- **Dry-stone walling:** this technique is used for building terraces or in field margins. They are a very common element in mountain olive groves. They are a refuge for wild fauna (lizards, snakes, insects…) and flora. Sometimes they are combined with plants and create very interesting complex structures from the biodiversity point of view. Unfortunately, they are very expensive to restore when they are damaged, as it is a job that few people can do now and entails a lot of time.
- **Feeders and drinkers for wildlife:** shaded areas with food for fauna and drinkers are placed in different points in the olive crop

Landscape elements in olive groves: water ponds, flower strips, hedges in borders.

- **Water ponds:** The water ponds can be permanent or temporary and very heterogeneous in terms of surface and depth. Ponds must have native vegetation associated and be accessible for fauna by creating irregular shores, avoiding steep slopes (less than 12°) and with different depths.
- **Hedgerows:** Hedgerow of at least 3–4 m width, with native species (3-5 different species) and a length depending on the function and the landscape mosaic. They usually hold early and late-flowering species as well as plants that produce edible fruits for fauna.
- **Field margins, flower strips:** ideally field margins should be as heterogeneous and structurally complex as possible. This means holding different types of plants (trees, shrubs, grass elements), with the highest biological diversity (species richness) and with plants that offer resources to wild fauna (fruit plants which are edible, that are produced along the year, that offer resources in winter time, etc.).

2.4.1. Benefits and experiences

Landscape elements provide **habitat and winter resources** for a variety of different beneficial animals and wildlife. **Flower margins and hedges** provide protection, foraging, nesting shelter and refuge for insects (beneficial and pollinators), hare and partridges and birds. They also serve as step stones and connect different areas for butterflies, grasshoppers and other insects. For instance, the plantations of coriander, *Coriandrum sativum,* in one pilot farm has increased the presence of lacewings, a predator of the olive fly (one of the main plagues for olive crops). Hedges support structural diversity, enhance climate regulation and act as a windbreak. In Mediterranean regions where water is a scarce resource**, the presence of water ponds is very important**, especially in dry seasons. These ponds are an important habitat and refuge of amphibians and reptiles linked to aquatic environments and suppose a water recharge of aquifers, and flood control.

Farmer´s concerns

1. Loss of productive surface (nevertheless these elements occupy a reduced surface and the losses are not significant)
2. Investment needed for some elements, as water ponds.
3. Woodpiles may not always be a good choice, especially when the olive grove has high densities of elm bark beetle or bark.

Costs

For building water ponds of 5 * 5 m: 950 €

Hedges planting costs: 100 lineal meters of hedgerows: 150 €

Sowing 10 ha of flower strips: 500 €

Water ponds in olive farm in Alcaraz Albacete

2.4.3. Lessons learned and recommendations

Olive plantations, especially traditional olive groves, are usually inserted into environmentally rich areas. For example, other trees occur naturally or are planted by farmers (e.g. fig trees, shrubs that produce edible fruits). Dry stone wall terraces were created to establish plantations, and small drinking points for water or forest patches live together with the olives. In the last decades, large surfaces were planted due to a better olive oil position in the international market, and these elements were progressively deleted from the landscape. Super-intensive high-density hedgerow plantations are the last incorporation to the olive oil scene and entails in most cases a complete disappearance of the ecological infrastructures.

However, landscape elements are so diverse that there is no reason for not implementing them, even when growing conditions are more intense. Some options may be more difficult to implement than others, some of them may entail higher investment and maintenance costs, but there are always simple elements that can be implemented.

After the experience gained in Viver plots, the biodiversity richness of field margins and hedgerows is very high by itself. In most cases, if such habitats are left undisturbed, a rich community of plants is developed and fauna makes use of it. The small size of the plots in mid mountain olive groves also eases this integration and natural melting with the surrounding habitat. Additionally, actions implemented by farmers and not expressly biodiversity-oriented, do contribute to a higher nature value. For example, stones found in the plot during agronomic works, dead trees or lugs obtained from pruning operations are usually piled and kept in parts of the plot where they do not interfere with field operations, offering interesting resources for wildlife. This proves once again that having ecological infrastructures in olive groves is easy and not necessarily expensive or time-demanding.

Anyway, **the more structural complexity** in these landscape elements, the more benefits. And this may entail some management. It's recommended, for instance in **field margins** to include species that represent the 3 strata: **grass or flowers, shrubs and tree** elements. Works such as pruning, re-planting … should be avoided during sensitive periods for biodiversity, usually in spring during breeding seasons. **Wood as well as stones** may ideally come from the surroundings e.g. collected on the agricultural plots. **Steep slopes in water ponds shall be avoided to allow free movement and easy access to fauna,** and shores shall be covered with native plants.

2.4.4. Quick Note

Diversified landscape elements have a notable positive effect on biodiversity, especially on beneficial fauna and insects.

In general, Landscape elements can be described as follows:

Cost **Benefit for biodiversity** **complexity of implementation and management**

„Cost" relates to the monetary and time expenses caused by the measure.

"Benefit for Biodiversity" symbolizes the positive effect of a measure for biodiversity.

"Complexity of implementation and management" describes the amount of work related to the implementation and the maintenance of a measure.

This scale is meant to compare the different actions with each other regardless of the area on which the actions are usually applied

3. Conclusion

Overall, 19 different actions were considered in this project for olive groves. Most of them were already implemented in the pilot farms, tested during the project or we had references from other olive farms not included in the pilots. The main conclusion is that the situation for implementing biodiversity friendly measures in olive groves is favourable, with no technical limitations or economic constraints, except for a few measures. This is due to the following reasons:

- traditional olive orchards and olive groves in mountain areas (that is, all the olive plantations except for super intensive ones) are usually integrated in the landscape, and as a result are rich in landscape elements

- olive production is mostly limited by the water availability, and traditional olive groves are in most cases in rainfed areas, being intensification limited. However, this trend is changing and olive irrigated surface has dramatically increased in the last years

- olive plantations are not especially demanding in terms of fertilization or pest management compared to other agricultural production

- the product obtained from olives (olive oils and especially extra virgin olive oil) supposes a very high added value compared to raw olives. Moreover, premium oils are a good option for EU producers that cannot compete for prices. Quality production entails in most cases a higher sensitivity to environmental aspects and company/cooperatives' staff specialization.

In this document we describe only a few measures in detail. It is a balance between those which we consider essential (which should be implemented in all olive groves, because they don't have technical or economic constraints) and those that are a bit more challenging but that would suppose a significant change if they were implemented widely. Even in the latter case, technical limitations are being overcome in the last years and only economic limitations remain. Two good examples are the cover crops and the integrated management of olive fruit flies: technical solutions do exist, more and more experiences show that alternative solutions and more environmentally-friendly are feasible, but the main barrier is still the cost.

The most important challenge for the sector is that the traditional olive groves that very easily deliver biodiversity benefits are being substituted by more efficient and intensive plantations, which have not that easy relationship with biodiversity. The pressure on olive oil price is the main lever behind this change. Public administrations, farmer unions, producers and consumers shall work together for a better recognition of farmers who work for biodiversity and quality.

All pilot farms of the LIFE Food & Biodiversity Project tested the Biodiversity Performance Tool (BPT), an online tool that helps to create a farm-specific Biodiversity Action Plan and thus supports the farmer in planning, adjusting and monitoring the measures for biodiversity on the farm. Furthermore, it helps auditors to assess the quality of the implemented measures.

4. Acknowledgement

Our special thanks go to the three cooperatives participating in the project: Al Alma, Viver and La Peraleña. Pilot farms chose voluntary to be engaged in the assessments and developing actions in order to increase the biodiversity on farm level. They accomplished their job very passionately. Thus, they contributed considerably to the project, not only supporting the project actions but also with tones of expertise. We are very grateful to all the farmers and cooperatives!

Exchange visit between the Pilot farms of the project and Tierra Verde Association in Alcaraz Albacete

A special thank goes to " Asociación Tierra Verde", in Sierra de Alcaraz, Albacete, that facilitate us a very interesting visit of exchange for our pilot farms cooperatives that allowed them to know very good practices to enhance biodiversity in olive crops.

5. Outlook

In spring 2019, the project organized "**Naturaceite**" a space for reflection on the importance of developing practices for the preservation of biodiversity in olive crops. The workshop included three round tables where academics, officials, producers and entrepreneurs of the olive sector shared their knowledge and good practices. Innovative experiences from our pilot farms and other cooperatives were presented to enhance biodiversity conservation and promotion as an element to differentiate their productions and improve the oil production quality. Within more than 60 participants from 40 different entities, the networking area in this workshop showed that there is a great space to improve biodiversity performance in olive crops.

6. Overview of the EU LIFE Project

The EU LIFE Project Food & Biodiversity "**Biodiversity in Standards and Labels for the Food Industry**" aims at improving the biodiversity performance of standards and sourcing requirements within the food industry by

- Supporting standard-setting organisations to include efficient biodiversity criteria into existing schemes; and encouraging food processing companies and retailers to include biodiversity criteria into respective sourcing guidelines
- Training for advisors and certifiers of standards as well as product and quality managers of companies
- Implementation of a cross-standard monitoring system on biodiversity
- Strong communication to raise awareness among all stakeholders in the industry

The project has been endorsed as a "Core Initiative" of the Programme on Sustainable Food Systems of the 10-Year Framework of Programmes on Sustainable Consumption and Production (UNEP/FAO).

Editor: LIFE Food & Biodiversity; Fundación Global Nature

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