Very Good Agricultural Practice

Guideline on Water Use and Biodiversity

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 guideline, we provide information about the current situation of water and its use in the agricultural sector, focusing on temperate climatic regions, as well as background for the measures of very good agricultural practices described in the "Recommendations to improve biodiversity protection in policy and criteria of food standards and sourcing requirements of food companies and retailers".

2. Water

Where there is water there is life, and its efficient and responsible use in agriculture is essential to the biodiversity and health of the ecosystem, being a fundamental, scarce and vulnerable resource.

It is fundamental in the sense of playing a key role in irrigation, proper animal nutrition and health and hygiene on farm level; vulnerable, because of the risk of pollution through nutrients, chemicals, pesticides and high content of organic matter derived from the agricultural activity; and scarce, since agriculture is a major user of fresh water and its availability is already in question for the coming years.

The scarcity and the irregular distribution of water in the foreseeable future, comes through the increasing demand of water for domestic and industrial use and through the effects of climate change. The expansion of drought-prone areas, the increasing of heavy rainfall events and of more frequent floods, makes the efficient management of water more and more difficult. This scenario leads also to an increment in price of the resource.

The balance between water demand and availability has reached a critical level in certain areas of Europe, where surface and groundwater levels have lowered and wetlands have being dried out, affecting also fish and bird life. Where the water resource diminishes, a deterioration of water quality normally follows, because there is less water to dilute pollutants and a simplification of the ecological processes usually occurs. In addition, salty water increasingly intrudes into over-pumped aquifers along the coast, which diminishes their quality and can even prevent subsequent use.

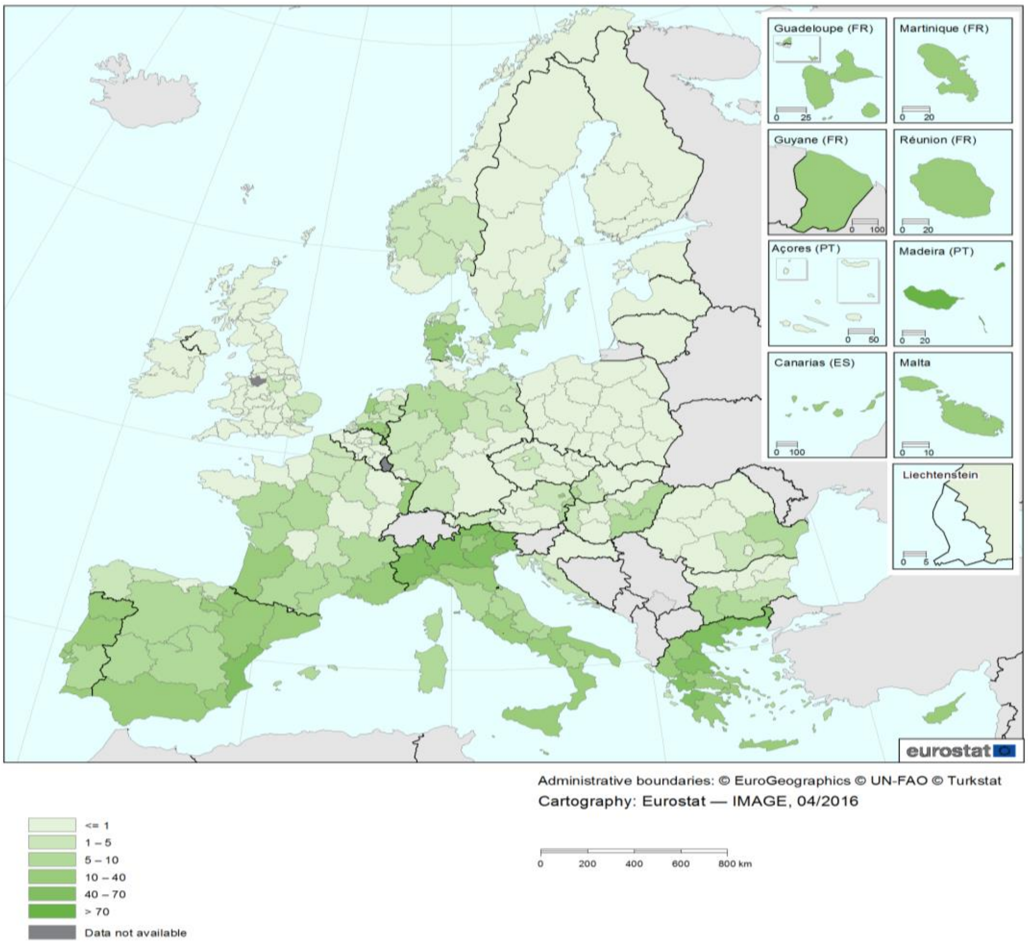
While water is a key element for enhancing yields and the quality of crops, the use of water for irrigation is also the cause of several impacts all over Europe. The effects of over-exploitation of this resource depend on the volume and season of the abstraction, the volume of returned water, the type of ecosystem and specific regional conditions. Of great importance is the timing of abstraction, being the peak typically during the summer season when water availability is normally at a minimum. In addition, agriculture has a high consumptive water use, with low return rates to a water-body after its use.

The management of water resources across Europe has traditionally focused on a supply-side approach. In Europe, regular supplies of water have been ensured using a combination of reservoirs, inter-basin transfers and increasing abstraction of surface water and groundwater. The disproportionate emphasis provided no incentive to limit water use in any sector, which left the major driving forces of use unchanged. However, the challenge is to reduce water consumption, increase the efficiency of the systems and re-use and recycle water as much as possible.

Also, where irrigation water is provided by public or private sector suppliers or via collective irrigation systems, tariffs only reflect the operational and maintenance costs, since governments often subsidize the other capital costs. As a result, water price does not reflect the actual cost, which does not help to act responsibly.

In the map below (2013), it can be observed that the share of irrigated areas in Southern Europe and the Mediterranean area is generally higher than in central and northern Europe. This is the result of a warmer climate, an irregular distribution of rainfall throughout the year and the need to compensate large dry periods with external water inputs.

Figure 1: Share of irrigated areas, 2013 (%)



The need for a more sustainable and integrated approach to managing water resources in Europe is reflected in water-related policy and legislation. The Water Framework Directive (WFD) for example, requires the 'promotion of sustainable water use based on long term protection of available water resources'. According to the WFD, EU member states were expected to set up appropriate water pricing policies by 2010 and implement them so that they provide incentives for the efficient use of water resources.

The European Commission has also recognized the challenge posed by water scarcity and droughts in a 2007 Communication COM/2007/0414. This outlines the severity of the issue and presents a set of policy options to address the issue including water pricing and a focus upon water efficiency and conservation.

Also, the Common Agricultural Policy (CAP) can be a very useful instrument to improve water management, although nowadays its potential is reduced to the some basic measures in Cross-Compliance, and only leaves room for more ambitious action in the second pillar, which Member States can implement or not. Furthermore, there are other policies in the EU which do not focus on water management but have a direct influence on it, such as the Habitats and Birds Directive, the Nitrates Directive and the Directive on Sustainable Use of Pesticides.

In 2012, the European Commission came with a Blueprint to safeguard Europe`s water resources. The 'Blueprint' comprehends actions for a better implementation of the existing water legislation, integration of the objectives exposed and detecting gaps in the current legislation, regarding for example quantity and efficiency. It makes a synthesis of water policy recommendation and its horizon covers a time span up to 2050.

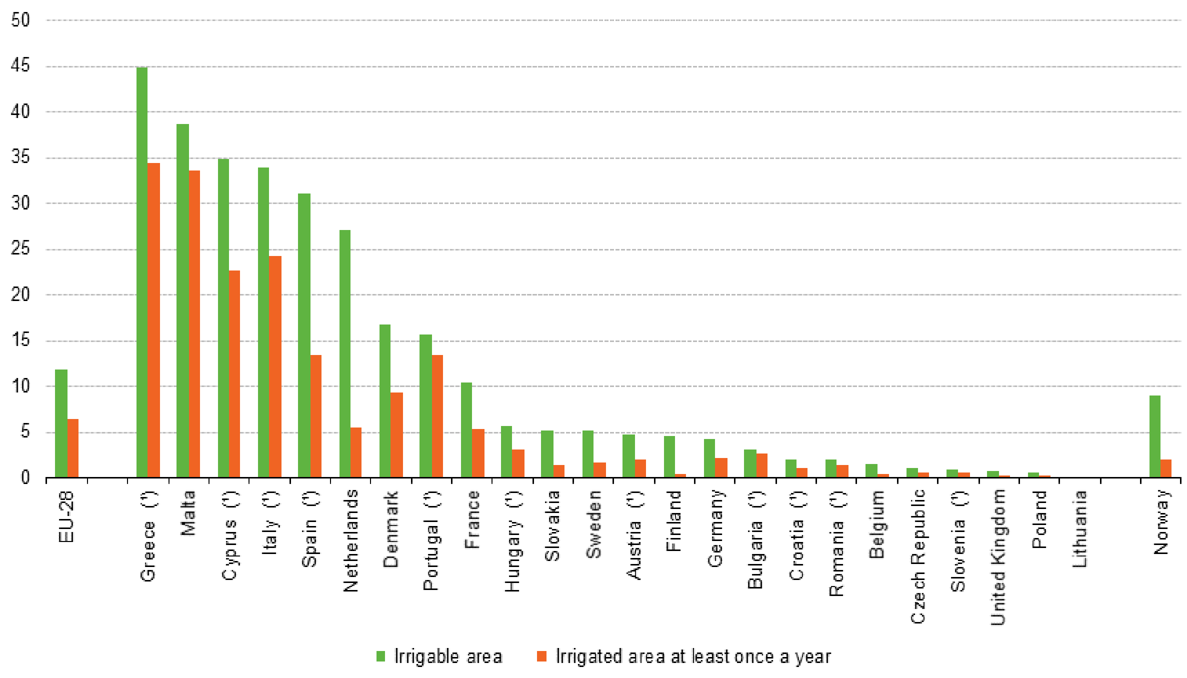
3. Very Good Agricultural Practices for Water Efficiency, Protection and Enhancement of Biodiversity

Good practices for water management at catchment level are not addressed in this document. The management of water at this geographical scale is regulated in Europe by several of the abovementioned policies. Water management authorities at the European, National and Regional level are well established. Although illegal withdrawal may occur in some particular situations, the problems encountered in other areas of the world (e.g. river and catchment area modification, impact on high value ecosystems, impact on local communities, etc.) are not relevant in European temperate regions. This is why the focus of this document is the efficient management of water at farm level.

The total irrigable area in 2013 accounts for circa 18.7 million ha (11.3% of the UAA), although only 10.2 million ha (6.2% of the UAA) were actually irrigated. These areas greatly vary among countries, mainly due to regional climate, and being more important in the Mediterranean countries. Spain and Italy had the largest irrigable areas in 2013 (6.7 million and 4.0 million hectares respectively). Greece, Malta, Cyprus, Italy and Spain had the largest share of irrigable UAA in 2013 (44.9 %, 38.6 %, 34.9 %, 33.9 % and 31.1 % respectively), while the largest share of irrigated UAA in 2013 was 34.4 % in Greece, 33.6 % in Malta, 24.3 % in Italy, and 22.6 % in Cyprus.

In Central and Western Europe, irrigation is also used on a supplementary basis to improve crop production in dry summers. This trend is well shown by the relatively large share of irrigable area in the Netherlands (27.0 %) and Denmark (16.8 %) in 2013, while only 5.5 % of UAA in the Netherlands and 9.2 % in Denmark was actually irrigated that year.

Figure 2: Share of irrigable and irrigated areas in UAA, 2013 (%)



Note: Estonia, Ireland and Latvia not significant; Luxembourg: data not available.
(¹) UAA calculated without common land.

Regarding the volume of water consumed for irrigation, it was estimated in 2010 that around 40 billion m³ of water were used to irrigate approximately 10 million hectares of land in the EU.

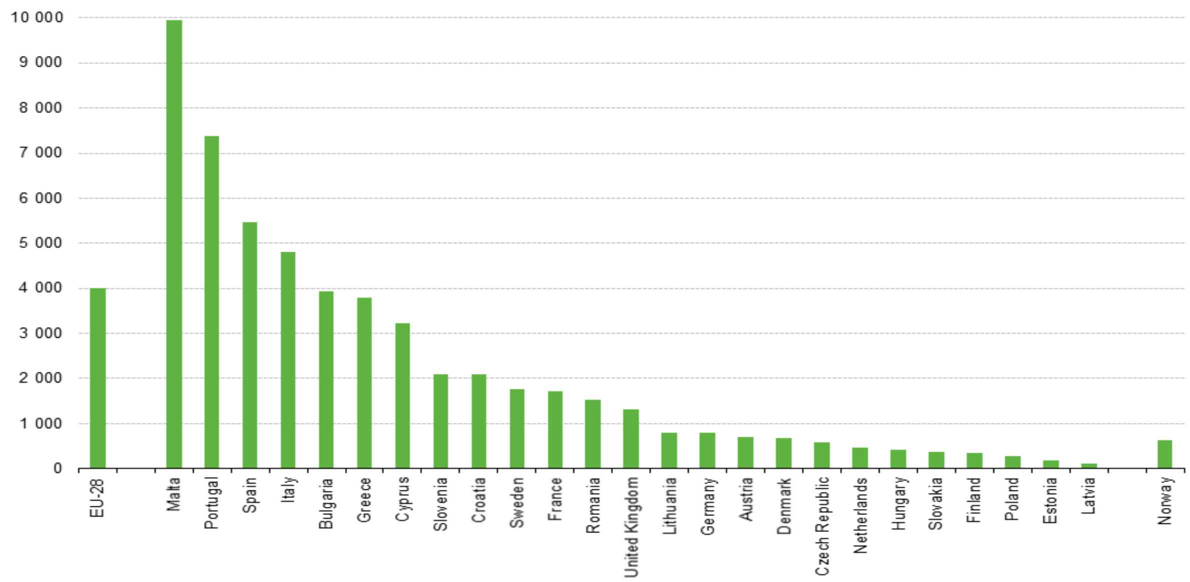
The highest volume of water used for irrigation was in Spain, with 16.7 billion m^3, followed by Italy with 11.6 billion m^3. However, special attention must be paid to the average volume of water used to irrigate one hectare of land. In that case, Malta used by far the highest volume of irrigation water with 9,956 m^3 per hectare in 2010. The scarce groundwater in Malta has been heavily exploited by farmers through wells to extract good-quality water. That is leading to the salinization of the aquifers and farmers even had to invest in reverse osmosis plants to desalinate the extracted water. Furthermore, Malta`s aquifers are getting polluted by the high nitrates use in agriculture. Malta's consumption per hectare lies far ahead of Portugal (7,371 m^3) and Spain (5,471 m^3). Bulgaria, Greece and Cyprus follow with values between 3,900 $m^3$and 3,200 m^3.

Figure 3: Volume of water used for irrigation, 2010

	Total area irrigated at least once a year (1 000 ha)	Volume of water used for irrigation per year (1 000 m³)	Average volume of water used for irrigation (m³ per ha)
EU-28	9984.3	39 863 943	3 993
Belgium	4.3	:	:
Bulgaria	90.4	355 610	3 934
Czech Republic	19.2	11 147	581
Denmark	320.2	219 246	685
Germany	372.8	293 374	787
Estonia	0.3	60	182
Ireland	0.0	0	0
Greece	1025.2	3 896 683	3 801
Spain	3044.7	16 658 538	5 471
France	1583.6	2 711 481	1 712
Croatia	14.5	30 281	2 091
Italy	2408.4	11 570 290	4 804
Cyprus	28.3	91 510	3 235
Latvia	0.7	73	103
Lithuania	1.5	1 215	794
Luxembourg	:	:	:
Hungary	114.6	48 907	427
Malta	2.8	28 176	9 956
Netherlands	137.3	64 857	472
Austria	26.5	18 316	692
Poland	45.5	12 855	282
Portugal	466.3	3 437 366	7 371
Romania	133.5	203 667	1 526
Slovenia	1.3	2 644	2 098
Slovakia	14.8	5 579	376
Finland	12.6	4 369	346
Sweden	63.3	111 053	1 756
United Kingdom	66.4	86 647	1 306
Norway	40.4	25 262	626

Note: the value '0' means that less than half the final digit shown and greater than real zero.

Figure 4: Volume of water used for ¡rrigation, 2010 (m3 per hectare of irrigated area)



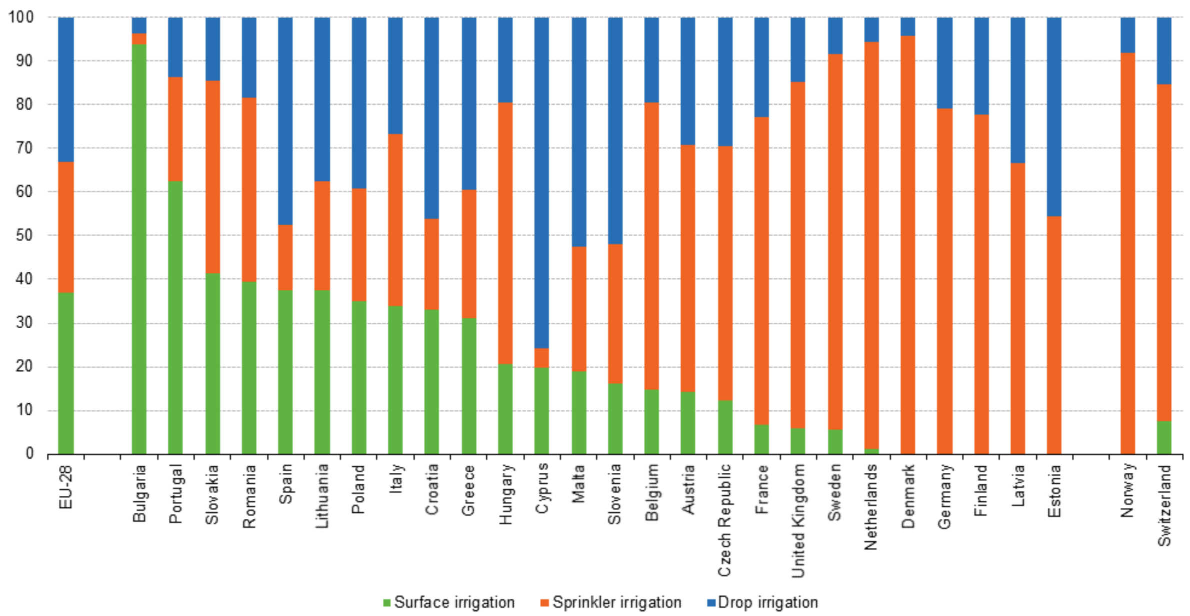
Note: Ireland:data considered not existing or non-significant; Belgium and Luxembourg: data not available.

Different irrigation methods are used and can be divided into surface or flood irrigation, sprinkler irrigation and drip irrigation.

Sprinkler and drip irrigation methods use less water than surface irrigation, which still predominates in some countries like Bulgaria and Portugal with 93,7% and 62,5% respectively. Drip systems tend to be more efficient in their use of water but are more expensive to implement. Still, in 2010 drip irrigation was the most widespread form of irrigation in Cyprus (applied by 75.9 % of all holdings with irrigation area), Malta (52.5 %) and Slovenia (52.0 %).

In the graphic below, the different methods and the share of holdings adopting each method per country of the EU can be seen. A reduced use of sprinklers in warmer countries can be also observed, where the water evaporation during the irrigation process can be very significant.

Figure 5: Irrigation methods, 2010 (% of holdings using each method)



Note: Ireland: data considered not existing or non-significant; Luxembourg: data not available.

Special attention must also be drawn to the irrigation system design. A design with the right emitters, the right distribution and the right materials implemented in the right place and at the right time, can have an enormous impact on the irrigation efficiency.

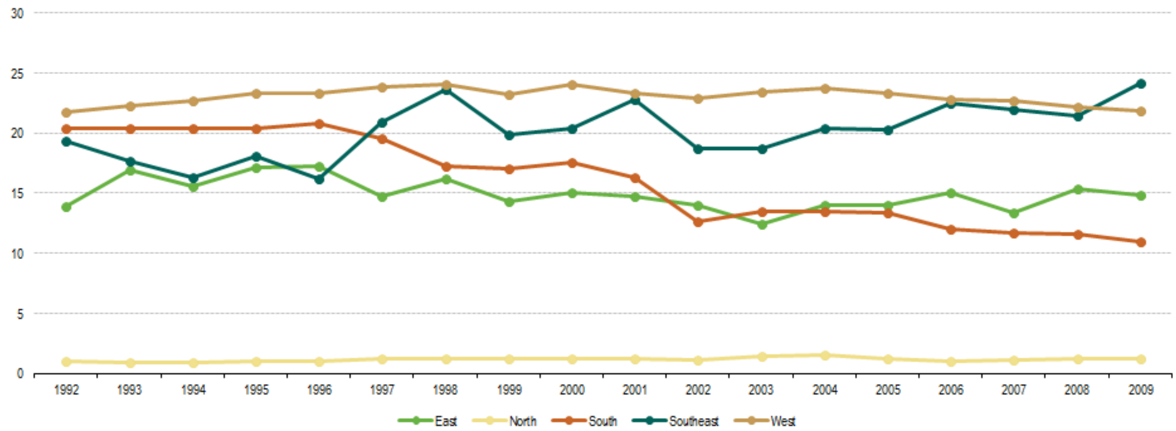
Apart from the need of an increment in water use efficiency, there are other issues affecting water quality like nitrates and pesticides pollution.

Excessive emissions of nutrients to water cause eutrophication, characterized by the proliferation of algal blooms, which not only reduce the clarity of water, but also involve frequently toxic cyanobacteria and are associated with the loss of native plant and animal species. Agriculture contributes with 50 to 75% to the high nitrate levels in freshwater across Europe.

Although nationally averaged nitrate concentrations are well below the Nitrate Directives and Drinking Water Directive limit of 50 mg NO_3/l (11.3 mg N/l), 13.2% of the groundwater monitoring stations across Europe exceeded that limit in for the reporting period 2012-2015. The highest proportion is observed in Spain, Germany and Malta (>20%) for the same reporting period. However, in general terms, groundwater nitrate concentrations have remained rather stable since 1992.

Regarding rivers, both national and river basin scale are below that limit, but current concentrations are enough to promote eutrophication though.

Figure 6: Annual average nitrate concentration in groundwater aggregated to different geographical regions of Europe, (mg NO_3/l),(1992 - 2009)



NB: The data series per region are calculated as the average of the annual mean for groundwater bodies (GWB) in the region.
Only complete series after inter/extrapolation are included (see the CSI 020 indicator specification).
As a result, stations used in the trend analysis are typically fewer in number than the set of stations used to portray the present day situation in Figure 1.

East (4 countries, 27 GWB): EE (5), LT (5), SI (7), SK (10).
North (3 countries, 37 GWB): FI (33), NO (1), SE (3).
South (1 country, 4 GWB): PT (4)
Southeast (1 country, 24 GWB): BG (24).
West (7 countries, 283 GWB): AT (26), BE (25), DE (115), DK (40), IE (67), LI (1), NL (9).

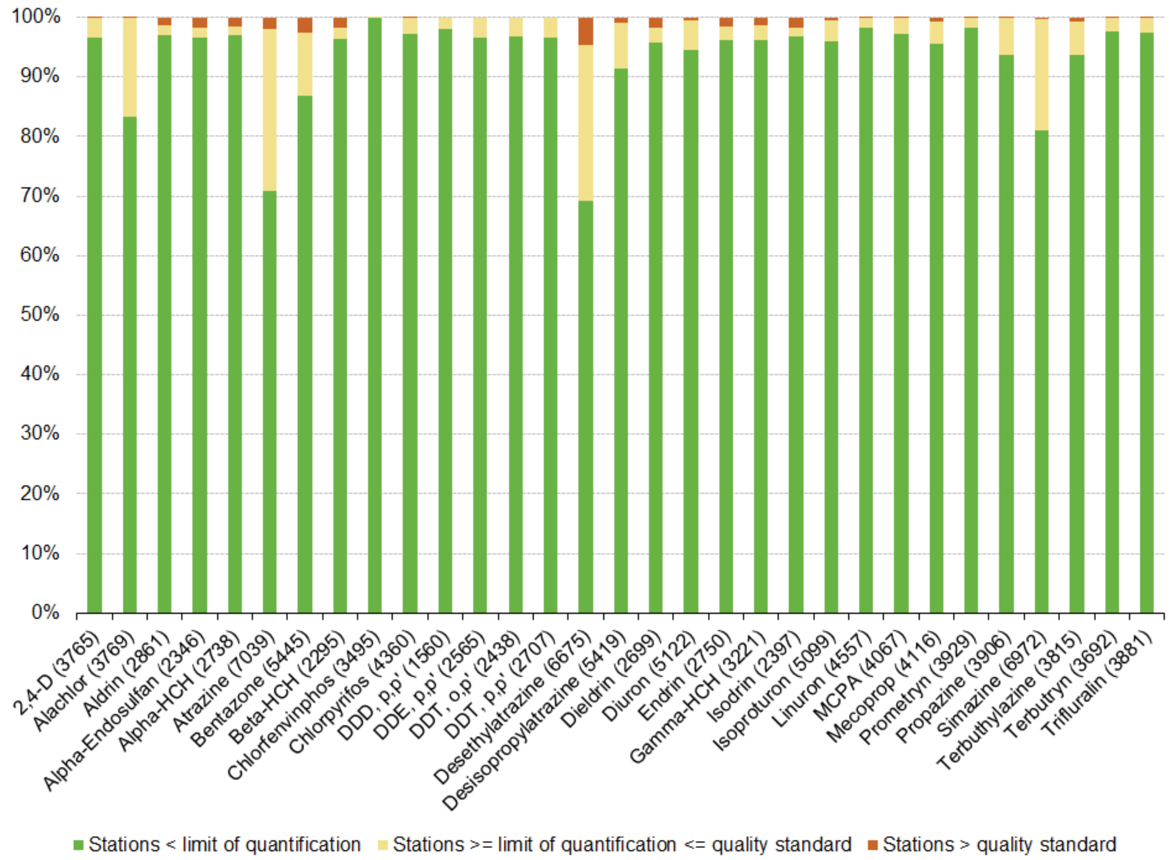
In the case of pesticides pollution, several European water bodies are also at risk nowadays.

Pesticides are used to control pests, weeds and diseases in agriculture. Although they are rigorously risk assessed, their use can lead to harmful effects upon non-target organisms in the wider environment, and even to risks for human health. Agriculture is the greatest contributor to pesticide entry in European surface and groundwater.

Several countries in Europe report groundwater concentrations of pesticides exceeding the quality standards (7% of the EU groundwater sampling stations reported excessive levels for one or more pesticides in 2010-2011). Atrazione and its metabolite Desethylatrazine are the more frequently detected pesticides exceeding the threshold vlaues of the quality standards.

At a river basin scale, the average annual concentrations of Alachlor and Atrazine were below the Environmental Quality Standards (EQS). For the rest of the pesticides monitored, except the Cyclodiene-group and Endosulfan, the EQS was exceeded less than 5% of the river monitoring stations. The EQS for the Cyclodiene-group were exceeded in 43% of the measured rivers, and in 35% of the river monitoring stations for Endosulfan.

Figure 7: Ocurrence and exceedance of Environmental Quality Standards (EQS) of individual pesticides in groundwater monitoring station (%), 2010-2011.



([1]) BE, BG, CZ, DK, DE, FR, IT, CY, AT, PL, SI, SK, UK, CH

Note: Numbers of monitoring stations are given in brackets.

The efficient use of water in animal breeding farms is essential and must be carefully managed. In this case, water is mainly used for animal drinking and hygiene activities, but it is also relevant in other processes like the cooling down of milk in plate heat exchangers. Practices like harvesting rainwater in tanks or recycling plate heat exchange water can also be very beneficial, since this water is generally suitable for animal consumption and farm cleaning, reducing considerably water inputs from other sources.

All the above mentioned impacts on biodiversity caused by poor water management at farm level can be significantly reduced through a strategy based on (1) an improved water use efficiency, (2) measures for protection of water bodies and (3) enhancement of biodiversity through water. All of them are described on the following pages.

3.1. Very Good Agricultural Practices for More Water Use Efficiency

By a better knowledge and sensitivity on the topic of water, an improved efficiency in its use and the adoption of technology and decision-support tools, water use management will become more evident. Very good practises are listed below.

3.1.1. Irrigation recording sheet

The first and basic step for monitoring the water used and optimising its use is an Irrigation Recording Sheet that can be easily integrated in the Farm Register Books.

Farmers can record a dedicated line for each irrigation episode recording the time devoted to each irrigation, the flow rate and the total volume used (if the farmer is not registered on a water meter, these figures shall be estimated); the sum of the water used during the crop cycle (total volume and total volume/ha); and the monthly rainfall, which is also recommended to be noted.

The objective is that farmers keep a record of the water used for irrigation and can improve their efficiency based on solid reference. There are further complex calculations that can be made regarding water use at farm level, tailored to specific crops, but this background information will always be needed as a starting point.

Status-quo: What is the actual situation in European agriculture?

Since the maintenance of an irrigation recording sheet is not mandatory within the EU , the action is not widely adopted by European farmers.

Challenges to implement these measures

There are no technical or economic constraints except for the necessary timely effort.

Implementation on the farm

In the table below, an example for an irrigation recording sheet is shown.

Date	Duration (h/week)	Flow rate (l/m)	Consumption (l/ha)	Water source

Apart from this, it is ideal to have a record of the amount of rainfall water per month for further consulting.

3.1.2. Irrigation systems for maximum efficiency

Where water is a scarce resource and water requirements of the crop are high, the following systems reduce the water used and ensure a high efficiency.

a) Standard drip irrigation

Apart from reducing the water used and increasing the efficiency, the use of drip irrigation has other benefits:

- The impact of weeds is reduced due to less soil surface moisture, so fewer herbicides are needed.
- Fertiliser use is more efficient as it can be distributed with every irrigation pattern, therefore delivering the right amount of fertiliser, in the right place at the right time.
- Low pressures in the tube system reduce energy costs.
- The system can be adapted to a wide range of agro-climates, soils and crops.

Special care should be taken with emitter components in the system. A regular inspection is needed to prevent them from blockage.

Drip irrigation shall be used when water consumption for irrigation exceeds 2,500 m^3/ha/year. When the used water volume is lower, the required investment may be a constraint.

Status-quo: What is the actual situation?

Drip irrigation is used all over Europe, representing 33% of existing irrigation types on agricultural holdings in 2010. However, its use is more frequent in the South and the Mediterranean area, reaching even 75% of holdings in countries like Cyprus or almost 50% in Spain. Where the region is warmer and water resources are more irregularly distributed, efficiency increases through drip irrigation.

On the other hand, in Central and Northern Europe its use is not so widespread, since lower evaporation and evapotranspiration rates coupled with a more gentle climate and water resources more evenly distributed, make other systems like sprinklers more suitable. In countries like Denmark or The Netherlands for example, only 5-10% of the holdings used drip irrigation in 2010.

Challenges to implement these measures

This practice entails additional costs for the farmers (e.g. annual fuel or electricity consumption for pumping and annual cost of tubing), but it is a very well established practice in warmer areas that can be of high interest for farmers according to climate change projections and, where implemented, farmers do appreciate the agronomic benefits of localized irrigation systems mentioned above.

b) Buried and semi-buried drip irrigation

Drip irrigation efficiency can be increased if the tubing is buried (at least 15 cm) or semi-buried (about 5 cm). This way, water is released closer to the root system and evaporation is reduced, and as a result water use is optimized.

Apart from water use optimization, the described technique has other benefits, such as a reduction in the risk of wild animals (especially birds and mammals) damaging the tubing, a lower risk of the wind blowing the tubing and less fungal diseases in the plant neck.

Buried and semi-buried drip irrigation has a higher cost than standard drip irrigation, as the installation and the tubing used are more expensive. This practice is normally adopted by holdings with high water consumption or for very demanding crops (at least when water consumption for irrigation exceeds 2,500 m^3/ha/year).

Status-quo: What is the actual situation?

Buried and semi-buried drip irrigation are not widely spread in Europe and for its implementation, an advanced knowledge of the irrigation needs and limitations is required. Apart from meeting crop and soil requirements, in some areas fauna damages or strong winds have been the driving forces to implementing this advanced practice.

Challenges to implement these measures

Burying (at least 15 cm) tubing has an additional cost compared to non-buried systems, due to installation cost and the use of thicker tubing. It also entails a certain risk, as tubing may be blocked by passing machinery and the farmer has a limited access for repair. In the case of semi-buried (at least 5 cm) systems, these risks are reduced, but also the potential benefits mentioned above apply.

Figure 8: Example of semi-buried drip irrigation

3.1.3. Decision support tools for irrigation

Decision-support tools are technologies that can help farmers to make well-informed decisions regarding the irrigation of the crop (e.g. tensiometric probes, dendrometers, suction probes, multispectral analysis, etc.). They are used for measuring different parameters regarding climate, soil and plant, and allowing the farmer to know with high accuracy the water needs of the plants and defaults in their irrigation systems, fertilization or pesticides application.

The data provided by these tools are very useful for monitoring and identifying the diurnal peak necessities of crops and allow the farmer to act accordingly by implementing, for example, the following practices:

- **Changing the time for irrigation**: the practice of changing the time for irrigation is one example of the high utility of this information. It might happen that some crops make better use of water at night than others, or crops which do not consume any water at night at all. Measuring their water consumption at different times during the day will allow the farmer to act accordingly and increase irrigation efficiency, crop health and yields per unit of irrigation water applied.
- **Deficit irrigation**: through the practice of deficit irrigation**,** water is applied mostly during the drought-sensitive growth stages of a crop (normally, the vegetative stages and the late ripening period). The total irrigation application is not proportional to irrigation requirements throughout the crop cycle. For this practice to work, the farmer needs to know the level of transpiration deficiency tolerable without significant reduction in crop yields. The main objective of deficit irrigation is to increase the water use efficiency of a crop by eliminating irrigation that have little impact on yield. The resulting yield reduction may be low compared with the benefits gained through diverting the saved water for other purposes.

Technology for informed-decision making in precision agriculture has increased significantly over the last years and this development is expected to be even more important during the coming years. It is impossible to describe in this document all the available technology for better irrigation and moreover this information would be rapidly outdated. On the next page, the main tools currently used are described.

a) Tools for climate-soil-plant control

- **Climate sensors (weather stations):** weather stations are facilities with instruments and equipment to measure atmospheric conditions such as temperature, atmospheric pressure, humidity, wind speed, wind direction, precipitation amounts, solar radiation, etc. This data can be also obtained from state agencies and other institutions in Europe, which can complement or substitute this tool on farm level. When this information is used by specialists at regional level, it can be a powerful tool for supporting farmers and for suggesting irrigation needs, timing, etc. See for example: http://riegos.ivia.es/necesidades-de-riego
- **Soil sensors:** soil sensors measure the moisture in the soil through different methods:
    - Tensiometers: measure the soil moisture tension in the vadose zone. It offers good accuracy and an instantaneous reading of the soil moisture tension. They are difficult to use in clay soils though, and a bit labour intensive to read.
    - Capacitance probes: measure the change in capacitance of the soil depending on the moisture level. Very little maintenance is required, although it is difficult to use the device in drier soils and several of them are needed for representative sampling.
    - Neutron probes: measure the change in speed within neutrons, which corresponds to soil moisture. It is very accurate and no cables are required. On the other hand, it is an expensive tool and labour intensive, uses radiation to work and requires an operator license.
    - Electric resistance blocks: measure the electric resistance of soil moisture. The reading is instantaneous and works over a larger range of tension. It is affected by the soil salinity and is difficult to use in clay soils.
    - Wetting front detectors: measure the depth of water in the soil. It is easy to use and a low cost tool. However, the accuracy is not their strongest point.
    - Modified atmometers: measure the evapotranspiration. They are relatively cheap and easy to use. It needs calibration and only provides reference evapotranspiration values.
- **Plant sensors (dendrometers):** a dendrometer is used to measure plant growth and water use, recording small contractions and expansions in plant tissue over a daily cycle and growth over several days, weeks or months. It is easy to maintain, non-destructive, and can be easily installed on trunks, stems, branches or fruits.

b) Teledetection and GIS tools

For optimum utilization of available water resources in agriculture, timely and reliable information regarding their nature, extent and spatial distribution along with their potential and limitations is of great importance.

The accuracy of data is improved when spatial tools like the Global Positioning System (GPS), Remote Sensing (RS) and Geographic Information Systems (GIS) are used.

This data is collected by satellites, conventional airplanes and/or drones. But it is in the area of multispectral imaging camera drones where the greatest improvements are being made.

Multispectral camera remote sensing imaging technology uses Green, Red, Red-Edge and Near Infrared wavebands to capture both visible and invisible images of crops and vegetation. It can measure the water content of the soil and control crop irrigation identifying the areas where water stress is suspected, allowing the farmer to make a better use of water for irrigation. It also provides data on soil fertility by detecting nutrient deficiencies, which will also help to avoid over fertilization and its consequences in water quality.

Another important use of multispectral camera imaging drones is the early identification of pests, diseases and weeds on the farm. This will allow the farmer to optimise pesticide usage and crop sprays through early detection.

A great advantage of the use of drones is that they can be used throughout the whole crop cycle, providing multispectral imagery at each step in every season. A cheaper alternative to drones are simple helium balloons with a multispectral camera attached to it.

c) Fertilization control tools

The fertilization control tools are also very helpful in the correct management of water, since over-fertilization can lead to problems of pollution in water through high concentration of nutrients. Multispectral imaging camera drones can be used for this effect, but also suction probes, which are used to collect undisturbed and authentic soil water samples to analyse the solutes and evaluate whether a new fertilizer application is needed and what its content must be.

Status-quo: What is the actual situation?

Some of the decision support tools above mentioned are relatively new or their use is not well established in Europe yet, mostly in consequence of the high costs or difficulty in handling.

However, when this technology is hired, advice services are often included. Also, the collective use of these technologies is a way to reduce costs. Tests performed under different situations (different varieties of crops, different planting times, type of soils, etc.) may benefit the entire farming community and the reduction of inputs for irrigation, fertilization or pesticide application by achieving efficiency adjustments may compensate the costs.

Challenges to implement these measures

The costs of the equipment used is probably the most important constraint along with the complex interpretation of the results, at least for some equipment. However, these costs are expected to be reduced in the coming years.

3.1.4. Changing crop type

The change of crop type (different species or variety) and/or the implementation of an improved rotation system can also be of great importance when it comes to improve water efficiency.

Less water-consuming crops or varieties with different peak necessities away from the driest periods during the summer can make the difference.

Very different variables will affect this decision and its practical implementation, such as specific climate of the region, soil, availability of water throughout the year, market considerations, etc., so very different approaches will need to be considered.

Status-quo: What is the actual situation?

Crop rotation and the research and experimentation with new varieties must be further enhanced and more studies and pilot farms must be developed to explore new possibilities and solutions for better yields, better soil and water condition and more biodiversity.

Actions performed in this direction will depend greatly on the specific conditions of each area regarding climate, soil, water availability, etc.

Challenges to implement these measures

The major challenge to implement these measures is the creativity and comprehensive study and experimentation needed to achieve the desired results. It requires time and a lot of thinking to come up with alternatives. However, benefits can be extremely positive according to climate change projections that show a progressive warming of Europe and water scarcity.

3.1.5. Animal breeding farms (recycling and harvesting)

Livestock farms need water, both for animal consumption and farm operations (e.g. cleaning). They also need it for producing animal feed, but the measures mentioned before would be applicable. Water consumed by animals and in some farm operations (e.g. in the milking parlour) needs a high quality and often comes from the water supply network. This water is expensive and has a higher footprint than the one harvested or recycled. Other farm operations (e.g. barn cleaning) do not need high quality water. If recycled water or harvested water is used, water from the supply network is saved. Finally, all the water consumed is transformed into other types of water and can have a more or less extended use according to its quality and future use.

A basic objective for livestock farms would be to understand the water inputs and outputs, and to limit the use of clean water to a minimum by using recycling water or harvesting it, and then by increasing the efficiency in farm operations. Below, two examples of very good practices that can be potentially implemented:

- **Rainwater harvesting:** it is a very simple practice to include in the farm system. Taking advantage of the building roof and including a system of gutters which leads the water into tanks, the farmer can passively collect all the rainwater falling upon that roof 24 hours a day, 365 days a year. Just to give a flavour to that, a pig farm in a dry region of the Mediterranean area, getting as little as 300 mm of rainfall a year and having a 200 m2 roof, will be collecting 60,000 litres of water per year.

Figure 9: Example of rainwater harvesting system

- **Recycling water from plate heat exchangers:** plate heat exchangers are devices used to cool down milk that comes straight from the cow before reaching the milk tank. These devices need 4 liters of fresh water per liter of milk for reducing significantly milk temperature before entering the tank. Assuming that a normal milking cow produces around 20-40 liters of milk a day and supposing that there are 80 milking cows in the farm, the farmer will be saving between 6,400 liters and 12,800 liters of water a day, just re-using that water for cleaning and/or animal feeding purposes. In the case of 200 milking cows in the farm, between 16,000 liters and 32,000 liters days would be saved.

Figure 10: Example of plate heat exchanger

Status-quo: What is the actual situation?

Although the measures mentioned above seem very reasonable and out of question, their implementation is still insufficient on many farms within Europe. Further informative actions are needed to spread their application as investment costs should not be a limitation in this case.

Challenges to implement these measures

Livestock farms are very diverse all over Europe and the challenges are difficult to foresee. As it happens with energy audits, advisers shall support farmers in auditing water consumption at farm level and suggest tailored solutions. The ones mentioned in these documents are just basic ones, but local opportunities may arise depending on the farm system, type and management of animals.

3.2. Very Good Agricultural Practices for Water Bodies Protection

To prevent excessive nutrient contents, sediments, heavy metals and pesticides from reaching water bodies, and its subsequent eutrophication and pollution, some measures can be implemented at farm level.

3.2.1. Buffer strips establishment

Buffer strips are vegetated areas, which help to control soil, air and water quality, increasing the environmental sustainability of intensive agriculture systems. When they are located along streams, riverbanks or water bodies, they receive the name of riparian strips.

Riparian strips can have many different configurations, from grasses only to combinations of grasses, trees and shrubs. However, structural complexity will deliver more benefits for biodiversity. Furthermore, as watercourses facilitate the spread of invasive plant species, seed mixtures must contain only native species, which will also have a positive effect on the native wildlife of the area, providing specifically the food and shelter it needs.

They perform different functions such as:

- Acting as sediment traps for eroded soil.
- Enhancing filtration of nutrients and pesticides by slowing down run-off water.
- Holding the soil particles together preventing erosion and landslides.
- Mitigating flood risks.
- Restoring ecological connectivity, enhancing biodiversity.
- Providing foraging resources for insect pollinators, stable habitats for immobile species such as flightless ground beetles and, overwintering habitat for invertebrates.

Large trees and shrubs are specially beneficial within the strip to cool down the water bodies under its shade, which will offer a more suitable habitat for fish, aquatic plants and other biota, as well as enhancing the water flow from warmer to cooler zones and vice versa (better oxygenation). Tree species typically found in riparian strips are birches, willows and alders, among many others.

Riparian strips should have a width of at least 10 m to 15 m to fully develop the abovementioned benefits. However, its typical value in the EU is around 5 m (or even less).

Status-quo: What is the actual situation?

Buffer strips are currently mandatory under the Common Agricultural Policy (cross compliance). However, there are some political, social and economic factors that can slow down their implementation. These are the lack of incentive programmes, , poorly defined goals, lack of maintenance and the opposition from landowners. and the lack of a common definition, which leads to a vast heterogeneity among governments on how buffer strips are designed and implemented.

Challenges to implement these measures

Riparian strips implementation requires the involvement of different actors such as river managers, farmers, etc. Its success is highly dependent on characteristics such as buffer zone width, gradient of the slope, soil type and variety and density of the vegetation. They may also lead to a slight reduction of the field UAA.

Figure 11: Example of a riparian strip

3.2.2. Catch crops and cover crops

Catch and cover crops are crops growing in the period between two main crops or between the rows of a main crop in the same time-frame, acting on and protecting bare soil.

Many are their benefits:

- Water and wind erosion reduction.
- Soil organic matter increment.
- Immobilization and storage of nutrients
- Biological nitrogen fixation.
- Increase of biodiversity.
- Weed and pest suppression.
- Management of soil moisture.
- Soil compaction reduction.
- Reducton of particulate emissions into the atmosphere.

In this guide, the focus is put on the benefits affecting water.

Catch and cover crops prevent substances from being washed away from the soil, retaining the nutrients in the root zone, which results in lower nutrient concentrations reaching water bodies. They are able to immobilize and store nutrients like N and P (among others) in their tissues and release them when terminated. Their effectiveness depends on the time of establishment, the time of termination, the growth rate and, the root depth and density (with fast establishments and deep roots, the performance is better); their termination is achieved by mowing, ploughing, chopping or exposure to extreme temperatures.

The growing of cover crops is supposed to be on bare soil, protecting soil against wind and water erosion, improving water infiltration and percolation. In this case, fewer soil particles and sediments from the farm will reach water bodies, preventing quality issues like water clouding or high heavy metal contents.

When talking about nutrient immobilization, the term used is catch crops; and when protection against erosion is the topic, they are usually called cover crops. However, catch and cover crops share many of the benefits and can be both at the same time.

Status-quo: What is the actual situation?

In some countries the implementation of cover and catch crops is mandatory due to the Nitrates Directive. However, it is a measure far from being widely implemented despite the benefits described.

Challenges to implement these measures

When implementing catch and cover crops, costs of seed bed preparation, seed, planting and termination must be taken into account.

Special attention must be given to the soil moisture content that can be depleted before seeding the main crops. Also to rodents and rabbits, which can find a suitable habitat in cover and catch crops.

However, the main limitation to implementing cover and catch crops is probably the lack of knowledge and difficulties for finding the most suitable option for a specific farm (and its climate, soil, economic priorities, etc.)

Implementation on the farm

The type of catch and cover crop will depend greatly on the specific conditions of the area like climate, soil, main crops, water availability, etc.

Figure 12: Example of cover crop

3.3. Very Good Agricultural Practices for Enhancement of Biodiversity.

Every living organism needs water. Increasing its availability in the farm (by new water points or artificial water retention areas) will enhance its biodiversity, attracting beneficial insects and wildlife from the surroundings.

3.3.1. Ponds and water retention areas

Artificial ponds can be included in the farm to increase biodiversity, but also to supplement irrigation. There are places, mostly in the warmer EU countries, where water is very irregularly distributed and the farmer has limited access to it, sometimes only for several days per week or per month. By building a pond and filling it up with water, the farmer will be able to irrigate the crops when needed until the next water supply occurs. Building the pond at the top of a field with a slight slope or a bit above ground level is especially beneficial, since a farmer relying on drip or flood irrigation would be able to water the crops just using the gravity force as energy input.

Artificial ponds can be built using pond liners (which prevent some of the natural pond life from developing) or, directly excavating and compacting the soil (if the clay content is higher than 30%, the area is relatively wet and, the topography adequate).

This extra availability of water will attract useful organisms like birds, snakes or amphibians, as well as dragonflies and other beneficial insects. Some of those creatures are very useful for pest control; like toads eating slugs, hedgehogs eating snails or snakes eating rodents.

A good drainage system design will also help when creating a pond. Water should remain in the system as long as possible and, instead of leading the water out of the farm, the farmer can direct its accumulation in a suitable area, thus the pond will be created with very little effort.

A different approach to achieve extra water retention in the farm is building small dams where the runoff water channels converge. Those dams can be built by digging up a trench where the wall of the dam is going to be placed, as long as a high clay content layer is found (see comment in above). With the help of a mechanical digger, the basin of the dam will be excavated as well and, when the depth reaches the clay layer, that material from the basin will be used to fill up the trench of the dam wall (that trench must be very well compacted after being filled). This way, both water running above and below ground will be stopped and accumulated.

Ponds and dams built directly into the soil without the use of pond liner, will not be 100% sealed. However, that is not strictly necessary, since the water level does not need to be stable and also a more humid area will help to create a microclimate for more biodiversity.

Furthermore, irregular ponds will perform better (increment of water flowing from cooler to warmer areas and vice versa, different microhabitats for more flora and fauna). In its design, shallow and deep areas must be considered, as well as a round and irregular shape, if possible.

The procedure to build ponds or dams is highly dependent on the specific conditions of the farm and expert advice must always be hired or consulted.

Status-quo: What is the actual situation?

Sometimes, small water retention areas naturally occur in wet regions. However, as long as these naturally evolving water bodies occupy an area, which are suitable for crop production as well, a drainage system is normally installed to divert that water somewhere else.

In dry places, where those wet areas can rarely be seen, the implementation of this measure is even more unusual.

The spread of information about the crop benefits of water retention areas must be enhanced.

Challenges to implement these measures

Expert guidance is needed to avoid problems such as landslides and floods. If the area is large, approval from the water regulatory authority is needed.

Implementation on the farm

Small ponds can be realised by hand-digging. However, for larger ones or dams, mechanical diggers will need to be used.

Figure 13: Example of an artificial pond

3.3.2. Water points

The inclusion of water points for fauna in the farm also enhances biodiversity.

Small solutions like a plate under a water tap (indirectly filled when used) or, small plates under certain drip irrigation emitters or at the end of the line, will be very helpful in creating a comfortable habitat for wildlife.

Implementation on the farm

The implementation of this measure will depend greatly on farm conditions and characteristics, and some creativity is required. The idea is not allowing water to be wasted and to identify the points where that occurs (no matter how insignificant they are) to implement a creative an easy solution.

Figure 14: Example of a water point

Overview of the Project EU LIFE Food & Biodiversity

Food producers and retailers are highly dependent on biodiversity and ecosystem services but also have a huge environmental impact. This is a well-known fact in the food sector. Standards and sourcing requirements can help to reduce this negative impact with effective, transparent and verifiable criteria for the production process and the supply chain. They provide consumers with information about the quality of products, environmental and social footprints, the impact on nature caused by the product.

The LIFE Food & Biodiversity Project "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:

A) 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;
B) Training of advisors and certifiers of standards as well as product and quality manager of companies;
C) Implementation of a cross-standard monitoring system on biodiversity;
D) Establishment of a European-wide sector initiative.

Within the EU-LIFE Project Food & Biodiversity, a Knowledge-Pool with background information linked to agriculture and biodiversity is provided. You can access the Knowledge Pool under the following link:

www.business-biodiversity.eu/en/knowledge-pool

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