GUIDANCE FOR

SUSTAINABLE WATER MANAGEMENT

BY NATURLAND AND BIO SUISSE

CONTENTS

1. SUSTAINABLE WATER MANAGEMENT

Water is a valuable natural resource that is not infinitely available. It is the basis of all life on our planet. Water is both essential and indispensable for agriculture and feeding a growing world population. But the world is thirsty, global water consumption is rising and water is becoming increasingly scarce in many of the world's regions.

This guide serves as an aid and provides a supplementary source of information on how to complete the water management plan (WMP). It is intended to help farmers, but also inspectors and advisers, on their way to ensuring sustainable water management.

1.1 Water and agriculture

As the main consumer of global water resources, agriculture is both a cause and a victim of water scarcity[1]. Agriculture is both a cause and a victim of water scarcity. In particular, the expansion of irrigated agriculture means that, at 70 per cent, this type of agriculture consumes most of the water resources worldwide[1]. A growing world population and climate change pose major challenges to the agricultural sector and increase the pressure on dwindling water resources. Intensification of water use can lead to loss of biodiversity, soil salinisation, loss of ecosystem services, inequality between users, and degradation of water sources and ecosystems[2, 3]. At the same time, climate change is increasing the frequency of extreme weather events and storms, and the risk of heavy rainfall and flooding is bound to increase in the future. Climate change is therefore responsible for exacerbating two extremes regarding water: one is flooding and inundation, the other is drought and aridity[4].

Water shortage – already harsh reality for many today
Even today, many people lack access to clean (drinking) water. One in four people on earth may face extreme water shortages by 2025[5]. Meanwhile, agriculture is making this problem worse: between 15 and 35 per cent of the water used for agricultural purposes comes from unsustainable sources, according to WWF. Many agricultural areas are also located in arid regions – regions that will increasingly suffer from water shortages in the future as a result of the climate crisis.

Protecting water resources: Organic farming has a duty
Agriculture and organic farming in particular have a special responsibility to ensure the careful use of water. For this reason, the two associations Naturland and Bio Suisse have developed their standards with regard to the sustainable use of water resources. Establishing standards and awarding certification represents an important measure towards ensuring sustainable water use in regions where water is scarce. In this way, Naturland and Bio Suisse are creating a regulatory framework for their farming operations with requirements for using water sustainably, and also for the possible exclusion of operations that do not meet these requirements.

Global problems – regional solutions
However, it is also clear that the single-operation approach is not powerful enough to overcome the difficult challenges we face surrounding this water crisis. Above all, political will and the political framework conditions put in place for sustainable water use are also crucial. Naturland and Bio Suisse, within the scope of their possibilities and together with their partners, are also committed at the political level to increasing sustainability in water use at the regional level.
Even though the global problem of dwindling water resources and water scarcity must be tackled at the national and global political level, operations can also do their part to ensure a more sustainable use of water. Taking operational measures and showing commitment at the regional level are

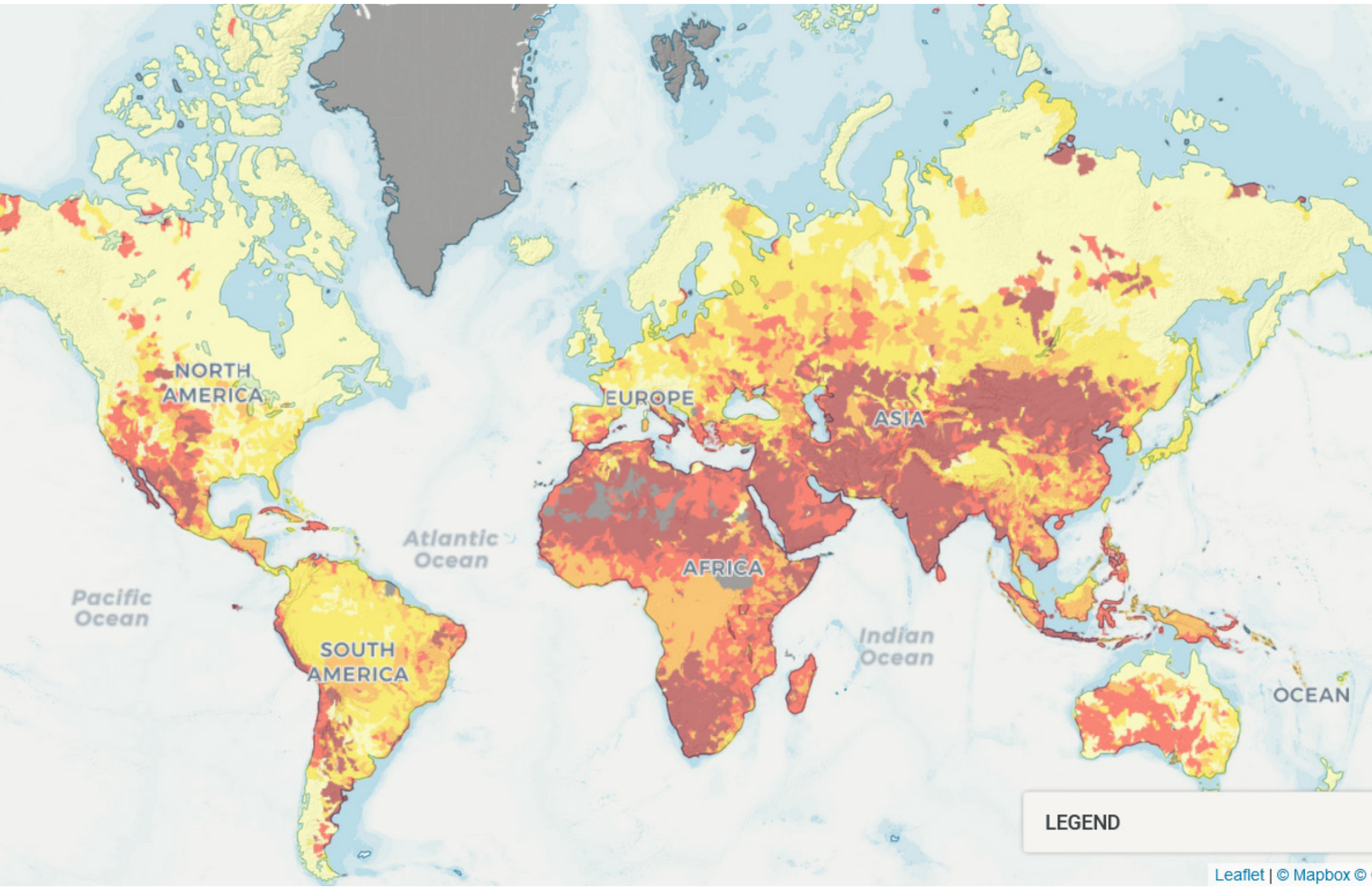
certification-relevant requirements set by Naturland and Bio Suisse for their farming operations and are to be recorded in the WMP.

1.2 Sustainable water management at Bio Suisse and Naturland

Naturland and Bio Suisse operations in areas with water risks must draw up a WMP. The WMP is designed to help operations optimise their water management, use water resources at the operation more sustainably, and further raise their awareness of water as a valuable and diminishing resource.

1.3 "Water Depletion" as an indicator for areas with water risks

To identify areas with water risks, Naturland and Bio Suisse use the Aqueduct Water Risk Atlas of the World Resources Institute (WRI) (see https://wri.org/applications/aqueduct/water-risk-atlas), as well as the Köppen-Geiger climate classification (see webmap.ornl.gov/ogcdown/dataset.jsp?d_id=10012_1). Instructions for using the two filters can be found in the appendix.

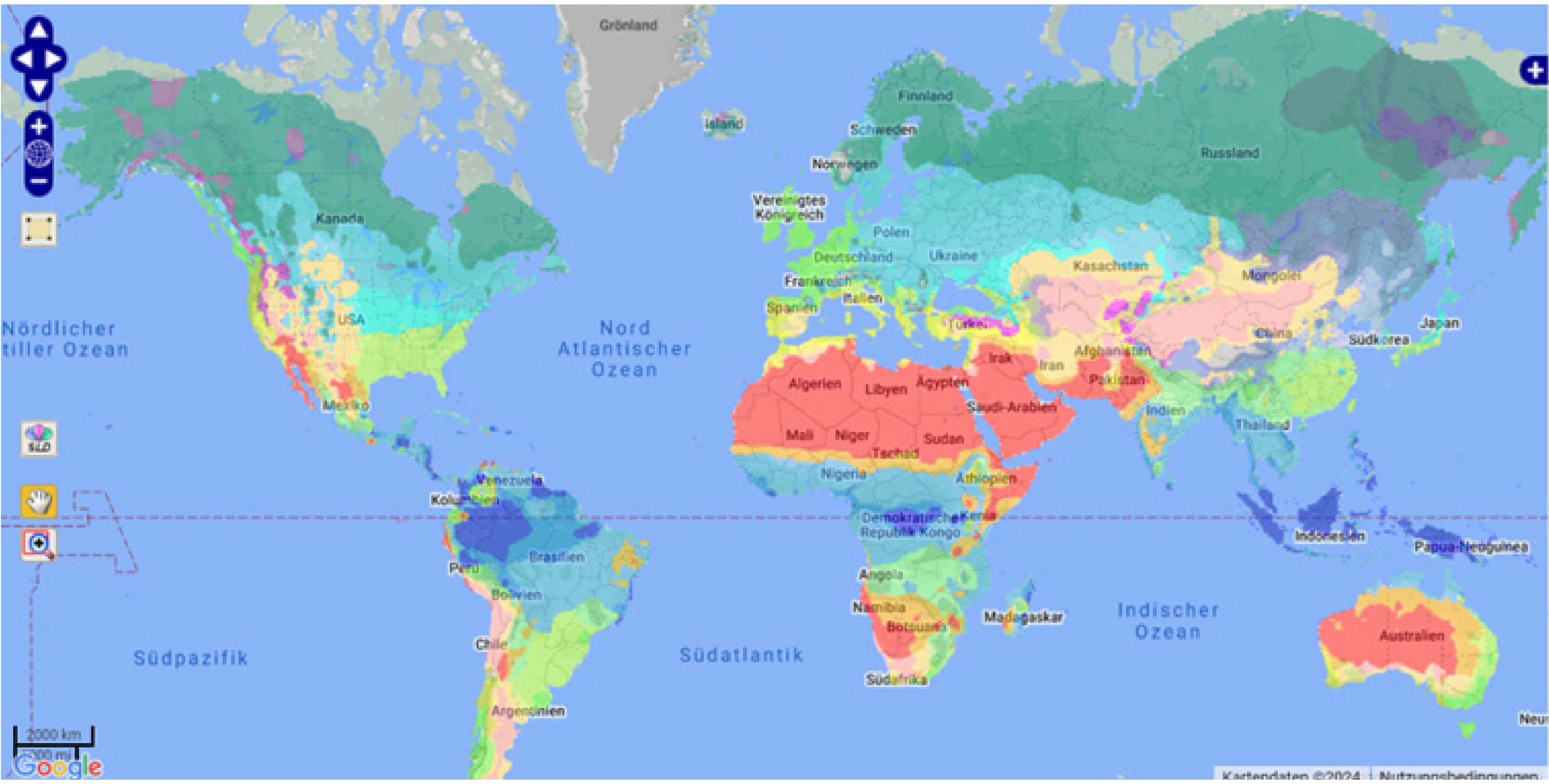


The Aqueduct Water Risk Atlas: areas shown in red or dark red on the map have high water consumption in relation to the availability of water.

Naturland and Bio Suisse use the indicator “Water Depletion” to classify the water risk of a region. Areas that are categorised as **“High”** (50 - 75 %) or **“Extremely high”** (>75 %) (and likely also as “Medium-high” from 2026) in terms of the **“Water Depletion”** indicator or that are located in a desert region according to the Köppen-Geiger climate classification (indicator **“BWh”**) of the Oak Ridge National Laboratory, are considered areas with water risks (Bio Suisse Part V, 3.6.2.1, Naturland 2.7.2.1).

Explanation of the “Water Depletion” indicator

The “Water Depletion” indicator measures the relationship between total water consumption (with backflows) and the resources of surface and groundwater available. It differs from the “Water Stress” indicator in that the backflow is taken into account. This refers to the portion of the water removed that is not consumed but flows back into the environment. Therefore, the areas experiencing water depletion are less extensive than those with “Water Stress”.



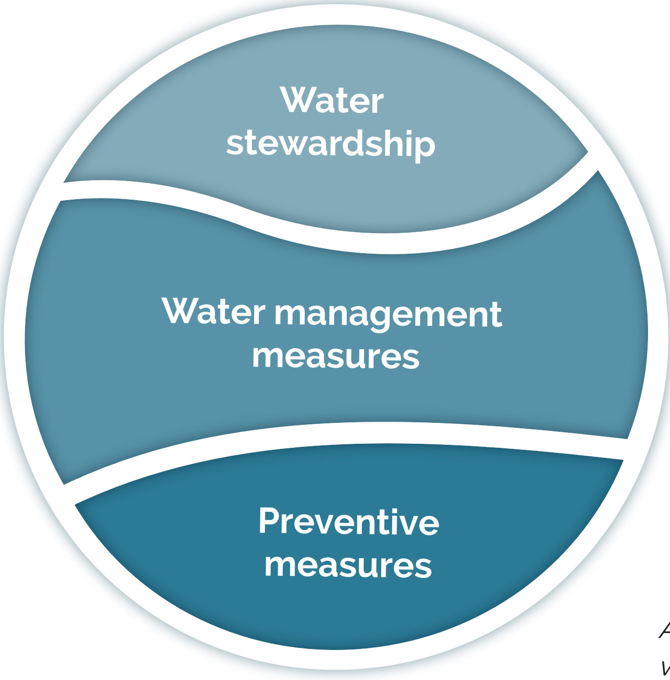
World map of the Köppen-Geiger climate classification: the areas shown in red on the map are considered desert areas (indicator BWh)

Explanation of indicator “BWh”

The Köppen-Geiger climate classification features five climate categories. Climate class B covers “arid” climates. “W” stands for desert. A distinction is drawn between deserts with an average annual temperature above 18°C (h) and below 18° (k). Bio Suisse and Naturland use the indicator “BWh”.

2. PRINCIPLES FOR SUSTAINABLE WATER MANAGEMENT

Sustainable water management comprises the following three aspects: The basis for good water management at an operation should always consist of introducing **preventive measures to maintain and improve soil fertility**. Next come the practical **water management measures** tailored to the operation, such as implementing an irrigation plan and choosing an efficient irrigation system. At the inter-operational level is **water stewardship**. This involves other stakeholders and water users and aims to ensure that water is used considerately throughout the entire watershed. Only if all three aspects are taken into account by the operation, sustainable water use can exist. In the following, the three dimensions are discussed in more detail.



Aspects of sustainable water management

2.1. Preventive measures

Maintaining and strengthening soil fertility is of central importance for organic farming (Naturland B.7.1; Bio Suisse Part II, 2.1). Good soil fertility forms the basis of sustainable water management (Bio Suisse Part V, 3.6.1.3). Irrigation measures must also not lead to an impairment of soil fertility, for example through salinisation (Bio Suisse Part V, 3.6.1.3, Naturland B.7.1).

A soil with active soil life is the best water reservoir.

A fertile soil with good structure and an intact soil life acts as a buffer for the water supply of the plants. It can absorb more water (improved infiltration), compensate for water shortages to a certain extent, store water more efficiently, and make it available to plants. All possibilities to promote and maintain soil fertility should be exploited to ensure sustainable water management.

The following table presents practical measures to promote soil fertility as part of preventive water management:

Preventive measure	Background	Practical examples
Formation of soil organic matter (SOM)	Organic material in the soil can store up to 90 per cent of its own weight in water. SOM also helps to create a beneficial soil structure that allows water to be stored in the pores. A good soil structure also enables optimal root growth and thus contributes to a good water absorption capacity of the plant.	Adding organic material to the soil, for example in the form of: • Compost • Biochar • Organic fertiliser • Crop residues • Humus-forming crop rotations • Green manure, catch crops
Mycorrhizae	Mycorrhizae are specialised fungi that form a symbiotic relationship with the roots of cultivated plants and thus increase the root surface of the plants. In addition, mycorrhizae can make water more readily available to plants and help them absorb water. Plants with mycorrhizae have a higher water stress tolerance and contribute to the stability of the soil aggregate.	Encourage mycorrhizae growth by: • Inoculating the soil • Gently tilling the soil • Ensuring the right pH value
Mulch	Applying mulch protects the soil from drying out as a result of evaporation as it reduces the soil temperature, prevents the transmission of air humidity and absorbs moisture from the air within the mulch cover. At the same time, organic matter adds nutrients to the soil and also keeps spreading of weeds under control.	Mulching, for example, in the form of: • Plant residues • Straw • Grass clippings • Recyclable cling film
Crop rotation	Crop rotation plays a crucial role in organic farming. A diverse crop rotation can increase the water storage capacity of the soil. Catch crops and undersown crops should, if possible, be integrated into the crop rotation to help form humus and promote soil life. It is important not to use only taprooting plants as catch crops alone, but to create as wide a variety as possible of different catch crops with different root systems. This can create a fine root system that can better retain and absorb water in the soil.	Crop rotation plan: • Create as diverse a crop rotation as possible • Include crop rotations boosting humus growth • Integrate catch crops and undersown crops
(Wind) hedgerows and agroforestry systems	Trees, hedges and other structural elements can create a local microclimate that favours the water balance of the soil and lowers water consumption by plants. Trees and hedgerows reduce drying out of the soil by blocking or reducing wind and shading the area. Humus is also formed. If the trees are leguminous (e.g. acacia), these can bind nitrogen at the same time. Possible uses for the wood in agroforestry systems are, for example, as firewood, mulch material or timber.	• Agroforestry systems • Hedgerows and other structural elements such as shrubs • Trees as wind breakers
Anti-erosion measures and collection of surface run-off	Collecting and retaining surface water is an important measure taken in order to minimise the use of irrigation water. Implementing anti-erosion measures prevents rainwater from running off and fertile soil being lost. For example, catch basins or dams made of earth, stones or plantings can keep water on the surface longer and thus enable plants to use it. You can find more information on the collection of surface run-off in the FAO manual for the Design and Construction of Water Harvesting Schemes for Plant Production: www.fao.org/3/U3160E/u3160e00.htm	• Living terraces • Dams • Planting holes • Planting erosion control plants along contour lines • Infiltration trenches

Tillage	Introducing soil-conserving tillage measures helps to protect the soil and therefore also to conserve water. Gentle or no tillage, such as no-till, protects the soil from erosion, improves soil structure and promotes soil life. You can find more information on reduced tillage in the FiBL publication on reduced tillage in organic farming: www.fibl.org/fileadmin/documents/shop/1652-bodenbearbeitung.pdf	Examples of reduced tillage: • No-till • Mulch-till • Strip-till
Selection of plants and varieties	Crops and varieties should be adapted to the conditions of the location. Drought-tolerant species allow for less irrigation.	• Plants and varieties adapted to the location • Drought-tolerant plants and varieties
Nutrient supply	The nutrient supply of plants strongly influences the water consumption of a crop. Ensuring optimum nutrient supply to young plants serves to cover the soil quickly with leaves and thus reduces evaporation. A dense root formation, which enables future water and nutrient utilisation, is improved by the optimal nutrient supply. At the same time, too much nitrate can lead to strong growth and high water consumption with non-increasing yields.	• Ensure optimal nutrient supply to the crops • Prevent over-fertilisation • Adapt fertilisation to the various vegetation stages of the plants
Checking the pH value	Optimum soil pH favours more intensive and deeper root penetration, stimulates plant development and contributes to improved soil aggregation. This increases the water absorption capacity of the plant and at the same time the water storage capacity of the soil.	• Regular measuring of the pH value • Lime, if necessary

Sources: 6, 7, 8, 9, 10

2.2 Water management measures

The second aspect of ensuring sustainable water management is putting concrete measures in place for carrying out irrigation at an operation. The WMP of Naturland and Bio Suisse focuses mainly on these measures.
Irrigation should always:

- Be adapted to the **water needs of the plant** at the various stages of its development
- Be adapted to the **water storage capacity of the soil** (for more information on the water storage capacity of different soil types, see the FiBL guide “Good agricultural practice in irrigation management”.
  Online at: https://www.fibl.org/fileadmin/documents/shop/2522-irrigation.pdf)
- Take **weather patterns** into account
- Prevent **evaporation loss**
- Prevent **leaching of nutrients**[11, 12]

Good agricultural practice for water management measures

- Planning the irrigation system thoroughly
- Adapting the irrigation system to the site and crop (see chapter "Type of irrigation system")
- Measuring and calculating water requirements of crops in order to adapt irrigation accordingly (see chapter "Type of irrigation" and „Irrigation practice")
- Taking into account current weather data when planning irrigation
- Maintaining the irrigation system regularly to prevent water loss and keeping maintenance records
- Documenting water use and consumption (see chapter "Measuring water consumption")
- Preventing and reducing water loss
- Making full use of all rainwater harvesting and storage options
- Keeping up to date with advances in irrigation technology and seeking expert advice on how to optimise water use at the operation
- Ensuring that the quality of water used for irrigation is suitable (see chapter "Water quality")

2.3 Water stewardship

Water management does not stop at the operation level, but concerns the **entire watershed**, including all other users, in the region. Water stewardship stands for inter-operational efforts with regard to water management. The aim of water stewardship is to **plan and manage water resources responsibly in the watershed**, beyond the individual operation.

The standards of Naturland and Bio Suisse povide for cooperation at inter-operational level with relevant stakeholder groups (water stewardship) as part of the WMP (Bio Suisse Part V, 3.6.2.6, Naturland 7.2.1). Operations must identify relevant stakeholder groups and actively work with them to achieve progress in the sustainable use of water, both at the level of the individual operations and at the regional level (e.g. watersheds). The identified stakeholder groups, the sustainability efforts of the producer and all planned or completed optimisation measures must be documented in the WMP.

Good agricultural practice for water stewardship

- Striving for equitable distribution of water resources in the watershed
- Understanding the water-related challenges in the watershed where your operation is located
- Understanding and seeking to mitigate the impacts of your operation's water use on other water users in the watershed
- Networking with other users and stakeholders in your watershed
- Actively contributing to stakeholder forums and relevant stakeholder groups

3. THE BIO SUISSE AND NATURLAND WATER MANAGEMENT PLAN

In this chapter, you will find the requirements that the water management plan (WMP) places on farms, as well as background information on each point, linked to examples of good professional practice. Furthermore, each chapter concludes with a Best Practice info box for completing the relevant section of the management plan. Farms must submit a complete WMP as proof of sustainable water management. Signing the inspection checklist also confirms the accuracy of the information in the WMP.

A fully completed WMP (tabs R0-R4) for individually certified operations includes the following:

1. Information on irrigation and water consumption (R1)
2. Information on the legality documents (R2) with the required appendices:
   - Written proof of legality for all water sources (incl. wells) (Appendix B)
   - Plot list or map(s) with all actually farmed plots, labelling of irrigated plots, plot numbers according to EU organic standards (Appendix C)
   - In the case of joint use of water rights, the distribution of water among all users must be demonstrated (Appendix D)
3. Transfer of figures from FAO analysis in R3 along with the required appendix or measure
   - Water analysis of the irrigation water according to FAO standards or equivalent methods (Appendix E)
   - If any of the analysis values exceed problematic thresholds, this must be stated as a risk in R4 and measures for dealing with it must be defined.
4. Operational risk analysis including plan of action and information on water stewardship (R4)
5. Signed declaration on data transfer (Appendix A) for operations with Bio Suisse certification and Naturland membership (R0)

Producer groups in areas with water risks must also submit complete documentation as proof of sustainable water management. The next chapter (Chapter 3.1) will discuss the special features of the group procedure.

Best practice for completing the WMP

- The WMP must reflect the current situation of the operation
- You must complete the WMP in full and submit it to Naturland or Bio Suisse
- The WMP is only complete if all the tabs (R0–R4) have been completed and all required appendices enclosed
- You must resubmit the WMP every three years

3.1 Special features of the group procedure

Producer groups within the meaning of the Naturland or Bio Suisse certification procedure must complete a WMP (R0, R3 and R4 only) every three years. This should be as representative of the entire group as possible. Documentation on the irrigation of the individual members is provided in the “Farmer List Irrigation, FLI” (replacing R2). Selected members must submit proof of legality from the competent authority for all water sources (R2).

Complete the WMP in a representative manner for the entire group:

1. Transfer of figures from FAO analysis in R3 along with the required appendix or measure:
   - Water analysis of the irrigation water according to FAO standards or equivalent methods (Appendix E)
   - If any of the analysis values exceed problematic thresholds, this must be stated as a risk in R4 and measures for dealing with it must be defined.
2. Risk analysis including plan of action and information on water stewardship (R4)
3. Signed declaration on data transfer (Appendix A) for operations with Bio Suisse certification and Naturland membership (R0)

Information required from individual members of the producer group:

4. Information on irrigation from all members is provided by means of a checklist for producer groups, the “Farmer List Irrigation, FLI” tab.
   NB: the FLI must be submitted to the inspection body (for Bio Suisse certification) or Naturland BEFORE the inspection.
5. Information on the legality documents (R2) with the required appendices:
   - Written proof of legality for all water sources (incl. wells) (Appendix B)
   - Plot list or map(s) with all actually farmed plots, labelling of irrigated plots, plot numbers according to EU organic standards (Appendix C)
   - In the case of joint use of water rights, the distribution of water among all users must be demonstrated (Appendix D)

   NB: using the integrated formula of the “crosscheck sample calculator” in the FLI, the inspection body will determine the number of members who need to complete additional R2s.

Other special features:

- Operations >25 ha are assessed as individual operations and must create their own WMP.
- The WMP must be completed by the representative of the group. The accuracy of the information is also confirmed by signing the checklist.
- The WMP must be submitted every three years with all appendices to the Naturland certification body or Bio Suisse (via the inspection body).
- However, the “Farmer List Irrigation, FLI” must always be kept up to date and submitted to the inspection body annually.

3.2 Introduction and data transfer (R0)

Tab R0 contains a brief introduction to the Naturland and Bio Suisse WMP. The declaration on data transfer is stipulated as a mandatory appendix (Appendix A) for operations that are certified by both Bio Suisse and Naturland.

The two associations use the same format for the WMP and their respective inspection and certification procedures are coordinated. This means that operations that have both a Bio Suisse certificate and Naturland membership only need to submit the WMP to one association. This step considerably facilitates document management for operations and saves time during annual inspections. Once an operation has completed and submitted the WMP for the first time, the certification decision shows which association is responsible for reviewing the WMP.

All operations that are certified by both Bio Suisse and Naturland can benefit from this. The prerequisite for this is the signing of the declaration on data transfer and the associated authorisation of both associations and the contractually bound certification and inspection bodies to exchange documents, data, and knowledge with each other.

Naturland and Bio Suisse Water Management Plan (WMP) – R0 Introduction and declaration on data transfer

Basis in the standards:
Bio Suisse Standards Part V, Article 3.6.2
Naturland Producer Standards Part B.I.9.2.2

Introduction

Your operation or producer group is located in an **area with water risks** according to the "Aqueduct" Water Risk Atlas from the World Resources Institute (WRI) with the indicator "Water Depletion". Regions that are categorised as "high" (50-75%) or "extremely high" (>75%) and, as of 2026, probably also "medium-high" (25-50%), or are located in a desert area according to the Köppen-Geiger climate classification (indicator "BWh") are considered areas with water risks.
Link to Water Risk Atlas: https://wri.org/applications/aqueduct/water-risk-atlas
Link to Köppen-Geiger climate classification: https://webmap.ornl.gov/ogcdown/dataset

Bio Suisse and Naturland producers who are located in areas with water risks and irrigate (without rainfed agriculture) must create a **Water Management Plan (WMP)**. The water management plan ensures sustainable water management, raises awareness and is also intended to support Naturland and Bio Suisse operations in optimising their water management. Please use this document (R1-R4) as a template.

The water management plan must be **submitted every three years** with all annexes to the Naturland (via the responsible contact) or Bio Suisse (via the inspection body) certification body. Irrigation data (R1) must be updated annually.
Operations that have both a Bio Suisse certificate and Naturland membership only need to submit the WMP to one association. The prerequisite for this is the signing of the **declaration on data transfer** and the associated authorisation of both associations and the contractually bound certification and inspection bodies to exchange documents, data and knowledge with each other. **Signing the inspection checklist also confirms the accuracy of the information in the WMP.**

Producer groups within the meaning of the Naturland or Bio Suisse certification procedure fill out **a WMP (without R1, R2) for the entire group every three years** (operations in the group > 25 ha are treated as individual operations and must submit a complete WMP). "R3 FAO Analysis" and "R4 Risk Analysis and Stewardship" must both be representative of the entire group. For producer groups, the documentation on the irrigation of the individual members is carried out using the checklist for producer groups, "Farmer List Irrigation, FLI" (replaces "R1 Irrigation data"). Producer groups must submit the FLI at the time of the inspection. As part of random checks, individual members must submit "R2 Legality" with regard to their own operation, including annexes.

☐ Required annex: A) Declaration on data transfer
Link to document

3.3 Information on irrigation and water consumption (R1)

Various pieces of information on irrigation and water consumption are entered in R1. Irrigation practices have a major impact on the sustainability of water management. This includes the choice of irrigation system, measuring water use, irrigation planning and monitoring water quality. The quantitative information should provide the farm managers with an **overview of the actual water consumption** on the farm and thus help them identify **potential savings**. At the same time, it serves Naturland and Bio Suisse as a possibility to assess the water consumption of a farm and to check the plausibility.

Note for the group procedure: this tab (R1) does not need to be filled in the WMP for a group procedure. The relevant information is submitted via the „Farmer List Irrigation" (further Excel document).

Best practice for completing R1

- Make sure the R1 tab is always kept up to date. The R1 tab is checked annually during the Naturland/Bio Suisse inspection
- To be submitted to Naturland/Bio Suisse every 3 years
- Overall water consumption is consistent with consumption in terms of water origin
- Consumption according to water origin corresponds to the amount of water approved by the responsible authority

3.3.1 Farm data

In the first section of R1, you enter all farm data under numbers 1.1 to 1.4 so that WMP can be clearly assigned to your farm.

1	**Information on the operation/farm**	
1.1	**Name of the operation:**	Farmer Smith
1.2	**Operation number (EU organic, Bio Suisse/Naturland):**	EU organic number and Naturland farm number
1.3	**Address/Region/Country:**	Farmstreet 1, 3133 Farmville
1.4	**Contact person:**	John Smith

3.3.2 Irrigation practice

Numbers 2.1-2.5 must be completed in the second section. The applicable check boxes can be selected for 2.1, 2.3 and 2.4. Multiple checkboxes can also be selected if applicable. If an answer marked with an asterisk (*) applies, this must be explained in 2.5, where any additional helpful explanations can also be entered.

2	**Irrigation practice**	
2.1	Type of water source used	☐ Groundwater ☐ Surface water ☐ Desalination plant ☐ Rainwater
2.2	Number of wells/other water inlets	
2.3	Irrigation system(s)	☐ Subsurface irrigation ☐ Drip irrigation ☐ Irrigation, sprinklers
2.4	Measurement of water consumption	☐ Water meter ☐ Calculation* ☐ Flow calculation*
2.5	* **Please explain, further explanations:**	

3.3.2.1 Water origin

Knowing the source of used irrigation water is an important prerequisite for carrying out sustainable irrigation practices and has an influence on the proof of legality (in the case of permits, there are often differences between groundwater and surface water, e.g. in case not the same authorities are responsible). Therefore, you must clearly identify the origin of the irrigation water and indicate this in the WMP (Bio Suisse Part V, 3.6.2.4, Naturland 7.2.2).

Best practice for identifying and documenting the source of irrigation water

- Exploiting all possibilities of collecting, storing and using (rain)water
- Specifying all types of water sources at your operation in full in the WMP
- Specifying all types of irrigation equipment in full in the WMP
- Labelling the map in detail (see minimum requirements)
- Explanations for the map must be made available
- Information provided in the WMP must correspond with that on the map

The categories for the origin of water are explained below:

1. Groundwater

Groundwater is subterranean water that ends up below the earth's surface through percolation of precipitation, but also partly through seepage of water from lakes and rivers. The rock body into which the groundwater flows and resides is called an aquifer. In semi-arid and arid regions with low groundwater recharge, excessive abstraction of groundwater leads to large-scale drawdown and corresponding environmental damage. Drawdown can have far-reaching consequences for the environment. Roots of trees, plants and crops lose their supply of groundwater. The consequences of this include forest dieback and droughts.

If groundwater is to be used for irrigation by means of wells, the assessment of the sufficient yield of the groundwater resource used is a fundamental prerequisite for the agricultural operation. In this respect, the use of a fossil groundwater source is only permissible under the Bio Suisse and Naturland standards as an exception in justified individual cases (Bio Suisse Part V, 3.6.3, Naturland 7.2.4). We speak of fossil groundwater when we mean that the aquifer has had no contact with the water cycle for thousands of years.

Overuse of a reservoir in Malaga, Spain, at the end of December

2. Surface water

Surface water comes from bodies of water on the earth's surface in the form of bodies of flowing (running waters) and standing water (lakes, seas, dams ...). These are integrated into the natural water cycle and are therefore ecologically highly significant and in need of protection. Operations that use surface water do so either by pumping it directly from the body of water through the operation (private law) or through water use communities (public law). In both cases, it is important that the river or lake/pond, etc., is left with enough residual water. This is of utmost importance for natural ecosystems, as well as for other users downstream. Furthermore, care must be taken to ensure that the irrigation water does not negatively affect the quality of the harvested products. This especially applies to irrigation water that flows through non-organic plots prior to being used at an organic operation (e.g. in paddy fields) or that could be contaminated by pathogenic bacteria, parasites or pesticides.

3. Surface water from desalination plants

Several methods that have already been tried and tested exist to obtain water of drinking water quality from saline water. Since the processes are very complex and consume a lot of energy, water from desalination plants still remains quite expensive. Desalination via distillation is particularly energy-intensive. Less energy is required for reverse osmosis. Another risk is that all large-scale plants produce extremely salty waste water, which is then returned to the sea and harms the organisms there. If mainly renewable energies are used for water desalination and the resulting salt is properly disposed of or further processed, seawater desalination could offer considerable potential for (future) sustainable water use.

4. Recycled waste water (process water)

Recycled waste water or process water is water that has been contaminated during production to such an extent that it is no longer considered safe to drink. Treated process water and waste water offer great potential in the way of sustainable water use and are therefore recommended, provided that no harmful substances are left in the water and there is no contamination of the harvested product or soil. Regular samplings must be carried out. In addition, the treatment of water should be conducted with the help of renewable energies.

5. Recycled rainwater

Rainwater harvesting is the process of collecting and storing rain instead of letting it run off. The use of rainwater offers great potential in the way of conserving water resources. All possibilities for collecting, storing and using rainwater must therefore be exploited (Bio Suisse Part V, 3.6.2.3, Naturland 7.1). The most common ways to use rainwater include collecting rainwater from rooftops and greenhouse roofs, as well as collecting water from field run-off, including building dams in water drains to create retention basins.[13] The FAO guide "Water harvesting" provides practical guidance on erosion control and water harvesting on open land[13] (http://www.fao.org/3/U3160E/u3160e00.htm). However, the country-specific requirements for the use of rainwater are very diverse and in part only possible to a limited extent. When using rainwater, you should regularly check the water quality to avoid contamination.

3.3.2.2 Irrigation systems

The WMP must specify the type of irrigation system. The Bio Suisse and Naturland standards specify that **irrigation systems must save water and be highly efficient**. The efficiency of the irrigation system can be calculated as follows:

$$Efficiency\ of\ irrigation\ system = \frac{Evapotranspiration\ ETc\ (\frac{l}{m^2})}{Irrigation\ water\ used\ \ (\frac{l}{m^2})}$$

Drip and subsurface irrigation systems have the highest efficiency with 80 to 95 per cent. Microsprinklers also have a high efficiency of 80 to 90 per cent, while surface irrigation has an efficiency of only 25 to 60 per cent.

the appendix 4.3, you can find an overview of different irrigation systems and their advantages and disadvantages (Appendix 5.2).

Good irrigation management also includes **regular inspection and maintenance of irrigation systems**. This way, deficiencies can be detected and corrected as early as possible to **prevent water losses**. A comprehensive overview for good agricultural practice for irrigated agriculture is provided in the FiBL guide "Good agricultural practice in irrigation management" (online at: www.fibl.org/fileadmin/documents/shop/2522-irrigation.pdf).

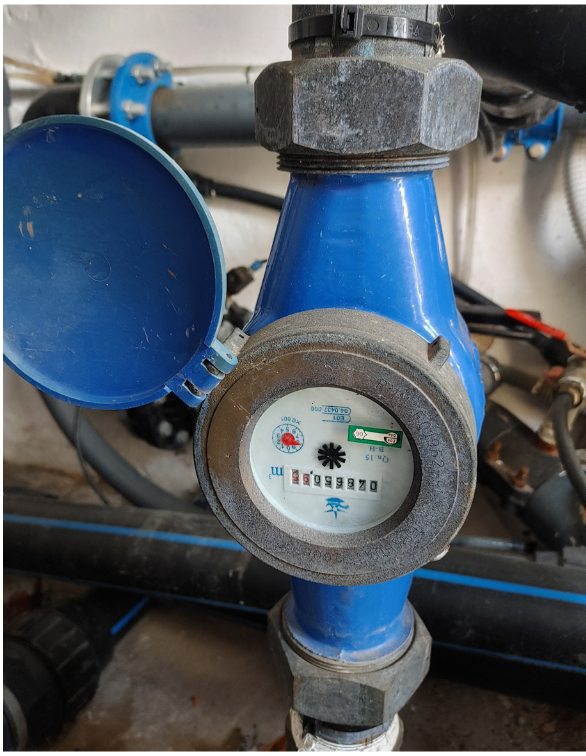
The irrigation paradox

The assumption that significant water savings can be achieved through the use of new/improved irrigation systems is now increasingly being challenged. This is a consequence of the increased use of efficient irrigation systems, which often results in the irrigated area being expanded and/or more water-intensive crops being grown. In addition, there is less backflow of irrigation water back into the aquifers.

As a result of this, the total water consumption increases at watershed level. Similarly, the climatic and economic impacts of irrigation system modernisation are associated with increased energy consumption and CO_2 emissions for groundwater extraction, pumping and distribution at the appropriate water volumes and pressure.

3.3.2.3 Measuring water consumption

According to the Naturland and Bio Suisse standards (Naturland B.I.7.2.1, Bio Suisse Part V, 3.6.2.4), **water consumption (m^3/ha/a) must be recorded at the operation**. Water meters or flow meters are suitable for this purpose.



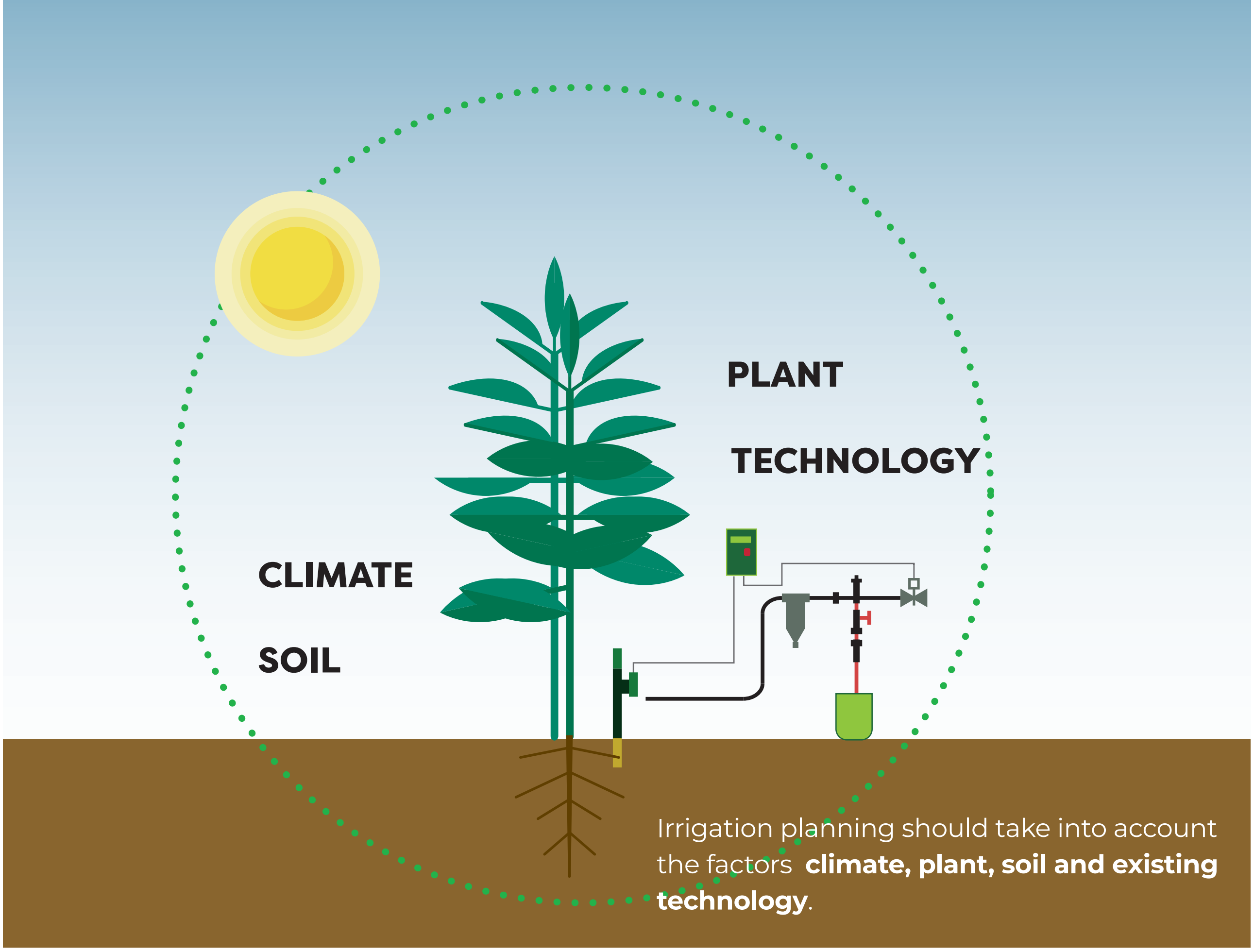
Example water meter

3.3.2.4 Irrigation practice and planning

The Naturland and Bio Suisse standards specify that **irrigation must be carried out in accordance with the codes of good agricultural practice** (Naturland 7.1). Irrigation planning involves deciding when to irrigate the crops and with what quantity of water. It is therefore one of the most important factors for plant growth and sustainable irrigation management[14].

Precision irrigation

Precision irrigation refers to the integration of information, , communication, and control technologies into the irrigation process in order to achieve optimal use of water resources while minimising the impact on the environment. Precision irrigation is a powerful tool used to plan and implement optimal irrigation.



Methods for assessing irrigation frequency and intensity
There are several methods for assessing how often and how much to irrigate, for example:

- Evapotranspiration models
- Methods for measuring soil moisture
- Plant assessments

These methods are briefly outlined below. We recommend a combination of all three methods for ensuring optimal irrigation planning.

Evapotranspiration models
Evapotranspiration models can be used to plan irrigation. Some parameters are important for the calculation, which are explained below:

Available water capacity
Soil pores with a diameter of more than 10 µm (coarse pores) or more than 50 µm (macropores) cannot hold soil water in their capillaries. It flows off through them. Pores smaller than 0.2 µm (fine pores) hold water by means of adhesion forces in such a way that plant roots can no longer extract it. This water in the fine pores is thus called dead water (TOT) (pF >4.2). The water in the medium-sized pores (10 to 0.2 µm) is therefore important for the plants in the long term. This water supply represents the available water capacity (AWC =FC –TOT). If the soil dries out to such an extent that only fine pores still carry water (pF 4.2), the permanent wilting point (PWP) is reached for many plants.

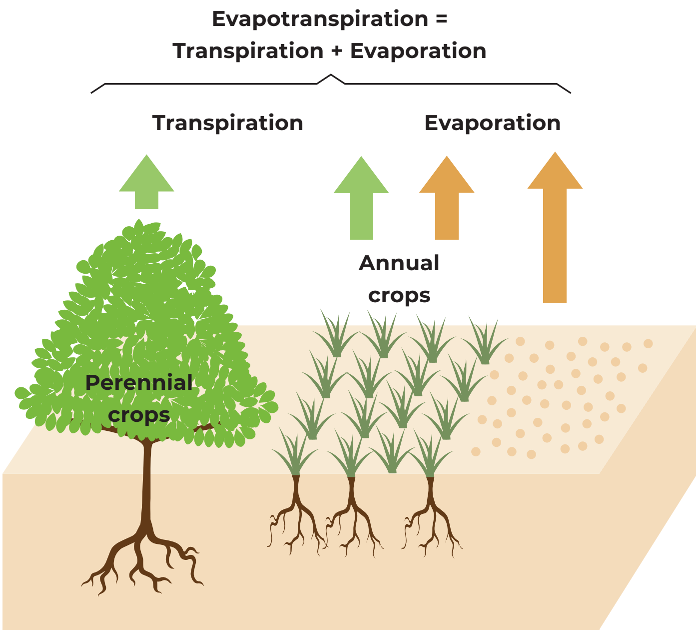
You can find detailed instructions on how to determine the available water capacity in the FiBL guide "Good agricultural practice in irrigation management" (www.fibl.org/en/shop-en/2522-irrigation.html).

Evapotranspiration

Transpiration: Most of the water that plants absorb from the soil through their roots is eventually released back into the atmosphere as vapour. The release of water vapour is known as transpiration.

Evaporation: Water also evaporates directly from the soil into the atmosphere. This process is called evaporation.

Evapotranspiration refers to the sum of transpiration and evaporation, i.e. the evaporation of water from plants and from soil and water surfaces. It is an important parameter in irrigation planning.



If evapotranspiration is greater than the usable field capacity → irrigation
If evapotranspiration is smaller than the usable field capacity → no irrigation

Evapotranspiration can be measured using an evaporation pan or calculated from meteorological data. In regions with extensive irrigated cropping, local meteorological services or agricultural authorities monitor and provide information on evapotranspiration.

Measuring soil moisture

A simple and inexpensive method to measure whether plants are suffering from water stress is to measure the soil water tension using soil moisture meters.

Instruments for measuring soil water tension and soil moisture:

- Tensiometers
- Gypson blocks
- Neutron probes

Plant assessment

An assessment of plants can also provide information about its water requirements. In the past, this was carried out by observing the plants. Today, there are technical possibilities to record water-stress-relevant parameters of plants.

Plant sensors:

- Pflant sap flow
- Stem microvariation
- Leaf temperature (see image)[18]

The absolute temperature of a leaf can be measured by using a leaf temperature thermometer.

Info box – deficit irrigation

Deficit irrigation is agricultural irrigation with a quantity of water given deliberately below the water requirement of the crop. Deficit irrigation offers the opportunity to increase water use efficiency in agriculture.
Water use efficiency (WUE) represents the crop yield per every unit of water:

$$\textit{Water use efficiency}\ (WUE) = \frac{\textit{Yield}\ (t/ha)}{\textit{Irrigation water used}\ (l/m2)}$$

Deficit irrigation in grapes, for example, leads to a higher sugar content and better quality of the fruit. For olives, deficit irrigation can lead to a higher oil yield with better quality (more unsaturated fatty acids and polyphenols).

3.3.3 Area of the operation calculated in the respective year

Number 3 of the table R1 concerns the areas of the operation in hectares. Firstly, you provide the total area (3.1), and then indicate the irrigated area (3.2). The non-irrigated area (3.3) is calculated using a stored formula. The table is intended for use over several years. As farm areas may change over time, please enter data on farm areas for each year (even if they have remained the same, please fill in the fields for each year).

3	**Surface of the operation/farm in the respective year**	**2023**	**2024**	**2025**
3.1	Total surface of the operation (ha)	229,75		
3.2	Of which has been irrigated (ha)	114,15		
3.3	Of which has not been irrigated (ha)	116	0	0

3.3.4 Water consumption and consumption according to water rights

Sections 4 and 5 of the table R1 deal with the total water consumption of the farm (4.1Here, all water quantities taken (e.g. from water bills, own measurements with water meter) are added up and given in m^3.

In section 5, the **quantity of water** is indicated by the **water origin** (private well, associations of water users, public water network, etc.). Here, the approved quantity according to the water rights (documented by proof of legality) must not exceed the quantity withdrawn. The data must coincide with the values in tab R2 "Legality".

4	**Annual water consumption**	**2023**	**2024**	**2025**
4.1	Total water consumption of the operation (m^3)	650		
4.2	Water consumption of irrigated area (m^3/ha)	6	#DIV/0!	#DIV/0!
5	**Consumption by water origin**	**2023**	**2024**	**2025**
5.1	Water consumption from private wells (m^3)	650		
5.2	Consumption from Water User Associations (WUA) (m^3)			
5.3	Water consumption from the public water network (m^3)			
5.4	Other water consumption in m^3 (e.g. rainwater)			
5.5	**Total water consumption in m^3 by water origin**	**650**	**0**	**0**

3.3.5 Climate data

Section 6 deals with the **amount of precipitation per year** and the **average temperature** of the region where your farm is located.

The climate data can be found on the pages of the weather services of the respective regions. If there were any special weather events in a year that affect your farm's water consumption, note this in field 6.3. This could, for example, be heavy rainfall or untypical dry periods.

4	**Climate data and specific incidents**	2021	2022	2023
4,1	Precipitation yearly (mm)	453		
4,2	Ø-temperatures [C°]	16;1		
4,3	Comments on climate, yearly variations and specific incidents	Particularly little precipitation last year		

3.4 Farmer List Irrigation (only for producer groups)

Producer groups located in an area with water risks use the Farmer List Irrigation to obtain information on irrigation from all members; this is an integral part of the inspection checklist. The table must be completed by the person responsible for the project and must be presented before the inspection to the inspection body (for Bio Suisse certification), or to the adviser (for Naturland certification). Further information can be found in chapter 3.1 "Special features of the group procedure". Lines 6 and 7 contain two examples to help you complete the table.

In the first step, the general information of the farms is requested. Here the name of the farm, the region, the total area and the irrigated area of the farm, as well as the number of irrigated parcels must be given.

Producer Name / Code	Region	Total area of each farmer (ha)	Irrigated area of each farmer (ha)	Number of irrigated plots
Example 1	name of region	12,52	13,60	2
Example 2	name of region	1,25	0,85	1

In column F, the origin of the irrigation water is requested. In chapter 3.3.2.1 of this guide, the different water sources are mentioned and described. Subsequently, the number of water sources should coincide with the information given in column F.
Furthermore, the legality of the water use is also queried. For this purpose, only the type of proof has to be given in this table. The accuracy and completeness of the information is then however checked in a sample of individual farms.

The relevant documents, such as plot lists (maps are also accepted) and proof of legality, should therefore already be available when the FLI table is completed. Further information on legality certificates can be found in the previous chapter 3.5 "Legality (R2)".

Source(s) of irrigation water (e.g. groundwater, surface water...)	Number of all water sources	Types of irrigation facilities (e.g. wells (private/public), water pumps...)	Type of proof of legal water use (for irrigated areas > 1 Ha)
groundwater + desalinated	2	private well + desalination plant	Concession of Hydrographic Confederation and Concession of offical irrigators' association (annex 2)
superficial water	1	water conduction from the creek	not relevant

In the following, the irrigation system is queried. Further explanatory information can be found in Chapter 3.3.2 and the Annexes to help with this declaration.
In the last columns, further information on the farm's water consumption must be provided. According to the standards of Naturland and Bio Suisse (Naturland B.I.7.2.1, Bio Suisse Part V, 3.6.2.4) the water consumption (m^3/ha/a) on the farm has to be recorded. Water meters and if necessary, flow sensors (flow meters) are suitable for this purpose. The measured values must then be declared. In column L the water consumption of the whole farm in one year is given in m^3. In column M, however, this value is converted to the area to show the water consumption per hectare in one year. Finally, all crops irrigated on the farm should be listed.

Irrigation system (e.g. drip irrigation, etc.)	How is water consumption monitored on the farm? (e.g. water meter, water bills ....)	Total water use of the farm/year (m^3)	Water use per ha/year (m^3)	Irrigated crops
Drip irrigation	water meter	45.000	3309	lemon
sprinklers	water meter	2.300	2705	apricots

3.5 Legality (R2)

In this tab R2, precise information is provided on the legality of the water resources used. Here the information should be consistent with the legality documents enclosed (required Appendix B).
Note for the group procedure: producer groups (as per chapter 3.1 “Special features of producer groups”) should note that R2 must only be completed and submitted by selected members.
A legality document must be annexed to the WMP for each water source. A separate line is created within the Excel spreadsheet for each legality document. Line 7 provides helpful explanations concerning the required information. Line 8 also contains a sample line as a practical aid to completion.

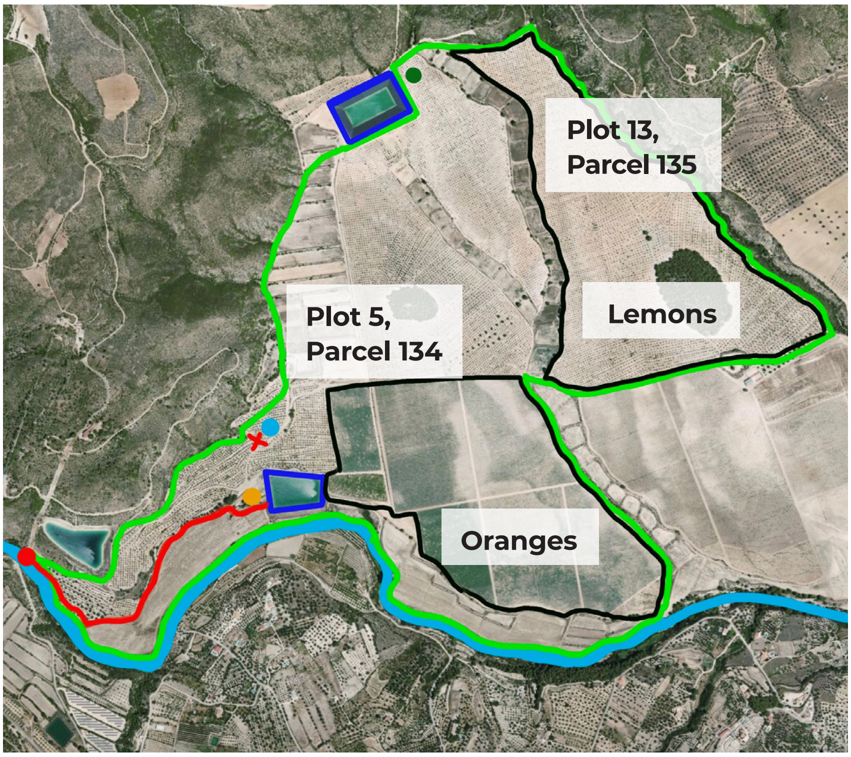
All data from the legality documents or alternative documents (e.g. water bills) that comply with national or regional laws and regulations on water extraction are carefully carried over into the table. All data to be carried over into columns B-I originate from the annexed documents. If the documents do not contain the information, the missing cells must be left empty, and a comment can be included in column K. If important information is missing from the legality documents (e.g. maximum total water quantity, plot numbers), this information must be presented plausibly from an alternative source (e.g. attach water bills).

Type of water source	Competent authority	Surface area	Amount of water per hectare	Total amount of water	Water right issued for ...	Plot identification	No. of irrigated plots (cumulative)	Validity or accounting period
Explanation: Wells, WUA, consortium, etc.	*Authority that issued the document*	*Unit: ha*	*Unit: m^3/ha*	*Unit: m^3*	*User, number, water meter, etc.*	*Name, cadastral, number, Pol/Parcela, etc.*	*With water source specified in column A*	*Date or year*
Example: Well	*Extract from the water register, Junta de Analucia*	*5*	*4'000*	*20'000*	*Name of former operations manager*	*70/110-70/115, 70/130*	*7*	*2025*

The cells highlighted in orange in this tab R2 must be entered by the operation and verified by the inspection body or by Naturland.

Plot list or map(s)
An up-to-date plot list must be submitted as a required appendix (Appendix C). All actually farmed plots must be displayed. It must be clear which plots are irrigated. The plots must be labelled with the official plot numbers (usually according to EU organic standards). In Spain, a list of plots is drawn up by the EU organic inspection body in most cases, and this list is accepted. In Italy, plot lists from the “Programma Annuale delle Produzioni Vegetali” (PAPV), for example, are acceptable. The inspection body compares all plots included in the plot list against the entries in R2. The completeness of the legality documents is verified with reference to the plot list.
Alternatively, a properly labelled overview map of the operation can be submitted.

The following map shows a best practice example of such a map



Example of a labelled map as an appendix to the WMP

Legend:
- Borders of the farm
- Active well
- Water reservoir
- Water meter
- Control system
- River water abstraction
- Inactive well
- Irrigated plot
- River
- Channel from the river to the reservoir

Joint use of water rights
Shared water rights for the same water source must also be noted. This is particularly important in order to resolve any confusion or uncertainty regarding the quantity of water from a source. In the case of joint use of water rights, the distribution of water among all users* must be demonstrated by an additional appendix (required appendix D).

3.5.1 Relevance of proof of legality

Here you will find some background information on the relevance of the proof of water legality. Appendix 4.4 also contains explanations of the documentation on the legality of water use in individual countries.

A central component of sustainable water management at operation level is the **legality of water use**. Illegal water use is a global problem: all over the world, water is used illegally. For example, studies estimate that up to 50 per cent of all wells in Mediterranean Europe are illegal[14]. WWF has reported that there are around 500'000 illegal wells in Spain[15]. Illegal wells are a major problem for the water balance of entire regions and for natural ecosystems: due to the over-exploitation of water resources through illegal, unauthorised wells, the groundwater table in the affected regions continues to fall. Not only does this harm natural ecosystems, but all users that depend on an intact water balance: agriculture, settlements, tourism and indigenous communities. Illegal water use affects not only the environment, but also legal users and, in the case of agriculture, results in disproportionate, unfair competition.[16] Legal regulations on water abstraction create framework conditions for legal water use that, ideally, does not exceed the limits of natural ecosystems, but is sustainable.

* The requirements for the documentation on the legality of water use are continuously revised and developed by Naturland and Bio Suisse.

According to Naturland and Bio Suisse standards, water abstraction must comply with national or regional laws and regulations (Naturland B.I.7.2.1., Bio Suisse Part V, 3.6.2.4). **Proof of legality from the corresponding government authority must be enclosed with the WMP for all water abstractions, including wells**. In countries without legal regulations on water use (or insufficient regulations), all other required appendices in accordance with the WMP must be submitted in conformity with the principle of governance*. In the case of joint use of water rights, the distribution of water among all users must be plausibly demonstrated. This information must also be entered in the second tab of the Excel attachment, “Legality/Plausibility”.
Chapter 3.2 Tab folder “Legality/Plausibility” describes the procedure for completing the Excel sheet.

The following three steps will help you to provide the required proof of legality:

- Step 1: identify the source of water
- Step 2: identify the competent authorities
- Step 3: provide proof of legality

Identifying the source of water
As described in the previous chapter, irrigation water can have different origins, such as groundwater, surface water or rainwater. Depending on country- or region-specific regulations, the different water origins have an impact on the proof of legality. It is also important to distinguish whether the use is private, for example through private wells or private pumps in a river, or whether the use is public, such as the public water network or a water use community.

Identifying the competent authorities
The next step for checking whether the water use is legal is to identify the competent authorities (for granting water rights). It is their responsibility to provide and issue proof of the legal use of water.

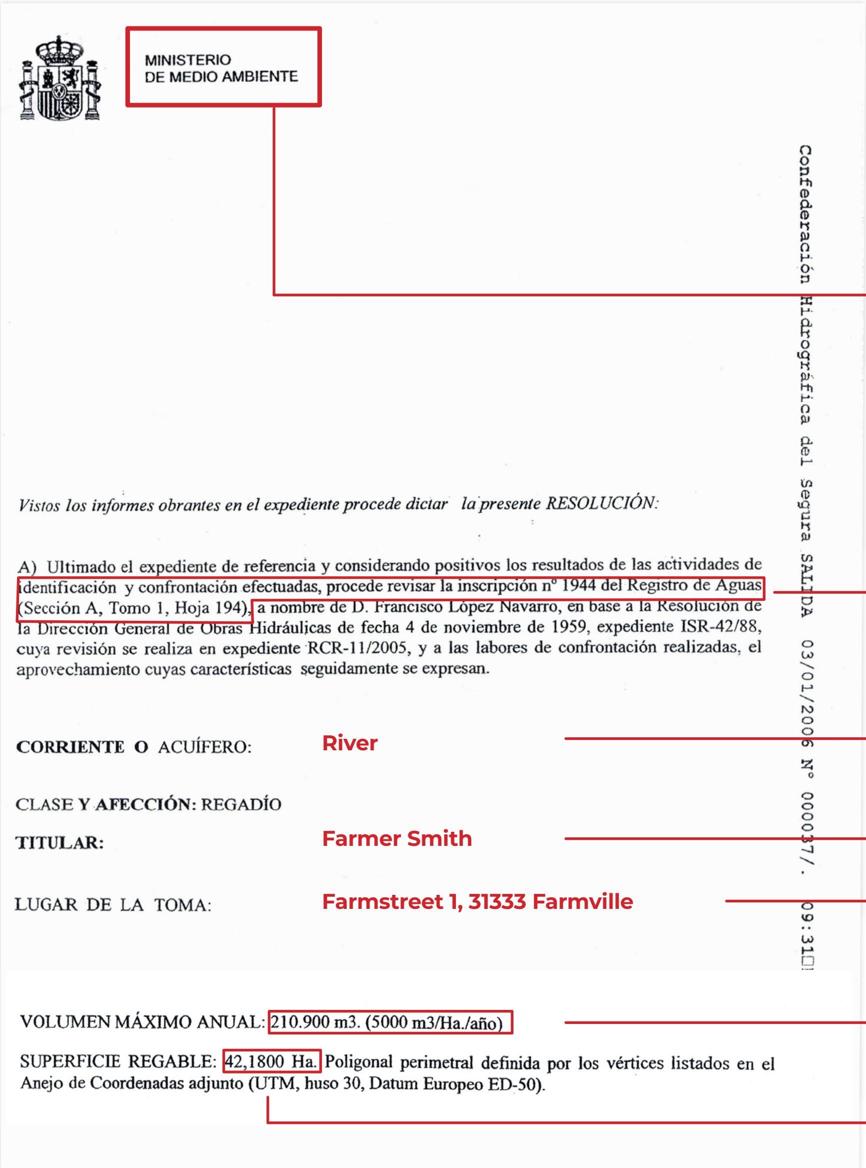
Submitting documentation of proof of legality
After you have identified the water origin and the competent authorities, the last step is providing the documentation.

Minimum requirements for proof of legality:
- The proof must be provided for all water sources
- The proof must be issued with reference to the operation
- The proof must be issued by the competent authority
- The proof must still be valid (for the time being)
- The irrigated plots must be marked
- The maximum authorised quantity of water abstraction must be visible
- The real consumption must not exceed the authorised amount of water

* Naturland and Bio Suisse are currently still working on criteria for governance with regard to water.

Here is an example of what a permit from the irrigation authority can look like and what type of data Naturland and Bio Suisse require:

Example 1 of proof of legality of water use



MINISTERIO
DE MEDIO AMBIENTE

Confederación Hidrográfica del Segura SALIDA 03/01/2006 Nº 000037/. 09:31

Vistos los informes obrantes en el expediente procede dictar la presente RESOLUCIÓN:

A) Ultimado el expediente de referencia y considerando positivos los resultados de las actividades de identificación y confrontación efectuadas, procede revisar la inscripción nº 1944 del Registro de Aguas (Sección A, Tomo 1, Hoja 194), a nombre de D. Francisco López Navarro, en base a la Resolución de la Dirección General de Obras Hidráulicas de fecha 4 de noviembre de 1959, expediente ISR-42/88, cuya revisión se realiza en expediente RCR-11/2005, y a las labores de confrontación realizadas, el aprovechamiento cuyas características seguidamente se expresan.

CORRIENTE O ACUÍFERO: River

CLASE Y AFECCIÓN: REGADÍO

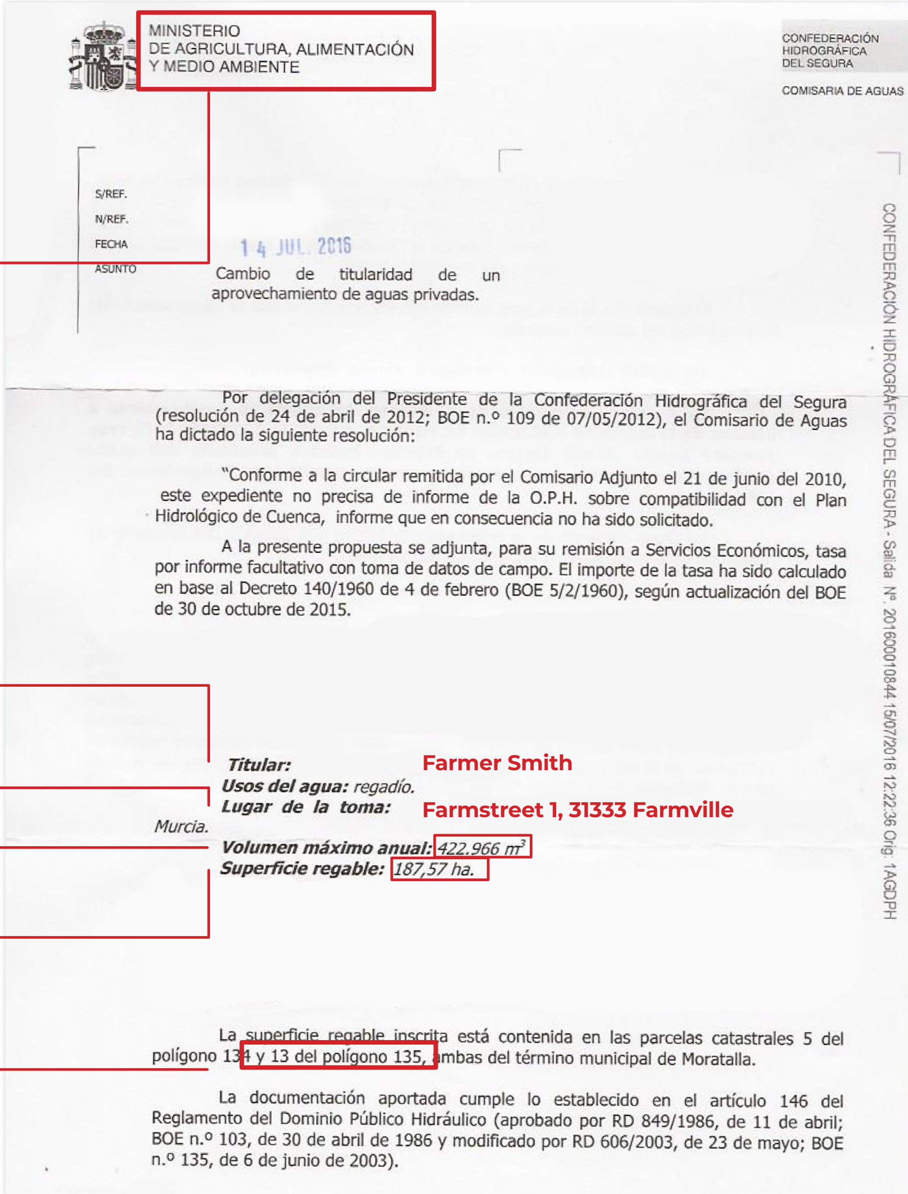
TITULAR: Farmer Smith

LUGAR DE LA TOMA: Farmstreet 1, 31333 Farmville

VOLUMEN MÁXIMO ANUAL: 210.900 m3. (5000 m3/Ha./año)

SUPERFICIE REGABLE: 42,1800 Ha. Poligonal perimetral definida por los vértices listados en el Anejo de Coordenadas adjunto (UTM, huso 30, Datum Europeo ED-50).

Example 2 of proof of legality of water use



MINISTERIO
DE AGRICULTURA, ALIMENTACIÓN
Y MEDIO AMBIENTE

CONFEDERACIÓN
HIDROGRÁFICA
DEL SEGURA

COMISARIA DE AGUAS

S/REF.
N/REF.
FECHA 14 JUL. 2016
ASUNTO Cambio de titularidad de un aprovechamiento de aguas privadas.

CONFEDERACIÓN HIDROGRÁFICA DEL SEGURA - Salida Nº. 201600010844 15/07/2016 12:22:36 Orig. 1AGDPH

Por delegación del Presidente de la Confederación Hidrográfica del Segura (resolución de 24 de abril de 2012; BOE n.º 109 de 07/05/2012), el Comisario de Aguas ha dictado la siguiente resolución:

"Conforme a la circular remitida por el Comisario Adjunto el 21 de junio del 2010, este expediente no precisa de informe de la O.P.H. sobre compatibilidad con el Plan Hidrológico de Cuenca, informe que en consecuencia no ha sido solicitado.

A la presente propuesta se adjunta, para su remisión a Servicios Económicos, tasa por informe facultativo con toma de datos de campo. El importe de la tasa ha sido calculado en base al Decreto 140/1960 de 4 de febrero (BOE 5/2/1960), según actualización del BOE de 30 de octubre de 2015.

Titular: Farmer Smith
Usos del agua: *regadío.*
Lugar de la toma: Farmstreet 1, 31333 Farmville
Murcia.
Volumen máximo anual: *422.966 m³*
Superficie regable: *187,57 ha.*

La superficie regable inscrita está contenida en las parcelas catastrales 5 del polígono 134 y 13 del polígono 135, ambas del término municipal de Moratalla.

La documentación aportada cumple lo establecido en el artículo 146 del Reglamento del Dominio Público Hidráulico (aprobado por RD 849/1986, de 11 de abril; BOE n.º 103, de 30 de abril de 1986 y modificado por RD 606/2003, de 23 de mayo; BOE n.º 135, de 6 de junio de 2003).

You can find explanations of the documentation on the legality of water use in individual countries in the appendix (Appendix 4.4)*.

Best practice for the legality of water use

- Complete proof of legality of all water sources is available
- Real water consumption does not exceed the authorised amount
- The documents are issued with a clear reference to the operation
- The documents are up to date and valid
- Documentation is unambiguous and clearly understandable
- A current water bill is presented to verify the plausibility of the irrigation quantity

* The requirements for the documentation on the legality of water use are continuously revised and developed by Naturland and Bio Suisse

3.6 Water quality, FAO analysis (R3)

Water quality is of utmost importance for plant growth and product quality. The Naturland and Bio Suisse standards specify **that irrigation must not lead to a long-term loss of soil fertility**, for example through salinisation or erosion. Furthermore, the **irrigation water** must not **negatively affect the quality of the harvested products** (Naturland 7.1, Bio Suisse Part V, 3.6.1.2). Preventive measures must be taken if there is a heightened risk. The FAO water quality standards are used to assess the quality of the irrigation water, see appendix of the guide (Appendix 4.6).

To complete the WMP R3 tab for the FAO analysis, a water analysis carried out according to FAO parameters or equivalent methods must be presented as a required appendix (Appendix E). The water analysis date and the analysis values indicated must be carried over into the cells provided for this purpose. It is important that the unit is correctly selected using a control box (if the mouse is hovered above it, the unit will appear on the right-hand side of the cell along with a selection menu). The problematic threshold values in the standard units are also visible.

Date of the Water Analysis:					
Analysis results:		**Data from analysis**		**Problematic threshold values**	
Salinisation:		Value	Unit	*FAO reference*	*Other units*
	Electric conductivity (EC)		Selection	*3.0 [ds/m]*	*> 3'000 µS/cm*
	Total dissolved solids (TDS value)		Selection	*> 2'000 [mg/l]*	*>2 g/l*
Toxic ions:		Value	Unit	*FAO reference*	*Other units*
	Sodium (Na)		Selection	*> 3 [mmol/l]*	*> 69 mg/l*
	Chlorine (Cl)		Selection	*> 3 [mmol/l]*	*> 106 mg/l*
	Boron (B)		Selection	*> 3 [mg/l]*	
Various effects:		Value	Unit	*FAO reference*	*Other units*
	Nitrates NO-N3		Selection	*> 30 [mg/l]*	
Remarks on the water analysis:					

If one of the values is in the problematic range, this must be stated as a risk in R4. Measures for dealing with it must be defined.

3.6.1 Explanation of the FAO water quality criteria

Salinisation: Irrigation with saline water can **irreparably destroy soil fertility**. The salt in the irrigation water accumulates in the soil and eventually reaches levels that make crop production impossible. Salts in the soil also reduce water availability to the plant to such an extent that yield is affected. Salinisation is measured by electrical conductivity (EC value) or by total dissolved solids (TDS value).[19]

You can find more detailed information on salinisation and ways to deal with excessive salinity in soils in the FAO manual “Salt-Affected Soils and Their Management” online at www.fao.org/3/x5871e/x5871e00.htm.

Infiltration: A **high sodium** or **low calcium** content of the soil or water **reduces infiltration**, i.e. the speed at which irrigation water penetrates the soil. In some cases, so much that not enough water can be infiltrated to supply the plants adequately from one irrigation to the next.

Toxic Ions: Certain ions (**sodium, chloride or boron**) from the soil or water can accumulate in sensitive crops at concentrations high enough to cause **crop damage** and **reduce yield**.

Nitrate: Excess nutrients **reduce yield and quality**[20] and affect groundwater.

Sampling material and technique, analysis package

The water analysis can only be as accurate, and therefore conclusive, as the sample drawn. For the sampling technique including material, transport conditions and the choice of analysis package, the operations manager should consult an accredited laboratory in advance. The sample must be labelled with the place of sampling (geographical; functional unit of the irrigation system) and the time.

Choosing time and place of sampling

The water applied to the soil and sprayed on the plants must comply with FAO requirements. The operations manager must think carefully about where to draw the water sample in order to obtain a representative analytical result. For example, if the irrigation system requires a treatment step, the water sample must be drawn after completing this step. Depending on how the irrigation system is built up (multiple origins, branched pipe system), several samples should be drawn. If the analytical result does not comply with the FAO requirements, the operation must determine further sampling locations in order to find the cause of the deviating values. The frequency of sampling depends on how much the parameters of the irrigation water fluctuate. Surface waters are generally subject to greater fluctuations than groundwater. Testing does not have to be carried out as frequently if it can be shown that the relevant parameters are subject to less fluctuation. We recommend carrying out an FAO analysis of the irrigation water annually. This must be submitted to Naturland or Bio Suisse every three years, together with the complete documentation of the WMP. Exceeded values must be documented and included in the risk analysis and plan of action.

Best practice for irrigation planning and practice

- Implementing an efficient irrigation system
- Measuring the water consumption
- Carrying out irrigation on the basis of the codes of good agricultural practice
- Regularly inspecting and maintaining the irrigation system
- Making sure maintenance schedules and records of maintenance are available
- Making sure the annual analysis of water quality according to FAO criteria is available

3.7 Risk analysis, plan of action and stewardship (R4)

The last section in the WMP is about water-related risks and measures. The operations or producer groups concerned must analyse the risks to which they are exposed in connection with water usage and plan and take measures to reduce or avoid these risks.

First of all, at least one operational and one inter-operational risk must be described. Existing and future risk reduction measures must be mentioned. Operational risks are water-related challenges that are strongly related to the operation's specific location and orientation. In the case of producer groups, risks that relate to a majority of the group are indicated.

Inter-operational risks are water-related problems or threats that affect multiple interest groups in the watershed. Inter-operational risks usually require inter-operational solutions (both existing and future measures). However, operational measures to reduce the risk may also be appropriate.

Risk Analysis and Plan of Action:

Operational risks	**Existing measures**	**Future measures**
Operational risks are water-related challenges that are strongly related to the operation's specific location and orientation; in the case of producer groups, they relate to the entire group.		
Description of the risk:	*Description of measures already in place to mitigate the risk:*	*Description of further measures that should be implemented to mitigate the risk:*

Cross-operational risks	**Existing measures**	**Future measures**
Cross-operational risks are water-related problems or threats that affect multiple interest groups in the watershed.		
Description of the risk:	*Description of measures already in place to mitigate the risk:*	*Description of further measures that should be implemented to mitigate the risk:*

Water stewardship

The third section of R4 deals with cooperation with other water users in the watershed (water stewardship). The main water users from all economic sectors (agriculture, industry, trade and services) are identified. Regional water management associations are mentioned (e.g. water associations, consortia). Finally, explain which of these associations your operation is involved in.
You can find examples of possible risks and measures in the Appendix 4.5.

Cooperation with relevant water user groups (water stewardship):

Who are the main water users in the watershed?		*Identification of water users in the watershed.*
What regional associations exist in the watershed?		*Listing of regional associations, e.g. water associations.*
Is your operation involved in a regional association? If YES: which one?		*Cooperation with other water users in the watershed.*

Best practice for the risk analysis and plan of action

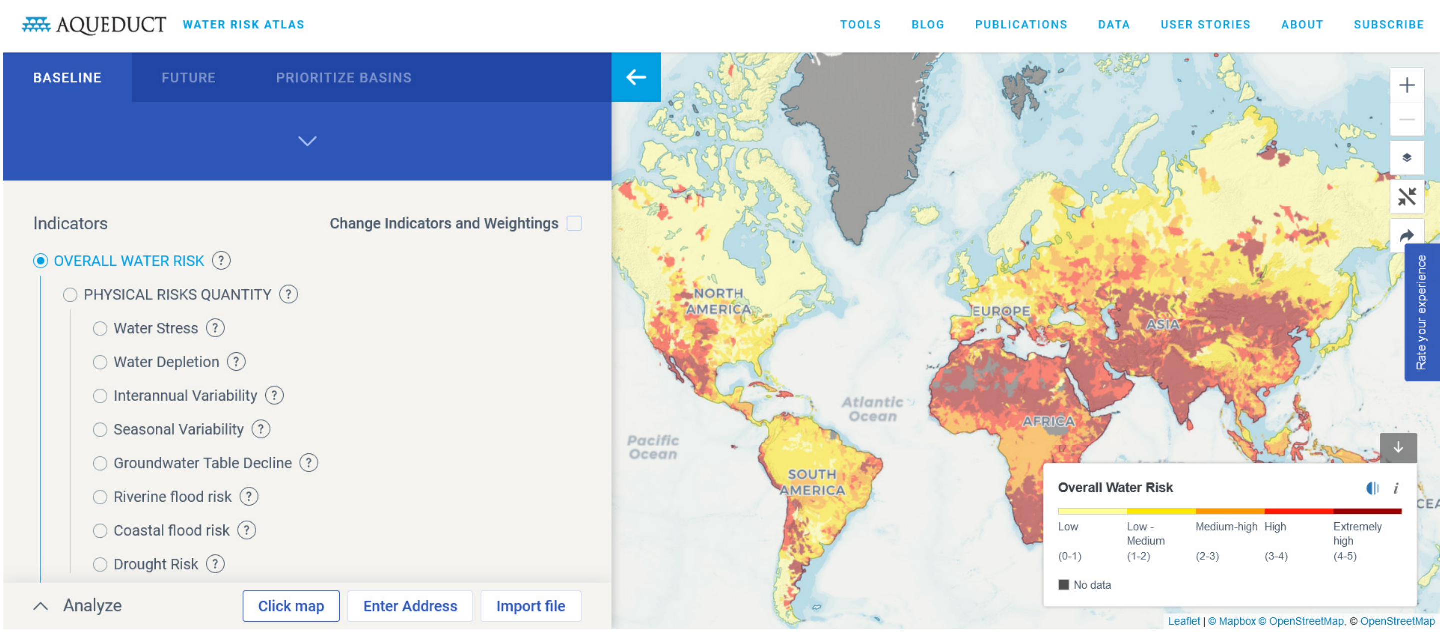
- Identifying and recording water risks
- Making sure the risk analysis takes into account both the operational situation and the inter-operational level of the watershed
- Analysing risks from all areas and taking into account any if applicable to the operation
- Taking and documenting measures
- Adapting such measures to the operation

4. APPENDIX

4.1 Instructions for the Aqueduct Water Filter

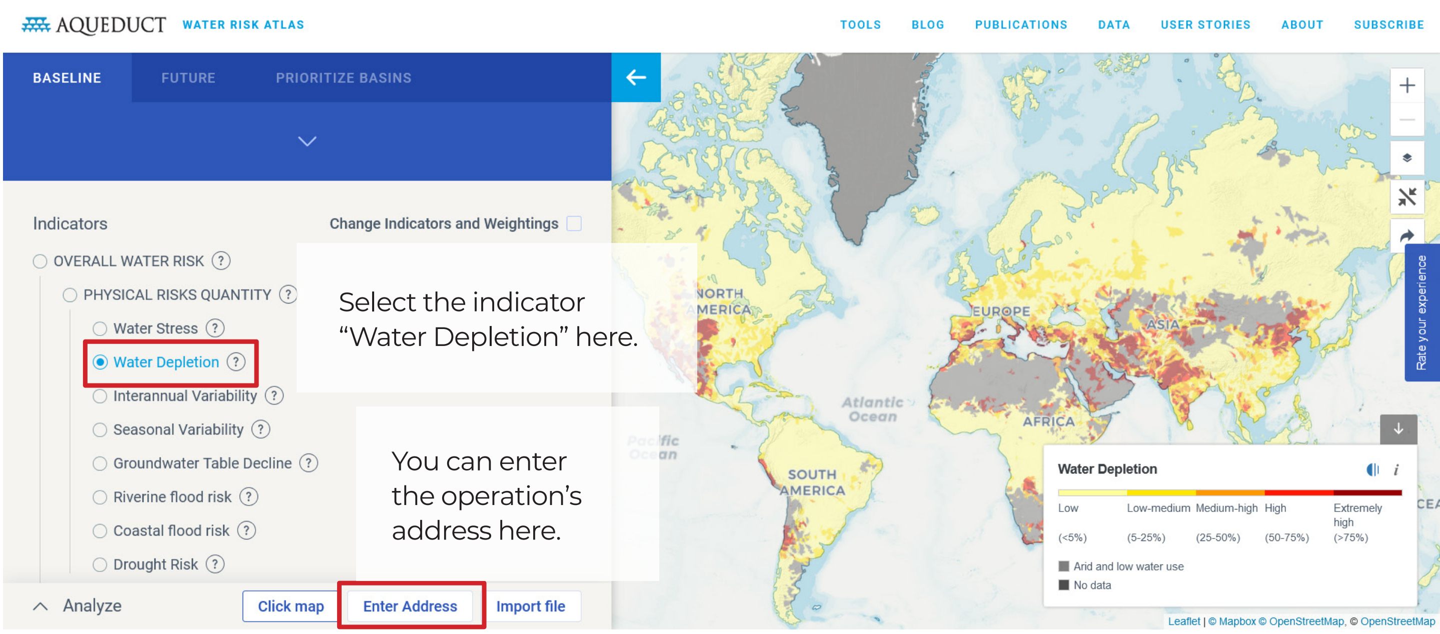
1

Open the Aqueduct Water Filter at the following address: **https://wri.org/applications/aqueduct/water-risk-atlas**



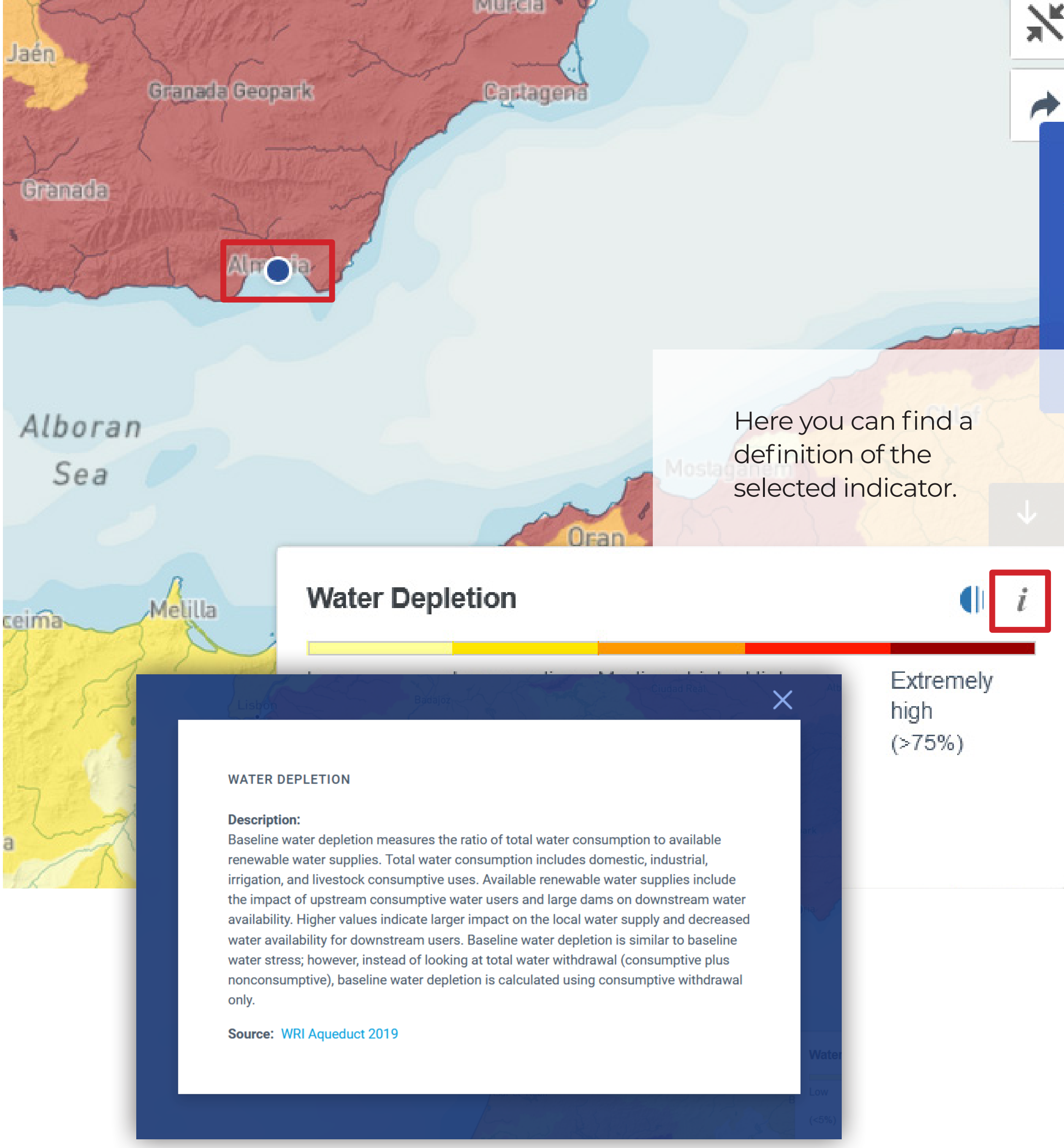
2

You can select the different indicators to be filtered in the tab on the left.
The Naturland and Bio Suisse standards refer to the indicator "Water Depletion". Operations located in regions classified as "High" (red on the map) or "Extremely high" (dark red on the map), according to the Aqueduct Water Filter, must submit a WMP.

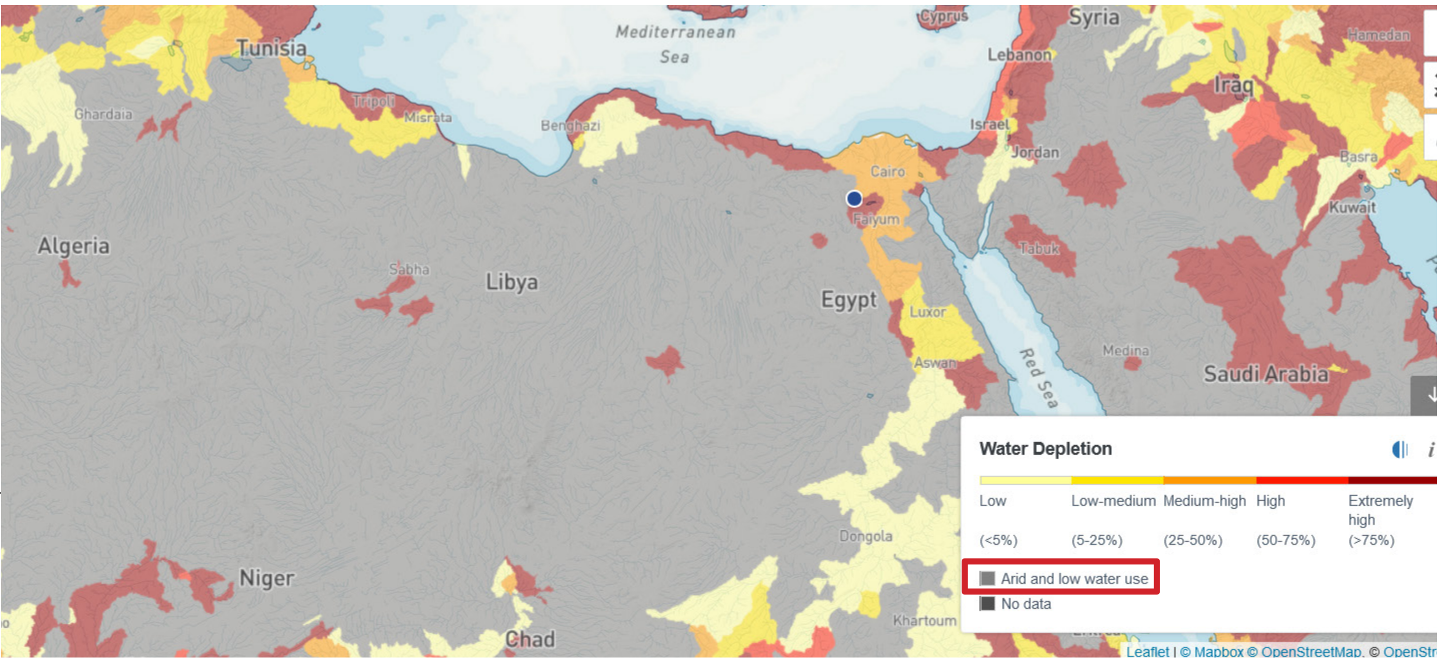


3 By using the “Enter Address” function, you can search for the address of an operation directly and it appears as a dot on the world map. You can also enter the GPS data of the operation.

4 Click the “i” button to view a definition for each indicator.



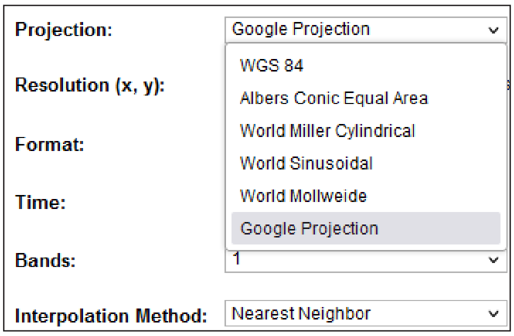
5 Operations in regions with desert climates or classified as “Arid and low water use” (grey on the map) also need a WMP.



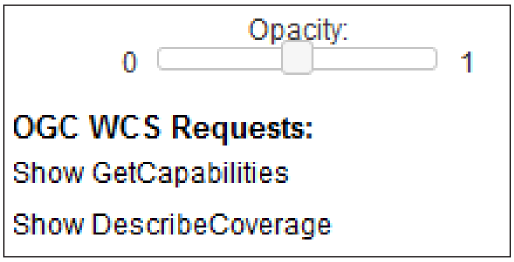
4.2 Instructions for the Köppen-Geiger climate classification

1 Open the Köppen-Geiger climate classification at the following address: **https://webmap.ornl.gov/ogcdown/dataset.jsp?dg_id=10012_1**
There is no need to log in to access the information.

2 Under “Projection”, select the “Google Projection”:



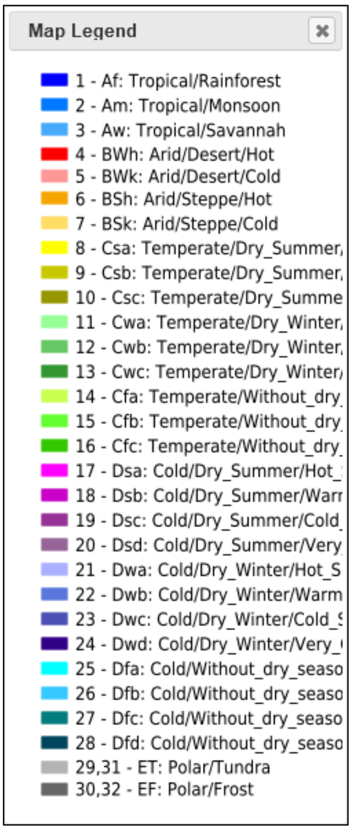
3 Place the bar for “Opacity” approximately in the middle:



4 For “Base Layer”, also select “Google Map”:

5 The breakdown of the climate classification can be viewed in detail using the mouse and the zoom function.

6 The key can be displayed by clicking on the coloured symbol.



4.3 Overview of irrigation systems

	Surface irrigation	Sprinkler irrigation
		
Types	• Flood irrigation • Furrow irrigation • Surge irrigation	• Fixed systems • Systems with fixed main and movable lateral pipelines • Pivot systems • Rain gun sprinklers
Features	• Gravity-fed irrigation • Flood irrigation: basins enclosed by earth dams and filled with water (e.g. for rice) • Furrow irrigation: water is directed through furrows along crop rows (e.g. vegetable crops) • Surge irrigation: water is directed through furrows at intervals	• Pressurised systems, usually with main and secondary lines ending in one or several sprinklers (emitters) • Different delivery diameters possible • Pressure and emitter dimensions are adjusted to prevent droplets from forming that are too large or too small
Advantages	• No or low energy demand • Low investment requirement in traditional systems • Irrigation of the entire root zone – better crop health in the root area • Reduced risk of salinisation • Enhancement of biodiversity	• Suitable for light soils • Suitable for sloping or uneven fields • Can be used to reduce evapotranspiration by lowering leaf temperature • Overhead irrigation can be used as frost protection in fruit cultivation
Dis-advantages	• Low irrigation efficiency in traditional systems • Risk of oversupply at the top of the field and undersupply at the bottom of the field • Risk of nutrients leaching out past the root zone • Risk of water loss through run-off (drag water) • Risk of internal and superficial erosion of the soil • Risk of waterlogging and consequent suffocation in poorly drained soils • High amount of work • High investment for improved systems	• Large drips can damage soil structure (especially with rain guns) • Requires pumps with high capacity and pressure-tight pipes • Irrigation from above can increase incidence of illness • Uneven water distribution pattern • Water loss due to drift, evaporation and irrigation of non-productive areas • High energy demand
Recommen-ded areas of application	• Regions with a plentiful supply of water resources but low or irregular rainfall • Regions with little infrastructure and traditional irrigation channels	• Frequent use in rows of fruit and field crops

	Microsprinkler irrigation	Drip irrigation
		
Features	• Micro-irrigation systems with which irrigation is confined to the actual root zone of the crop • Has a larger wetting pattern than drip irrigation • Microsprinklers deliver higher volumes of water per hour than drip irrigation	• Micro-irrigation system with which irrigation is confined to the actual root zone of the crop • Operated at low pressure and with low water volumes per hour
Advantages	• High irrigation effectiveness • The wetted area is larger than with drip systems and enables maximum root penetration • Precise irrigation according to the plant's current needs • Microsprinkler emitters are larger than drip emitters and become clogged less frequently	• Very high level of irrigation efficiency • Lower investment than microsprinklers • Lower amount of work • Largely avoids water losses through evaporation and seepage • Irrigation possible at all hours of the day • The canopy remains dry and the probability of fungal diseases remains low
Dis-advantages	• High investment costs • Requires large volumes of water and pumps with high capacity • High energy demand • High water losses through evaporation when used in hot and sunny or windy areas • Salt enrichment in the border zones between dry and wet soil • Uneven water distribution due to overlapping of sprinklers	• Nozzles can become clogged with algae, bacterial slime or debris • Root zone is restricted to the wetted area • Suboptimal wetting pattern in light soils • Requires an efficient filtration system • Salt enrichment in the border zones between dry and wet soil • Drip tubes hinder mechanical weed control
Recommen-ded areas of application	• Frequently used in high-value tree crops • Also suitable for seed germination	• Especially suitable for vegetable crops

Source: 21

4.4 Documentation on the legality of water use

Example Spain

Since 1 January 1986, all surface waters and ground water in Spain are part of the public water law. From this date, any use or private use (> 7000 m^3 per year) of public water must be authorised by the responsible authority of the water catchment area.

Possible authorisations:

- Water concession (concesión de aguas)
- Private use by law (uso privativo por disposición legal)
- Temporary use of private waters (aprovechamiento temporal de aguas privadas)
- Inclusion in the catalogue of private waters (inclusión en el catálogo de aguas privadas)

Valid documents regarding water use

- Certificate of the water register of the responsible water administration. (Certificado del registro de aguas de la administración hidráulica competente (agua publica) or "Catalogo de aguas privadas").
- Certificate of the secretary of the irrigation communities with official constitution (Certificado del secretario de comunidades de regantes oficialmente constituidas)
- Valid concession or authorisation (Concesión o autorización vigente) issued by:
    - inter-municipal hydrographic associations (confederaciones hidrográficas intercomunitarias) or intra-municipal basin bodies (autonomous communities with water competences) (comunidades autónomas con competencias en aguas). E.g. Andalusia: "Junta de Andalucia".
    - Ministry of the Environment (ministerio con competencias en medio ambiente) (before 1986)

Invalid documents regarding water use

- Documents that only certify the beginning of a request or procedure, but do not constitute a final concession.
- Certificates from other administrations without jurisdiction (municipalities, agriculture, etc.).
- Certificates from the mining authority (Minas) authorising the well drilling.
- Certificates from farmers' associations.
- Water concession granted by the water management administration that has been amended, expired or lapsed at a later date.
- Sigpac or cadastral file

Requirements for a valid certificate:

The farm has a certificate from the water authority (autoridad hidráulica) or its affiliated bodies (comunidad de regantes legalmente constituida), with the following information:

- Purpose of water use (agriculture…)
- Duration of the permit
- Maximum flow rate / annual withdrawal quantity, if applicable, maximum monthly withdrawal quantity
- Indication of the period of use, if on restricted days,
- The municipality and province where the water abstraction takes place,
- Cartographic references of the water withdrawals and their locations
- Mention of the superior body granting the concession, otherwise the register extract from "registro de aguas" or "Catalogo de aguas privadas" must be enclosed.

Attention: It is important to ensure that the administration signing the water rights document is the responsible one. Irrigation communities must be officially constituted and need an entry of the right in the water registry, this entry can be claimed by the holding if there is no reference to the superior body on the document. There may be user communities that are **not officially** constituted or simply an association of farmers who do not have the authority to issue valid certificates of water legality.

For more information on the legality of water use in Spain, the WWF guide „Guía de WWF para verificar el uso legal del agua en agricultura" is recommended at https://wwfes.awsassets.panda.org/downloads/guia_usos_wwf_ok_para_web_1_1.pdf.

4.5 Examples of risk analysis and plan of action

Operational risk: quality of groundwater and surface water, quality of products

Risk	Possible measures to be taken by the operation
• Has there been/will there be contamination of groundwater, surface water or products by contaminated waste water, leachate or plant protection products at the operation? • How great is the risk that such events will occur (again)?	• Preventing the spread of pollutants (e.g. by proper storage of manure and fertiliser) • Making sure fertilisation is appropriate to the site, time and requirement • Preventing drift into surface waters by the correct time of treatment, implementing an adapted application technology or drift protection measures (e.g. windbreaks or nets) • Creating buffer zones • Planting or maintaining riparian vegetation along surface waters • Preventing oil spills from pumps or other equipment
• There is a risk of contamination of crops/products	• Regularly analysing irrigation water for pollutants • Preventing potential contamination of irrigation water • Not using water that has first passed through conventionally farmed land (e.g. rice cultivation) or testing it for possible contaminants

Operational risk: soil fertility degradation

Risk	Possible measures to be taken by the operation
• Erosion and/or surface run-off	• Erosion control measures (e.g. living terraces, dams) • Infiltration trenches • Planting cultivation in strips along contour lines • Improving soil fertility and structure; supply of organic matter (compost)
• Salinisation	• Analysing water regularly according to FAO criteria • Mixing irrigation water (with low-salt water) • No excess irrigation • Codes for good practice/best practice for irrigation • Correcting the pH value (after soil analysis, sulphur fertilisation if necessary)
• Reduced infiltration • Low water storage capacity	• Improving soil fertility and structure; supply of organic matter (compost) • Functional drainage • Adapting soil cultivation to the site

Operational risk: efficiency of irrigation – optimising water use – reducing water consumption

Risk	Possible measures to be taken by the operation
• High water consumption compared to irrigation plan and/or guideline values	• Reducing water consumption by, for example: • Maintaining irrigation equipment • Investing in water-saving irrigation system • Reducing evaporation (e.g. mulch, mulch film) • Irrigating only in the evening, at night, in the morning
• Inefficient irrigation system – optimisation of water use needed	• Checking water use records at different levels at the operation for accuracy, reliability and plausibility and optimising them • Training staff involved in irrigation • Identifying water losses and correcting and documenting problems occurring during the operation and maintenance of the system • Assessing whether climatic conditions are sufficiently taken into account regarding irrigation • Checking irrigation against the recommendations of recognised local institutions and authorities • Regularly questioning, evaluating and, if necessary, correcting the length and frequency of the irrigation cycles and the irrigated quantity • Ensuring even distribution of irrigation water (e.g. through short intervals of irrigation, pressure equalisation)

Inter-operational risk: adverse effects on ecosystems, ecosystem services, biodiversity

Risk	Possible measures to be taken by the operation
• Abstracting excessive water, surface water (lakes, rivers) → water shortage downstream, adverse effects on wetland • Are high conservation value (HCV) areas affected?	• Using alternative and various water sources (e.g. also treated process water, water from seawater desalination) • Water recovery • Retaining, collecting and utilising rainwater
• Abstracting excessive water – lowering groundwater table → adverse effects on wetland • Are HCV areas affected?	• Using alternative and various water sources (e.g. also treated process water, water from seawater desalination) • Water recovery • Retaining, collecting and utilising rainwater

Inter-operational risk: situation in the watershed

Risk	Assessment and possible measures to be taken by the operation, or necessary measures at inter-operational level
• Limited/reduced availability of water (overall, seasonal)	• Using alternative and various water sources (e.g. also treated process water, water from seawater desalination) • Water recovery • Retaining, collecting and utilising rainwater
• Water shortages in the watershed (overall, seasonal)	• Using alternative and various water sources (e.g. also treated process water, water from seawater desalination) • Water recovery • Retaining, collecting and utilising rainwater
• Overusing water resources in the watershed • Water abstraction exceeds groundwater recovery • Negative water balance in the watershed	• Inter-operational solutions required at regional and political level (spatial planning, water rights)
• Groundwater table has (drastically) fallen	• Inter-operational solutions required at regional and political level (spatial planning, water rights)
• Have the social, economic and environmental impacts of water consumption on the immediate or downstream environment been assessed?	• Inter-operational solutions required at regional and political level (spatial planning, water rights)

4.6 FAO criteria for the assessment of irrigation water

Potential irrigation problem	Unit	Water use		
		unproblematic	restricted	problematic
Salinisation **EC** **TDS**	 [ds/m] [mg/l]	 <0,7 <450	 from 0.7 to 3.0 from 450 to 2000	 >3,0 >2000
Infiltration **SAR and EC**	SAR [-] EC [dS/m]	SAR from 0 to 3 EC > 0.7	SAR from 0 to 3 EC 0.2 to 0.7	SAR from 0 to 3 EC < 0.2
	SAR [-] EC [dS/m]	SAR from 3 to 6 EC > 1.2	SAR from 3 to 6 EC from 0.3 to 1.2	SAR from 3 to 6 EC < 0.3
	SAR [-] EC [dS/m]	SAR from 6 to 12 EC > 1.9	SAR from 6 to 12 EC from 0.5 to 1.9	SAR from 6 to 12 EC < 0.5
	SAR [-] EC [dS/m]	SAR from 12 to 20 EC > 2.9	SAR from 12 to 20 EC from 1.3 to 2.9	SAR from 12 to 20 EC < 1.3
	SAR [-] EC [dS/m]	SAR from 20 to 40 EC > 5.0	SAR from 20 to 40 EC from 2.9 to 5.0	SAR from 20 to 40 EC < 2.9
Toxic ions				
Sodium **Na**				
for soil irrigation	SAR	<3	From 3 to 9	>9
for sprinkling	mmol/l	<3	>3	
Chlorine **CL**				
for soil irrigation	mmol/l	<4	From 4 to 10	>10
for sprinkling	mmol/l	<3	>3	
Boron **B**	Mg/l	<0,7	0.7 to 3.0	>3,0
Trace elements				
Al	µg/l	5.000		
As	µg/l	100		
Be	µg/l	100		
Cd	µg/l	10		
Co	µg/l	50		
Cr	µg/l	100		
Cu	µg/l	200		
F	µg/l	1,000	(maximum recommended concentrations)	
Fe	µg/l	5.000		
Li	µg/l	2.500		
Mn	µg/l	200		
Mo	µg/l	10		
Ni	µg/l	200		
Pd	µg/l	5.000		
Se	µg/l	20		
V	µg/l	100		
Zn	µg/l	2.000		
Various effects				
NO-N₃	Mg/l	<5	From 5 to 30	>30
With sprinkling **HCO_3**	Mmol/l	<1,5	From 1.5 to 8.5	8,5
pH value	-	Between 6.5 and 8.4		

a) Electrical conductivity, electrical conductivity
b) Total concentration of soluble salts, total dissolved solids

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