



GUIDANCE FOR

# **SUSTAINABLE WATER MANAGEMENT**

BY NATURLAND AND BIO SUISSE

# CONTENTS

<b>1. INTRODUCTION TO THE WATER MANAGEMENT PLAN (WMP)</b>	3
“Water Depletion” as an indicator for areas with water scarcity	4
1.1 Principles for sustainable water management	6
1.1.1 Preventive measures	7
1.1.2 Water management measures	9
1.1.3 Water Stewardship	10
<b>2. COMPLETING THE WATER MANAGEMENT PLAN (WMP)</b>	10
2.1 Special features of the group procedure	11
2.2 Farm data	12
2.3 Source of irrigation water	12
2.3.1 Type of water sources	13
2.3.2 Type of irrigation devices	15
2.4 Legality of water use	16
2.5 Type of irrigation and irrigation practice	19
2.5.1 Type of irrigation system	19
2.5.2 Measuring water consumption	20
2.5.3 Irrigation practice and planning	20
2.5.4 Methods for assessing irrigation frequency and intensity	21
2.5.5 Water quality	23
2.6 Risk analysis and plan of action	25
<b>3. INSTRUCTIONS FOR COMPLETING THE EXCEL ATTACHMENT</b>	26
3.1 Register folder 1: “Quantitative data on irrigation”	26
3.1.1 Water consumption and use by water rights (section 2 + 3)	27
3.1.2 Climate data (Section 4)	28
3.1.3 Crop water use (Section 5)	28
3.2 Register folder 2: “Legality/plausibility”	29
<b>4. EXCEL ANNEX “FARMER LIST IRRIGATION FLI”</b>	30
<b>5. APPENDIX</b>	32
5.1 Instructions for the Aqueduct Water Filter	32
5.2 Overview of irrigation systems	34
5.3 Documentation on the legality of water use	36
5.4 Examples of risk analysis and plan of action	37
5.5 FAO criteria for the assessment of irrigation water	40
<b>6. SOURCES</b>	41

# 1. INTRODUCTION TO THE WATER MANAGEMENT PLAN (WMP)

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.

## **Water and agriculture**

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<sup>1</sup>. 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<sup>2,3</sup>. 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<sup>4</sup>.

## **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<sup>5</sup>. 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.

## **The new WMP**

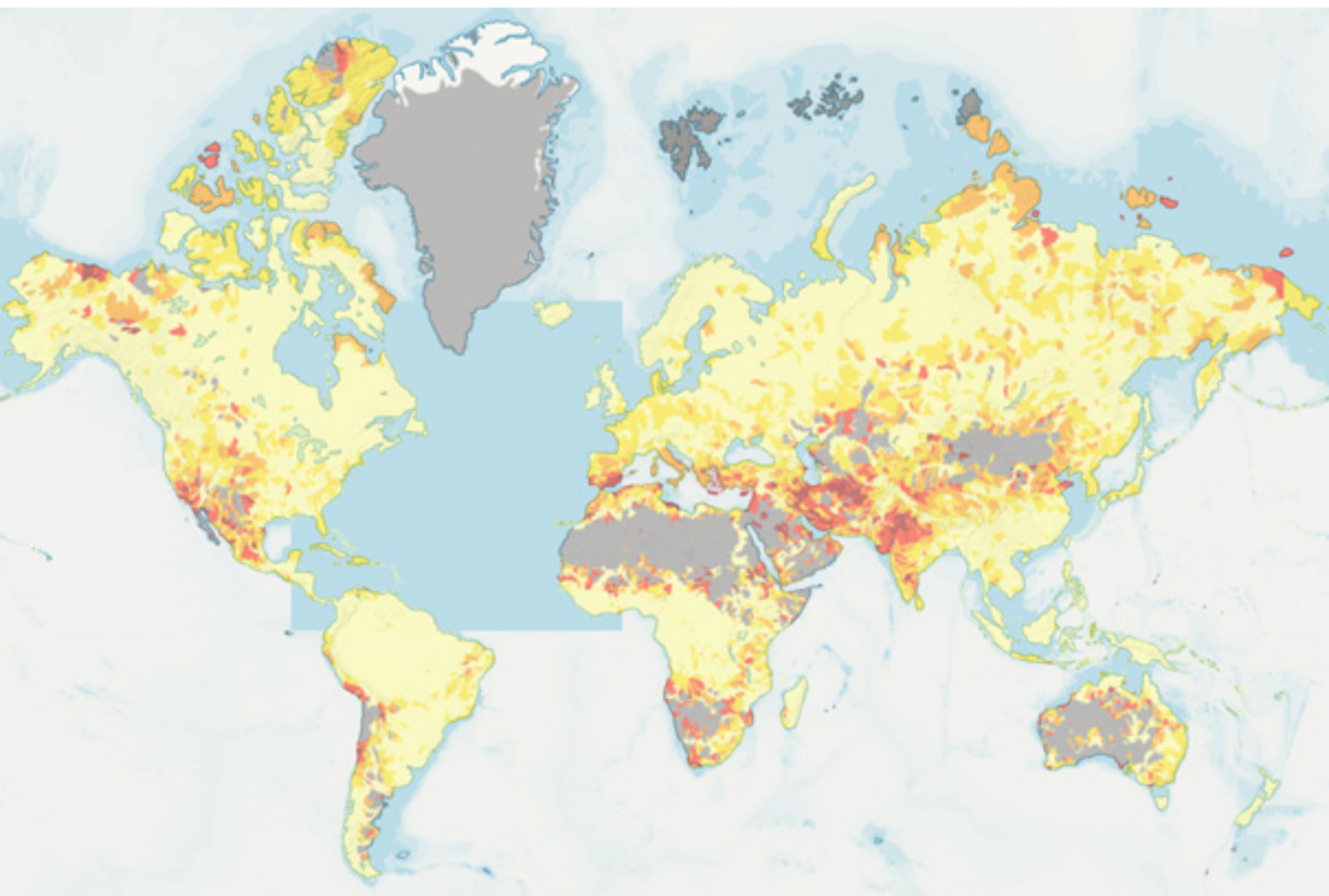
Your operation is located in a region with scarce water resources. Naturland and Bio Suisse operations must draw up a WMP in areas with scarce water resources. The WMP is designed to

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.

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

### **“Water Depletion” as an indicator for areas with water scarcity**

To identify regions with water scarcity, Naturland and Bio Suisse use the Aqueduct Water Risk Atlas of the World Resources Institute (WRI) (see [www.wri.org/applications/aqueduct/water-risk-atlas](http://www.wri.org/applications/aqueduct/water-risk-atlas)). Instructions for using the Aqueduct Water Filter can be found in the appendix (Appendix 4.1).



*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 to 75 per cent) or “**Extremely high**” (>75 per cent) in accordance with the indicator “**Water Depletion**” or that are located in a desert region that is labelled with “**Arid and low water use**” are considered areas that experience water scarcity (Bio Suisse Part V, 3.6.2.1, Naturland 2.7.2.1). But what exactly is water depletion?

### **Water Stress**

A general indicator for water scarcity is water stress. Water stress measures the ratio of the total amount of water abstraction (excluding backflows) to accessible resources of renewable surface and groundwater. Water abstraction includes domestic, industrial, irrigated agriculture and livestock use. Accessible resources of renewable water refer to all surface and groundwater resources that we have access to.

### **Water depletion**

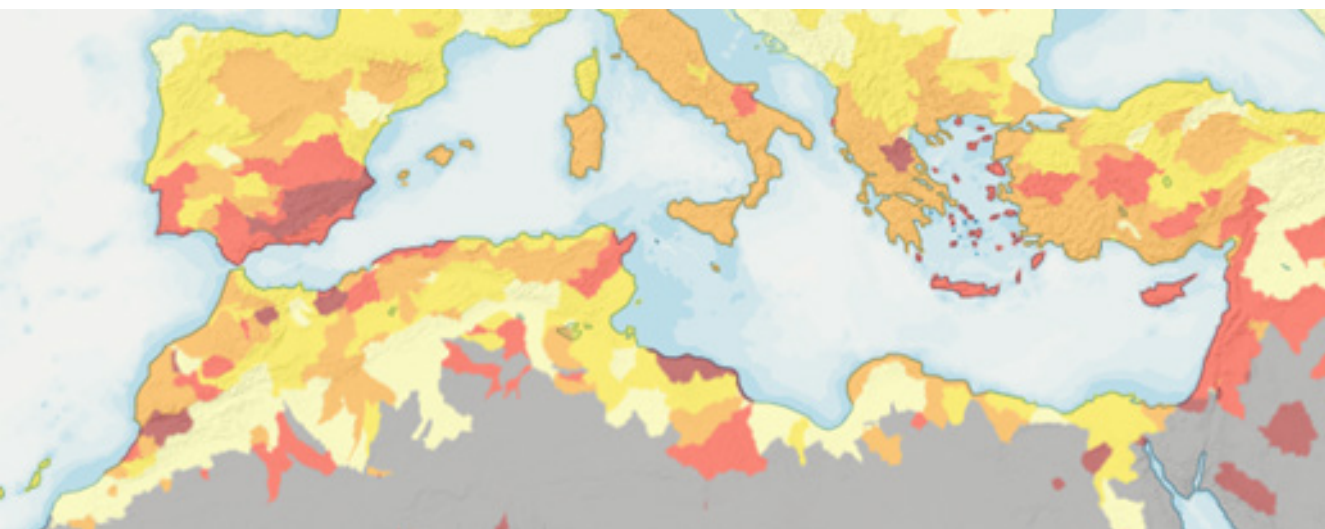
The “Water Depletion” indicator measures the relationship between total water consumption (with backflows) and the resources of surface and groundwater available. How it differs from “Water Stress” is that it takes into account that part of the water withdrawn is not consumed, but flows back into the environment. Therefore, the areas experiencing water depletion are less extensive than those with water stress.

### **Examples of areas with water scarcity**

Areas with scarce water resources are mostly located in regions with desert, steppe or dry savannah climates or in warm, summer-dry regions. A look at the world map shows that drought-prone areas are mainly located between the 20<sup>th</sup> and 40<sup>th</sup> parallels.

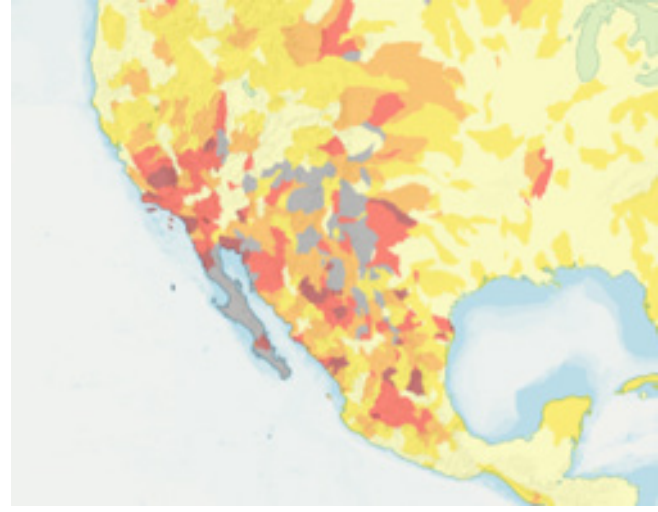
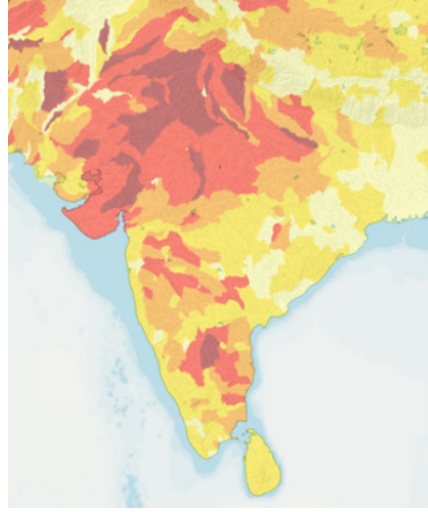
### **Mediterranean region**

In Europe, the Mediterranean region is particularly affected by water scarcity. Particularly high water depletion is found on the southern Iberian Peninsula in Spain and Portugal. However, areas in Italy, Greece and Turkey are also affected. In the southern and eastern Mediterranean, many regions suffer from severe water scarcity and some even have desert climates. Affected regions include Morocco, Algeria, Libya, Tunisia, Egypt, Israel and Palestine.



*The red and dark red areas are affected by high and very high levels of water depletion.*

*Water depletion in India, Mexico and the southern US*



### **India**

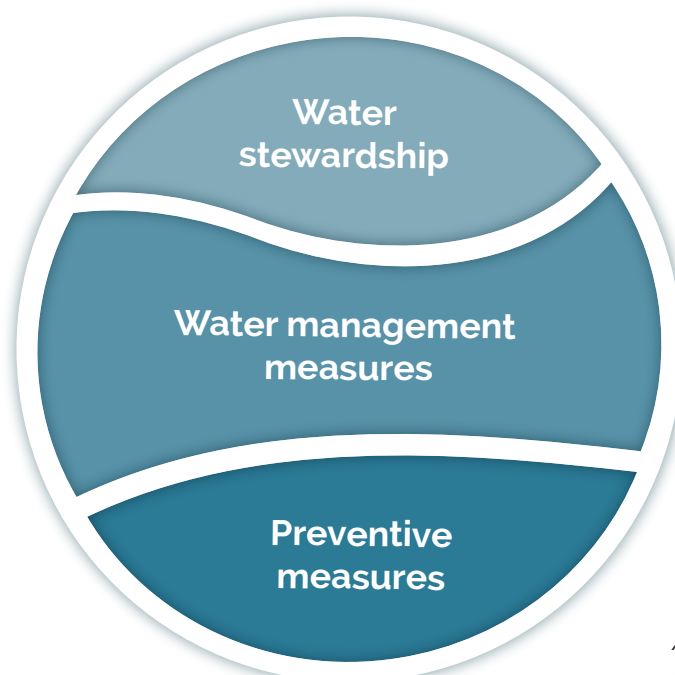
Large parts of India are affected by water scarcity. Areas suffering from water depletion in particular include the states of Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh, but regions in South India are also affected.

### **Mexico and the USA**

Northern Mexico and regions in the southern US also experience water shortages.

## **1.1 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*



## 1.1.1 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
<b>Formation of soil organic matter (SOM)</b>	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: <ul style="list-style-type: none"> <li>• Compost</li> <li>• Biochar</li> <li>• Organic fertiliser</li> <li>• Crop residues</li> <li>• Humus-forming crop rotations</li> <li>• Green manure, catch crops</li> </ul>
<b>Mycorrhizae</b>	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: <ul style="list-style-type: none"> <li>• Inoculating the soil</li> <li>• Gently tilling the soil</li> <li>• Ensuring the right pH value</li> </ul>
<b>Mulch</b>	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: <ul style="list-style-type: none"> <li>• Plant remains</li> <li>• Straw</li> <li>• Grass clippings</li> <li>• Recyclable cling film</li> </ul>
<b>Crop rotation</b>	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: <ul style="list-style-type: none"> <li>• Create as diverse a crop rotation as possible</li> <li>• Include crop rotations boosting humus growth</li> <li>• Integrate catch crops and undersown crops</li> </ul>

<p><b>(Wind) hedgerows and agroforestry systems</b></p>	<p>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.</p>	<ul style="list-style-type: none"> <li>• Agroforestry systems</li> <li>• Hedgerows and other structural elements such as shrubs</li> <li>• Trees as wind breakers</li> </ul>
<p><b>Anti-erosion measures and collection of surface run-off</b></p>	<p>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.</p> <p>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:  <a href="http://www.fao.org/3/U3160E/u3160e00.htm">www.fao.org/3/U3160E/u3160e00.htm</a></p>	<ul style="list-style-type: none"> <li>• Living terraces</li> <li>• Dams</li> <li>• Planting holes</li> <li>• Planting erosion control plants along contour lines</li> <li>• Infiltration trenches</li> </ul>
<p><b>Tillage</b></p>	<p>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.</p> <p>You can find more information on reduced tillage in the FiBL publication on reduced tillage in organic farming:  <a href="http://www.fibl.org/fileadmin/documents/shop/1652-bodenbearbeitung.pdf">www.fibl.org/fileadmin/documents/shop/1652-bodenbearbeitung.pdf</a></p>	<p>Examples of reduced tillage:</p> <ul style="list-style-type: none"> <li>• No-till</li> <li>• Mulch-till</li> <li>• Strip-till</li> </ul>
<p><b>Selection of plants and varieties</b></p>	<p>Crops and varieties should be adapted to the conditions of the location. Drought-tolerant species allow for less irrigation.</p>	<ul style="list-style-type: none"> <li>• Plants and varieties adapted to the location</li> <li>• Drought-tolerant plants and varieties</li> </ul>
<p><b>Nutrient supply</b></p>	<p>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.</p>	<ul style="list-style-type: none"> <li>• Ensure optimal nutrient supply to the crops</li> <li>• Prevent over-fertilisation</li> <li>• Adapt fertilisation to the various vegetation stages of the plants</li> </ul>
<p><b>Checking the pH value</b></p>	<p>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.</p>	<ul style="list-style-type: none"> <li>• Regular measuring of the pH value</li> <li>• Lime, if necessary</li> </ul>

Sources: 6, 7, 8, 9, 10



## 1.1.2 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**<sup>11, 12</sup>



### Good agricultural practice for water management measures

- Planning the irrigation system thoroughly
- Adapting the irrigation system to the site and crop (see chapter 2.5.1 Type of irrigation system)
- Measuring and calculating water requirements of crops in order to adapt irrigation accordingly (see chapter 2.5 Type of irrigation and irrigation practice)
- Taking into account current weather data when planning irrigation
- Planning and carrying out irrigation in a way that saves water (timing and duration of irrigation ...) (see chapter 2.5.3 Irrigation practice and planning)
- Maintaining the irrigation system regularly to prevent water loss and keeping maintenance records
- Documenting water use and consumption (see chapter 2.5.2 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 2.5.5 Water quality)

### 1.1.3 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 require 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

## 2.2. COMPLETING THE WATER MANAGEMENT PLAN (WMP)

In this guide, 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. A complete documentation for farms, as proof of sustainable water management, includes the following components:

### Minimum requirements for submitting the water management plan for individual farms:

1. Fully completed WMP
2. Labelled map of all parcels
3. Proof of legality of water use for all water sources
4. Completed Excel spreadsheet; both register folders:
  - Record quantitative water use
  - Information on legality and plausibility
5. Analysis of water quality according to FAO criteria or equivalent methods.

Producer groups in regions with scarce water resources must also submit complete documentation with the following components. In this case, a water management plan is prepared for the entire group.

### Minimum requirement for submitting the Water Management Plan for groups:

1. Fully completed WMP for the entire group.
2. Completed Excel spreadsheet „Producer List Irrigation
3. Representative analysis of water quality according to the FAO criteria.

You can find out more about the Water Management Plan for Producer Groups in the following chapter.



## Best practice for completing the Water Management Plan

- 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 annexes, maps and the Excel spreadsheet are enclosed

## 2.1 Special features of the group procedure

Producer groups within the meaning of the Naturland or Bio Suisse certification procedure complete a water management plan for the entire group. There are some special features to be considered here:

- For the entire group, **one** water management plan is created.
- Exceptions to this are farms >25 ha, which are assessed as individual farms and must create their own water management plan.
- The water management plan must be completed and signed by the representative of the group.
- The water management plan, including all appendices, must be submitted to the certification centre of Naturland or Bio Suisse (via the inspection body) every 3 years.
- The Excel spreadsheet “Producer List Irrigation” (PLB) however, must always be kept up to date and submitted annually to the inspection body.
- The quantitative information on water consumption is submitted via the Excel attachment “Producer List Irrigation”.
- The risk analysis and the corresponding action plan must relate to the entire group.

For the verification of the water management of producer groups, Naturland/the inspection body selects a sample. The size of that sample depends on the size of the producer group. For the selected producers of the sample, maps of all areas and proof of legality must be submitted. Naturland/the inspection body informs the producer group for which producers maps and legality certificates have to be submitted.

The producer groups receive the results of the evaluation of the WMP together with the next certification decision from Naturland or Bio Suisse.

Chapter 4 helps complete the corresponding Excel tables. In the corresponding chapters, reference is also made to the special features of the group procedure.

## 2.2 Farm data

In the first part of the WMP, you enter all data identifying the holding, the holder(s) and the contact person(s) in a table. After the name of the farm, please enter **your Naturland/Bio Suisse identification number** and your **EU organic number**. Then enter the **name(s) of the farm manager(s)** or **representative(s)** (for producer groups), the e-mail and the **complete farm address**. All attachments to the WMP (especially maps and receipts from authorities) should be specific to the farm or producer group to be certified. For the localisation of the farm, please provide the GPS data.

## 2.3 Source of irrigation water

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

## 2.3.1 Type of water sources

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.

### 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.



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

### 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

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. The FAO guide "Water harvesting" provides practical guidance on erosion control and water harvesting on open land<sup>13</sup> (<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.



## Good agricultural practice for using rainwater

- Exploiting all possibilities to collect rainwater
- Storing the collected water in tanks, basins or lagoons, if not used directly
- Natural reservoirs must be made impermeable by sealing the well with concrete, impermeable tarpaulins or compacted clay
- Providing covers for rainwater storage tanks in order to prevent evaporation

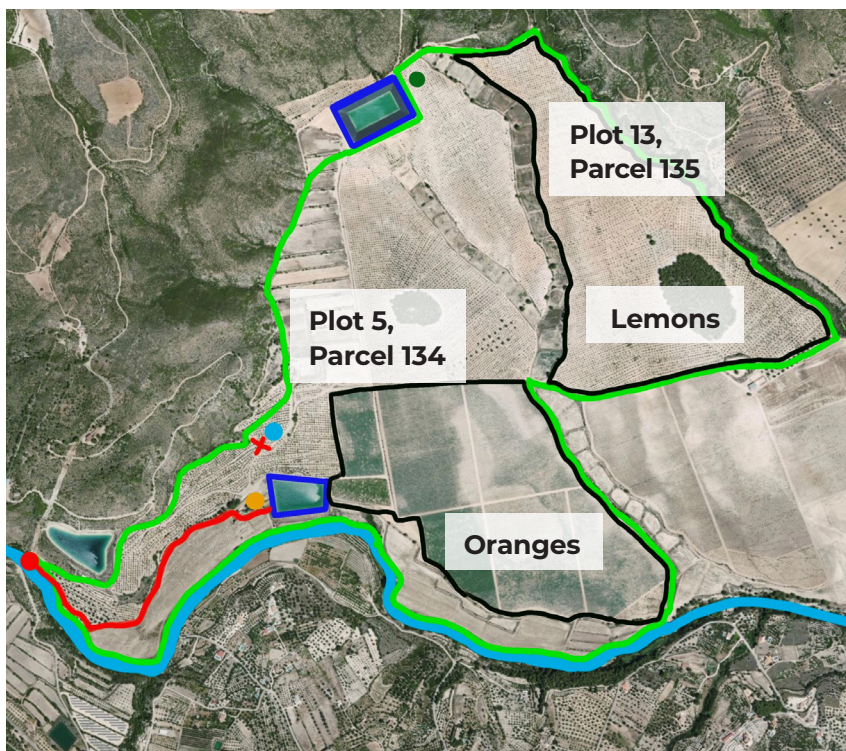
## 2.3.2 Type of irrigation devices

The WMP must **list all irrigation devices**. This includes all wells, water meters, water pumps, water inlets and storage facilities including their storage capacity. Wells include both active and inactive wells. You must submit one or **several maps** as evidence of the operation's irrigation devices and areas (both all irrigated and all non-irrigated areas). **All irrigation devices are to be marked and labelled on this operation map**. The irrigation devices indicated and the map must correspond with one another.

### Mindestanforderungen an die Karte:

- **EU organic number and Naturland/ Bio Suisse operation number**
- **Operation boundaries:** must be clearly marked
- **Plots:** all plots must be listed and identifiable (distinction made between irrigated and non-irrigated)
- **Water inlets:** all water inlets must be shown: wells (active and inactive), pumps, points where rainwater is collected, pipes...
- **Connection between water inlets and reservoirs, as well as water pipelines:** these must be shown, as well as the connections and water pipelines running between reservoirs and irrigated plots
- **Position of meters:** should be marked
- **Legend:** a legend explains the inscription on the map
- **Coherence:** all information must be consistent with that from other documents submitted

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



*Example of a labelled map as an appendix to the WMP*

## 2.4 Legality of water use

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<sup>14</sup>. WWF has reported that there are around 500'000 illegal wells in Spain<sup>15</sup>. 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.<sup>16</sup> 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.

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, 3.6.2.5). **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.

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



**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

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:

**MINISTERIO DE MEDIO AMBIENTE**

Confederación Hidrográfica del Segura SALIDA

03/01/2006 N° 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 1 of proof of legality of water use

Responsible authority

Type of proof of legality

Type of water source

Name of the farm manager/ farm

Place of operation

Maximum annual withdrawal quantity

Maximum area to be irrigated

## Example 2 of proof of legality of water use

Responsible authority

MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE

CONFEDERACIÓN HIDROGRÁFICA DEL SEGURA  
COMISARIA DE AGUAS

S/REF.  
N/REF.  
FECHA  
ASUNTO

14 JUL 2015

Cambio de titularidad de un aprovechamiento de aguas privadas.

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 m<sup>3</sup>  
**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).

CONFEDERACION HIDROGRAFICA DEL SEGURA - Salida Nº: 201600010944\_15/07/2016 12:22:36 Orig: 1ASDPPH

Name of the farm manager/  
farm

Place of operation

Maximum annual  
withdrawal quantity

Maximum area to be  
irrigated

Parcel designation  
according to cadastre

You can find explanations of the documentation on the legality of water use in individual countries in the appendix (Appendix 5.3)\*.



## 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 Natur-land and Bio Suisse.

## 2.5 Type of irrigation and irrigation practice

The type of irrigation and 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.

### 2.5.1 Type of irrigation system

The WMP must specify and briefly describe 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:

$$\text{Wirkungsgrad des Bewässerungssystems} = \frac{\text{Evotranspiration } ET_c \left(\frac{l}{m^2}\right)}{\text{Eingesetztes Bewässerungswasser} \left(\frac{l}{m^2}\right)}$$

Drip 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.

In the appendix, 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](http://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<sub>2</sub> emissions for groundwater extraction, pumping and distribution at the appropriate water volumes and pressure.



## 2.5.2 Measuring water consumption

According to the Naturland and Bio Suisse standards (Naturland B.1.7.2.1, Bio Suisse Part V, 3.6.2.4), **water consumption (m<sup>3</sup>/ha/a) must be recorded at the operation**. Water meters or flow meters are suitable for this purpose.



*Example water meter*

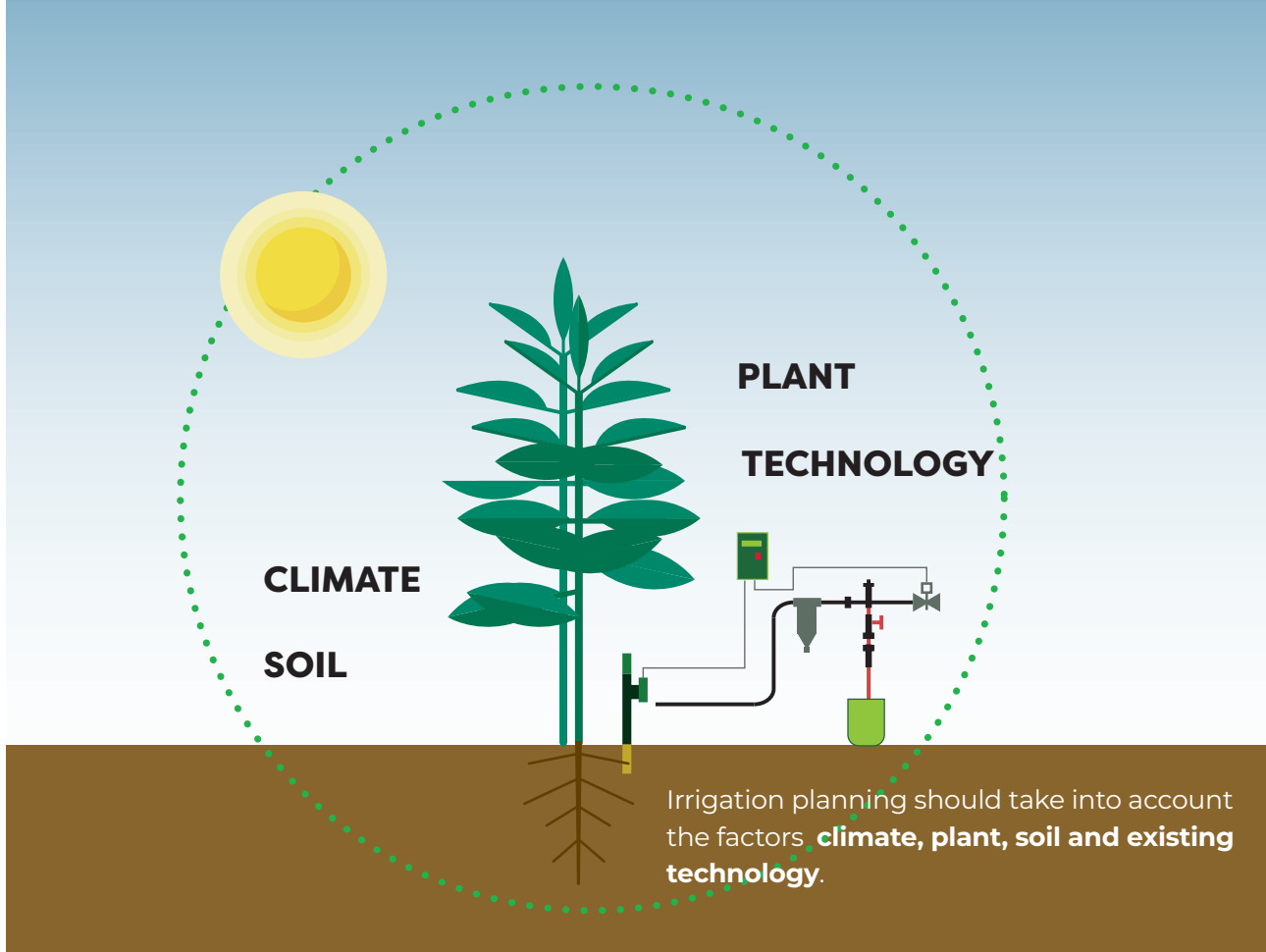
## 2.5.3 Irrigation practice and planning

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<sup>17</sup>.



### 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.



## 2.5.4 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  $\mu\text{m}$  (coarse pores) or more than 50  $\mu\text{m}$  (macropores) cannot hold soil water in their capillaries. It flows off through them. Pores smaller than 0.2  $\mu\text{m}$  (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  $\mu\text{m}$ ) 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.

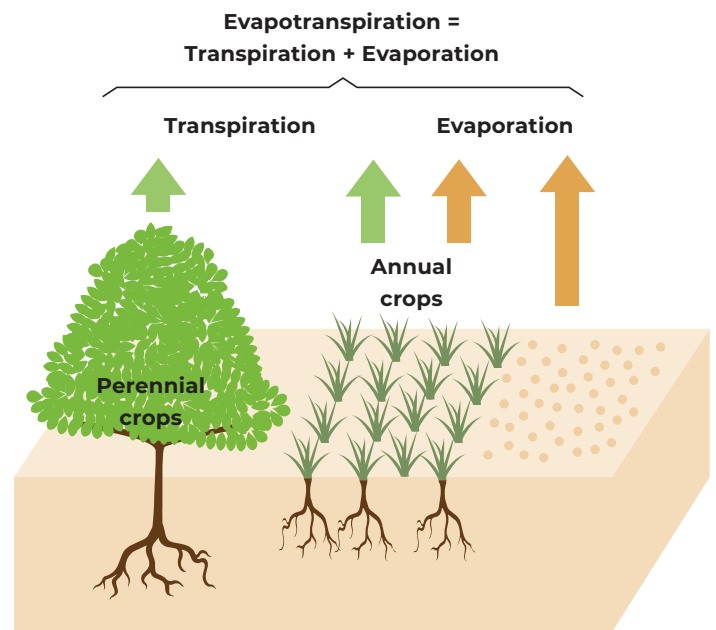
You can find detailed instructions on how to determine the available water capacity in the FiBL guide "Good agricultural practice in irrigation management" ([www.fibl.org/en/shop-en/2522-irrigation.html](http://www.fibl.org/en/shop-en/2522-irrigation.html)).

## 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.



### Pflanzen-Sensoren:

- Pflanz sap flow
- Stem microvariation
- Leaf temperature (see image)<sup>18</sup>

*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:

$$\text{Wassernutzungseffizienz (WNE)} = \frac{\text{Ertrag } \left(\frac{\text{t}}{\text{ha}}\right)}{\text{genutztes Bewässerungswasser } \left(\frac{\text{l}}{\text{m}^2}\right)}$$

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).

## 2.5.5 Water quality

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 5.5).

The relevant FAO criteria on water quality are briefly outlined below:

**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).<sup>19</sup>

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](http://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**<sup>20</sup> 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

- Es wird ein effizientes Bewässerungs-
- 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

## 2.6 Risk analysis and plan of action

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. Firstly, name and explain the three most important risks to your operation and list the water users or stakeholder groups who are also affected. Then name and explain three implemented or planned measures. Measures that are or will be implemented by several water users or stakeholder groups in the watershed must also be listed. You can find examples of possible risks and measures in the appendix (Appendix 5.4).



## 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

### 3. Instructions for completing the Excel attachment

It is mandatory that the WMP includes the Naturland and Bio Suisse **Excel spreadsheet** for the **quantitative recording of the amount of irrigation** and for the **proof of the legality and plausibility** of the water resources. The table should provide the farm managers with an **overview of the actual water consumption** on the farm and thus to enable them to 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. All quantitative data on irrigation must be entered in the register folder 1 Excel spreadsheet. You will receive the template for the table together with the WMP. Below, we explain the structure of the table and provide useful help for completing it.



#### Best practice for completing the Excel spreadsheet

- Complete the table with both registration folders consecutively
- Table to be checked annually at Naturland/Bio Suisse inspection
- To be submitted to Naturland/Bio Suisse every 3 years
- Data from the WMP and the table coincide
- Water consumption and irrigation volume are plausible
- Total water consumption according to water rights corresponds to the amount of water approved by the responsible authority

#### 3.1 Register folder 1: “Quantitative data on irrigation”

Im ersten Schritt geben Sie in den Zeilen 2 bis 6 alle Betriebsdaten an, damit WMP und Tabelle eindeutig Ihrem Betrieb zuzuordnen sind.

##### Assessment of Quantitative Water Use as Attachment to the Water Management Plan

Name of Farm:	Framer Smith
Farm Number (EU-Bio No. and BS/NL No.):	EU organic number and Naturland farm number
Address / Region / Country:	Farmstreet 1, 3133 Farmville, Farmland
Person of Contact:	John Smith

The next step is to enter the area of the holding in hectares. First, the total area is given (1.1), then divided into irrigated (1.2) and non-irrigated areas (1.3). If the entire area of the holding is irrigated, please enter a zero in line 1.3. **This data should match your data in the WMP in part “1.1 Farm areas”**. 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).

This register folder does not need to be filled in the water management plan for a group procedure. The relevant information is submitted via the “Farmer List Irrigation” (further Excel document).

<b>Fields in yellow must be filled out!</b>		Y 1	Y 2	Y 3	Y 4	Y 5
<b>1</b>	<b>Surface of farm in the relative year</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
1,1	Total surface of the farm (ha)	229,75				
1.2.	Of which irrigated (ha)	114,15				
1.3.	Of which not irrigated (ha)	115,60				

### 3.1.1 Water consumption and use by water rights (section 2 + 3)

Section 2 of the table handles the total water consumption of the farm (2.1). Here, all water quantities taken (e.g. from water bills, own measurements with water meter) are added up and given in m<sup>3</sup>.

<b>2</b>	<b>Water use total &amp; per ha in the relative year</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
2.1.	Total water use of the farm (m <sup>3</sup> )	650.038				
2.2.	Water consumption of the irrigated area in cubic metres per hectare (m <sup>3</sup> /ha)	5.695	#DIV/0!	#WERT!	#WERT!	#WERT!
<b>3</b>	<b>Use according to water rights</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
3,1	Water use in m <sup>3</sup> according to private rights granted (6)	653.866				
3,2	Water use in m <sup>3</sup> from Water User Association (WUA) (7)					
3,3	Water consumption in m <sup>3</sup> from a public water network					
3,4	Further water consumption in m <sup>3</sup> (e. g. rainwater collection)					
3,5	<b>Total use of water in m<sup>3</sup> according to water rights</b>	<b>653.866</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

In section 3, the water quantity is listed again, based on the water rights (private or communal). Here, the approved quantity according to the water rights (documented by proof of legality) must not exceed the quantity withdrawn. The data here must coincide with the values in register folder 2 “Legality/Plausibility”.

### 3.1.2 Climate data (Section 4)

Section 4 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 4.3. This could, for example, be heavy rainfall or untypical dry periods.

4	Climate data and specific incidents	2021	2022	2023	2024	2025
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 rain last year				

### 3.1.3 Crop water use (Section 5)

In the last section, you can calculate the water footprint of individual crops. To do this, please enter the irrigated area in hectares (5.1.1) and the total water consumption for that crop (5.1.2) for each crop grown on your farm. You also enter the yield in kilograms per hectare (5.1.4) for the respective crop. With this data, the table will automatically calculate the water consumption in litres per kilogram of product. This tells you how much water is needed for one kilo of the respective crop. In our example, this would be 486 litres of water for one kilo of lemons.

Fields in green are recommended to be filled out!		Y 1	Y 2	Y 3	Y 4	Y 5
5	Water use per crop/culture	2021	2022	2023	2024	2025
5,1	<b>ADD YOUR 1. CROP HERE →</b>	Lemon	CROP 1	CROP 1	CROP 1	CROP 1
5,1.1	...of which CROP 1 IRRIGATED (surface in ha)	81,0				
5,1.1	Crop 1: Total water use (m <sup>3</sup> )	461.295				
5,1.3	Crop 1: Water use in m <sup>3</sup> /ha	5.695	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5,1.4	Crop 1: Yield in kg (total)	950.000				
5,1.5	Crop 1: Yield in kg/ha	11.728	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5,1.6	Crop 1: Waterfootprint in l/kg	486	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5,2	<b>ADD YOUR 2. CROP HERE →</b>	Orange	CROP 2	CROP 2	CROP 2	CROP 2
5,2.1	...of which CROP 2 IRRIGATED (surface in ha)	33,8				
5,2.2	Crop 2: Total water use (m <sup>3</sup> )	192.206				
5,2.3	Crop 2: Water use in m <sup>3</sup> /ha	5.687	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5,2.4	Crop 2: Yield in kg (total)	1.400.000				
5,2.5	Crop 2: Yield in kg/ha	41.420	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5,2.6	Crop 2: Waterfootprint in l/kg	137	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

### 3.2 Register folder 2: “Legality/plausibility”

In this register folder, precise information is provided on the legality of the water resources used. The information should coincide with the attached legality documents. For each irrigation source, a line is created within the Excel spreadsheet.

In the first section, “Information from legality documents”, the data from the documents is carefully entered into the table. For this purpose, the type of legality document and the issuing authority are mentioned first. The next column contains information on the area and the corresponding water source. The area is shown on the legality certificate, as is the maximum amount of water that may be abstracted per hectare or the total amount of water. Finally, the name of the holding to which the water rights are issued and the parcel designation are entered in this section. The parcel designation is usually the cadastral number, which can also be found in the legality documents.

Irrigation	Information from legality documents					
type of water source (well, WUA, etc.)	proof of legality and the competent authority	area (ha)	volume of water per ha (m3/ha)	total volume of water (m3)	water rights issued to (name)	identification of plot (normally as shown in land register)
River	Extract from the water register, Ministry of Environment	42,18	5000,00	210900,00	Farmer Smith	26,80
Well	Extract from the water catalogue, Ministry of Agriculture, Food and Environment	187,57	2254,00	442966,00	Farmer Smith	10,38

In the next section, the information from the EU organic certificate is transferred. This mainly concerns information on the area so that the irrigated parcel can be easily identified. Thus, the parcel designation must first be given analogous to the current EU Organic Certification. In addition, the number of parcels and the total area of these parcels in hectares must be entered. This information must be verified by the inspection body.

verified information EU organic certificate			
identification of plot as per EU organic cert.		number of plots added up	total area (ha)
poligono (cadastral no.)	parcel (plot)		
134	5	1	42,18
134	13	1	187,57

In the last section of the register folder, additional information is noted. For example, which of the listed parcels is irrigated or not. Furthermore, shared water rights of the same water source are also noted. This is particularly important to eliminate confusion and ambiguity regarding the amount of water from a source. Therefore, the name of the person with whom the water rights are shared should be noted in the penultimate column. Additional information on the water source can also be provided. For example, whether the contracts of the spring are still issued to previous owners.

remarks/further information		
irrigated (YES/NO) - list all plots	shared water rights (if so, with whom?)	any other information which would serve to understand the situation better (e. g. records applying to former owners, shared water rights)
Partially	No	Example 1
Partially	No	Example 2

Chapter 2.4 Legality of water use provides background information on the relevance of proving water legality. Moreover, the annex (Annex 5.3) provides explanations on the documentation of the legality of water use in individual countries\*.

#### 4. Excel Annex “Farmer List Irrigation FLI”

This Excel annex is to be completed only for the members of a producer group who are located in an area with scarce water resources. The table must be completed by the person responsible for the project and then checked by the inspector. Here, a separate line must be fully completed for each farm that uses irrigation.

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 2.3.1 of this guide, the different water sources are mentioned and described. Subsequently, the number of water sources should

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

coincide with the information given in column F. The type of irrigation system is then requested. Chapter 2.3.2 provides further information on this.

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 maps and proof of legality, should therefore already be available when the PLB table is completed. Further information on legality certificates can be found in the previous chapter 3.2 “Legality/Plausibility Register File”.

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 official irrigators' association
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 Chapters 2.5 and 5.2 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<sup>3</sup>/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<sup>3</sup>. 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 <sup>3</sup> )	Water use per ha/year (m <sup>3</sup> )	Irrigated crops
Drip irrigation	water meter	45.000	3309	lemon
sprinklers	water meter	2.300	2705	apricots

## 5. Appendix

### 5.1 Instructions for the Aqueduct Water Filter

Open the Aqueduct Water

Filter at the following address: <https://wri.org/applications/aqueduct/water-risk-atlas>

The screenshot shows the Aqueduct Water Risk Atlas interface. The left sidebar is set to 'BASELINE' and 'FUTURE' tabs. Under 'Indicators', 'OVERALL WATER RISK' is selected. Below it, 'PHYSICAL RISKS QUANTITY' is also selected, with sub-options: 'Water Stress', 'Water Depletion', 'Interannual Variability', 'Seasonal Variability', and 'Groundwater Table Decline'. The 'Analyze' button is visible at the bottom of the sidebar. The main map area shows a world map with a color scale for 'Overall Water Risk' ranging from Low (0-1) to Extremely high (4-5). A legend for 'Overall Water Risk' is shown in the bottom right of the map area.

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.

This screenshot is similar to the previous one but includes annotations. A red box highlights the 'Water Depletion' option under 'PHYSICAL RISKS QUANTITY'. A text box next to it says: "Select the indicator 'Water Depletion' here." Another red box highlights the 'Enter Address' button in the 'Analyze' section. A text box next to it says: "You can enter the operation's address here." The map legend now shows 'Water Depletion' with categories: Low (<5%), Low-medium (5-25%), Medium-high (25-50%), High (50-75%), and Extremely high (>75%).

1

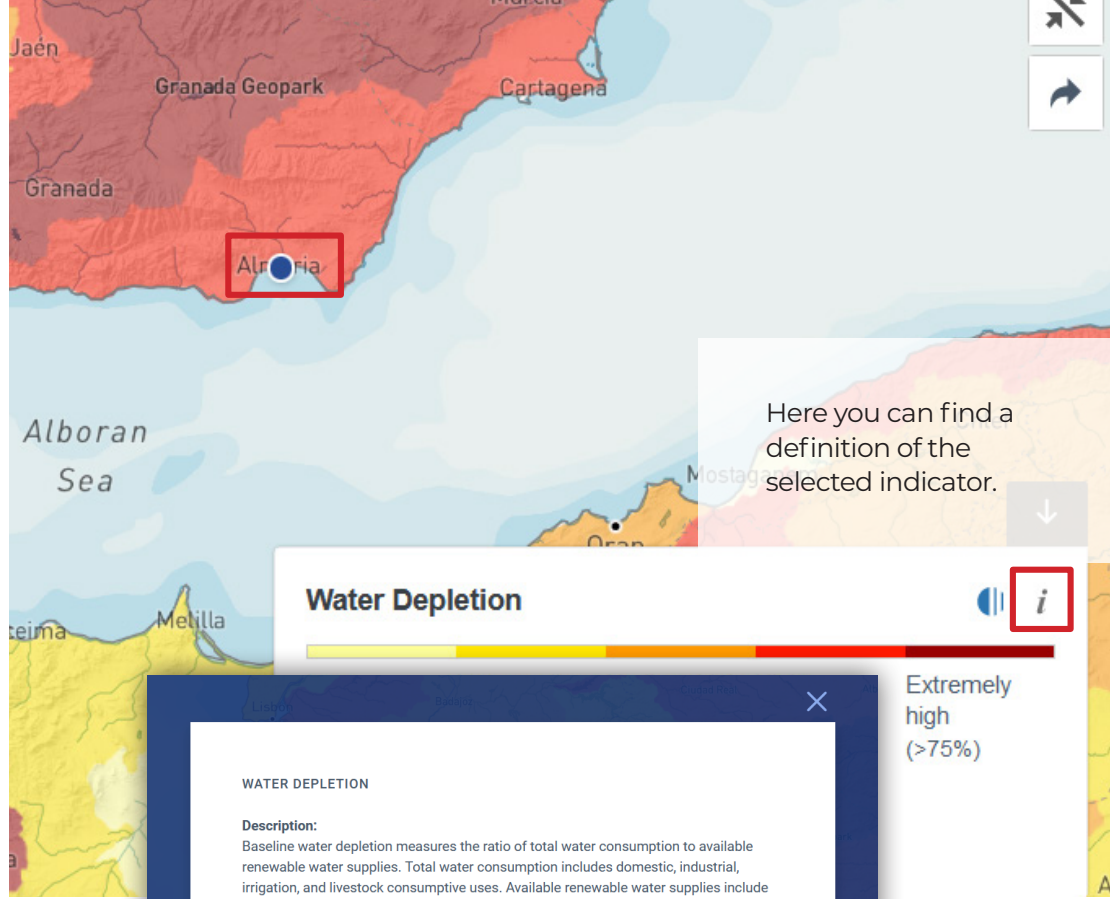
2

32



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.

**Water Depletion** ⓘ

Extremely high (>75%)

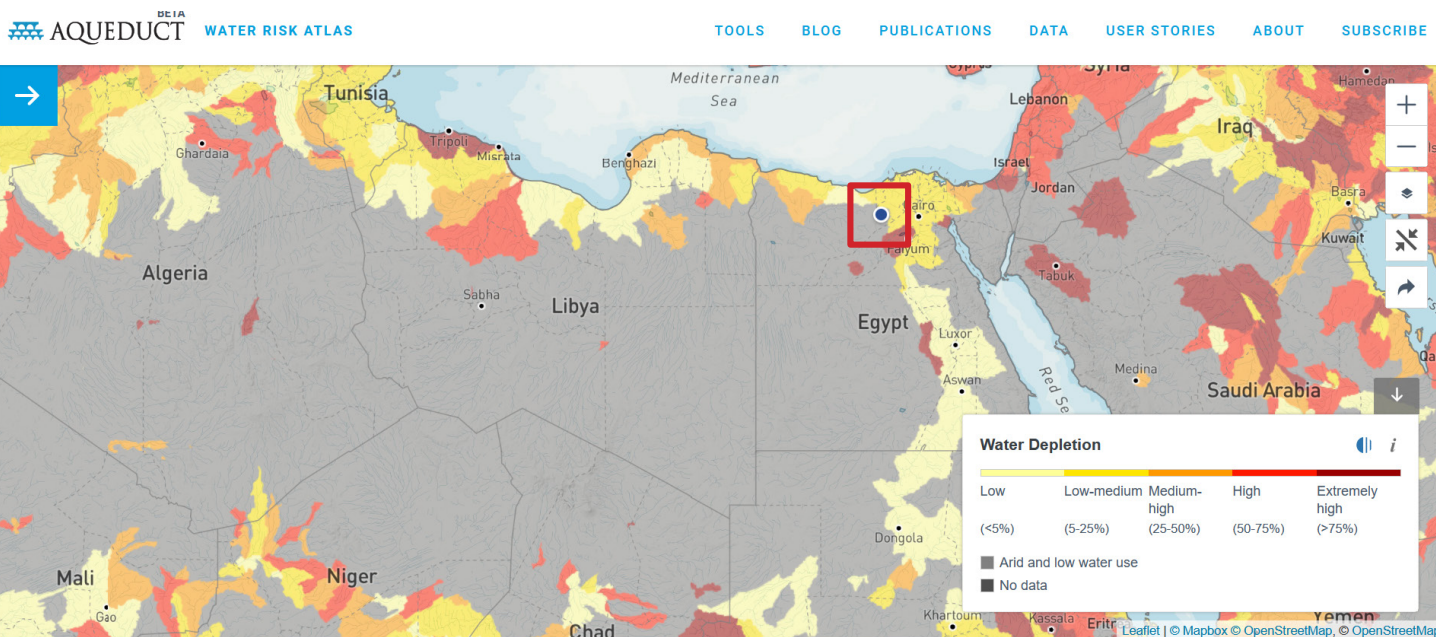
**WATER DEPLETION**

**Description:**  
Baseline water depletion measures the ratio of total water consumption to available renewable water supplies. Total water consumption includes domestic, industrial, irrigation, and livestock consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate larger impact on the local water supply and decreased water availability for downstream users. Baseline water depletion is similar to baseline water stress; however, instead of looking at total water withdrawal (consumptive plus nonconsumptive), baseline water depletion is calculated using consumptive withdrawal only.



**Source:** WRI Aqueduct 2019



5

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



## 5.2 Overview of irrigation systems

	Surface irrigation	Sprinkler irrigation
		
<b>Types</b>	<ul style="list-style-type: none"> <li>• Flood irrigation</li> <li>• Furrow irrigation</li> <li>• Surge irrigation</li> </ul>	<ul style="list-style-type: none"> <li>• Fixed systems</li> <li>• Systems with fixed main and movable lateral pipelines</li> <li>• Pivot systems</li> <li>• Rain gun sprinklers</li> </ul>
<b>Features</b>	<ul style="list-style-type: none"> <li>• Gravity-fed irrigation</li> <li>• Flood irrigation: basins enclosed by earth dams and filled with water (e.g. for rice)</li> <li>• Furrow irrigation: water is directed through furrows along crop rows (e.g. vegetable crops)</li> <li>• Surge irrigation: water is directed through furrows at intervals</li> </ul>	<ul style="list-style-type: none"> <li>• Pressurised systems, usually with main and secondary lines ending in one or several sprinklers (emitters)</li> <li>• Different delivery diameters possible</li> <li>• Pressure and emitter dimensions are adjusted to prevent droplets from forming that are too large or too small</li> </ul>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• No or low energy demand</li> <li>• Low investment requirement in traditional systems</li> <li>• Irrigation of the entire root zone – better crop health in the root area</li> <li>• Reduced risk of salinisation</li> <li>• Enhancement of biodiversity</li> </ul>	<ul style="list-style-type: none"> <li>• Suitable for light soils</li> <li>• Suitable for sloping or uneven fields</li> <li>• Can be used to reduce evapotranspiration by lowering leaf temperature</li> <li>• Overhead irrigation can be used as frost protection in fruit cultivation</li> </ul>
<b>Dis-advantages</b>	<ul style="list-style-type: none"> <li>• Low irrigation efficiency in traditional systems</li> <li>• Risk of oversupply at the top of the field and undersupply at the bottom of the field</li> <li>• Risk of nutrients leaching out past the root zone</li> <li>• Risk of water loss through run-off (drag water)</li> <li>• Risk of internal and superficial erosion of the soil</li> <li>• Risk of waterlogging and consequent suffocation in poorly drained soils</li> <li>• High amount of work</li> <li>• High investment for improved systems</li> </ul>	<ul style="list-style-type: none"> <li>• Large drips can damage soil structure (especially with rain guns)</li> <li>• Requires pumps with high capacity and pressure-tight pipes</li> <li>• Irrigation from above can increase incidence of illness</li> <li>• Uneven water distribution pattern</li> <li>• Water loss due to drift, evaporation and irrigation of non-productive areas</li> <li>• High energy demand</li> </ul>
<b>Recommended areas of application</b>	<ul style="list-style-type: none"> <li>• Regions with a plentiful supply of water resources but low or irregular rainfall</li> <li>• Regions with little infrastructure and traditional irrigation channels</li> </ul>	<ul style="list-style-type: none"> <li>• Frequent use in rows of fruit and field crops</li> </ul>

	Microsprinkler irrigation	Drip irrigation
		
<b>Types</b>		
<b>Features</b>	<ul style="list-style-type: none"> <li>• Micro-irrigation systems with which irrigation is confined to the actual root zone of the crop</li> <li>• Has a larger wetting pattern than drip irrigation</li> <li>• Microsprinklers deliver higher volumes of water per hour than drip irrigation</li> </ul>	<ul style="list-style-type: none"> <li>• Micro-irrigation system with which irrigation is confined to the actual root zone of the crop</li> <li>• Operated at low pressure and with low water volumes per hour</li> </ul>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• High irrigation effectiveness</li> <li>• The wetted area is larger than with drip systems and enables maximum root penetration</li> <li>• Precise irrigation according to the plant's current needs</li> <li>• Microsprinkler emitters are larger than drip emitters and become clogged less frequently</li> </ul>	<ul style="list-style-type: none"> <li>• Very high level of irrigation efficiency</li> <li>• Lower investment than microsprinklers</li> <li>• Lower amount of work</li> <li>• Largely avoids water losses through evaporation and seepage</li> <li>• Irrigation possible at all hours of the day</li> <li>• The canopy remains dry and the probability of fungal diseases remains low</li> </ul>
<b>Dis-advantages</b>	<ul style="list-style-type: none"> <li>• High investment costs</li> <li>• Requires large volumes of water and pumps with high capacity</li> <li>• High energy demand</li> <li>• High water losses through evaporation when used in hot and sunny or windy areas</li> <li>• Salt enrichment in the border zones between dry and wet soil</li> <li>• Uneven water distribution due to overlapping of sprinklers</li> </ul>	<ul style="list-style-type: none"> <li>• Nozzles can become clogged with algae, bacterial slime or debris</li> <li>• Root zone is restricted to the wetted area</li> <li>• Suboptimal wetting pattern in light soils</li> <li>• Requires an efficient filtration system</li> <li>• Salt enrichment in the border zones between dry and wet soil</li> <li>• Drip tubes hinder mechanical weed control</li> </ul>
<b>Recommended areas of application</b>	<ul style="list-style-type: none"> <li>• Frequently used in high-value tree crops</li> <li>• Also suitable for seed germination</li> </ul>	<ul style="list-style-type: none"> <li>• Especially suitable for vegetable crops</li> </ul>

## 5.3 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<sup>3</sup> 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 pública) 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 Andalusia”.
  - 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.
- Sigmoid 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](https://wwfes.awsassets.panda.org/downloads/guia_usos_wwf_ok_para_web_1_1.pdf)

## 5.4 Examples of risk analysis and plan of action

### Quality of groundwater and surface water, quality of products

Risk	Possible measures to be taken by the operation
<ul style="list-style-type: none"> <li>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?</li> <li>How great is the risk that such events will occur (again)?</li> </ul>	<ul style="list-style-type: none"> <li>Preventing the spread of pollutants (e.g. by proper storage of manure and fertiliser)</li> <li>Making sure fertilisation is appropriate to the site, time and requirement</li> <li>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)</li> <li>Creating buffer zones</li> <li>Planting or maintaining riparian vegetation along surface waters</li> <li>Preventing oil spills from pumps or other equipment</li> </ul>
<ul style="list-style-type: none"> <li>There is a risk of contamination of crops/products</li> </ul>	<ul style="list-style-type: none"> <li>Regularly analysing irrigation water for pollutants</li> <li>Preventing potential contamination of irrigation water</li> <li>Not using water that has first passed through conventionally farmed land (e.g. rice cultivation) or testing it for possible contaminants</li> </ul>

### Soil fertility degradation

Risk	Possible measures to be taken by the operation
<ul style="list-style-type: none"> <li>Erosion and/or surface run-off</li> </ul>	<ul style="list-style-type: none"> <li>Erosion control measures (e.g. living terraces, dams)</li> <li>Infiltration trenches</li> <li>Planting cultivation in strips along contour lines</li> <li>Improving soil fertility and structure; supply of organic matter (compost)</li> </ul>
<ul style="list-style-type: none"> <li>Salinisation</li> </ul>	<ul style="list-style-type: none"> <li>Analysing water regularly according to FAO criteria</li> <li>Mixing irrigation water (with low-salt water)</li> <li>No excess irrigation</li> <li>Codes for good practice/best practice for irrigation</li> <li>Correcting the pH value (after soil analysis, sulphur fertilisation if necessary)</li> <li></li> </ul>
<ul style="list-style-type: none"> <li>Reduced infiltration</li> <li>Low water storage capacity</li> </ul>	<ul style="list-style-type: none"> <li>Improving soil fertility and structure; supply of organic matter (compost)</li> <li>Functional drainage</li> <li>Adapting soil cultivation to the site</li> </ul>

## Efficiency of irrigation – optimising water use – reducing water consumption

Risk	Possible measures to be taken by the operation
<ul style="list-style-type: none"> <li>High water consumption compared to irrigation plan and/or guideline values</li> </ul>	<ul style="list-style-type: none"> <li>Reducing water consumption by, for example:</li> <li>Maintaining irrigation equipment</li> <li>Investing in water-saving irrigation system</li> <li>Reducing evaporation (e.g. mulch, mulch film)</li> <li>Irrigating only in the evening, at night, in the morning</li> </ul>
<ul style="list-style-type: none"> <li>Inefficient irrigation system – optimisation of water use needed</li> </ul>	<ul style="list-style-type: none"> <li>Checking water use records at different levels at the operation for accuracy, reliability and plausibility and optimising them</li> <li>Training staff involved in irrigation</li> <li>Identifying water losses and correcting and documenting problems occurring during the operation and maintenance of the system</li> <li>Assessing whether climatic conditions are sufficiently taken into account regarding irrigation</li> <li>Checking irrigation against the recommendations of recognised local institutions and authorities</li> <li>Regularly questioning, evaluating and, if necessary, correcting the length and frequency of the irrigation cycles and the irrigated quantity</li> <li>Ensuring even distribution of irrigation water (e.g. through short intervals of irrigation, pressure equalisation)</li> </ul>

## Adverse effects on ecosystems, ecosystem services, biodiversity

Risk	Possible measures to be taken by the operation
<ul style="list-style-type: none"> <li>Abstracting excessive water, surface water (lakes, rivers) → water shortage downstream, adverse effects on wetland</li> <li>Are high conservation value (HCV) areas affected?</li> </ul>	<ul style="list-style-type: none"> <li>Using alternative and various water sources (e.g. also treated process water, water from seawater desalination)</li> <li>Water recovery</li> <li>Retaining, collecting and utilising rainwater</li> <li></li> </ul>
<ul style="list-style-type: none"> <li>Abstracting excessive water – lowering groundwater table → adverse effects on wetland</li> <li>Are HCV areas affected?</li> </ul>	<ul style="list-style-type: none"> <li>Using alternative and various water sources (e.g. also treated process water, water from seawater desalination)</li> <li>Water recovery</li> <li>Retaining, collecting and utilising rainwater</li> </ul>

## Situation in the watershed (inter-operational level)

Risk	Assessment and possible measures to be taken by the operation, or necessary measures at an inter-operational level
<ul style="list-style-type: none"> <li>Limited/reduced availability of water (overall, seasonal)</li> </ul>	<ul style="list-style-type: none"> <li>Using alternative and various water sources (e.g. also treated process water, water from seawater desalination)</li> <li>Water recovery</li> <li>Retaining, collecting and utilising rainwater</li> <li></li> </ul>
<ul style="list-style-type: none"> <li>Water shortages in the watershed (overall, seasonal)</li> </ul>	<ul style="list-style-type: none"> <li>Using alternative and various water sources (e.g. also treated process water, water from seawater desalination)</li> <li>Water recovery</li> <li>Retaining, collecting and utilising rainwater</li> <li></li> </ul>
<ul style="list-style-type: none"> <li>Overusing water resources in the watershed</li> <li>Water abstraction exceeds groundwater recovery</li> <li>Negative water balance in the watershed</li> </ul>	<ul style="list-style-type: none"> <li>Inter-operational solutions required at regional and political level (spatial planning, water rights)</li> </ul>
<ul style="list-style-type: none"> <li>Groundwater table has (drastically) fallen</li> </ul>	<ul style="list-style-type: none"> <li>Inter-operational solutions required at regional and political level (spatial planning, water rights)</li> </ul>
<ul style="list-style-type: none"> <li>Have the social, economic and environmental impacts of water consumption on the immediate or downstream environment been assessed?</li> </ul>	<ul style="list-style-type: none"> <li>Inter-operational solutions required at regional and political level (spatial planning, water rights)</li> </ul>

## 5.5 FAO criteria for the assessment of irrigation water

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

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



## 6. Sources

- <sup>1</sup> Pedro-Monzonís, M.; Solera, A.; Ferrer, J.; Estrela, T.; Paredes-Arquiola, J. A review of water scarcity and drought indexes in water resources planning and management. *J. Hydrol.* 2015, 527, 482–493.
- <sup>2</sup> Mancosu, N.; Snyder, R.L.; Kyriakakis, G.; Spano, D. (2015): Water scarcity and future challenges for food production. *Water* 2015, 7, 975–992.
- <sup>3</sup> Nikolaou, G., Neocleous, D., Christou, A., Kitta, E., & Katsoulas, N. (2020). Implementing sustainable irrigation in water-scarce regions under the impact of climate change. *Agronomy*, 10(8), 1120.
- <sup>4</sup> Fischer, G.; Tubiello, F.N.; Van Velthuizen, H.; Wiberg, D.A. Climate change impacts on irrigation water requirements: Effects of mitigation, 1990–2080. *Technol. Forecast. Soc. Chang.* 2007, 74, 1083–1107.
- <sup>5</sup> Food and Agriculture Organization of the United Nations (FAO). *Review of World Water Resources by Country*; Water Report No. 23; FAO: Rome, Italy, 2003.
- <sup>6</sup> Heggelin, D., Clerc, M. (2014): Reduzierte Bodenbearbeitung. Umsetzung im biologischen Landbau. Forschungsinstitut für biologischen Landbau. Frick, Schweiz. Online unter: <https://www.fibl.org/fileadmin/documents/shop/1652-bodenbearbeitung.pdf>
- <sup>7</sup> Beste A. (2005): *Landwirtschaftlicher Bodenschutz in der Praxis. Grundlagen, Analyse, Management. Erhaltung der Bodenfunktionen für gesunde Erträge und Klimaresilienz – Humusaufbau, Fruchtfolgegestaltung, Bodenbearbeitung. Aufbau der Bodenfruchtbarkeit, Gewässerschutz, Wasserspeicherung in Trockenzeiten und Hochwasservermeidung.* Verlag Dr. Köster, Berlin.
- <sup>8</sup> Drastig, K., Brunsch, R., & Prochnow, A. (2010): *Wassermanagement in der Landwirtschaft.* Berlin: Berlin-Brandenburgische Akademie der Wissenschaften.
- <sup>9</sup> Critchley, W., Siegert, K., Chapman, C., & Finkel, M. (1991). *Water harvesting.* FAO, Rome
- <sup>10</sup> ,21 Van den Berge, P. (2020): Good agricultural practice in irrigation management. Forschungsinstitut für biologischen Landbau. Frick, Schweiz. Online unter: <https://www.fibl.org/fileadmin/documents/shop/2522-irrigation.pdf>
- <sup>11</sup> Beck, M. (2021): *Grundlagen zur Steuerung der Bewässerung. Klimatische Wasserbilanz und sensorgesteuerte Bewässerung.* Forschungsanstalt für Gartenbau. Fachhochschule Weinhstefhan
- <sup>12</sup> Frone, Simona & FRONE, Dumitru-Florin. (2011). *PRINCIPLES FOR A SUSTAINABLE WATER MANAGEMENT.* University of Agricultural Sciences and Veterinary Medicine, Bucharest. Online unter: [principles-and-practices-for-sustainable-water-management-\\_at-a-farm-level-final-2.pdf](https://www.saiplatform.org/principles-and-practices-for-sustainable-water-management-_at-a-farm-level-final-2.pdf) (saiplatform.org)
- <sup>13</sup> Prinz, D. (1996). Water harvesting—past and future. In: *Sustainability of irrigated agriculture* (pp. 137-168). Springer, Dordrecht.
- <sup>14</sup> Rouillard, Josselin & Dyk, Gawie & Schmidt, Guido. (2020). *HOW TO TACKLE ILLEGAL WATER ABSTRACTIONS? Taking stock of experience and lessons learned.*

<sup>15</sup> WWF (2021): Durstige Pflanzen – Wasserschlucker Landwirtschaft. Online unter: Wasserver-schwender Landwirtschaft (wwf.de), aufgerufen am 15.04.2021, 16:01

<sup>16</sup> Fuentelsaz, F., Carmona, J., Seiz, R. (2021): GUÍA DE WWF PARA VERIFICAR EL USO LEGAL DEL AGUA EN AGRICULTURA, WWF Spanien, Madrid

<sup>17</sup> Abioye, E. A., Abidin, M. S. Z., Mahmud, M. S. A., Buyamin, S., Ishak, M. H. I., Abd Rahman, M. K. I., ... & Ramli, M. S. A. (2020). A review on monitoring and advanced control strategies for precision irrigation. *Computers and Electronics in Agriculture*, 173, 105441.

<sup>18</sup> Chartzoulakis, K., & Bertaki, M. (2015). Sustainable water management in agriculture under climate change. *Agriculture and Agricultural Science Procedia*, 4, 88-98.

<sup>19</sup> Vargas, R., Pankova, E. I., Balyuk, S. A., Krasilnikov, P. V., & Khasankhanova, G. M. (2018). Handbook for saline soil management. FAO/LMSU.

<sup>20</sup> Ayers, R. S., & Westcot, D. W. (1985). Water quality for agriculture (Vol. 29, p. 174). Rome: Food and Agriculture Organization of the United Nations.

#### **Image sources:**

Title: freepik

P. 7 Naturland e.V.

P. 13: Ulf Stuve

P. 15: Naturland e.V.

P. 20 Lea Moog

P. 21 Naturland e.V.

P. 22 Paul van den Berge

P. 22 Lea Moog

P. 23 Dr. Michael Forster, Implexx Sense

P. 34 Paul van den Berge, stock von Sabine

S. 35 stock von Sabine, Lea Moog

**Imprint:**

Version 2/2023

Authors: Lea Moog, Alexander Koch, Paula Ott (Naturland) & Anna Lochmann (Bio Suisse)



Naturland  
Verband für ökologischen Landbau e.V.  
Kleinhaderner Weg 1  
82166 Gräfelfing  
Deutschland



Bio Suisse  
Peter Merian-Strasse 34  
4052 Basel  
Schweiz