GLOBALG.A.P.®

Integrated Farm Assurance

Guideline for Fruit and Vegetables

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This guideline is a recommendation for consideration.

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1 CONTINUOUS IMPROVEMENT PLAN

1.1 Documentation of a continuous improvement plan

No process is perfect; there is always room for improvement. You as a producer are aware of the need to constantly have an eye on your products to achieve the best result. This also applies to the idea of the continuous improvement plan.

Continuous improvement means systematically identifying and mitigating waste of resources as quickly as possible and at the lowest possible cost, thus increasing efficiency. In short: continuous improvement is the consequent increase of productivity in small steps.

The process of continuous improvement includes monitoring and analyzing data. Only with relevant data can self-defined targets be planned, implemented, and verified. Such a target does not necessarily have to be a numerical value. A yes/no statement, for example on whether a particular goal has been reached, is also possible.

Within the context of the standard, the initial approach to continuous improvement is:

- Establishing a continuous improvement plan: Major Must
- Implementing the continuous improvement plan: Minor Must

The continuous improvement plan identifies relevant self-defined targets and describes how progress toward each target will be monitored. The plan may include:

- Topic
- Current status with date of initial establishment of target
- Planned activity
- Planned outcome with estimated date of achievement

Once the targets documented in the continuous improvement plan have been reached, new targets are established by the producer.

1.2 Implementation of a continuous improvement plan

It is up to you to choose the topics and activities for continuous improvement of your operation. Once a topic and activity are identified, you shall document this in your continuous improvement plan.

The continuous improvement plan shall be established for the first self-assessment and CB audit to IFA v6. The plan may cover a period of time, normally a period of three to four years, but is linked to the planned activities (can also be within one year). Within this set time, milestones (defined targets) can be defined to be able to verify whether the activities are having the intended effect.

For the first self-assessment, internal audit, and CB audit the continuous improvement plan will be established.

During the second self-assessment and CB audit to IFA v6, the initial results of the continuous improvement plan shall be presented and discussed.

The implementation of the continuous improvement plan is supported by documents and/or other objective evidence. The evidence kept on file may include:

- Actual outcome of efforts, with date of evaluation
- Comments on why the effort was successful or not successful

Once the topics in the continuous improvement plan are implemented, new topic(s) shall be identified, and a new continuous improvement plan shall be established.

If one or more of the goals identified in the continuous improvement plan are not reached, justification and description of further action shall be documented.

1.2.1 Implementation in Option 1 (individual certification)

An individual producer is allowed to implement one or more verifiable topics. These may differ per product, region, or any other factor.

1.2.2 Implementation in Option 2 (group certification)

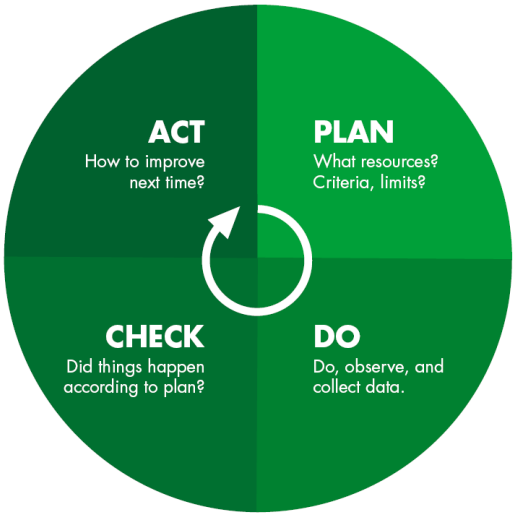
For a producer group there are different ways of implementing the continuous improvement plan. What is important is that all producer group members be involved.

- Implementation of one or more topics at producer group level
  - Not all producer group members may be doing the same activity.
  - Activities may differ per product, region, or any other factor.
- Implementation of one or more topics at producer group member level
  - All producer group members are involved.
  - Activities may differ per product, region, or any other factor.
- Implementation of one or more topics at producer group and producer group member levels
  - All producer group members are involved either at producer group or producer group member level.

1.2.3 Plan – Do – Check – Act cycle

Careful management of this process is essential. To make sure that the integration of data and reporting in the production process's day-to-day operations is working, having a good plan and the right tools is essential.

The Plan – Do – Check – Act (PDCA) cycle is a good tool for continuous improvement.



The four steps of the PDCA cycle are:

- **Plan**: Identify an opportunity for continuous improvement in the production process. Plan how to implement the change. Write down the expected results once you have determined your course of action.

- **Do**: Implement the change on a small scale.
- **Check**: Analyze data on the results of the change and determine whether it made a difference.
- **Act**: If the change was successful, implement it on a wider scale and continuously assess the results. If this change did not work, identify another opportunity for continuous improvement and start the cycle again.

1.3 Examples

Continuous improvement can mean: *Responding, reducing, maintaining, achieving, completing, ensuring, enhancing, improving, etc.*

For example:

- Responding to complaints within a specified time frame
- Reducing the number of complaints/non-conforming products
- Improving a training program/traceability system

In the different sections of IFA v6 there is reference to topics that may be identified for the continuous improvement plan, for example the consumption of:

- Water
- Energy
- Fertilizer
- Plant protection products

For these or other topics targets can be defined, for example based on volumes. However, any other topic can be chosen. The list below is not exhaustive and only offers ideas. Other topics covered in the standard or related to the production process can also be used for the continuous improvement plan.

a) Food safety
   - Testing of products and utilities (e.g., testing for chemical residues, microbial water quality)
   - Non-conforming products
   - Postharvest washing process

b) Workers' well-being
   - Support of professional development (training)
   - Social benefits
   - Childcare
   - Improvement of social surroundings
   - Incentives for good and safe working performance

c) Biodiversity
   - Buffer strips along watercourses
   - Planting trees
   - Retention of landscape features (walls, hedges, ponds, watercourses, or trees)

- Building new structures (stones, wood) next to farm or production areas
- Conservation of wild birds (birdhouses for birds and bats)
- Stopping invasive alien species

d) Other

- Outcome of self-assessment
- Complaint management

2 HUMAN RESOURCE MANAGEMENT AND TRAINING

Successful agricultural production relies on the collaboration of many individuals. Farms require a reliable workforce. The farming profession often results in workers remaining at a single farm for a defined amount of time and then moving to a new farm or location. Many farms do not maintain workers year-round, and the number of workers present on the farm will fluctuate. Additionally, during peak seasons of harvest, new workers may come to the farm daily and existing workers may depart. The fluidity of the nature of a farm workforce necessitates a flexible and effective approach to training farm workers.

The need for worker training is emphasized in the standard, and such training is a critical element of any farming operation. The approach to worker training shall be adapted to the farm size, number of seasonal workers, fluidity of seasonal workers, their knowledge of the farming operations, and to the complexity of the activities to be carried out. In addition, it is important to consider the culture, languages, and level of education the seasonal workers will bring with them.

2.1 Farms with a small number of permanent workers

Family farms often have a small number of family members that work on the farm. There is very low turnover and a high predictability of who will be employed on the farm for the duration of the production season. For these farms, it may be possible to conduct documented training annually, and the farm may not need to establish continual training programs throughout the season. However, a plan for training potential new workers should be in place if additional workers are needed.

Even if the farm workers have been with the farm for many years or are members of the family, they shall be trained annually. Training reminds workers of critical practices that keep workers safe and support the safe production and handling of the product.

In farms with small numbers of permanent workers, the workers are often asked to do several different tasks. Workers may be asked to perform tasks that require a high level of skill, such as operating forklifts, sprayers, and tractors. These same workers may also be asked to participate in the harvest, irrigation activities, and weed control. The training shall reflect the full range of possible tasks that may be assigned to the workers and prepare them to manage the risks of each.

2.2 Farms with seasonal workers and low turnover

Many farms have a core group of workers that remains stable for a period during the season. For example, a producer may hire 20 workers for a period of 60 days. Those workers may be expected to complete their days of service on a single farm and therefore provide a degree of stability to the farm workforce. While the producer still must have a plan to train potential new workers that can be used at any time, workforces with minimal turnover may be able to institute training on days of expected hire or days of crew changes or turnover. For example, if 10 workers are hired by the farm to till weeds for a period of 30 days and no new workers are employed during this time, the training may occur only once during this period. If any additional workers are hired to carry out harvest activities, they must be trained in accordance with their assigned duties.

2.3 Farms with seasonal workers and high turnover

Some farms – particularly large operations – have a very high rate of turnover. New workers may appear on the farm daily during peak seasons, and these workers must be trained to ensure compliance with the worker safety, food safety, and hygiene policies of the farm. For farms with high turnover, training programs that rely on technology may be of use. For example, some large farms use videos to train workers, and follow up the viewing of the training video with a signature sheet attesting to comprehension. Additionally, many agriculture organizations produce worker safety and food safety training videos that are specific to their industry and region. These may be available from your local department of agriculture, extension office, university, commodity commission, or may be found by searching online for reputable training content. These training videos may need to be supplemented with additional information that is specific to your farming operation. Videos and other media must always be offered in the language of the workforce. Pictograms may be used to promote understanding with workers who learn better visually.

Training of new workers on farms with high turnover may occur daily, and additional resources may need to be allocated for this effort. Permanent workers may need to be trained to oversee daily training sessions, and space allocated for workers to receive training. Additionally, documentation of the training of numerous workers requires a well-organized system.

2.4 Tips for training documentation

During an audit or assessment, the auditor may ask farm management to produce documentation that a specific worker has been trained. Organizing worker training records alphabetically can help staff retrieve this information quickly to present to the auditor. Additionally, workers may be asked if they have been trained by their employer in accordance with the scope of the standard. Workers shall be informed of the auditor's role, as workers can at times be fearful if they do not understand why they are being questioned. Communicate with workers about the audit process, and the role of the auditor. Remind them that if the auditor asks for their names, it is only to cross-reference their name with the training records held in the office. Effective communication reduces stress and confusion.

3 SUBCONTRACTORS

3.1 Definition of "subcontractor"

Subcontractor: An entity under contract with the producer to supply labor, plant protection product (PPP) applications, and/or other support for performing specific farm tasks (e.g., harvesting products, application of PPPs). The subcontracted activities shall be related directly to the production of the product for which certification is sought.

3.2 Types of subcontractors

Subcontractors covered under the standard directly support *main farming activities* of agricultural production on the premises of the farm or product handling unit (farm labor, PPP application, etc.). "Main farming activity" refers to those activities directly related to the production of the product (e.g., including pruning of fruit trees, but excluding construction of new buildings).

3.3 Types of subcontractors outside the scope

Any subcontractor related to the operation, but whose services are not directly related to the production of the product, shall be considered outside of the scope (e.g., IT services for office, telecommunications providers, mowing lawn at office location).

3.4 Obligation of producer with subcontractors outside the scope

If the subcontractor is not in the scope but the subcontracted activities or provided product/service requires the presence of staff of the subcontractor on the farm, the producer shall ensure that compliance with policies related to visitors, hygiene, and product safety are upheld. Subcontractors are informed of policies protecting workers' health, food safety, and proper hygiene by use of signs, documents, contracts, training, or other means. Some farms may make use of a sign-in sheet that has an accompanying list of visitor policies which everyone present on the farm shall comply with.

3.5 Sample decision tree for defining subcontractors for assessment and audit

Does the subcontracted activity or service provide direct support of production activities at the production site (labor, harvesting services, PPP applications)?

> **NO → excluded from scope but subject to awareness** (e.g., IT services to home office, electrical upgrades for headquarters, communications providers, cellular telephone providers)
>
> **YES → may be included** (go to next question)

Does the activity or service provided by the subcontractor occur on the farm or product handling unit near the production site, and is it directly linked to the production of the product?

> **NO → excluded from scope but subject to awareness** (e.g., company installing security cameras on the farm, building of a new home on the farm, mowing the lawns, plowing snow from parking areas)
>
> **YES → may be included** (go to next question)

Does the labor or service relating to production of the product involve at least one worker and extend beyond a single signee of a contract (i.e., additional workers other than the one single person performing the subcontracted activity and bound by legal agreement)?

> **YES → included. Subcontracted services with direct impact of worker safety, food safety, and hygiene are included, even if only a single person is doing these tasks** (e.g., single contracted truck driver, transportation subcontractor with hired drivers and a crew to load the boxes on the truck).
>
> **NO → excluded from scope**

4 EQUIPMENT MANAGEMENT AND CALIBRATION

Agricultural production relies on the effective use of equipment. The types of equipment can range from a simple shovel to a sophisticated electronic sorting machine in a packhouse. Regardless of cost and sophistication, all types of equipment need maintenance and management to support safety of workers and the product. This guideline offers a brief description of some basic best practices for equipment management and calibration.

4.1 Equipment procurement

When purchasing new equipment, care shall be taken to ensure that it is fit for its intended purpose. Equipment may need to be modified to support worker safety and food safety. Equipment that is new to the operation may result in an updated risk assessment, additional

worker training, and even inclusion in a continuous improvement plan. It may also require updating maintenance and service plans.

The selection of new equipment shall consider how the equipment will be used in the operation and what resources are needed to support the proper maintenance and repair.

4.2 Equipment maintenance

Equipment that is in poor condition or in need of repairs can endanger workers and risk contamination of the product. When equipment is not operational, delays in operations can result, and revenue is lost. Equipment maintenance can be performed by the producer or by external service providers.

Equipment maintenance of shovels, rakes, and other hand tools can include cleaning and inspection. Equipment that is more sophisticated, such as electronic sorting machines, may require maintenance by the manufacturer. Attempting to maintain some sophisticated equipment oneself may void the manufacturer's warranty. The producer shall ensure that their approach to maintenance reflects any of these potential restrictions.

Documentation of maintenance of equipment shall include enough detail to determine the types of activities completed. This will ensure that specific maintenance tasks required for equipment are not missed or duplicated due to a lack of clear communication.

Inspection of equipment at start of use each season is critical. Pests may be present in equipment, and the equipment may be a source of contamination with animal fecal matter. Equipment needs to be inspected and cleaned throughout the production and/or product handling season at a schedule determined by the risk assessment and in a manner that supports effective food safety.

Equipment that has moving parts which come into direct contact with product may need to use a lubricant that is labeled as suitable for food contact surfaces. Where required by the risk assessment, a supply of necessary food-safe lubricants shall be available on the site.

There shall be no leakages from pumps, spray liquid tanks (when the cover is closed), pipes, hoses, and/or filters. All devices for measuring, switching on and off, adjusting pressure and/or flow rate shall work reliably and there shall be no leakages. The nozzle equipment shall be suitable for appropriate application of the plant protection products. All the different parts of any (sprayer) equipment, e.g., nozzle holder/carrier, filters, blower, etc., shall be in good condition and work reliably (type, size, material, and origin), form a uniform spray jet (i.e., uniform shape, homogeneous spray), and there shall be no dripping after switching off the nozzles.

4.3 Equipment storage

Storage of equipment shall not risk the safety of the product or pose a risk to workers. Additionally, equipment that is stored outside may be subject to pest contamination and damage from environmental conditions. Tampering with equipment may also be a risk in some areas, as thieves may remove parts from unsecured equipment at the farm. Care shall be taken to inspect equipment regularly, even when it is not in use. A pest control program may be necessary in the location of equipment storage, as determined by the risk assessment for the site.

4.4 Calibration of equipment

Effective calibration of equipment can range from using a simple metal weight of known mass to calibrate a mechanical scale to digital calibration of expensive electronic sorting machines capable of high-volume output. The standard creates space for use of numerous calibration methods, providing they are aligned with a sound method and supported by documentation. There are numerous recommendations and publications that support the appropriate calibration of sprayers and fertilizer spreaders. Many local extension offices, universities, and departments of

agriculture have publications on these topics. Reference can be made to these sources to indicate the use of sound calibration practices.

It is recommended to include a system of identification for all measuring equipment that is subject to calibration. The level of accuracy of calibration shall also be considered.

Situations shall be avoided that rely on calibration from unreliable sources or using unproven standards. For example, setting a scale using a metal weight for which the mass has not been assured or checked can result in a false calibration. When purchasing tools for calibration, ensure that the sources are sound and verifiable.

Calibration of fertigation and chemigation equipment and pumps requires an understanding of the volume of water, pressure, type of product, and area of application relevant to the farm. There are several ways in which these types of calculations can be completed. The manner in which calculations are conducted shall be transparent and use a verifiable approach.

5 FOOD DEFENSE

Food defense: The process of ensuring food is safe from all forms of malicious attack, including ideologically motivated attack, leading to contamination. (GFSI, 2017)

The protection of products and premises from malicious actions is imperative for all producers. Attacks for the purpose of causing harm typically include intentional contamination, sabotage, or adulteration by biological, chemical, physical, or radiological agents introduced. A food defense plan shall address additional concerns including physical, operational, and workers' security.

Examples of potential behaviors a food defense plan may address include: Putting needles inside of products, purposely applying chemicals that should not contact food, or introducing microbial pathogens that could make people ill. To formulate a food defense plan, the following question could be posed:

If someone entered your operation with the intention to make people sick or contaminate the product, what types of measures are in place to protect the product?

a) Steps to consider during the implementation of a system:
   - Identifying potential threats and vulnerabilities
   - Defining the significant threats and vulnerabilities
   - Identifying suitable control measures for the significant threats and vulnerabilities
   - Documenting the assessment, control measures, and procedure as part of the food safety management system

It is important to consider your own operation and site, but also keep in mind the relevant supply chain elements.

b) Other considerations when identifying and assessing vulnerabilities:
   - Who might want to attack us?
   - How might they do it?
   - What is the potential impact on food safety for our operation?
   - How can we prevent this scenario's occurrence?

5.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

5.2 References

GFSI (The Global Food Safety Initiative, www.mygfsi.com)

European Commission website/Food Safety (www.ec.europa.eu)

SSAFE (www.ssafe-food.org)

5.3 Examples

A good food defense risk assessment and plan consider internal risks (site, workers) as well as external risks (elsewhere in the supply chain) and identify ways in which the product is protected from people who may want to do harm. People (internal and external) have an impact on the effectiveness of a food defense plan. Having trusted workers and supervisors, an open working area, quality control checks, a visitor policy, and strong communication with customers are ways to minimize risks.

Furthermore, secure storage and transportation of raw materials, packaging, equipment, hazardous chemicals, and products are important considerations in a food defense plan.

6 FOOD FRAUD

Food fraud: The intentional substitution, addition, tampering, or misidentification of food, raw materials, food packaging, labeling, or product information, or else false or misleading statements made about a product for economic gain that could impact consumer health. (GFSI, 2017)

Several food scandals in recent years have led to reduced consumer confidence in the food industry. Food fraud, typically driven by economic gain, can also result in food safety risks.

For producers, the economic impact of food fraud can include product recall, loss of sales, and loss of reputation.

All pose a risk, as food being received may not be what it says it is. Food fraud plays a role where product claims are made or product is being labeled according to a certain status (e.g., specific origin, variety claims, GLOBALG.A.P. certified, GMO) or identity preserved (organic product).

When writing a food fraud risk assessment and plan, consider how you control your packaging, the flow of the product on site, and what you could do if you found someone using your boxes to sell products that are not yours.

a) Steps to consider during the implementation of a system:
   - Identifying potential vulnerabilities
   - Defining the significant vulnerabilities
   - Identifying suitable control measures for the significant vulnerabilities
   - Documenting the assessment, control measures, and procedure as part of the food safety management system

   It is important to identify as many vulnerabilities as possible, but keep in mind that not every single vulnerability will be significant to the individual operation.

b) Other considerations when identifying and assessing vulnerabilities:
   - How economically attractive is fraud?
   - Has it happened before?
   - How easy is it to detect?
   - Is there easy access to raw materials, packaging, labeling and products?

- Which suppliers are involved?
- Are other independent certification or control systems involved?
- How complex is the supply chain?

The key to assessing the vulnerabilities is to “think like a criminal.”

Several tools have been developed to assist companies in setting up a food fraud vulnerability assessment. One of them is the SSAFE food fraud vulnerability assessment tool, which is freely available. GFSI endorses the SSAFE food fraud vulnerability assessment tool.

a) Food fraud generally involves one or more of the following activities (albeit not all applicable for the primary production industry):
   - *Substitution* (replacing a product with another one of lower value)
   - *Concealment* (hiding the low quality of food ingredients in products)
   - *Unapproved enhancement* (adding unknown and undeclared compounds to a product in order to enhance their quality attributes)
   - *Mislabeling* (false claims or distortion of the information provided on the label/packaging)
   - *Gray market forgery* (production/theft/diversion, e.g., sale of excess unreported product)
   - *Counterfeiting* (infringements to intellectual property rights; products not produced with acceptable safety assurances)

6.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

6.2 References

GFSI (The Global Food Safety Initiative, www.mygfsi.com)

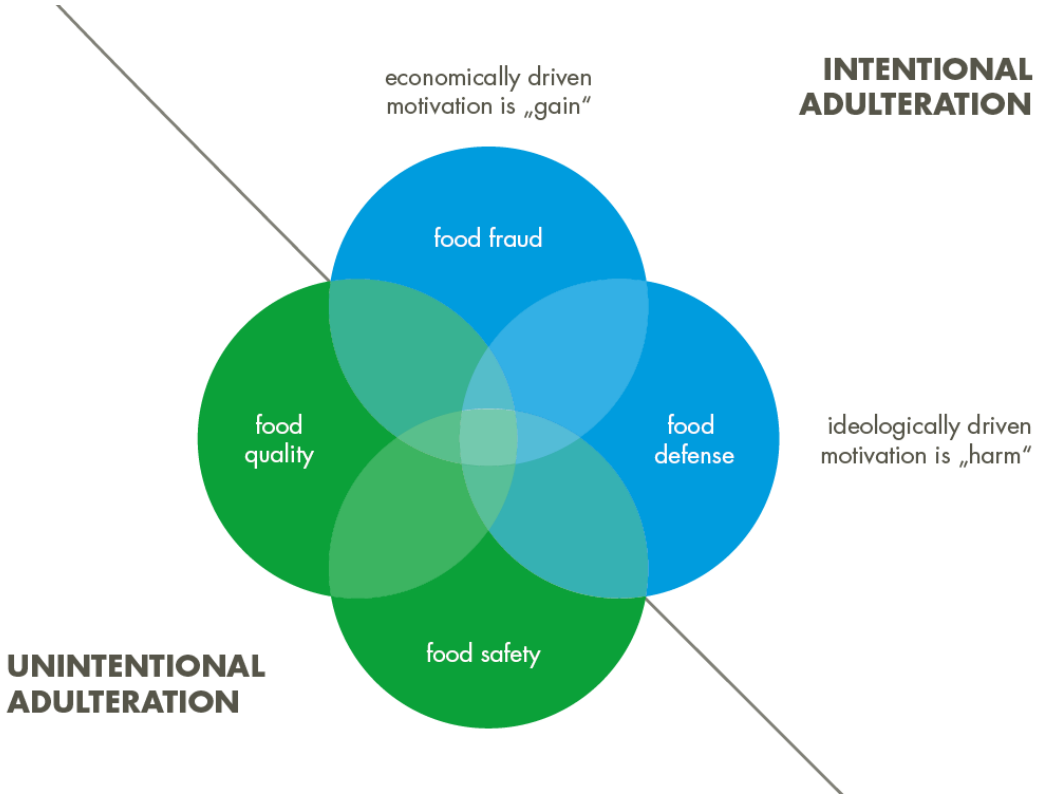
European Commission website/Food Safety (www.ec.europa.eu)

SSAFE (www.ssafe-food.org)

6.3 Examples

One example of food fraud is someone using your boxes or bags to sell product not grown on your farm. It is possible that someone uses your packaging to make market claims that are not true, for example packing boxes with unknown fruit or vegetables and labeling the product as organic, not genetically modified, or certified.

Another example of food fraud is making inaccurate marketing claims, such as stating that the product is a specific variety or specific cultivar when it is not.



7 RISK ASSESSMENT

This guideline contains information relevant to all production methods (conventional, organic, controlled environment agriculture, hydroponics, etc.)

7.1 Steps for the preparation of risk assessments

A risk assessment is an important step in protecting the products, workers, and business, as well as complying with GLOBALG.A.P. requirements and prevailing regulations. A risk assessment helps focus on critical risks that have the potential to cause harm. In many instances, there are straightforward, simple, effective, and inexpensive measures that can mitigate risks.

It is not expected that all risks be eliminated, but products shall be protected to ensure human health and mitigate food safety risks.

There are many ways to design an effective risk assessment. The content provided in this document serves as only an example of one method and format, with a specific focus on water.

7.2 What is a risk assessment?

A risk assessment is a careful examination of what could cause harm to the product, so that risks can be evaluated to determine whether sufficient precautions have been taken to prevent harm.

Analyzing risks need not be a complicated exercise. Risks are often evident and the necessary control measures are already common industry practices. Furthermore, a wealth of information is readily available to support the identification of risks associated with water in the production of crops. Prevailing regulations can serve as a guide, as can resources from universities, producer journals, and extension education websites.

Useful terminology is as follows:

- A *hazard* is anything that may cause harm, such as chemicals, bacterial contamination, allergens, foreign materials, etc.
- The *risk* is the chance, high or low, that these and other hazards are present, together with an indication of how serious the harm could be.

Assessing the risks associated with a particular crop involves the following steps:

Step 1: Identify the hazards.

Step 2: Decide who or what might be harmed and to what extent.

Step 3: Evaluate the risks and determine mitigation measures.

Step 4: Document the noted risks and demonstrate implementation of mitigating actions.

Step 5: Review the assessment and update at least once a year and whenever changes occur that impact risks.

Step 1: Identify the hazards

Identify how the product could be impacted. This may be done by:

- Walking around the workplace and looking for possible sources of harm or contamination (e.g., areas of animal access to water systems, types of irrigation delivery equipment, storage areas for irrigation equipment)
- Asking the workers (if applicable) what hazards they can identify; based on their daily tasks, they may have noticed things that are not immediately obvious.
- Checking manufacturers' instructions or data sheets for chemicals, equipment, and sanitizing agents, as these can be very helpful in identifying the hazards and putting them in their true perspective
- Reviewing prior records for maintenance, repairs, corrective actions, and customer complaints, as these often help to identify less obvious hazards

Step 2: Decide who/what might be harmed and how

For each hazard, identify who or what might be harmed or affected.

Note the following:

- Some activities have unique hazards associated with their undertaking (e.g., irrigation versus postharvest washing).
- Some hazards will require careful mitigation, especially in situations where workers may not be in the workplace year-round, and the mitigation effort requires routine checks.

Step 3: Evaluate the risks and decide on precautions

Having identified the hazards and identified who or what might be harmed or affected, decide what to do about them. Consumer health is critical and prevailing regulations shall be considered when determining effective mitigation strategies. Protocols and recommendations reflecting good practices for water quality are readily available in the industry and may serve as references.

Consider what actions are already being taken and consider how these relate to the recommended best industry practices for the product. During the evaluation process, consider the following:

- Is it possible to eliminate the hazard completely?
- If not, can the risk be managed to make harm unlikely?

When managing risks, if possible, apply the principles below:

- Try a less risky option (e.g., irrigate in a manner that minimizes water contact with the edible portion of the crop).
- Prevent access to the hazard (e.g., use plastic barriers between drip tape for water and the edible portion of the crop to mitigate contact).

Step 4: Record the work plan/findings and implement them

Documenting the results of the risk assessment and sharing them with your workers encourages implementation and fostering a culture of food safety on the farm.

When documenting the results, use clear language.

The risk assessment is a living document that is frequently reviewed and updated. New risks can be added as hazards are identified throughout the growing seasons or years. Demonstrate that:

- A proper check was made.
- Who or what might be affected is clearly identified.
- Significant hazards are addressed.
- Precautions are reasonable and the remaining risk is low.
- Workers were involved in the process, including training on topics related to food safety.

A good plan of action may include a mixture of different responses such as:

- Temporary solution until a permanent control can be put in place
- Effective and sustainable solutions for risks likely to impact food safety and consumer health
- Arrangements for training workers on the primary risks that remain and how these risks are to be controlled
- Regular checks to make sure that the control measures are implemented at the desired frequency
- Clearly defined responsibilities for workers

Prioritize the most critical potential risks first.

Step 5: Review the risk assessment and update if necessary

The farm changes from year to year, and the risk assessments shall be updated to reflect these changes. Risk assessments shall be updated whenever changes occur that impact food safety and the topics addressed in the standard.

Consider:

- Have there been any changes that alter risks on the farm?
- Are there improvements still to be made?
- Have workers spotted problems?
- Have there been incidents, complaints, or issues that could be addressed with risk mitigation?

Establishing an annual review of the risk assessment ensures that mitigation actions are updated regularly.

Source: "Risk assessment – A brief guide to controlling risks in the workplace" (www.hse.gov.uk/pubns/indg163.pdf)

8 MITIGATING MICROBIAL RISKS DURING GROWING AND HANDLING

Agricultural crops are generally grown in environments that host a wide range of microorganisms. Soils contain high levels of microflora and are in direct contact with crops for much or all of their life cycles. Water, wind, animals, and other vectors provide mechanisms for microorganisms to move and attach to crops. Consequently, crops will normally be associated with a natural and nonpathogenic microbial population. However, it is possible that pathogens of human health significance are present in the environment and can contaminate products.

Fresh products have been linked to outbreaks of illness, with microbial contamination identified as the causal agent. Mitigating the presence of microorganisms that endanger the health of consumers is a critical element of food production.

Fruit and vegetables may be vulnerable to microbiological contamination of human health significance for the following reasons:

- They are often eaten raw.
- Contamination can occur via many routes during production and packing, including contaminated water, contact with animal and human feces, infected workers, and contact with animals and pests.
- Washing and disinfection can reduce the microbiological population (including any pathogens present), but it cannot eliminate the microorganisms or consistently reduce the microbial load to an acceptable level. Once microbial contamination is present on the product, washing and disinfection techniques usually serve to mitigate transfer of the pathogen to other products, but do not remove the risk or clean the product.

Therefore, it is vitally important to minimize opportunities for the introduction of pathogenic organisms and cross contamination during growing, harvest, and handling.

The standard and associated guidance recognizes that effective fresh product safety management must begin in the field with the identification and control of potential microbiological food safety hazards at each stage in the production process.

8.1 Purpose

Fruit and vegetables shall be produced following agricultural practices that *minimize opportunities for the introduction of pathogenic organisms*. Such introduction can occur both directly and indirectly, via cross contamination occurring during growing, handling, and use. Effective food safety management begins in the field with the identification and control of potential microbiological food safety hazards at all stages.

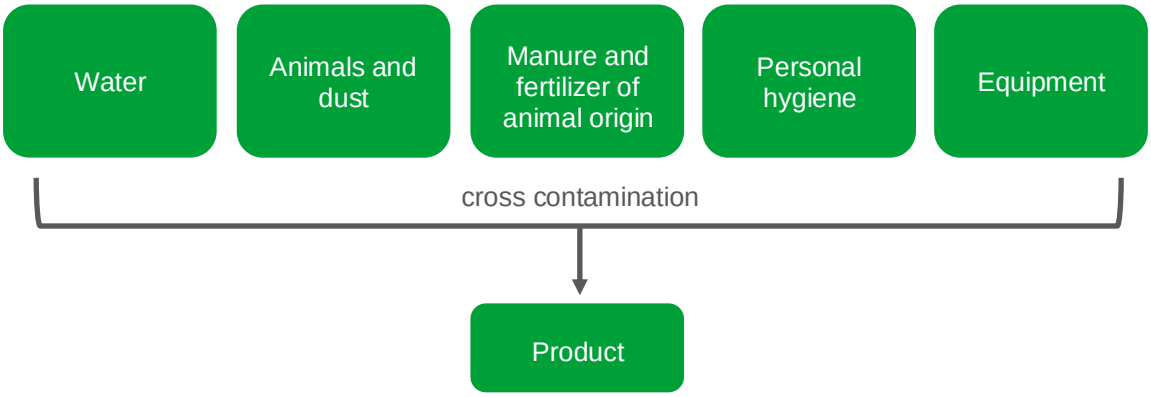
8.2 Risk assessment

Fresh fruits and vegetables are grown and harvested under a wide range of climatic and geographical conditions, using a variety of agricultural inputs and technologies. Hazards and risks may vary significantly from one production system to another. Therefore, risk assessments shall be used to determine appropriate practices for the production of safe fresh fruits and vegetables in each specific case.

A risk assessment will establish the need to address identified risks. Procedures designed to manage risks shall be established and implemented. Assessing the risks is necessary to identify the hazards.

8.3 Specific hazards

Pathogenic microorganisms can readily survive and potentially multiply in the environment. Contamination can come from several sources. All procedures associated with primary production shall follow good hygienic practices and shall minimize potential hazards to the product. There are five key sources of microbial hazards to consider when evaluating and managing risk. Each of these sources has the potential to contaminate, as well as cross-contaminate, crops with pathogens. Therefore, each hazard must be considered in the context of the whole farm system.



Farm maps are useful tools and can help identify the hazards present on a farm. It is recommended that, as part of any risk assessment, farm maps be used to record hazards identified and the approach taken to manage risks.

The following considerations are designed to inform and direct the risk assessment process.

8.4 Guide to identifying hazards and mitigation measures on farms

The sections below help identify the most common hazards and provide examples of mitigation alternatives that shall be adapted on the farm. The *producer shall consider these as guidance that is helpful in preparing the risk assessment, not as a comprehensive list of hazards.*

8.4.1 Water (in combination with the guideline on water management)

Microbiological risk from water arises when water has become contaminated with pathogens that can make humans ill and the water subsequently comes into contact with the crop or harvested product. Water contamination can occur at any point from source to application/outlet and can affect the crop either in the field or during handling and packing.

8.4.1.1 Water in preharvest operations

Producers shall prepare a risk assessment covering the quality of the water used on the crop in all preharvest operations (i.e., this is not applicable to water used for drinking or other activities not involving the crop). The level of risk will be affected by many factors, including the quality of the water, the cleanliness of the water conduction system, the timing of application, the application method, and the type of crop.

The following table is merely a guide and not an exhaustive list of hazards and risk mitigation alternatives.

Source of hazard (examples)	**Risk mitigation alternatives (examples)**
Contact between water and harvestable portion of the crop	• Application method: Avoid letting irrigation water come into direct contact with the harvestable portion of the crop. • Avoid using irrigation water that does not meet set requirements directly for application of plant protection products (PPPs) or fertilizers where the harvestable portion comes into contact with water. • For irrigation of crops where the harvestable portion comes into contact with water, consider using treated water with disinfectant as allowed by local regulations. • Sample the water at an established schedule and review microbial water quality analysis results, taking mitigation actions, where appropriate.
Water from wells	• Wells shall be closed and covered. • Pipes and pumps shall be closed and maintained.
Water from open channels	• Regularly inspect channels and conduction systems. • Avoid the presence of animals (domestic and wild) in the water channels. If necessary, use fences or other methods to prevent animals from entering water sources. • Do not use water channels or conduction systems for washing equipment, harvest tools, etc. • Water channels shall be separated from sanitary facilities. • Use drip irrigation or variable rate sprinkler technology (where feasible for the crop). • Train workers to ensure sewage never enters the water stream.

Source of hazard (examples)	Risk mitigation alternatives (examples)
Water for frost prevention or hydrocooling that comes into contact with the harvestable portion of the crop	• The quality of water shall be the same standard as for water in direct contact with the harvestable portion of the crop.
Potential contamination of the water source with fecal matter	• Avoid animals grazing upstream of a river. • In the case of ponds, use fences or other methods to prevent the entrance of animals. • Where water comes into contact with the harvestable portion of the crop, consider using water treated as permitted by prevailing regulations. • Monitor and record the presence of excessive natural fauna near water sources. • Consider the risk of storm water causing a sewage treatment plant to overload into the water source.
Cross contamination	• Manure shall be stored and protected to avoid leaching into water sources. • Inspect all the water sources regularly to detect hazards.

Once the hazards on the farm have been identified and mitigation measures taken, producers are expected to assess the risks of their preharvest water use. A testing program to verify that microbiological quality of water is acceptable and consistent may be required or advisable depending on the type of crops and hazards identified. *Escherichia coli* is widely recognized as an indicator of fecal contamination.

The Integrated Farm Assurance (IFA) standard for fruit and vegetables requires a minimum water-testing regime of one sample per certification cycle or more, based upon the assessed risk and prevailing regulations. This relates to water used pre- and postharvest. Water analysis shall always be carried out at a frequency according to the results of the risk assessment, with documented actions taken in response to the results of the analysis.

It is important to consider that periodic water testing by itself cannot prove that the water quality is always acceptable. Therefore, good practices to manage the risks in water shall always be in place. Water testing can provide reassurance that the source is adequate, the variability of water quality is understood, and good practices are working to maintain water quality.

If microbial analysis is to be made, samples are to be taken at the exit point of the irrigation system or the practical sampling point nearest to that exit point. Where a producer meets requirements such as those of a specific customer, the producer shall be able to show that these requirements are at least as demanding as those required by the standard.

The following table is a tool that helps identify the most common hazards in water from uncontrolled events and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. It provides guidance only and is not an extensive or unique list.

Source of hazard (examples)	Mitigation alternatives (examples)
Water not from a mains (or municipal) supply	• The Water source shall be designed, constructed, and maintained to prevent potential contamination. • Consider treating the water.
Use of irrigation water for washing produce	• Irrigation water shall never be used for washing products. • The source of water used for washing products shall meet the microbial standard for drinking water.
Recirculation of water in equipment	• Water shall be treated using a method or antimicrobial treatment permitted by prevailing regulations and in accordance with the chemical label. • Consider frequencies at which water is changed.
Records and controls of water used postharvest	• Monitor treated water at a frequency that ensures the desired water quality is maintained. • Records of water treatment (e.g., antimicrobial agents) shall be maintained and verified regularly. • Frequency of monitoring and corrective actions shall be clearly established and complied with.
Cleaning of tanks, pipes, and pumps used for washing	• Equipment shall be cleaned regularly and kept dry until the next day. • A supervisor shall inspect the cleanliness of equipment daily, and this inspection shall be recorded. • Records of cleanliness and sanitation shall be maintained. • Equipment shall be sanitized according to a risk assessment considering the type of crop, equipment, water source, etc.
Refills of drinking water containers	• Refill drinking water containers with water that meets the microbial standard for drinking water.
Use of ice for cooling or storage (or in any aspect of the postharvest process)	• Ice shall be sourced from known suppliers. • Suppliers of ice can demonstrate that it has been produced with water of appropriate quality (microbial standard for drinking water). • Ice shall always be obtained from water sources that meet the microbial standard for drinking water.

Source of hazard (examples)	Mitigation alternatives (examples)
Storage of ice on the farm	• Ice shall be handled under sanitary conditions to prevent contamination. • Ice shall be stored inside a covered tank or similar structure to avoid accidental contamination. • Ice shall never come into contact with soil or other potential sources of contamination. • All tools used to handle or distribute the ice shall be kept clean and stored appropriately. • Water that does not meet the microbial standard for drinking water shall never be used to create or maintain ice.

8.4.1.2 Water from uncontrolled events

Hazardous contaminants (e.g., toxic waste, fecal matter, dead animals) can be deposited at the production site by heavy flooding, affecting the growing crop directly or indirectly through the contamination of soil, watercourses, equipment, etc. Where a reasonable risk of flooding exists, producers are required to implement strategies to mitigate these risks. Note that pooled water arising from rainfall, broken irrigation pipes, etc., that is assessed as a low risk for microbial contamination of product would not be considered flooding.

The following table is a tool that helps identify the most common hazards in water from uncontrolled events and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. It provides guidance only and is not an extensive or unique list.

Source of hazard (examples)	Mitigation alternatives (examples)
Flooding during crop production	• Crops from flooded areas may not be suitable for harvest for fresh consumption. (Note: The United States Food and Drug Administration considers any crop that has come into contact with floodwater to be an adulterated commodity that cannot be sold for human consumption.) • Following a flood event, irrigation water (from a well, river, reservoir, etc.) shall be tested to assess the risk of human pathogens in the water.
Soil flooded prior to planting	• When appropriate, there shall be an interval between the floodwater receding and planting. An appropriate interval shall be established by the risk assessment.
Cross contamination	• Prevent cross contamination by cleaning or sanitizing any equipment that may have come into contact with previously flooded soil. • Areas that have been flooded at any time of the season shall not be used to store products or packing material.

Source of hazard (examples)	Mitigation alternatives (examples)
Sediment from dredging activity	• The sediment can contain microbiological contamination, therefore the spoil shall not be deposited on growing or handling areas.

8.4.1.3 Water-testing protocol

If the risk assessment or other requirement indicates that microbiological sampling of water is an appropriate measure, the following aspects shall be considered:

- The person responsible for sampling the water shall be properly trained to ensure a correct sampling technique is applied and to prevent unintentional contamination.
- Sterile containers shall be used to collect the samples.
- Samples shall be kept cool (ideally at no more than 2°C).
- Within 24 hours of collection, samples shall be delivered to a capable laboratory operating according to ISO/IEC 17025 or an equivalent standard.

8.4.2 Animals and dust

The presence of animals (including birds, reptiles, insects) and dust can transport pathogenic organisms that can contaminate fresh products and water sources. It is important to consider both *direct and indirect* contamination routes. Examples of indirect contamination are:

- Feces from pests as well as wild and domestic animals
- Remains of dead animals
- Effluent from intensive animal facilities

Reasonable precautions shall be taken to minimize the risk arising from these hazards on the farm during harvest and in postharvest operations. The site risk assessment required obliges the producer to consider microbiological hazards. The following table is a tool that helps identify the most common hazards regarding animals and dust and provides some examples of mitigation alternatives that shall be adapted to the farm-specific operations.

The following table is a tool that helps identify the most common hazards in water from uncontrolled events and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. It provides guidance only and is not an extensive or unique list.

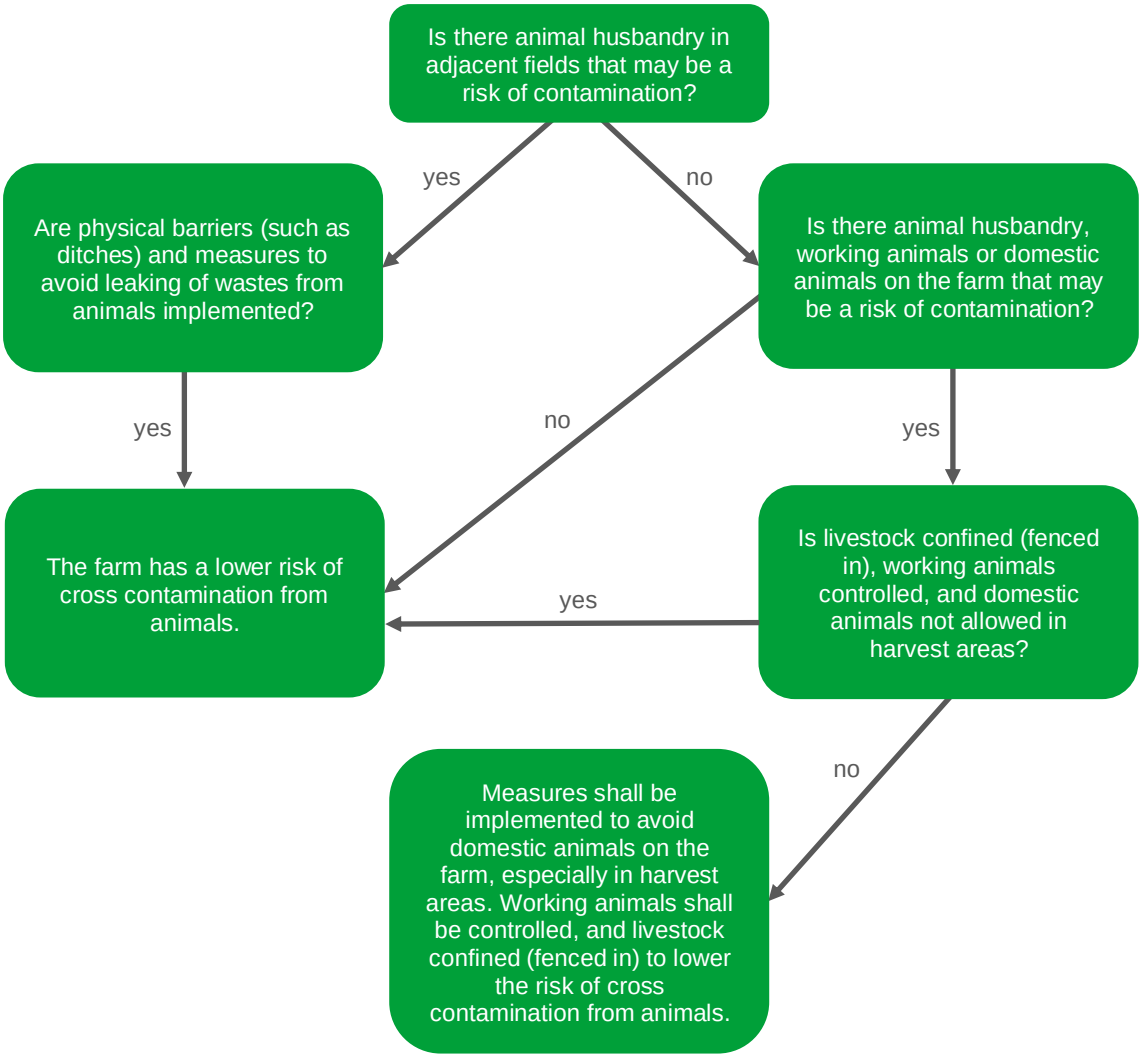
Source of hazard (examples)	Mitigation alternatives (examples)
Adjacent land use	To prevent the potential contamination of production areas by adjacent land use with identified risk, action shall be taken to manage these risks. Mitigation strategies can include: • Distance: It is reasonable to assume that increasing distance will help reduce the risk, although distance by itself does not guarantee that no risk is present. • Barriers: Physical barriers such as fences, hedges, retaining walls, ditches, or other types of animal control strategies may be required to mitigate risks. Barriers can be used to contain

Source of hazard (examples)	Mitigation alternatives (examples)
	livestock, restrict access by wildlife, and prevent leakage of wastes into production, harvest, and handling areas.
Presence of animal populations or animal activity near the crop from nearby commercial animal operations	• Identify the location of animal populations with respect to crop production and their distance from these operations. • Identify specific areas of animal congregation (e.g., water troughs, natural watering locations, and feed stations) near the crop and take special measures for the affected production area, especially during harvest. • Use effective fencing or other barriers. Fencing shall be robust according to the scale of the animal population and farming operation. • Identify potential contamination routes and identify specific prevention measures. • Water wells and sources shall be covered and protected to avoid animal access. • Ensure routine inspection and regular maintenance of fencing to verify its condition.
Presence of composting sites and manure heaps at the farm or on adjacent lands	• Alter the slope of the adjacent land. • Plant outside the prevailing wind direction (risk of contamination blowing toward the production site). • Erect barriers to avoid the contamination of water or the production area with manure or compost. Constantly monitor barriers to detect manure sliding.
Presence and proximity of activities likely to attract pests, including animals, rodents, birds, and insects	• Harvested crops shall be maintained in controlled areas. • Harvested crops shall be stored at the end of the day.
Domestic and working animals	• Avoid the presence of domestic animals in the farm or in production areas. • Working animals shall be managed in a manner that prevents contamination (e.g., manure collection, confinement to field edges).
Pest species (e.g., rodents, birds, flies)	• Have an up-to-date pest control plan implemented that is reviewed whenever changes to the assessed risk occur (updated storages, new buildings, newly purchased machinery, etc.).

8.4.2.1 Decision tree to ascertain hazards due to presence of animals

A decision tree can be used to help identify hazards and assess risks. This decision tree is a guideline only. This example may not fit all possible scenarios. In those cases, such as when the producer wants to use livestock in combination with the farming activity, producers shall conduct a similar analysis.

Where fruit and vegetable crops are grown or handled near potential sources of contamination, producers shall be able to explain how the risk is mitigated.



8.4.3 Manure and fertilizer of animal origin

If they come into contact with the product directly or indirectly via the soil or a water splash, fertilizers and soil additives containing manure can further contaminate fresh products as well as water sources. Examples of contamination are:

- Direct or indirect contact between untreated fertilizers or soil additives containing manure and the harvestable portion of fresh products
- Accumulations and run-off of manure or compost that could leach into water systems or production/handling areas

Reasonable precautions shall be taken to minimize the risk arising from these hazards on the farm during harvest and in postharvest operations. The site risk assessment obliges the producer

to consider microbiological hazards. Producers are required to risk-assess any use of organic fertilizer and take appropriate action to manage risks.

The following table is a tool that helps identify the most common hazards in the use of raw or treated manure or organic fertilizers and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. The table provides guidance only and is not an extensive or unique list.

Source of hazard (examples)	Mitigation alternatives (examples)
Application of manure and fertilizer of animal origin	• Identify the type of product used, how the product has been treated, and where and how it is going to be used. • Observe the exclusion period between application of the product and harvest. • Ensure appropriate storage of product to reduce the risk of leaching or run-off.
Storage of raw and/or treated organic fertilizers, compost, or manure	• Storage of all fertilizers, compost, and manure shall be located far from water sources. Physical barriers can help contain leachates to prevent their entry into water systems. • Storage shall be protected against rain to avoid leaching, dissemination by wind or animals, etc. • Traffic of people, animals, or machinery over raw organic fertilizers shall be avoided. • Do not locate the manure storage in proximity to fresh fruit and vegetable production areas or areas used for the storage of harvest tools and materials.
Use of compost or treated manure	• During compost, exposure to temperatures above 55°C for three days is sufficient to kill pathogenic organisms. The manure heap/pile shall be turned to ensure that all parts of the material are exposed to the above temperature regime. • If compost or treated manure is bought, the supplier shall guarantee the treatment. • The incorporation of applied composted manure into the soil can help reduce run-off and the risk of contamination of watercourses, neighboring fields, etc. This practice is recommended. • The interval between application and cropping shall be considered. The time between the application of composted manure and the harvest of fresh fruits and vegetables shall be maximized.

Source of hazard (examples)	Mitigation alternatives (examples)
Composting or treatment of manure at farm	• Producers shall be able to demonstrate that the compost has been subject to a controlled process. Records can include details of the composting regime, dates of treatment, and temperatures reached in the manure heap. • Do not locate manure storage or treatment sites in proximity to fresh fruit and vegetable production areas or areas used for the storage of harvest tools and materials. • Physical barriers can help contain leachates to prevent their entry into water systems.
Equipment used in raw or composted manure treatment and applications	• Equipment (such as tractors, trucks, or transporters) and tools can contaminate crops by moving from treatment areas or storages or areas treated with manure. All equipment that has come into contact with untreated manure (e.g., tractors, tools) shall be cleaned prior to access to harvest areas.
Use of manure (treated or untreated) in neighboring land	• Avoid possible contamination from manure use on neighboring land. Look for leaching or contamination through irrigation channels. Heavy rainfall onto a manure pile can result in leachate reaching production areas prior to, or at, harvest.
Type of crop	• Low-growing crops that may be splashed with soil during irrigation or heavy rainfall shall be considered at higher risk because pathogens from manure (or other sources) can persist in the soil. Products where the harvestable portion of the crop generally does not come into contact with soil has a lower probability of contamination.

8.4.4 Personal hygiene (workers and visitors)

Proper hygiene among workers and visitors is an important element of food safety for every farm, as is the provision of toilets to workers.

Compliance with proper hygiene measures by workers occurs when:

- Sanitary infrastructure and facilities are available for workers.
- Information and training in hygiene and health is given to all workers.
- Supervision ensures that instructions are complied with.

8.4.4.1 Sanitary infrastructure for workers

To comply with the basic aspects of hygiene, workers shall have access to the use of specific installations and equipment. All workers in the field shall have access to proper sanitary facilities to prevent hazards, and harvest workers shall, in all cases, have access to clean toilets within reasonable proximity to the workplace.

The following table is a tool that helps identify the most common hazards in sanitary infrastructure for workers and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. The table provides guidance only and is not an extensive or unique list.

Source of hazard (examples)	Mitigation alternatives (examples)
Quantity of toilets	• The number of toilets shall be adequate and in accordance with the number of workers in the field and with prevailing regulations.
Location of toilets	• The location and system of toilets to use near the field may depend on local legislation. • Toilets shall be within reasonable proximity to the workplace. • Toilets shall be located away from water sources, including streams, wells, ponds, and water tanks. • Toilets shall not be in areas prone to flooding.
Accessibility	• Toilets shall be easily accessible to workers and in compliance with any prevailing regulations. All workers shall be allowed to use the toilets whenever necessary.
Condition of toilets	• Toilets shall be constructed of or covered with a washable material. • Toilets shall be regularly inspected to ensure that they are clean and adequately supplied (e.g., with clean water, paper towels, etc.). Ideally, records of these inspections shall be available. • Toilets shall be clean and in good condition to mitigate the risk of contamination to soil, water, crops, and workers.
Handwashing facilities	• Handwashing facilities shall be provided inside or adjacent to the toilets and in other locations, as required by prevailing regulations. • Clean water and soap shall be available for workers to wash their hands. • Signs indicating that hands must be washed after the use of the toilet facility shall be in place. • Supervisors shall be responsible for verifying that handwashing takes place.
Waste and wastewater	• Where possible, waste and wastewater from the toilets and handwashing facilities shall be captured for disposal in such a way that it does not contaminate the crop, land, products, or materials. • Removal of the waste and serving of the toilets shall occur in accordance with the number of workers and the capacity of the system. Waste tanks shall be thoroughly washed at a frequency corresponding to conditions on the farm. Waste shall never be disposed of in waterways.

8.4.4.2 Information and training in hygiene and health for all workers

Instruction and training on basic hygiene shall be given to all the workers and supervisors. The training shall incorporate the following aspects:

a) The basic set of instructions on hygiene shall include all the hygiene aspects that could be of importance according to the farm, crop, and harvest conditions.
b) Workers shall be trained on the risks of handling products while ill and the importance of reporting illnesses to their supervisor. Conditions and requirements for returning to work after an illness shall be clearly communicated to workers.
c) Supervisors shall also be trained on how to handle relevant conditions and the detection of unsanitary conditions in the field (presence of pests, pest habitat, litter, etc.).

Supervisors are responsible for ensuring the implementation of the hygiene procedures and necessary worker training.

8.4.5 Equipment

Equipment includes harvest machinery, containers, and tools. If equipment has been in contact with microbial hazards, the contamination can be transferred to products. To avoid spreading microbial contamination, all equipment shall be kept clean and in good condition.

8.4.5.1 Harvest containers and tools

The following table is a tool that helps identify the most common hazards in harvest containers and tools and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. The table provides guidance only and is not an extensive or unique list.

Source of hazard (examples)	Mitigation alternatives (examples)
Dirty containers and tools	• Containers and tools shall be kept clean and in good condition to avoid contaminating or damaging the products. A visual inspection shall be used to verify suitability. • Containers for products shall be inspected before use and washed as needed. • Tools used for harvest and any trimming of the harvested products shall be periodically disinfected per assessed risk. (Note: Tools with wood handles cannot be fully sanitized.) • Damaged harvest containers that present a risk to food safety shall not be used for products.
Contact of containers and tools with soil	• Tools and containers used for harvest and any trimming of the harvested products shall not be allowed to have direct contact with the soil. Cardboard sheets, plastic sheets, or other barriers can be used to help keep packaging material off the ground.
Untrained workers	• Workers shall be trained to use only those containers and tools that are clean and in good condition. Depending on the assessed risk, harvest containers shall be cleaned at defined internals, including trailers, boxes, and bins.

Source of hazard (examples)	Mitigation alternatives (examples)
Contact with contaminants	• Any container or tool suspected of being contaminated (e.g., with animal feces, blood, soil) shall be washed and disinfected prior to use.
Other uses of harvesting containers	• Harvesting containers shall not be used for carrying any material or substance other than the product. Workers shall be trained in this aspect.
Trash and waste	• Trash and waste shall be handled in such a way that they do not pose a contamination hazard. • Harvest containers shall not be used for storage of waste or trash. • Containers for waste, byproducts, and inedible or dangerous substances shall be identified. • Containers used for waste shall not be used for product or packaging material.

8.4.5.2 Harvest machinery and equipment

The following table is a tool that helps identify the most common hazards regarding harvest machinery and equipment and provides some examples of mitigation alternatives that shall be adapted to farm-specific operations. The table provides guidance only and is not as an extensive or unique list.

Source of hazard (examples)	Mitigation alternatives (examples)
Damage to products	• When harvest machinery is used, it shall be properly calibrated and maintained to prevent physical damage to products.
Cleanliness of harvest machinery	• Harvest machinery shall be cleaned and washed according to the manufacturer's recommendations and the specific working conditions.
Cleanliness of transportation	• Vehicles shall be adequately cleaned and, where necessary, disinfected to avoid cross contamination. • A vehicle that may be a source of contamination shall never be used.

Source of hazard (examples)	Mitigation alternatives (examples)
Cross contamination	• Equipment and transport vehicles shall be prevented from traveling through potentially contaminated areas (e.g., areas associated with untreated manure) to reach fields or harvesting locations. • Vehicles used for transport of fresh and packed fruit and vegetables shall not be used for the transport of hazardous substances.

8.5 Examples of types of pathogens

Foodborne illness attributed to contaminated fresh products has been associated with a consistent list of pathogens. The following table provides some examples of the most common microorganisms that have been associated with foodborne disease outbreaks. Note that this list is not exhaustive.

List and characteristics of some microbial pathogens that have been linked to outbreaks in fresh products

Microorganism	Common main source
Bacteria	
Escherichia coli O157:H7 and other strains	Animal feces, especially cattle, deer, and human. Cross contamination through contaminated water used for irrigation or other purposes. People not washing hands after using restrooms.
Salmonella spp.	Animal and human feces. Cross contamination through contaminated water used for irrigation or other purposes.
Shigella spp.	Human feces. Contaminated water used for irrigation or other purposes.
Listeria monocytogenes	Soil, food production environments that maintain wet conditions.
Viruses	
Hepatitis A	Human feces and urine. Contaminated water used for irrigation or other purposes. People not washing hands after using restrooms.
Norovirus (previously known as Norwalk virus)	Human feces, vomitus. Contaminated water used for irrigation or other purposes. People not washing hands after using restrooms.

Microorganism	Common main source
Parasites	
Cryptosporidium spp.	Animal and human feces.
Cyclospora spp.	Human feces from people carrying the parasite. Contaminated water used for irrigation, application of PPPs, or other purposes.

Based on:

www.fda.gov

General Principles of food hygiene CXC 1-1969 (Adopted in 1969. Amended in 1999. Revised in 1997, 2003, 2020. Editorial corrections in 2011.). https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/

Code of hygienic practice for fresh fruits and vegetables CXC 53-2003 (Adopted in 2003. Revised in 2010 (new Annex III for fresh leafy vegetables), 2012 (new Annex IV for melons), 2013 (new Annex V for berries), 2017.), https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/

"Guidelines for on-farm food safety for fresh produce." Australian Government. Dept. of Agriculture, Fisheries, and Forestry (2019).

9 PROVISION OF TOILETS TO WORKERS

Toilets can be in the form of stationary or mobile units. Where the establishment of structures for permanent toilets is not possible, the provision of mobile or portable toilet units (e.g., porta-potties) will suffice.

Regardless of the type of unit provided, it shall be designed and located in a way that facilitates cleaning, service, and maintenance.

Toilets and handwashing facilities shall be located in reasonable proximity to the place of work (wherever agronomic activities, including product handling, take place). This means that toilets shall be provided so as to allow everyone to use them without unreasonable delay. It is important that people can visit the toilet quickly when necessary, as undue delay can lead to distress and health problems as well as posing a risk to the safety of products.

Where it is not possible to position either permanent or mobile toilets in reasonable proximity to the place of work, a mode of transportation to the nearest toilets shall be provided at reasonable frequencies.

There is no specific parameter to quantify reasonable proximity (e.g., distance or travel time between the toilet and point of work), and compliance with this principle and the relevant criteria is based on risk.

Where personal dialogue or observation during audit reveals that the toilets that have been provided are used infrequently because of, e.g., restricted access or limited travel opportunities, this shall lead to a non-conformance.

9.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

10 BIODIVERSITY

This guideline focuses on the two P&Cs on land conversion and restoration as well as on the documented biodiversity plan.

10.1 No conversion of relevant areas into agricultural use

Land use and land conversion are often highly regulated.

The implementation of P&C FV 22.03.01 starts with the on-farm identification of areas where legal protection prevents land conversions.

The definitions can be taken from prevailing regulation or from other locally relevant sources. An indicative definition is provided in the glossary of IFA v6:

Regarding the documentation of on-farm land use before 2014, it will often suffice to obtain documentation once and keep it for future certification body (CB) audits, unless new information requires updating the documentation of on-farm land use prior to 2014.

10.1.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

10.1.2 National interpretation

It is possible to indicate specific definitions and examples for natural or seminatural ecosystems and habitats, areas where legal protection prevents land conversions, and areas recognized as HCV areas.

10.1.3 References

While references linked to locally prevailing regulations and practices will be crucial, global references include the online libraries and resources of:

- The International Union for Conservation of Nature (IUCN)
- The United Nations Food and Agriculture Organization (FAO)
- The Accountability Framework
- The High Conservation Value Areas Network
- The United Nations Convention on Biological Diversity
- The World Wide Fund for Nature (WWF)
- The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
- The Global Nature Fund (GNF)
- The Intergovernmental Panel on Climate Change (IPCC)

10.2 Restoration of relevant areas converted into agricultural use

Restoration of ecosystems and habitats is as important as it is challenging. Obtaining results can often take years, depending on local conditions. P&C FV 22.03.02 on restoration of converted areas can for example be used in connection with the P&C FV 02.01 on continuous improvement.

The current decade, 2021–2030, is the United Nations Decade on Ecosystem Restoration, which includes calls to award flagship restoration projects.

It is highly recommended that a restoration project include, for example:

- Identification of the area to be restored
- Engagement with relevant stakeholders, e.g., local land-use authority, other stakeholders active in restoration, etc.
- Baseline description of the area to be restored
- Expected results of the restoration process
- Adaptation measures for the restoration project in case results differ from the results originally expected

10.2.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

10.2.2 National interpretation

It is possible to indicate specific definitions and examples for restoration.

10.2.3 References

While references linked to locally prevailing regulations and practices will be crucial, global references are expected to be increasingly accessible in connection with, for example:

- The United Nations Decade on Ecosystem Restoration 2021–2030
- The World Wide Fund for Nature (WWF)
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

10.3 Documented biodiversity plan required

Because all the P&Cs on biodiversity are interrelated, it is highly recommended that the biodiversity plan include at least the measures that relate to the P&Cs:

- Biodiversity is protected.
- Biodiversity is enhanced.
- Unproductive sites are used as ecological focus area to protect and enhance biodiversity.

The biodiversity plan can be presented as a simple table that indicates:

- Baseline: Initial situation of biodiversity
- Measures: Ways to implement protection and enhancement of biodiversity and to use unproductive sites as ecological focus area to protect and enhance biodiversity
- Monitoring: Summary of results of the implementation of the measures
- Adjustment: Refining the measures based on monitoring results
- Landscape beyond the farm: Actions, projects, or collaboration considered for implementation with other stakeholders

10.3.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

10.3.2 References

The increasing attention to biodiversity in prevailing regulation will likely increase the availability of references. Here are just a few examples:

- The Biodiversity Performance Tool of the Global Nature Fund (GNF)
- The Integrated Biodiversity Assessment Tool (IBAT; not all resources are free of charge)
- The United Nations Food and Agriculture Organization (FAO)
- The United Nations Convention on Biological Diversity
- The World Wide Fund for Nature (WWF)
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

11 WASTE MANAGEMENT SYSTEM

A written waste management plan is not required.

Visual inspection as evidence that waste is separated and disposed of replaces a documented system. As documentation, invoices from disposal or recycling entities may be supportive.

Waste management opportunities differ from place to place. It makes sense that waste separation categories correspond to those which are used in the region, based on the available disposal/recycling options.

The newly introduced elements in the principles and criteria (P&Cs) in relation to plastics call for evidence on the awareness of types of plastics used, where they are used, and where there is potential to substitute plastics for more renewable materials. It also calls for evidence that plastic (waste) is not released to the environment and awareness of workers to accomplish this.

Different (new) efforts can be made at farm level. This will depend on the reality of each producer, but could include, for example:

- Identifying the different types of plastics used, where these are used, and whether they can be replaced by renewable materials
- Establishing rules, providing tools to collect waste, and assigning places to keep the different waste categories.

In general, for all waste, workers and management shall be made aware of where the specific waste shall go.

11.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

11.2 National interpretation

Local legislation or industry-specific information may be added to a national interpretation guideline.

12 WATER MANAGEMENT

This guideline is intended for producers seeking GLOBALG.A.P. certification. It is designed to help them carry out and comply with principles and criteria (P&Cs) concerning water use, such as performing a risk analysis and drafting a water management plan. This guideline attempts to identify all the relevant factors that need to be considered and/or the measures that need to be implemented to support effective water management on the farm.

12.1 Prevailing regulation

Most countries have prevailing regulations that govern the use of water, permits for water abstraction, restrictions on the amount allowed to be abstracted, storage facilities, and other considerations. Adherence to prevailing regulations is required by the standard, and where prevailing regulations have not been established, international guidelines (e.g., from the World Health Organization and/or European Union) may serve as references.

12.2 Responsible water management on the farm

Good practices for improving a farm's water management focus on:

- Reducing direct and indirect contamination of water bodies from agricultural fields
- Not depleting water sources
- Helping to improve the efficient and safe use of water resources to grow crops

Specifically, recommended good practices for water management at farm level mainly address:

- *Irrigation and soil* (e.g., avoiding overirrigation, leaching, excessive drainage, and agricultural runoff; reducing soil erosion; improving soil fertility; etc.)
- *The use of plant protection products (PPPs)*
- *The application of fertilizers and organic soil amendments* such as manure
- *Waste management* (e.g., the management of spray tank leftovers, the disposal of empty PPP containers, etc.)

The following points characterize sustainable and responsible water management at farm level:

- Farm management has an overview of all the water sources surrounding the farm. This includes identifying the sources that are used for abstraction, identifying how much water is abstracted and when, and having an overview of the farm water distribution system.
- Farm management is aware of any water sources considered to be in a critical state as per common knowledge, i.e., publications in the media, conflicts with a community or with civil society organizations.
- The farm uses water resources in an efficient and planned manner for irrigating crops.
- The irrigation water quality is controlled.
- There is control over the possible return of wastewater from the farm back into water bodies.
- There is proper handling and use of PPPs, fertilizers, and organic soil amendments (correct time, place, and amount of application).
- Good soil management practices are in place (to prevent soil erosion, improve the soil's water retention and as such prevent water pollution by surface runoff, subsurface runoff, and drainage).

12.2.1 Water quality

The three main sources of water contamination in agriculture are chemical (i.e., nitrates, phosphates, and agrochemicals), physical (e.g., soil, stones, glass), and microbial (e.g., nematodes, fungi, bacteria, viruses).

This can affect both the farm as well as the water sources and the surrounding environment, and in some cases, the health of workers or the community outside the farm.

If excessive quantities of organic and/or inorganic fertilizers build up in surface waters, this can cause eutrophication of water bodies.

It is important to handle and use *PPPs* and *fertilizers* according to their registered uses, while following recommended best practices to prevent such products from transferring to other parts of the environment, notably vulnerable areas such as drinking water sources.

Fertilizer applications may result in runoff that enters irrigation systems, particularly during times of heavy rainfall or flooding. The standard requires careful control of organic fertilizer. However, water quality may also be impacted by neighboring land through which irrigation water passes.

The application of PPPs shall be conducted in a manner that mitigates water contamination. In addition to evaluating the effect of practices on the production area under certification, consider risks associated with neighboring land and applications.

Understanding the route of travel for water used for irrigation is critical. In recent years, food safety incidents that impacted human health were linked to contamination of water applied to a crop. Carefully assess whether the water used passes through areas where livestock are present.

The standard requires that for specified uses, water meet the microbial standard for drinking water. For analyzing water that meets the drinking water standard, sample at the closest point of contact. If handwashing water is added to a tank that is dispersed through a spout to workers' hands, the water shall be tested at the spout. At times, microbial contamination can be present and persist inside a tank. While the tank can be recharged with water meeting the microbial drinking water standard, the water dispensed to the user will then be contaminated.

12.2.2 Direct and indirect contamination

Direct contamination (also known as point source contamination) refers to clearly identifiable sources of contamination, for example spills of PPPs made during mixing and loading of the sprayers or the disposal of tank leftovers in fields without properly diluting the mixture and/or without considering adjacent water bodies.

By contrast, *indirect contamination* (also known as diffuse source contamination) is distributed at various locations around the farm and fields. Transfer routes from indirect sources include runoff, drainage, leaching, and spray drift. The prevention of indirect source contamination is more complicated than the prevention of direct contamination. Preventing indirect source contamination often involves changing agricultural practices in the field, for example by introducing:

- Vegetative buffers at the edges of cropped fields
- Crop rotation with more diverse crops
- Improvements in soil organic matter and erosion prevention
- Contour cropping
- Minimum tillage
- Modified irrigation scheduling and rates
- Use of low-drift spray nozzles

- Recalibration of spray equipment, etc.

It is important to assess whether direct contamination occurs on the farm and to identify the main areas of risk. This will enable plans to be put in place to ensure that risks are reduced.

Evaluating the risk and likelihood of indirect contamination to agricultural water may be more challenging. A careful assessment of the production area may reveal indicators that a risk is present. For example, visible erosion in the form of tramlines indicates the occurrence of surface runoff. This may be caused by poor infiltration capacity of the soil due to poor soil management practices (e.g., deep plowing, no crop rotation, and/or the absence of a proper farm traffic plan). It is more difficult to assess whether the fields are susceptible to leaching of agrochemicals. Local farm advisers or farm service providers can support producers in assessing the risk of agricultural runoff, leaching, drainage, and drift from agricultural fields.

According to the type and source of contamination, tailored mitigation measures and best management practices can be implemented. The most important mitigation measure is the correct management of PPP applications. It is important to keep track of the weather forecast. Applying PPPs before a heavy shower can increase the risk of agricultural runoff and leaching, leading to contamination of water bodies.

12.2.3 Water sources

There are four types of water source:

- Groundwater: Water that is captured and stored naturally under the soil. Renewable groundwater is stored in underground aquifers which are usually recharged in the short term by rainfall. Fossil groundwater is stored in deeper aquifers which are not recharged by rainfall.
- Surface water: Fresh water in lakes, rivers, natural and artificial ponds, canals, and ditches
- Municipal water or water from an aqueduct
- Captured water: Water stored in reservoirs, tanks, or artificial basins

Unsustainable (over)abstraction of water from *groundwater aquifers* can cause a drop in the groundwater table. Lower groundwater tables impact not only the producers, as they will have to drill deeper to abstract groundwater, but also the wider community. It can also cause the intrusion of salt water into freshwater aquifers in regions close to the sea.

A good practice for producers is to reduce their consumption of irrigation water through more *efficient use* (and thus less wasteful irrigation). This can be achieved by better irrigation management through timely applications of the correct amount of water the crops need. It can also be achieved through better soil management, for example, by increasing the organic matter content or investing in mulching, both of which improve the soil's water retention. Some crop varieties also use water more optimally. Moreover, better retention of available water in the soil allows crops to consume more water, which can improve crop biomass and yields in rain-fed agriculture in arid and semiarid regions. Increasing soil organic matter content is critical in raising the soil's capacity for holding water. The efficient use of water for irrigation also does not reduce crop yields if planned properly, for example by avoiding water stress (e.g., by using soil moisture probes).

12.3 Good practices for water management

It is recommended to assess the economic investment against the benefits in terms of water volumes captured. In the case of rain-fed agriculture, tools can be put into place to store excess precipitation, which can then be used in periods of water stress, improving water quantity management. Precipitation can be stored by collecting water from roofs or by storing water in reservoirs built in areas that are not cultivated. Collected rainwater may still be a source of

microbial contamination and shall be included in the water risk assessment. For example, the rainwater may travel down the roof of a building prior to collection, creating opportunity for contamination. Rainwater storage tanks and reservoirs shall be evaluated as part of the risk assessment to ensure water quality is maintained in accordance with the intended end use.

The following are examples of practices that may be implemented to ensure responsible on-farm water management:

12.3.1 Water quality

- At regular and frequent intervals, test the quality of irrigation water and monitor, where possible, the amount of effluent entering water bodies from agricultural fields.
- Preferably mix and load the PPP sprayer on a concrete/impermeable area at the farm within a safe distance from streams, ditches, wells, food and feed storage rooms, residential areas, and roads. Make sure that the area has a small depression that directs spills and wastewater from washing the sprayer and the nozzles into an artificial drain for collection and safe disposal. The collected effluent and any remnants, such as tank leftovers, can be sent off for disposal to authorized waste disposal companies or treated at the farm using an effluent management system.
- Never mix PPPs or load PPP sprayers in the vicinity of irrigation storage reservoirs.
- Use the correct irrigation method based on crop, soil, climate, and slope to prevent erosion, leaching, evaporative losses, and agricultural runoff.
- Reduce agricultural runoff by improving topsoil permeability. This can be done, for example, by preventing capping or compaction of the soil, introducing controlled farm traffic, and improving soil structure by applying minimum tillage or no tillage if the soil and other circumstances allow this.
- Install buffers next to streams to prevent agricultural runoff from directly entering surface water bodies. This will protect surface water bodies from agrochemicals or nutrients that may run off the fields due to precipitation or irrigation.
- Do not irrigate with surface or groundwater if it is contaminated (e.g., by microbes, heavy metals, industrial pollutants, etc.).
- If irrigation water is recycled through a drainage system, check that the crops receiving the recycled water are not sensitive to herbicides in water even at very low concentrations (this information is normally provided on the label about sensitivities of crops).
- Do not use PPPs with high leaching potential (the label will normally state this) if the groundwater table is very close to the surface and the soil is vulnerable to leaching (e.g., sandy soil or heavy clay with extensive cracks).
- Ensure that oil from tractors and equipment is not disposed of in ditches.
- Adhere to all local laws and bylaws regarding water quality management.

12.3.1.1 Surface irrigation systems

- For crops treated with agrochemicals, ensure that border, basin, or furrow irrigation is delayed for a few days after applications. In the case of furrow irrigation or if the borders are relatively small, surge irrigation can be applied to allow for better infiltration of water into the soil, avoiding runoff at the tail ends.
- Avoid irrigating with water that contains a high level of industrial effluents or with greywater. The use of untreated sewage of human origin is not permitted by the standard, even if the sewage is diluted into irrigation water.

12.3.1.2 Sprinkler and drip irrigation systems

- If PPPs are applied through chemigation, routinely inspect and maintain delivery systems to ensure nozzles are functioning without drips or obstructions.
- Use delivery mechanisms (e.g., nozzles, lines, pumps) designed to accommodate and be compatible with chemigation. Ensure that permanent drip irrigation systems (such as in orchards) are equipped with back-flow prevention devices.
- Implement water applications in accordance with root volume and depth in an effort to minimize leaching.

12.3.2 Water quantity

- Maintain the correct irrigation rate and intervals depending on crop needs, soil type, and water availability. The latter is important because in the case of serious water shortages or water scarcity, one can choose to apply deficit irrigation, i.e., applying water during the most critical growth stages of the crops, such as flowering, to prevent yield loss.
- Avoid overirrigation to prevent leaching, agricultural runoff, and drainage.
- Minimize evaporative losses, for example from open water surfaces.
- When using groundwater for irrigation, use it sustainably. This means not abstracting more than the yearly recharge rate to avoid a drop in the groundwater table.
- Maintain an appropriate irrigation application rate depending on the crop, the growth stage, the availability of water, and the crop water requirements, which also depend on the weather conditions (heat and amount of precipitation).
- Obtain and follow advice on the correct irrigation application rates during the season from water user associations, local water management authorities, or private service providers. Producers can also estimate correct irrigation application rates themselves if tools such as soil moisture probes are available.
- Engage in timely maintenance of the irrigation system to reduce leaks and improve irrigation efficiency or water use efficiency.
- Increase the soil's water retention, reduce agricultural runoff and leaching, and prevent soil erosion. The soil's water retention can be improved by increasing soil organic matter. Conservation agriculture, which includes minimum tillage or no tillage, helps improve soil organic matter depending on the local circumstances, e.g., soil type, climate, etc.
- Monitor and document water use.

12.3.2.1 Surface irrigation systems

- Improve conveyance and application efficiencies where needed and possible. If return flows have clearly proven to be useful for downstream users and this does not financially impact the producer, allow these return flows to occur and avoid recapturing these flows for reuse in the irrigation system.
- Properly maintain irrigation systems, considering efficiency and water quality when designing updates or new system installations.

12.3.2.2 Sprinkler and drip irrigation systems

- Use quality drip lines to decrease damage and leaks.
- Optimize irrigation efficiency by monitoring the application pattern, avoiding unintended overlap of sprinklers.

- Drip irrigation: Use correctly sized pipes or tubes and maintain the appropriate level of pressure.

12.4 Guideline on the GLOBALG.A.P. principles and criteria to water management on the farm

This section provides guidance on what to consider for supporting the sustainable and responsible management of water, mitigating food safety risks, and fulfilling the requirements of the standard. This is particularly important in regions where water resources are scarce.

12.4.1 Predicting irrigation requirements

Producers who use a groundwater well or abstract water directly from bordering streams or ditches can use tools, such as weather data and soil moisture probes, to best decide when crops need to be irrigated. Proper planning of an irrigation schedule is strongly recommended. Different tools can be used to do so, and local agronomists and farm advisers can support farm management in training, scheduling, and in properly calculating the crop water requirements.

Also, data from the on-farm water management plan can support the producer in estimating how much water would be needed to irrigate the crops and assess whether there are/will be water shortages and water needs to be stored.

If water is allocated by a water user association , producers may receive advice from the water user association on when and when not to irrigate the crops.

The water management plan may include a reference to how the crop water requirements have been calculated, and how the irrigation schedule has been agreed.

12.4.2 Water risk assessment (in combination with the guideline on mitigating microbial risks)

The risk assessment shall establish whether water quality is fit for the intended purpose. In some instances, fitness for the intended purpose may be defined by prevailing regulations. The potential for upstream contamination shall be evaluated (sewage, animal farms, etc.), and ways to mitigate the food safety risks shall be determined.

Prevailing regulations may have established microbial contamination thresholds for irrigation water. The allowable microbial contamination thresholds, required testing methods, sample schedules, and water application schedules may be based on specific crops or crop categories. The GLOBALG.A.P. Secretariat does not establish a microbial threshold for irrigation water. The producer conducts a risk assessment of their water quality. The standard requires that water used for specific purposes, such as handwashing and product washing, meet drinking water microbial standards. Where prevailing regulations do not exist for the definition of drinking water, the "Guidelines for drinking-water quality" (2017) of the World Health Organization (WHO) shall be used as a guide.

A documented risk assessment may include an identification of the relevant environmental impacts and risks to workers' health, of off-farm impacts on water sources, or of on-farm water use. This includes risks concerning the potential contamination of water (water quality) as well as the overuse of water (water quantity).

For this purpose, it is important to assess the way in which water is used and to identify any activities that could result in the inefficient and wasteful use of water, as well as opportunities for more efficient water use. Issues such as overirrigation and the use of wastewater for irrigation shall be addressed.

Farm water sources and distribution systems may be described to help identify potential sources and opportunities for contamination. The risk assessment will provide guidance on how to best

manage possible direct and indirect sources of contamination. The risk assessment shall be reviewed, updated, and approved annually by farm management and shall be farm-specific.

12.4.3 Water source

The risk assessment may address the water sources on and surrounding the farm and the specific use of the water.

- Describe the sources and distribution systems of water used on the farm.
- Identify which sources of water are under pressure or considered critical by stakeholders.
- Describe any natural or man-made water bodies on the farm.
- Determine whether the water source contains nitrogen and phosphorus, and consider these amounts, if significant, in fertilization programs.
- Determine whether the water source contains debris and/or sediment.
- Identify any national legislation stipulating maximum allowed residue levels of PPPs, nitrogen, and/or phosphorus in groundwater and surface water.

12.4.4 Permits and licenses

- Determine whether permits or licenses are needed to abstract and store groundwater or surface water.
- Quantities of water within legal limitations: Determine whether local authorities or irrigation schemes to which the producer belongs have set any water use restrictions.
- Permits for all installations: Determine whether permits are needed for wells, pumping stations, storage basins, and/or distribution systems.

12.4.5 Water use

- Identify all uses of water on the farm.
- Identify activities that could result in wastage and overuse of water (e.g., leakage from water distribution systems, poorly maintained irrigation equipment, inefficient irrigation).

12.4.6 Water quality

- Determine whether the use of water could result in runoff containing PPPs, nutrients, and/or hazardous contaminants.
- Identify locations where upstream contamination of water bodies and runoff could occur, for example due to sewage, animal farms, the use of organic or inorganic manure, or similar factors (e.g., where there is close proximity to water or where land is steep).
- Identify activities that could be potential sources of contamination of water bodies (streams, ponds, etc.) and water sources. This includes the disposal of wastewater, spray-tank washings and leftovers as well as the use of agrochemicals (pesticides, organic/inorganic fertilizers).
- Identify locations where wastewater and spray-tank leftovers are disposed of and these locations' proximity to water sources.
- Identify locations where the use of PPPs could contaminate water bodies and sources through runoff or spray drift.

- Identify sites that have been subject to flooding, as typically crops from flooded areas may not be suitable for harvest for fresh consumption. Where appropriate, there shall be an interval between floodwater receding and planting.
- Determine whether the use of water could result in product contamination (e.g., through water being recycled for washing of product or water being used for frost prevention or hydrocooling).
- Identify the type of crop and whether water makes contact with the harvestable part of the crop.
- Identify water sources used for creation of ice that is used during postharvest handling.

12.4.7 Water management plan (in combination with the guideline on mitigating microbial risks)

A written on-farm water management plan will help identify practices that may need to be changed or optimized to improve overall on-farm water use and water quality management. Such a plan can be better implemented if approved by the farm manager.

An on-farm water management plan can provide a description of which measures are in place or will be put into place. These measures address the efficient use of water resources as well as the prevention of contamination of water bodies. The plan can be formulated based on the risk assessment. It can include factors to mitigate the risks identified in the risk assessment and include training for producers and workers to ensure proper implementation.

Short and long-term plans for improvement, with timescales where appropriate, shall be included. This plan can either be an individual plan or a regional activity that the farm may be participating in or be covered by such activities.

12.4.7.1 Quality of water used pre- and postharvest

Once the hazards on the farm have been identified and mitigation measures taken, producers are expected to conduct a risk assessment for their use of water during preharvest activities. A testing program to verify that microbiological quality of water is acceptable and consistent may be required or advisable depending on the type of crops and hazards identified. *Escherichia coli* is widely recognized as an indicator of fecal contamination.

IFA for fruit and vegetables requires a minimum water-testing regime of one sample per certification cycle or more, based upon the assessed risk and prevailing regulations. Water analysis shall always be carried out at a frequency according to the results of the risk assessment, with documented actions taken in response to the results of the analysis.

It is important to remember that periodic water testing by itself cannot prove that the water quality is always acceptable. Therefore, good practices shall always be in place to manage the risks associated with water quality. Water testing can provide reassurance that the source is adequate, the variability of water quality is understood, and good practices for maintaining water quality are effective.

If microbial analysis is to be made, samples shall be taken at the exit point of the irrigation system or the nearest practical sampling point. Where a producer meets specific requirements such as those of a particular customer, the producer shall be able to show that these requirements are at least as demanding as those required by the standard.

At least one analysis per season or certification cycle is required for water used for postharvest treatment that comes into contact with the product. For such analysis, the sample shall be taken as near the point of application as possible. A minimum of one analysis is required even when using municipal water sources. This requirement applies, for example, if water is used for washing, transfer, or cooling during the postharvest handling process.

Type of crop

- Avoid irrigation water directly contacting the harvestable part of the crop.
- If PPPs or fertilizers come into direct contact with the harvestable part of the crop, avoid using irrigation water for application of PPPs or fertilizers.
- For irrigation of crops where the harvestable parts are in contact with water, consider using water treated with disinfectant, if allowed by local regulations.
- Sample the water according to an established schedule and review microbial water quality analysis results, taking mitigating actions when appropriate.

Water from wells

- Wells shall be closed and covered.
- Pipes and pumps shall be closed and maintained.

Water from open channels

- Regularly inspect channels and conduction systems.
- Prevent the presence of animals (domestic and/or wild) in water channels. If necessary, use fences or other methods to prevent animals from entering water sources.
- Do not use water channels or conduction systems for washing equipment, harvest tools, etc.
- Keep water channels separate from sanitary facilities.
- Use drip irrigation or variable rate sprinkler technology (if feasible for the crop).
- Train workers to ensure sewage never enters the water stream.

Water sources with potential contamination with fecal matter (via presence of animals or use of animal manure)

- Avoid using water from rivers if animals graze upstream.
- In the case of ponds, use fences or other methods to prevent animals from entering.
- If water comes into contact with the harvestable portion of the crop, consider using water treated with disinfectant if permitted by prevailing regulations.
- Monitor and record the presence of excessive natural fauna near water sources.
- Consider the risk posed by storms, which could cause the overloading of a sewage treatment plant into the water source.
- Store and protect manure so as to prevent its leaching into water sources.
- Inspect all water sources at regular intervals to detect hazards.

Untreated sewage:

- The plan shall take note of the fact that untreated sewage shall not be used for fertigation or irrigation.

No water from a mains (or municipal) supply

- Design, construct, and maintain your water source to prevent potential contamination.
- Consider treating the water.

Recirculation of water in equipment

- Consider treating water using a method or antimicrobial treatment permitted by prevailing regulations and in accordance with the chemical label.
- Consider frequencies at which water is changed.

Records and controls in water used at postharvest level

- Monitor treated water at a frequency that ensures the desired water quality is maintained.
- Maintain and regularly verify records of water treatments (i.e., antimicrobial agents).
- Clearly establish and comply with an appropriate frequency of monitoring and corrective actions.

Cleaning of tanks, pipes, and pumps used for washing

- Regularly clean equipment and keep it dry until its next use.
- Ensure and record a daily evaluation of the cleanliness of the equipment by a supervisor.
- Maintain records of cleanliness and sanitation.
- Sanitize equipment according to a risk assessment considering the type of crop, equipment, water source, etc.

Use and storage of ice for use during postharvest handling

- Source ice from known suppliers only.
- Require suppliers of ice to demonstrate that it has been produced with water of appropriate quality (microbial standard for drinking water).
- Obtain ice produced from water sources that meet the microbial standard for drinking water.
- Handle ice under sanitary conditions to prevent contamination.
- Store ice inside a covered tank or similar structure to avoid accidental contamination.
- Prevent ice from coming into contact with soil or other potential contamination sources.
- Keep all tools used to handle or distribute the ice clean and store them appropriately.
- To create or maintain ice, never use water that does not meet the microbial standard for drinking water.

12.4.7.2 Sustainable soil and crop management practices

- Implement practices such as conservation agriculture, mulching, controlled traffic, crop rotation and planting of cover crops. These can reduce agricultural runoff and thus possible contamination of surface water bodies.
- Raise the soil's organic matter content.
- Choose crop varieties that use water optimally (perhaps with specific features to optimize water use).

Losses

- Prevent water loss in the irrigation system
- Prevent leaks through effective maintenance of the irrigation system.
- Use well-designed basins, pipes, and pumps to avoid losses.

Evaporative losses

- Prevent substantial evaporative losses in the irrigation.
- Attempt to avoid such losses by measuring or estimating them.

Irrigation interval

- Ensure irrigation intervals are managed to ensure efficiency.
- Consider precipitation events and the soil moisture content to calculate the required irrigation interval and irrigation application rate.
- Be flexible and reactive in adjusting the irrigation interval according to changing crop water requirements.

Pressure management in hydrants

- In the case of pressurized irrigation systems (i.e., sprinkler and drip irrigation systems), ensure the correct pressure is maintained in all hydrants and on all plots to optimize the distribution of irrigation and thus avoid too much or too little irrigation.

Downstream shortages

- Consider whether the use of water by the farm could cause water shortages downstream.

It is recommended to include the following aspects in the on-farm water management plan:

a) Measure the water use for all on-farm water abstraction and distribution infrastructure, such as:
   - All groundwater wells used for irrigation (m^3/month, m^3/year)
   - All intakes from streams or ditches (m^3/month, m^3/year)
   - All irrigation infrastructures, such as water distribution pipes or channels
   - Main, secondary, and tertiary irrigation channels and gates in the case of surface irrigation water pumps (capacity m^3/ha)
   - All hydrants in the case of a pressurized irrigation system
   - All reservoirs either used for irrigation or used to capture precipitation
   - All water-harvesting constructions

b) Make a map of all fixed constructions on the farm. The map may also include larger water bodies outside the farm if any are close to the fields.

c) Identify instances where the distribution of water is centrally managed. This may include water distribution through associations or governmental organizations. Identify production areas irrigated by private wells or by pumping from adjacent waterways.

d) Include data on crops and water use: Measure/Estimate how much water has been applied on the field (m3/ha/month/crop, m3/ha/year/crop). Review and explain the methods used to calculate this.

e) If possible and relevant to the irrigation method used (e.g., drip irrigation systems, etc.), include irrigation system efficiency data, such as the conveyance, which will help in assessing and improving the efficiency of the irrigation infrastructure. Conveyance is the efficiency of water transport in irrigation canals or through irrigation pipes. This efficiency is a function of canal/pipe length, canal characteristics (e.g., earthen or lined canals), soil type, and system maintenance and can be determined using widely available estimation tables (measured in percentage) and application efficiencies (the volume of water added to the root zone divided by the volume of water applied to the field (measured in percentage).

f) Indicate how crop water requirements are calculated. Also include the irrigation intervals and length of irrigation cycles. Optimal intervals and cycle lengths shall be maintained. For example, in the case of furrow-irrigated fields, surge flow can significantly improve irrigation uniformity and beneficial uptake of the water by crops. Temperature can also trigger differences in intervals (e.g., lower temperatures allow longer intervals and thus a reduced need for crop evapotranspiration).

g) Maintenance: It is important to have a plan in place for the maintenance of the irrigation system and of farm machinery:

- Indicate how often the fixed water abstraction and distribution infrastructure are maintained and/or repaired and who is responsible for maintenance/repairs.
- Address whether there is proper pressure management for optimal design flow through the drip and sprinkler irrigation systems.
- There shall be a plan in place in case emergency maintenance is required.
- The persons who carry out the maintenance shall be properly trained to do so.
- Maintenance records shall be available and include a description of the repairs, the name(s) of the individual(s) who completed the repairs, and the date.

h) Surface irrigation systems: Address whether the design of surface irrigation systems makes optimal use of gravity to minimize the use of pumps and consequent energy use.

i) Direct and indirect sources of contamination: Outline any measures put in place to mitigate the risks related to direct and indirect sources of water contamination identified in the risk assessment. The plan needs to address issues such as potential spillage from the PPP mixing area and the sprayer loading and cleaning area, as well as contamination due to agricultural runoff, leaching, and/or drainage.

j) Fertigation and/or chemigation: If fertigation and/or chemigation activities are maintained, outline the details of the process (e.g., amounts applied, whether drip irrigation systems are used for fertigation/chemigation, etc.). Measures to mitigate any risks of contamination of water bodies and/or sources identified in the risk assessment shall also be outlined (e.g., avoiding applications on or near water, especially on sloping land; use of runoff-reducing techniques such as contour planting).

k) Climate data: Add information concerning the precipitation and temperature and, if available, the reference evapotranspiration throughout the year to make informed decisions on irrigated agriculture. Indicate whether this information is easily accessible.

l) Training: Assess who needs training and in which topics. Drafting/Implementing a comprehensive water management plan may require training on matters including logbooks and record keeping. Producers, technicians, and farm workers may also need basic training in on-farm water quality management; the management, maintenance, and operation of irrigation systems; and water quantity management. Producers, technicians, and farm workers shall be aware of the water management plan and its goals.

Basic training on the following is recommended to assist the farm in implementing good water management practices:

- The control of water quality
- Safe use of pesticides on the farm and how to handle the sprayer and spray solutions/remnants
- Management of the soil to maintain soil organic matter, improve infiltration capacity, improve soil water retention, and prevent erosion
- Calculating the crop water requirements to make informed decisions about when to irrigate, what the irrigation interval shall be, whether deficit irrigation can be applied in times of need, etc.

m) Record keeping: The guidance on record keeping is provided under the guidelines of metrics.

n) Water use permits and licenses: Indicate all prevailing regulations and irrigation scheme rules concerning water abstraction and use. The plan shall aim to ensure that all necessary licenses and permits have been obtained, are up to date, and are complied with. It shall include details on all records that need to be kept to demonstrate how all relevant licenses, bylaws, and regulations are complied with.

o) Permits may be required for installing water storage infrastructure and for the on-farm use of the captured or stored water. For example, local water harvesting and storing of precipitation shall not impact users elsewhere in the catchment area.

12.5 Example – risks summary

How to use the table below:

- In the column “status/risk,” identify whether the related issue is applicable to the situation on the farm. The questions aim to provide guidance. Use short sentences or answer “yes/no.”
- In the column “action,” include a short sentence describing an action which can be referenced in the water management plan.

Type of risk	Issue		Status/Risk	Action
Physical	**Water scarcity**	Does the river basin or area face water scarcity due to the overexploitation of water resources? Might water scarcity affect the current or planned water usage by the producer? Does the producer contribute significantly to water scarcity in the river basin or area, or might the producer do so in future?		

Type of risk	Issue		Status/Risk	Action
	Drought events	Does the river basin or area face droughts due to irregular rainfall? Would droughts affect the producer's water use? How flexible is the farm's water use? Might droughts affect environmental, social, and/or cultural issues?		
	Flood events	Does the river basin or area face floods due to irregular rainfall or water management? Might floods affect the producer? Might this variability affect environmental, social, and/or cultural issues?		
	Water pollution	Does the river basin or area face water pollution? Are current or potential pollution sources upstream or located in the same groundwater area as the producer? Might pollution affect the product or production? Might pollution affect environmental, social, and/or cultural issues?		
	Alternative water sources	Do alternative, non-overexploited and/or nonpolluted water sources exist? Can this water be allocated to the producer on a regular basis? Can this water be allocated to the producer in extreme situations (drought, pollution, etc.)? Are there (new) storage mechanisms in order to address temporary extreme situations? What are the environmental effects of the alternative sources or water storage systems?		

Type of risk	Issue		Status/Risk	Action
Regulatory	**Water allocation and management scheme**	Is the river basin or area managed according to a plan or scheme? Have interested parties and the public been consulted on this plan or scheme, and has it been approved by the corresponding water authority? Is the plan being implemented and updated on a regular basis? Is the producer's water usage included in the plan or scheme? If not, is the producer's water usage consistent with the plan's allocation and management scheme? Does this plan adequately consider environmental, social, and/or cultural issues?		
	Water use permit	Is there a procedure for acquiring a water use permit? Does the producer hold a water use permit adequate to their actual water use? Does this permit interact with other (water use) permits?		
	Unauthorized use of water	Does the producer use any water without a corresponding permit? Do other users use water without a corresponding permit? Might such unauthorized use of water affect the producer's water use permit or the use of water? Might such unauthorized use of water affect environmental, social, and/or cultural issues?		
	Priority use	Is the use of water prioritized in the river basin or area? What is the ranking of the producer in relation to other water users? Are specific regulations foreseen for extreme situations (drought, pollution, etc.)? In trend scenarios of priority water users and extreme situations, is the producer's water use at risk? Can the permit be derogated in order to supply water to priority water users?		

Type of risk	Issue		Status/Risk	Action
Reputational	**Water conflict**	Does the river basin or groundwater area cross national, regional, local, or cultural/ethnic borders? Are there conflicts over water in the river basin or area? What are the reasons for these conflicts? Are these conflicts addressed by conflict-resolution dialogue processes? Is the producer involved in water conflicts in this particular area or in any other geographical area in which the producer operates? Are similar water users involved in water conflicts in the river basin or area or adjacent areas?		
	Environmental issues	What is the current situation of the freshwater environment in the river basin or area? What are the environmental and biodiversity trends for the river basin or area? Might these environmental trends negatively affect the farm's operations? Does the farm's water use significantly impact, directly or indirectly, key environmental or biodiversity features? Has the producer developed a (public) environmental statement and/or plan? Does this plan respond to any water-related environmental conflicts or concerns that have arisen? Is this plan implemented, audited, and updated on a regular basis?		

Type of risk	Issue		Status/Risk	Action
	Social issues	What is the current social situation regarding water issues (access to drinking water and adequate sanitation, etc.) in the river basin or area? What are the social trends for those aspects? Might social requirements or claims negatively affect the farm's operations? Does the farm's water use significantly impact, directly or indirectly, access to drinking water and sanitation for the inhabitants of the river basin or area? Has the producer developed a (public) statement and/or plan in this regard? Does this plan respond to any conflicts or concerns that have arisen on the water usage? Is this plan implemented, audited, and updated on a regular basis? Is this plan publicly accessible?		
	Cultural issues	What are the key cultural issues related to water in the river basin or area? What has been their evolution? Might cultural trends, requirements, or claims negatively affect the farm's operations? Does the farm's water use significantly impact, directly or indirectly, the cultural heritage of the river basin or area? Has the producer developed a (public) statement and/or plan in this regard? Does this plan respond to any conflicts or concerns that have arisen on the water usage? Is this plan implemented, audited, and updated on a regular basis?		

Type of risk	Issue		Status/Risk	Action
	Farm's water management	Is water on the farm managed according to a plan? Does this plan include keeping records of historical, current, and future use of water? Does this plan include provisions for the sustainable and efficient use of water? Does this plan respond to any conflicts or concerns that have arisen regarding the farm's water management? Is this plan implemented, audited, and updated on a regular basis?		
Financial	**Financing**	Does the producer require regular or irregular external financing? Do the (current and potential) investors consider water-related criteria in their funding evaluation? Are there any specific aspects (e.g., water management plan, water use permits) required by the investors? Do the investors establish thresholds for compliance with their water-related criteria?		
	Insurance	Has the producer insured their operations? Do the (current and potential) insurance operators consider water-related criteria in their evaluation? Are there any specific aspects (e.g., water management plan, water use permits) required by the insurance operators? Do the insurance operators establish risk thresholds for compliance with their water-related criteria?		
	Water pricing	Does the producer pay for water use? How is this price/tax/tariff fixed? Does it include operational costs and (environmental) externalities? Is the pricing system stable, foreseeable, and transparent? How likely is it that water prices will be increased on a regular or irregular basis?		

13 INTEGRATED PEST MANAGEMENT – DEVELOPMENT/RETENTION OF BASIC KNOWLEDGE

To be successful with IPM, it is important to have a basic knowledge of:

- The key pests, diseases, and weeds that can affect a crop
- The potential strategies, methods, and products to control them

For this purpose, producers shall gather information on:

a) Pests, diseases, and weeds relevant to their production. Producers shall have the following basic information: List of relevant pests, diseases, and weeds in the target crop for that specific area, region, or country. A pest is considered relevant once it has a significant effect on a registered or relevant crop. Relevance to a particular crop can be based on one or more of the following:

   - When a crop occupies a significant area
   - When the pest management costs of the crops are significant
   - When the crop value is significant

   Basic information (e.g., fact sheets) about the biology of the relevant pests, diseases, and weeds and about their natural enemies, including:

   - Information about their life cycle
     - Different life stages and their approximate dates of appearance
   - Development requirements (minimum temperature threshold for development, number of flights per season, season of the year when they attack or develop, etc.)
     - Overwintering places (in the case of pests)
   - Photo guides to relevant pests (different stages), diseases, and weeds and their typical damage
   - Photo guides to relevant natural enemies (different stages)
   - Economic injury levels and action thresholds
   - Knowledge about organisms that have a quarantine status in target/export markets

b) Plant protection products. Producers shall have the following basic information: List of plant protection products (PPPs) that can be legally applied against the relevant pests, diseases, and weeds in the target crop. Basic information (fact sheets) about:

   - Mode of action
   - Contact route (systemic, translaminar, vapor activity, contact, stomach)
   - Dose rates
   - Maximum residue levels (in own country and in target/export countries)
   - Persistence
     - Re-entry (interval) time
     - Preharvest interval
   - Optimal application technique
   - Optimal timing of application
   - Maximum number of applications per season
   - Selectivity for natural enemies and for pollinators

c) Other protection methods. Similar information shall be available for other protection methods.

d) Training. Training of relevant workers (own workers or specialized consultant) in the following topics:

- IPM principles, techniques, methods, and strategies
- Recognition of pests, diseases, weeds, and relevant natural enemies
- Scouting and monitoring techniques, including record keeping
- Knowledge about PPPs and application techniques

13.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

13.2 National interpretation

Local legislation or industry-specific information may be added to a national interpretation guideline.

13.3 References

Fundación para el Desarrollo Frutícola, 2004, Guía para el Monitoreo de Plagas. 2nd ed. Santiago de Chile. 50 pp.

IOBC-OILB, 2004, Guidelines for Integrated Production: Principles and Technical Guidelines. 3rd ed. Switzerland.

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FAO, 2002, International Code of Conduct on the Distribution and Use of Pesticides.

EISA, Code on Integrated Farming

14 INTEGRATED PEST MANAGEMENT PLAN

The IPM plan is a document in which the producer lists/describes the strategies they plan to use, or already use, to manage the relevant pests, diseases, and/or weeds for each specific crop (individually or per group of crops).

The document can, for example, be organized around a specific crop (or group of crops), describing for this crop the following:

- Relevant pests, diseases, and/or weeds
- Intended strategies for dealing with the pests, diseases, and/or weeds (listed, or ideally also briefly described)
- Possible interactions between strategies (e.g., the use of plant protection products (PPPs) may affect a natural enemy)

Strategies may include monitoring activities (identify), a threshold (if applicable), and/or preventative and control measures.

A pest, disease, or weed is considered relevant if it needs to be managed (costly to control).

The following can be included:

- A stepwise approach to managing pests
    - Preventive measures, including the planning phase of the crop, and hygiene measures to avoid spread of pests, diseases, or weeds
    - Successive measures compatible with introduced natural enemies, if applicable
    - Between each step or strategy, thresholds as defined by the producer based on own experience, external advice, or training
    - Introduction of the use of more toxic or less compatible PPPs if and only if the previously mentioned thresholds are passed

Note: By default, the order of the strategies in the stepwise approach is expected to follow the above-described gradual increase of measures; however, it is up to the producer/advisor to judge whether the situation requires, e.g., the initial use of a PPP to make manageable the growth conditions of the crop, and aim to re-establish the path of a stepwise approach as described above.

- Growing conditions which could promote the development of the relevant pests, diseases, and/or weeds
- Measures to avoid the build-up of resistance to PPPs in the relevant pests, pathogens, diseases, and/or weeds

Producers shall critically evaluate, at least every year, their current crop protection practices and systematically evaluate the potential outcome of different IPM practices for their crop.

14.1 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

14.2 National interpretation

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15 INTEGRATED PEST MANAGEMENT – PREVENTATIVE MEASURES

Efforts shall be made to mitigate problems with pests, diseases, and/or weeds to avoid the need for intervention. This includes the adoption of cultivation techniques and management actions at farm level to prevent the incidence and reduce the intensity of pests, diseases, and weeds. In the case of some chronic pests (see reference below), this may include preventative pest management options, including spraying or seed treatments.

15.1 Potential integrated pest management (IPM) measures before planting

15.1.1 Risk assessment

Make a risk assessment of the site

15.1.1.1 History of the site

- Which crops have been grown on this site in the last three years?
- What were the main problems with pests, diseases, and/or weeds on this site?
- Which plant protection products (PPPs) were used?
- Has the PPP use
    - created problems with residues on your crop (e.g., because of pesticide accumulation in the soil)?
    - caused pest or disease outbreaks during the following cropping season (e.g., because pests' natural enemies were exterminated in perennial crops such as trees and vines)?

15.1.1.2 Context of the site

- What are the IPM practices on neighboring crops?
- What PPPs are used on neighboring crops, and what is the risk of drift?
- What potential pest or disease problems could be created by surrounding crops and vegetation?

15.1.1.3 Soil and water samples

Take and analyze soil and water samples to check for:

- Presence of diseases and pests (including nematodes)
- If relevant, presence of PPP residues, heavy metals, and/or other toxins
- The nutritional level of the soil

15.1.2 Prevention

Where relevant, the following preventive measures shall be considered for new sites:

15.1.2.1 Soil

For the prevention of (soil) pests, nematodes, (root) diseases, and weeds, the following measures can be taken:

- Crop rotation according to a crop rotation program and depending on the crop
- Year of rest/fallow, depending on the crop
- Disinfection of the soil or of the growing substrate (e.g., solarization, fumigation, inundation, steaming, hot water)
- Promotion and/or augmentation of beneficial macrobial and microbial soil organisms
- Clean tillage or sanitation of crop residues (including fruits in the case of tree crops) to reduce overwintering populations of certain pests or diseases

15.1.2.2 Water

Preventive measures shall be taken to ensure:

- Clean water (meeting local regulations about pests, diseases, and chemical residues or reducing their content, if applicable)
- Optimal irrigation methods and/or use of fertigation

15.1.2.3 Plants

Preventive measures that can be taken to reduce problems with pests, nematodes, and diseases include:

- Choice of optimal, resistant varieties
- Use of resistant rootstock (grafting)
- Use of pest- and disease-free starting material (seeds or plants), possibly by testing for pests and pathogens in the rhizosphere
- Optimal plant spacing or plant density

15.1.2.4 Climate

Climatic conditions can have a big influence on the development of diseases, as well as on pests and weeds. Therefore, consider:

- Cultural measures to prevent or reduce the development of pests and/or diseases
- The establishment of a climatological monitoring station or subscription to an information or warning service

15.1.2.5 Timing

With respect to the (first) appearance of key pests, diseases, and weeds during the cropping season, consider:

- The choice of an optimal planting date to reduce or avoid problems with key pest, diseases, and weeds
- The choice of early-maturing or short-season varieties to avoid periods with high infestation pressure from certain pests or diseases

15.1.2.6 Location and site selection

Assess risks from neighboring crops as potential source of especially problematic harmful pests or diseases.

15.2 Potential preventive measures during cropping

Cleanliness of the farm (hygiene and sanitation)

Hygienic measures are aimed at preventing pest, diseases, and weeds from entering the field and from further spreading or dispersing in the crop.

Prevent transmission of pests, diseases, and weeds by *vectors* by:

- Identifying vectors, such as insects, animals, pets, rodents
- Identifying actions to keep these vectors out of the crop
- Identifying whether weeds in the borders or adjacent areas might be hosting pests

Prevent transmission of pests, diseases, and weeds by *people* by:

- Working from healthy to diseased plants and areas
- Wearing suitable clothing, gloves, shoes, hairnets (depending on the crop)
- Disinfecting hands, shoes, clothes before entering the field, especially after visiting other producers' plots (depending on the crop)

Prevent transmission of pests, diseases, and weeds by *equipment* or materials by:

- Cleaning all equipment (including machines) and materials after working and before entering a new field
- Using different, dedicated equipment and materials in different fields (if possible) depending on the crops
- Using clean harvesting boxes and crates

Prevent transmission of pests, diseases, and weeds through crop residues by:

- Cleaning the orchard after pruning, harvest, leaf-picking and any other task that produces organic residues
- Not keeping any crop residues near the field

Prevent drift of PPPs from neighboring plots by:

- Making agreements and communicating with neighboring producers to eliminate the risk of undesired drift

15.3 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

15.4 National interpretation

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16 INTEGRATED PEST MANAGEMENT – MONITORING, SCOUTING, AND DECISION-MAKING

Monitoring is the systematic inspection of the crop and its surroundings for the presence, developmental stage (eggs, larvae, etc.), intensity (population level, infestation level), and location of pests, diseases, and weeds.

It is one of the most critical activities of integrated pest management (IPM), as it will alert the producer to the presence and level of pests, diseases, and weeds in the crop. This will allow the producer to choose the most appropriate intervention.

Monitoring and decision support tools are major instruments for reducing the number of interventions with chemical plant protection products (PPPs). As such, these instruments are fundamental for a reliable and sustainable IPM plan. Monitoring is preferably used in combination with the decision support tools.

16.1 Organization

16.1.1 Responsible person

- Nominate a person responsible for scouting and monitoring.
- This person shall receive training in:
  - Recognizing pests, diseases, and weeds
  - Scouting and monitoring techniques
  - Record keeping
- This training shall be refreshed on a regular basis.

16.1.2 Observation

Organize a monitoring and scouting program for the farm:

- Identify which pests, diseases, and/or weeds shall be monitored and why.
- Establish how they shall be monitored (direct observation in the crop on key plant parts, traps, indicator plants, etc.).

- Establish during which period of the year and at which life stages of the pest monitoring shall occur.
- Participate in existing area-wide monitoring/warning systems.
- Identify the monitoring frequency.
- Establish the area that constitutes a monitoring unit.
- Establish the amount of sampling points per unit area.

16.1.3 Record keeping

- Establish record sheets (computer- or paper-based) which can include the following information:
    - Identification of the plot and crop being monitored
    - Name of the monitor
    - Date of monitoring
    - Name of the pest, disease, or weed being monitored
    - Number of samples
    - Number of findings
    - Life-cycle stage of the findings (in the case of pests)
    - Comparison with thresholds
    - Location inside the plot
    - Decision taken
- Record sheets shall be archived in order to allow comparison of records from different years and different plots.

16.1.4 Warning systems and decision support tools

- Use of predictive models and decision support systems (e.g., temperature-driven phenological computer models, degree-day models) in combination with information from monitoring and weather forecasts
- Use of area-wide warning systems
- Other type of forecast-supporting information, such as historical graphs (trends) on pest incidence, quality reports, client complaints, productivity losses

16.1.5 Evaluation/Decision-making

- Use action thresholds for the relevant pests, diseases, and/or weeds to decide whether an intervention is needed.
- Document the decisions that were taken to perform a certain intervention.
- Review records at the end of the season, draw conclusions, and plan adaptations of the IPM plan for the following season.

16.2 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

16.3 National interpretation

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17 INTEGRATED PEST MANAGEMENT – INTERVENTION

Different IPM techniques can be used when monitoring results indicate that at least one action threshold has been reached and that intervention is required to prevent economic impacts on the crop's value or the spread of the disease/pest to other crops.

Within an IPM plan, priority is given to nonchemical methods that reduce the risk to people and the environment if these methods effectively control pests, diseases, and weeds.

These methods may be mostly preventative.

In cases where chemical plant protection products (PPPs) are considered, selective PPPs shall be compatible with an IPM approach (i.e., consider whether natural enemies can be used). The selection of IPM-compatible PPPs is especially important at the beginning of a season, and the products shall be applied selectively.

17.1 Cultural and technical measures

17.1.1 Optimal crop care (fertilization, irrigation, etc.)

Too much fertilization and too little fertilization can be equally detrimental to pest management because overfertilization can result in free amino acids in the phloem and xylem, increasing the breeding potential of pests such as aphids. Optimal crop care results in a healthier crop, which is better able to resist pests and disease attacks.

17.1.2 Canopy management and micro-climate

Cultural measures, such as pruning, canopy management, and leaf picking, can be used to assure an optimal micro-climate (humidity, temperature, light, air) and prevent or reduce the development of pests and diseases.

17.1.3 Cropping systems

Different cropping systems can be used to prevent or reduce problems with pests, diseases, and weeds:

- Covering crops to prevent weeds and to stimulate natural enemies
- Special types of cropping systems (e.g., mixed crops, strip cropping, strip harvesting, and permaculture)
- Other practices related to the cropping system (e.g., fallow field margins to prevent intrusion of pests such as slugs and snails)

17.1.4 Exclusion techniques (in protected crops)

Especially in protected crops, different techniques can be used to exclude harmful pests from the crop, such as air locks, double-entry doors, and insect-proof netting or UV-cut foils in plastic tunnels to reduce immigration of certain pests.

17.1.5 Mulching

In certain circumstances, mulches (plastic mulches, reflective mulches, straw mulches, etc.) can help minimize problems with certain pests, diseases, and weeds.

17.1.6 Other technical measures

- Analysis of which other preventive technical measures could be undertaken
- Prevention of mechanical plant and product damage
- Evaluation of mechanical and physical techniques to kill or remove harmful pests, diseases, and weeds. Such techniques may include:
    - Pests:
        - Rouging and isolating infested leaves, fruits, or plants (sanitation)
        - Vacuuming of pests (e.g., *Lygus* spp.)
    - Diseases:
        - Rouging and isolating damaged and infected leaves, fruits, or plants (sanitation)
    - Weeds:
        - Mowing
        - Hand removal of weeds
        - Mechanical weeding

17.2 Conservation biological control

17.2.1 Measures to increase populations of natural enemies and pollinators in and around the crop

- Use of different cropping systems: strip cropping, strip harvesting, mixed crops, permaculture, etc.
- Use of border crops (including hedgerows): pollen-producing plants, nectar-producing plants, plants that harbor alternative hosts for natural enemies (banker plants)
- Use cover crops inside the field: pollen-producing plants, nectar-producing plants, banker plants
- Use of attractants for natural enemies
- Providing hiding and nesting places for natural enemies and pollinators
- Use of selective chemicals, selective placement and/or timing of sprays where and when chemical control is necessary
- Use of push-pull technology: attract and kill, use of repellents
- Providing nesting places for predatory birds to control rodents

17.2.2 Measures to prevent population reduction of natural enemies through PPP use

- Use of selective PPPs that are compatible with natural enemies
- Use of selective application techniques: seed treatments, spot treatments, soil application of systemic products, etc.

17.2.3 Other semiochemicals

Semiochemicals can be used in different ways to control pests:

- Attract and kill (also known as lure-and-kill):
  - Mass-trapping with semiochemicals
  - Trap crops
  - Bait-spraying techniques
- Chemosterilization (possible alternative to the sterile insect technique listed below): attracting the males of a wild population of a pest to bait that is laced with a chemosterilant
- Repellents
- Mating disruption (mating confusion)

17.2.4 Augmentative biological control

Different natural enemies and microbial products can be released or applied to manage populations of pests and diseases:

- Seasonal inoculative or inundative applications of mass-reared natural enemies to control harmful insects and mites
- Use of insect-pathogenic viruses (nuclear polyhedrosis virus (NPV) or baculoviruses), fungi, bacteria, or nematodes to control harmful insects and mites
- Use of antagonistic fungi and bacteria to control root and leaf diseases

17.2.5 Sterile insect technique

This area-wide technique is successfully used in many regions of the world to manage populations by frequently releasing mass-reared sterile insects of the target pest.

17.2.6 Use of natural products

Different natural products can be used, provided they are compatible with the IPM plan.

- Oils (mineral oils and vegetable oils)
- Botanicals (e.g., natural pyrethrum, azadirachtin, etc.)
- Soaps
- Diatomaceous earth
- Others

17.3 Chemical PPPs

If an intervention with a chemical PPP is needed, consider the following:

17.3.1 Decision-making

The following information supports optimal decision-making on timing and targeting:

- Application timing which maximizes the effect on the target pest, disease, or weed
- Information about the re-entry interval
- Information about the correct application frequency
- A weather forecast with information about:
    - Wind and temperature conditions to avoid problems during the applications
    - The possibility of rain during the post-intervention period (not applicable for greenhouses)
- The use of predictive models and field observations to determine whether the pest is in a sensitive stage of its life cycle

17.3.2 Action threshold

Where feasible, the action threshold for the relevant pests, diseases, and weeds can be documented.

17.3.3 Product selection

- Before application of a chemical PPP, identification of the goal – total cleanup, spot treatments, population correction, compatibility with natural enemies, etc. – and selection of a product according to the goal
- In the case of tank mixes, identification of any known negative cocktail effects that shall be avoided

17.3.4 Anti-resistance management

Development of resistance to chemical PPPs reduces the number of available PPPs and often leads to more frequent application of higher doses. It is important to have in place an anti-resistance management plan to prevent pests/diseases/weeds from developing resistance to chemical PPPs. For additional details, see the separate guideline on this topic.

17.3.5 Application

Optimal application of chemical PPPs can drastically reduce PPP use while maximizing the effect of an application.

- Identification and use of the optimal spraying equipment (including type and size of nozzles) and technique:
  - Pressure
  - Amount of water
  - Water pH, if relevant to the PPP
  - Use of adjuvants (effective stickers and spreaders)
- Periodic calibration of the spraying equipment
- Use of application techniques that are selective for natural enemies such as:
  - Electrostatic applications with lower rates
  - Spot treatments
  - Strip applications
  - Treatment of only a part of the plants
  - Timing of applications when the natural enemy or enemies are not active in the crop
  - Bait spraying
  - Use of bait and traps
- Nomination of a person who is responsible for the application of PPPs and will:
  - Receive periodic training in chemical PPP application
  - Have knowledge in calibration of the equipment

17.4 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

17.5 National interpretation

Local legislation or industry-specific information may be added to a national interpretation guideline.

17.6 References

Fundación para el Desarrollo Frutícola, 2004, Guía para el Monitoreo de Plagas. 2nd ed. Santiago de Chile. 50 pp.

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18 INTEGRATED PEST MANAGEMENT – ANTI-RESISTANCE

18.1 Anti-Resistance Management

Development of resistance to chemical plant protection products(PPPs):

- Reduces the number of available PPPs
- Often leads to more frequent application of higher doses, increasing the risk of exceeding the maximum residue limit (MRL).

Therefore, it is very important to have in place an anti-resistance management plan to prevent pests/diseases/weeds from developing resistance to chemical PPPs.

PPPs shall be used as part of an anti-resistance management strategy. The resistance management strategy shall consider the holistic approach of integrated pest management (IPM), including the following points:

- Monitor and know the life cycle of pests/diseases/weeds and apply PPPs accordingly.
- To keep pest/disease/weed pressure low, incorporate non-chemical methods for crop protection such as mechanical and biological control, planting tolerant varieties, implementing good agronomic practice, maintaining plant hygiene/sanitation, etc.

Refer to the websites of FRAC, IRAC, and HRAC (see “References”) for more specific recommendations.

18.2 Applicable legislation

Relevant (local) legislation may be referenced; together with information on which norm (GLOBALG.A.P. and/or legislation) overrules/becomes mandatory.

18.3 National interpretation

Local legislation or industry-specific information may be added to a national interpretation guideline.

18.4 References

Fungicide Resistance Action Committee (FRAC): https://www.frac.info/fungicide-resistance-management/background

Insecticide Resistance Action Committee (IRAC): https://irac-online.org/

Herbicide Resistance Action Committee (HRAC): https://www.hracglobal.com/

Fundación para el Desarrollo Frutícola. 2004, Guía para el Monitoreo de Plagas. 2nd ed. Santiago de Chile. 50 pp.

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19 PLANT PROTECTION PRODUCT EXTRAPOLATION

Registration scheme in country of use	**Safe use criteria (operator and environment)**	**Authorization of PPP for use on individual crops**
No registration scheme exists: Some control over PPP imports may be in place.	PPPs that are used shall have clear user guidance to enable the safe use of the PPP in accordance with the “International Code of Conduct on the Distribution and Use of Pesticides” of the Food and Agriculture Organization (FAO).	Extrapolated uses are permitted.
A registration scheme exists: Imported PPPs are permitted for sale with the label of the country of origin. This may be in addition to the national labels for the PPPs.	If the PPP is a direct import, it shall be provided to the user with clear guidance to enable safe use. This guidance can be in the form of label translations or notes provided by the distributor.	1. The imported PPP carries a label that matches the nationally approved label.
		2. The imported PPP carries a label that is different from the current nationally approved label. In this case, use of the PPP is permitted on only those crop(s) listed on the nationally approved label.

Registration scheme in country of use	Safe use criteria (operator and environment)	Authorization of PPP for use on individual crops
		3. The crop is not covered on the nationally approved label. Extrapolated uses are permitted if the prevailing regulations explicitly allow this practice.

Exception

Where producers participate in field trials conducted in accordance with prevailing regulation in support of regulatory approval and research of PPPs, the producer can still achieve IFA. certification, even though part of the crop will be destroyed or used for further analyses. There shall be clear traceability and information on the area (size) used for the trials. The producer shall also have available meaningful documents indicating that the producer is taking part in a legal field trial in full conformance with the legislation of the country of crop production. Furthermore, clear procedures shall exist on the management of these trials. The PPPs being tested are not allowed for use on the crop to be registered for certification, and residue testing shall show no residues of these PPPs.

20 RESIDUE TESTING AND MAXIMUM RESIDUE LIMIT EXCEEDANCE RISK ASSESSMENT

Today, consumers are used to choosing year-round from a diverse variety of fresh and processed food products of high quality at affordable prices. To satisfy this demand, in many cases crops may have to be protected during growth against pests and diseases by applying PPPs according to the principle, “as little as possible, as much as necessary.”

Legally applicable MRLs are set in order to have a set of standards on PPP residues on food and feed, to enable trade in food commodities to take place, to check compliance with G.A.P., and to ensure that human health is protected.

It is in the interest of all persons working in primary agricultural production and the food chain, including GLOBALG.A.P., to ensure that practical measures are taken to ensure compliance with these trading standards. For GLOBALG.A.P., a key tool is the GLOBALG.A.P. standards and their correct implementation.

However, despite many due diligence measures in place at producer level, it is not always possible to achieve 100% compliance with MRLs; yet it is the responsibility of all in the food production chain to avoid exceedances of MRLs.

In order to deliver improved compliance with GLOBALG.A.P. standards, producers shall assess the risk associated with use of PPPs. This document provides examples of how MRL exceedances can occur so that producers can modify their on-farm production procedures during production.

20.1 Key reasons why MRL exceedances may occur

- Non-compliance with G.A.P. and label instructions, including improper or illegal use of PPPs
- No proper quality assurance standard applied to check production methods
- Differences in MRLs between the country of production and country of destination, and other legal challenges in the application and communication of MRLs, such as occasional changes to MRLs midway through the growing season, which fail to allow a producer to change his G.A.P. to ensure the final product complies with the modified MRL
- Exceptional circumstances in which abnormal crop conditions or climatic/agronomic conditions are experienced

20.2 Requirements for destination markets

- Evidence of the list of the currently applicable MRLs for the country, countries, or region in which the product is intended to be traded (even if it is the country of production itself) shall be available, or any other documentation that shows that the producer (or his direct customer) has incorporated this information.
- The producer can present letters or other verifiable evidence to show communication with clients. These can be present or future clients.
- As an alternative to 2., for example where the producer does not yet know with whom trading will take place, the producer can participate in a residue screening system that meets the strictest MRLs (or import tolerances if they exist and are different) in the country, countries, or region in which the product is intended to be traded. Where there is a harmonized MRL for that region, it shall be conformed to. If the producer sells the product on the market of the country of production, the currently applicable (national) MRL list shall still be available as in 1. above.
- Internal segregation and traceability of products from certified production processes is needed if trying to meet MRLs of different markets for different batches of product (e.g., simultaneous production for US, EU, country of production).
- This principle and the relevant criteria shall be cross-referenced with the information given at the registration of the producer and any updates sent to the certification body (CB) since registration. For example, the producer shall verify that they sell their product exclusively on the market of the country of production and shall declare this at registration.
- Guidance shall be sought from plant protection product (PPP) industries/producer organizations or technically responsible advisers on how to adapt production methods (e.g., to increase the preharvest interval) that are necessary to take any stricter MRLs into account.
- If the producer sells their product exclusively on the national market of the country of production and declares this at registration, this principle and the relevant criteria are considered complied with (since legislation on good agricultural practices (G.A.P.) such as preharvest interval, dosage, etc. in the country of production covers this point already).

20.3 Sampling and testing procedures

According to a risk assessment a sampling plan is available with at least the following minimum requirements:

- The sample frequency is defined (e.g., one sample per x kg/pieces, package, or sample per week/month/year, etc.).

- A description of the analysis method (GCMS-MS, LCMS-MS, specific methods, …) is included.
- The risk assessment is done at least annually.
- The sampling plan is devised according to a risk-based procedure.
- The plan follows a standardized operating procedure for sampling based on the Codex Alimentarius or EU regulations.
- The plan includes the following considerations: cross contamination, traceability of samples (to the lab and the residue analysis results back to the sample source) process, sample/courier practices.

20.4 Laboratory requirements

- Proficiency testing is part of ISO/IEC 17025 accreditation. It is, however, important for laboratories that are in the process of accreditation to ISO/IEC 17025 or those accredited to an equivalent standard (e.g., GLP) to prove participation in proficiency testing.
- Laboratory techniques shall be able to detect to the appropriate performance limits (e.g., LOD 0.01ppm, etc.).
- Traceability of individual laboratory results back to individual samples, as well as of samples back to production batches shall be maintained.

20.5 Action plan in the event of deviations

See “GLOBALG.A.P. general regulations – Rules for individual producers,” subsection 7.4.1, “Burden of proof” for additional context.

The action plan shall include, at minimum, the following steps and shall provide a detailed account of the actions for each step:

- Verifying the traceability of the results; identifying the nature and source of the MRL exceedance
- Interpreting the laboratory results and agreeing on appropriate corrective action (must involve relevant reference group, e.g., industry experts, producers, laboratory, etc.)
- Implementing corrective actions (where required), amending of relevant controls and procedures, sanctions where required in case of an MRL exceedance.
- Communicating to relevant parties regarding an MRL exceedance (recalls/withdrawals, where required)

20.6 General information

20.6.1 Producer level (farm level)

Cases that can be controlled by producers

- Failure to observe and comply with the on-label use instructions of PPPs:
  - Application method
  - Preharvest interval
  - Handling and mixing
  - Errors in calculating concentration or spray volumes
  - Production practices (covered vs. noncovered)

- Application of nonregistered PPPs (e.g., on minor crops)
- No proper use of additives or oils
- Application of illegal PPPs or use of formulation from nonauthentic sources
- Failure to comply with general G.A.P. (e.g., cleaning of equipment, discharge of spray mixture, management practices, including water management) and preharvest interval
- Wrong delivery system, improper use of the application equipment, or poor condition of the equipment (e.g., no calibration, wrong nozzles)
- Use of compost produced from treated plants
- Residues in the subsequent crops in crop rotation
- Sampling methods (by producer):
    - Cross contamination during sampling in field/packhouse
    - Incorrect sample taken due to human error in field/packhouse

Cases where control by producer is minimal

- Rapid plant growth after application, leading to earlier harvest than foreseen and hence reduced preharvest interval
- Spray drift from very closely planted neighboring crops

20.6.2 Off-farm level (post–farm gate)

Cases that can be controlled by producers

- Non-compliance with label instructions for postharvest treatment used in downstream processing (e.g., packhouses); see above
- Poor management practices (e.g., failure to follow instructions and rules regarding hygiene/sanitation, safe storage, and transport of PPPs, which are designed to avoid direct contact of product and PPPs)

No direct control by producer

- Lack of a complete set of globally harmonized MRLs
    - Preharvest interval not applicable to MRL in country of destination (not relevant for products of EU origin)
    - Lowering of MRL or withdrawal of active ingredients combined with insufficient communication of changes
    - Different MRLs in country of production and country of destination
    - Confusion regarding which MRL to comply with, given use of several legal and private standards, each with different MRL requirements
- Sampling methods (by third parties)
    - Cross contamination during sampling:
        - In field
        - At depot
        - In storage
    - Incorrect sample taken due to human error:

- In field
- At depot
- In storage

  - Dry matter not divided homogenously in soil and in plant material
  - Sample size too small
  - No harmonized sampling methods
- Testing and laboratory
  - Inherently large error margin in residue analyses
  - Wrong analytical method used
  - False positives (interference from plant-made active compounds, poor lab procedures, or matrix effect)
  - Contrasting ability of certified and approved labs
- Statistical methods used and conservatism in the way MRLs are set:
  - According to EU regulations, MRLs are set based on a limited number of field trials using specified statistical methods, and in this context the ALARA (as low as reasonably achievable) principle is employed
  - Due to the conservative way in which MRLs are set, and the statistical procedures that are in place, it is a mathematical inevitability that there will be a certain small percentage of MRL exceedances. The statistical possibility of such exceedances could only be eliminated by revising the legislation.

20.7 Risk assessment guidelines to define a sampling plan to ensure MRL compliance

20.7.1 Background and principles

- This risk assessment shall determine:
  - Whether or not PPP analyses are needed and how many
  - Where and when to take the samples
  - What type of analysis to perform
- The output of this risk assessment is a sampling plan that indicates where and when how many samples shall be taken and what analysis to perform. The risk assessment is the process followed to reach these conclusions and shall include the reasoning and considerations followed.
- Producers shall have systems to verify the correct implementation of G.A.P. and the compliance of the product with the legal MRLs. PPP residue analysis is a very efficient verification system.
- The sampling program shall:
  - Be a robust verification system of G.A.P. implementation at the farm and product handling level
  - Be a robust verification system to ensure that the residues in the products comply with the legal MRLs and customer specifications, if applicable
  - Ensure that there is no cross contamination from neighbors, adjacent fields, or through the environment (water, soil, application equipment, etc.)

- Ensure that only authorized products are used (i.e., only products registered for the crop are used if the country of production has a PPP registration scheme; for organic products, only products allowed in organic farming are used)

- The risk assessment shall be done for each crop (or group of similar crops, as can be the case for herbs), since the type of crop normally has a major impact on the risk.
- The risk assessment shall be documented and reviewed annually.

20.7.2 Number of samples

Factors to take into account to define the number of samples shall include at least the following:

- **Crop:** The type of crop can have a major impact on the risk. Some crops may not require any use of PPPs during the production season or during post-harvest handling. In such cases the risk assessment may conclude that analyses are not required.
- **Country of production:** The country where the production site is located can have an impact. The historical data for each crop and country shall be known in order to assess the risk.
- **Size** (surface or tons of production): The bigger the size, the higher the number of samples to verify compliance with the MRLs.
- **Number of production sites:** The higher the number of production sites, the higher the number of samples to verify compliance with the MRLs.
- **PPP use intensity:** This factor is generally related to the type of crop (some crops require more PPP use than others), the location of the production (in some areas there are more advanced integrated pest management (IPM) techniques, in other areas there is more pest pressure, etc.), and the skills and expertise of each producer.
- **Product historical data:** The historical data on PPP issues related to each product shall be taken into account.
- For **producer groups and multisite producers**, in addition to the factors above, the number of producer group members and production sites shall be taken as a main factor. The bigger the number of producer group members and production sites, the higher the number of samples to verify compliance with the MRLs.

The number of samples needs to be decided on a case by case basis.

A rule of thumb that could serve as a guideline: In many cases the value of the sampling + analysis is around 0.1–0.5% of the value of the crop.

20.7.3 When and where to take samples

Once the number of samples is defined, it is important to decide when and where to take the samples.

- **When** to take samples: For each crop the most risky periods shall be identified. To identify these periods, historical data for that crop and area shall be considered. Also, it is important to have a good understanding of the crop agronomy and PPP use. In some cases, it is useful to identify at which points in the cycle there are more problems in complying with the preharvest intervals.
- **Where** to take samples: This shall consider varieties and also locations.
    - Crop varieties: The risk of the different varieties is not the same. Some varieties tend to have more spraying than others; or have PPPs applied closer to harvest; or be more sensitive to pests or diseases.

- Sampling point: It shall be considered whether samples shall be taken in the field, in the packhouses, in transit, in destination, etc.
- Origin of product: It shall be considered whether some fields have bigger risks than others; possible cross contaminations from adjacent fields, previous crops, etc.; and/or more pest pressure, etc.

20.7.4 Type of analysis

There are multiple analyses available on the market, and it is important to select those that are most appropriate and economically affordable. Considerations shall include:

- If postharvest treatments are used, these shall also be covered by the analysis.
- The analysis shall cover all (or at least most) of the active ingredients used as well as other active ingredients not used but that could be present in the environment (sprayed by the neighbor on another crop, cross contamination, etc.).
- Active ingredients used that are not covered by the analysis for technical or economic reasons shall be identified and the risk of each one of these active ingredients shall be assessed.
  - Those active ingredients which are used at the beginning of the season long before harvest, which are not persistent, and for which the industry (laboratories, customers) has detected no problems could be considered a low risk. In these cases, the risk assessment could conclude that these active ingredients do not need to be included in the analysis scope.
  - Other active ingredients with higher risks shall be included in the analysis screening wherever possible. This could be done at origin in other laboratories, at destination by the customers, or in specific analysis undertaken not on a routine basis but as spot validation of the use of this PPP.

21 CONTROLLED ENVIRONMENT AGRICULTURE

This guideline is directed at CEA producers who are applying for certification.

The term “controlled environment agriculture” (CEA) covers a variety of covered production systems, including greenhouses, indoor farming, and vertical farming.

CEA is designed to provide optimal growing conditions and prevent damage from disease and pests by using closed ecosystems. There, parameters like humidity, light, carbon dioxide levels, temperature, and nutrition can be controlled.

In this guideline, you will find guidance on implementing the relevant requirements according to your situation, with reference to the realities of CEA.

Principles and criteria not mentioned in this guideline do not have additional guidance.

A core element of the standard is risk assessments, each covering a special aspect of production:

- Hygiene
- Workers’ health and safety
- Site management
- Water management

Aspects of CEA shall be incorporated into each of these risk assessments. The findings from these risk assessments are then summarized in a management plan where the relevant actions are documented.

This is followed, where relevant, by training of staff to ensure the implementation of the defined measures.

Within CEA, special care shall be taken to prevent microbiological contamination of the production facilities and the products themselves.

21.1 Recall and withdrawal

The recall and withdrawal procedure shall also cover situations where growing cabinets/production facilities are situated in restaurants or retail stores.

21.2 Equipment and devices

The term “equipment” covers items which come into contact with the products. Growing cabinets/production facilities are considered production sites. Food safety is paramount here.

21.3 Food defense

Access to the growing cabinets/production facilities shall be controlled. In cases of potential public access to growing cabinets/production facilities (e.g., in retail stores, restaurants, etc.), care shall be taken that these are locked and accessible to trained staff only.

21.4 Hygiene

The term “farm” covers all locations connected with the production and handling of the registered products. Special care shall be taken to avoid microbiological contamination of the growing cabinets/production facilities and the products.

Hygiene procedures shall be aligned with the risk assessment and include applicable harvest and postharvest activities. If growing cabinets/production facilities are situated in restaurants or retail stores, only trained staff shall work with them. Pictograms or signs can be part of work instructions.

If growing cabinets/production facilities are situated in restaurants or retail stores, staff shall have access to handwashing and toilet facilities.

Risks associated with products classified as “ready-to-eat” or “wash-before-use” product shall be observed and mitigated accordingly.

21.5 Workers’ health, safety, and welfare

The term “farm” covers all locations connected with the production and handling of the registered products.

Risks that shall be included in the risk assessment and training include glass breakage, cleaning agents, handling of liquid fertilizers, plant protection products (PPPs), etc.

A written procedure shall be established which covers the topics from the risk assessment that concern hazards to workers’ health and safety.

The content of the written procedure on hazards to workers’ health and safety shall be the basis of the training.

If growing cabinets/production facilities are situated in restaurants or retail stores, only trained staff shall work with them. Emergency cut-offs for electricity and water supplies shall be identified and can also be handled by staff of the restaurant or retail store. Permanent accident and emergency response procedures can be part of work instructions.

If growing cabinets/production facilities are situated in restaurants or retail stores, safety advice on hazardous chemicals (information – e.g., websites, telephone numbers, material safety data sheets, etc. – related to safe handling of substances) shall be available. The information may be stored inside the growing cabinet.

If growing cabinets/production facilities are situated in restaurants or retail stores, first aid kits may be stored inside the growing cabinet.

Staff working outside the main growing cabinets/production facilities shall be trained in first aid.

21.6 Site management

"Sites" refers to the growing cabinets/production facilities.

The aim is to make sure that the growing cabinets/production facilities are fit for food production.

Topics to be considered:

- Growing cabinet/Production facility design
- Cleaning and monitoring procedures
- Biological, physical, and chemical hazards (including allergens)
- Check of the new growing cabinets/production facilities before first production cycle
- Site history, i.e., history of existing production facilities concerning food safety aspects (e.g., microbiological contamination, pest infestation, etc.)

The management plan that establishes strategies to minimize the risks identified in the risk assessment shall have been developed and implemented and shall include all risks associated with the growing cabinets/production facilities.

All growing cabinets/production facilities shall be identified.

Energy management shall be supported with metrics. A possibility for CEA producers is to collect energy input consumption data according to the Impact-Driven Approach.

The water used for washing and cleaning purposes shall be disposed of in a manner that ensures minimum environmental, health, and safety impact. If growing cabinets/production facilities are situated in restaurants or retail stores, there shall be a procedure for how to deal with water used for washing and cleaning purposes.

21.7 Fertilizers and biostimulant

As per the site management requirements, all growing cabinets/production facilities shall be identified.

The amount of fertilizer to be applied in weight or volume relative to a unit of area or number of plants or unit of time per volume of fertigation shall be detailed in the records of all applications. The actual quantity applied shall be recorded, as this is not necessarily the same as the recommendation.

All records of fertilizer applications shall contain the name of the operator who applied the fertilizer.

If a single individual makes all the applications, it is acceptable to record the operator details only once.

If there is a team of workers performing the fertilization, all of them shall be listed in the records.

Management of fertilizers is supported with metrics. A possibility for CEA producers is to collect input consumption data according to the Impact-Driven Approach.

21.8 Water management

In most cases, the water supply for CEA comes from the public water system. Even in this situation a risk assessment is needed, including the pipes and pumps used for the water supply. The focus here is food safety.

The term “farm” covers all locations connected with the production and handling of the registered products.

In general, the amount of water used in CEA is low and efficient and causes no environmental problems.

The water management plan shall be established and annually reviewed.

Water analysis forms part of the water management plan and shall be completed at least once per year, or more frequently if required by the risk assessment. For CEA, microbiological contamination of the water used is a significant risk factor. Utmost care shall be taken to avoid contamination; therefore, microbial water analyses shall be conducted frequently.

21.9 Plant protection product use

In CEA, PPPs are used in extreme situations only. In most cases, the risk assessment shall state that no PPPs are used and, in these cases, records shall be checked and residue testing shall be “not applicable” (N/A).

Management of PPPs shall be supported by metrics. A possibility for CEA producers is to collect input consumption data according to the Impact-Driven Approach.

21.10 Packing and storage

If growing cabinets/production facilities are situated in restaurants or retail stores, special care shall be taken during harvesting and any packing activities to minimize food safety risks.

A documented cleaning and maintenance schedule shall be established. Special attention shall be given to microbiological contamination of the growing cabinets/production facilities.

If packing material is supplied in retail stores next to the growing cabinets/production facilities, measures shall be taken to mitigate food safety issues.

Growing cabinets/Production facilities with environmental monitoring programs shall show documentation for applicable production activities and not be limited to the handling activities.

22 METRICS

This guideline addresses the metrics for the product category fruit and vegetables for both of the following:

- Integrated Farm Assurance (IFA) standard, version 6
- Impact-Driven Approach to Sustainability (IDA) add-on in its current version

The purpose of this guideline is to provide producers and auditors with information to support the interpretation of the principles and criteria (P&Cs) associated with the use of metrics. The guideline gives more detailed specifications on what type of metrics producers are expected to record in order to meet the requirements of the P&Cs.

The same guideline is used for the IDA add-on. Those parts of the guideline which apply to the IDA add-on only are indicated.

22.1 Glossary for this guideline

Definition: Definition of the metric and a short description of what shall be recorded for the metric

Frequency to record: Indicates how often and when the producer shall record the events related to the metric. Certification body (CB) auditors shall check that the recording of the data meets the frequency requirement. CB auditors shall also check that the producer has a system in place

where the information is consistently recorded and that the recording of the metrics is centralized to this system.

Frequency to report to the GLOBALG.A.P. Secretariat: *Applicable to the IDA add-on*. To comply with the IDA add-on, the producer shall transfer the metric-related data to the GLOBALG.A.P. Secretariat on regular basis via a GLOBALG.A.P. approved farm management system (FMS). The FMS can also automatically transfer the information as soon as it has been recorded, but this section defines the minimum frequency of transferring the metric-related data to the GLOBALG.A.P. Secretariat.

The producer shall make sure to use the FMS as instructed by the FMS provider so that information can be transferred to the GLOBALG.A.P. Secretariat. The producer shall also make sure that the FMS has the necessary permissions to transfer information to the GLOBALG.A.P. Secretariat. The FMS shall be set up so as to ensure that the technical connection to the GLOBALG.A.P. Secretariat is working and that any potentially necessary unit conversions are done before transferring the information to the GLOBALG.A.P. Secretariat.

Impact-Driven Approach (IDA): IDA is a GLOBALG.A.P. add-on applicable to flowers and ornamentals, fruit and vegetables, and aquaculture. The IDA add-on uses data and metrics to encourage and measure continuous improvement at farm level. Certain sections of this metrics guideline address requirements that are relevant to only those producers aiming to comply with the IDA add-on. These sections are marked with an asterisk (*) and do not concern IFA-related metrics or their evaluation.

Information related to the Impact-Driven Approach (IDA): For the purposes of the IDA add-on, the GLOBALG.A.P. Secretariat will require that the data be transferred to the GLOBALG.A.P. Secretariat in a particular format so that proper data analysis and aggregation can be performed. For this purpose, the producer shall use an approved FMS that can convert the units and data used by the producer so that they will be compatible with GLOBALG.A.P. requirements. The CB auditor shall check that the producer is using one of the approved FMSs.

Approved FMSs can be found here.

Latest technical documentation on data formats and system requirements for FMSs can be found here.

Indicator: A type of data that indirectly measures the (sustainability) issue in question

Information to be recorded: Indicates what level of information recording is expected in order to meet the P&Cs. The producer shall have records of the expected data points to meet the metric criteria. The producer can record the data points in the units most appliable to the producer's circumstances, as long as the recording of the information is consistent and done with the necessary frequency.

Metric: A system or standard of measurement

Peer group: *Applicable to the IDA add-on.* For the purposes of the IDA add-on, the GLOBALG.A.P. IT systems will compile similar producers into peer groups to provide comparable data on the peer group's average inputs (see "Type of output") compared to the producer's own inputs. The peer group is based on the producer's location, crops grown, and growing circumstances as recorded by the producer according to GLOBALG.A.P. requirements. Members in the peer group are anonymized and an individual producer cannot see the data of other individual producers, only aggregated average values of the peer group.

Purpose: Briefly describes the rationale ("the why") for using the metric.

Type of output: *Applicable to the IDA add-on.* With participation in the IDA add-on, the producer will receive benchmark reports sent to their FMS. The benchmark reports will contain the producer's aggregated historical data regarding the input consumption of the metric. Furthermore, the benchmark report will contain an anonymized comparison to other relevant producers in the

peer group in the IDA system and the intensity of the input consumption of the producer compared to peer producers for the given metric.

22.2 Prerequisites for metric recording

Site

To record metrics, the producer shall have a clear understanding and records of relevant sites and their boundaries. The producer shall be aware of the site's total area, as well.

*For IDA add-on purposes, the producer shall also record the location of the site with geospatial coordinate information.

*Note: Only with the above-mentioned data points shall the producer be able record the metric data for the IDA add-on.

Crop

Some metrics require the producer to register the input consumption associated with the metric of a crop grown on the site. Therefore, the producer shall be aware of and record the crops grown on each site, the dates when the crops are grown, and the area of the crop on the site. With this information, the producer can relate the input consumption metrics to the size of production.

*For IDA add-on purposes, the producer shall also record the yield of harvested products, a production type, and other growing circumstances as specified here. This information allows generating the outputs that compare the producer to the relevant peer group growing under similar circumstances.

*The producer shall also indicate the company type for each crop and whether the producer is a member of a producer group.

*Note: Only with the above-mentioned data points shall the producer be able record the metric data for the IDA add-on. Note also that some outputs of the IDA system cannot be generated until the producer has indicated the yield of the crop.

22.3 Compliance with Impact-Driven Approach for fruit and vegetables – elements for auditing

The producer shall have three months of consecutive data registering history before a first CB audit may take place.

Once the CB audit can take place, three conditions are required for a producer to demonstrate compliance with IDA for fruit and vegetables (as described in the IDA fruit and vegetable rules, section "Audit process").

The CB audit includes checking the following three aspects:

a) **Reliability of digitally registered data** against farm conditions, including records kept at farm level and ways in which data is collected and recorded

b) **Compliance with the P&Cs** of the IDA add-on

c) **Confirmation** that the **producer digitally registered the data through the FMS for the GLOBALG.A.P. Secretariat on a monthly basis**, as required in the P&Cs

Reliability of digitally registered data refers to the confirmation that registered and digitally shared data correspond to real use/applications and to real farm conditions. The CB audit is not meant to verify all data. A sample or several samples of data may be verified in different ways. Examples of verification may include the following:

- Confirming that the fields and crops are active at the time of the use/application
- Identifying how data was obtained: whether through estimations or using measuring devices
- Confirming whether the mentioned devices are on site and functional
- Cross-checking data with invoices or records of fertilization/pest management programs

Compliance with the P&Cs of the IDA add-on refers to the CB audit of the P&Cs as specified in the corresponding P&Cs in the add-on.

Confirmation that the producer digitally registered the data through the FMS for the GLOBALG.A.P. Secretariat on a monthly basis is a critical element in IDA for fruit and vegetables, since the producer is required to share data at regular intervals.

Prior to the audit, the CB shall confirm that the producer has been sharing data as required in the add-on, i.e., with respect to periodicity and data points.

- If the applicant producer is already certified against a scheme that claims to digitally collect the same data points, the CB may perform the audit without confirmation that the producer has shared data for the minimum period required. At the producer's risk, the CB can confirm this during the audit.
- If the producer applying for the CB audit has already registered data through a different FMS, the audit can take place as long as the data has been shared with the GLOBALG.A.P. Secretariat and meets the required periodicity and data points.

If a producer has been granted a letter of conformance, failing to report continuously may lead to sanctions. It is important for the CB to monitor every month whether the producer meets this requirement.

22.4 Quantitative fertilizer indicator

Metric	Amounts of nitrogen (N), phosphorus (P), and potassium (K) used for fertilization in agricultural production
Definition	This indicator describes the amounts of N, P, and K used per crop per hectare in a defined time period. Area refers to the area under production.
Purpose	• Avoiding the excessive use of N and P, as these may leak into the environment, causing pollution and eutrophication of water bodies • Implementing good agricultural practices (see IFA standard) in order to avoid leakage of N, P, and K, optimize fertilizer use, and save money • Monitoring the amounts of N, P, and K inputs used at crop/farm level, allowing producers to set quantitative goals and have better control

Information to be recorded	To record the fertilizer-related metrics, the producer shall record/report each fertilizer application along with the following data: • Amounts of N, P, and/or K used; N, P, and K amounts to be recorded separately • Date of the application • Crop to which the fertilizer was applied The N, P, and/or K amounts can be manually entered by the producer or can be automatically calculated by the producer's FMS based on the amount of commercial product applied. The producer shall, regardless, be aware of the N, P, and/or K loads of fertilizer applications.
IDA-related information*	The data shall be recorded with a GLOBALG.A.P. approved FMS that will ensure that the data is transferred to the GLOBALG.A.P. Secretariat. The FMS shall enable the correct conversion of units so that the GLOBALG.A.P. Secretariat can receive the data.
Frequency to record	After each fertilizer application is made. Each application shall be recorded separately.
Frequency to report to the GLOBALG.A.P. Secretariat*	Monthly – at the end of a calendar month, the GLOBALG.A.P. Secretariat shall receive the fertilizer application information.
Type of output*	An individual historical report, a report with data of a single producer showing trends in use over time: • Amounts of N, P, and/or K used per ha • Amounts of N, P, and/or K used per kg of product A benchmarking or comparison report between peer producers, comparing amounts (in kilograms) of N, P, and/or K used by different producers near the producer's location. Comparison on a monthly level with peer producers' average consumption and the producer's N, P, and/or K use intensity in terms of percentile. Within a peer group, the indicator provides a notion of the range of distribution of N, P, and K consumption in the same crop under similar circumstances. Peer producers are anonymized.

22.5 Quantitative active ingredient indicator

Metric	Amounts of active ingredient of plant protection products (PPPs) (of chemical synthesis) used in agricultural production
Definition	This indicator describes the amounts of each active ingredient used per crop per hectare of area. Area refers to area under production. Active ingredient refers to the active ingredient(s) of PPPs obtained from chemical synthesis and to biopesticides. It does not include biological controls such as those containing living organisms.
Purpose	• Identifying the amount of active ingredient(s) applied through use of PPPs on a particular crop or at the farm in a defined time period • Monitoring amounts of active ingredient use in relation to crops and sites • Setting quantitative goals in active ingredient consumption as a complementary indicator of pest management
Information to be recorded	To record the active ingredient metric, the producer shall record each PPP application with the following data: • Amounts of active ingredient used, with each different active ingredient being recorded separately • Identification of which active ingredient is used • Date of the application • Crop on which the active ingredient was applied The active ingredient amounts can be manually entered by the producer or can be automatically calculated by the producer's FMS based on the amount of PPP. The producer shall, regardless, be aware of the active ingredient loads of PPP applications.
IDA-related information*	The data shall be recorded with a GLOBALG.A.P. approved FMS that will ensure that the data is transferred to the GLOBALG.A.P. Secretariat. The FMS shall enable the correct conversion of units so that the GLOBALG.A.P. Secretariat can receive the data. For active ingredient identification, a Chemical Abstract Service CAS number shall be given (usually provided by the FMS).
Frequency to record	After each PPP application is made. Each application shall be recorded separately.
Frequency to report to the GLOBALG.A.P. Secretariat*	Monthly – at the end of a calendar month, the GLOBALG.A.P. Secretariat shall receive the active ingredient use information.

Type of output*	An individual historical report, a report with data of a single producer showing trends in use over time: • Amounts of active ingredient(s) used per ha • Amounts of active ingredient(s) used per kg of product A benchmarking or comparison report between peer producers, comparing amounts (in kilograms) of the total sum of active ingredient(s) used by different producers near the producer's location. Comparison on a monthly level with peer producers' average consumption and the producer's active ingredient use intensity in terms of percentile. Within a peer group, the indicator provides a notion of the range of distribution of the total sum of active ingredient consumption in the same crop under similar circumstances. Peer producers are anonymized.

22.6 Quantitative water use indicator

Metric	Volume of water abstracted and used in agricultural production
Definition	This indicator describes the volume of water abstracted and used on site.
Purpose	Identifying and monitoring the pressure of the production system on water resources

Information to be recorded	To record the water metrics, the producer shall record water abstraction and use with the following data:
	• Water abstraction
	  ○ Volume of water abstracted, also indicating the source from where the water was abstracted
	  ○ Date of water abstraction (if a specific date cannot be given, the date can be the last date of the month)
	  ○ Indication for which site the water was abstracted
	• Total water used
	  ○ Volume of total water used
	  ○ Date by which total water was used (if a specific date cannot be given, the date can be the last date of the month)
	  ○ Indication at which site the water was used
	• Irrigation[1]
	  ○ Volume of water used for irrigation
	  ○ Date of irrigation (if a specific date cannot be given, the date can be the last date of the month)
	  ○ Indication at which site the irrigation took place

	[1]Recording this data point is not mandatory for compliance with the IFA standard, but the producer shall record and report it to comply with the P&Cs of the IDA add-on.
IDA-related information*	The data shall be recorded with a GLOBALG.A.P. approved FMS that will ensure that the data is transferred to the GLOBALG.A.P. Secretariat. The FMS shall enable the correct conversion of units so that the GLOBALG.A.P. Secretariat can receive the data. For water source indication, a list of water sources retrieved from the GLOBALG.A.P. IT systems shall be used. This list is constantly updated and shall be retrieved from the FMS connected to the GLOBALG.A.P. IT systems.
Frequency to record	At minimum on a monthly basis. Information can be aggregated per site per month if more accurate recording of water abstraction and use is not possible.
Frequency to report to the GLOBALG.A.P. Secretariat*	Monthly – at the end of a calendar month, GLOBALG.A.P. shall receive the water abstraction and use information. Information can be aggregated per site per month if more accurate recording of water abstraction and use is not possible.
Type of output*	An individual historical report, a report with data of a single producer showing trends in use over time: • Volume of water abstracted per source per ha • Volume of water used in agricultural production per ha • Volume of water used in agricultural production per kg of product • Volume of water used for irrigation in agricultural production per ha • Volume of water used for irrigation in agricultural production per kg of product A benchmarking or comparison report between peer producers, comparing amounts of water abstracted and used by different producers near the producer's location. Comparison on a monthly level with peer producers' average consumption and the producer's water abstraction and use intensity in terms of percentile. Within a peer group, the indicator provides a notion of the range of distribution of water abstraction and use under similar circumstances. Peer producers are anonymized.

22.7 Quantitative energy use indicator

Metric	Amount of energy generated and used in agricultural production
Definition	This indicator describes the amount of energy used and generated on the site.

Purpose	Identifying and monitoring the impact of energy sourcing and use on the environment and on climate change

Information to be recorded	To record the energy metrics, the producer shall record energy use with the following data:
	• Energy use indicating
	  ○ Source of energy (incl. all energy sources such as fuels)
	  ○ Amount of energy consumed from each source
	  ○ Amount of renewable energy (if known) from each source
	  ○ Date of energy use (if a specific date cannot be given, the date can be the last date of the month)
	  ○ Site where the energy was used
	• Energy generation[1]
	  ○ Amount of energy generated on the site
	  ○ Date when energy was generated (if a specific date cannot be given, the date can be the last date of the month)
	  ○ Amount of energy exported to the grid from the site
	  ○ Date when energy was exported to the grid (if a specific date cannot be given, the date can be the last date of the month)
	[1]Recording this data point is not mandatory for compliance with IFA/IDA, but such reporting is supported by GLOBALG.A.P. and is recommended for further data for IDA.

IDA-related information*	The data shall be recorded with a GLOBALG.A.P. approved FMS that will ensure that the data is transferred to the GLOBALG.A.P. Secretariat. The FMS shall enable the correct conversion of units so that the GLOBALG.A.P. Secretariat can receive the data. For energy source indication, a list of energy sources retrieved from the GLOBALG.A.P. IT systems shall be used. This list is constantly updated and shall be retrieved from the FMS connected to the GLOBALG.A.P. IT systems. If there is no energy generation on the site or no energy exported to the grid, these metrics do not need to be recorded. For IDA purposes, the producer shall indicate a value of zero for these metrics.
Frequency to record	At minimum on a monthly basis. Information can be aggregated per site per month if more accurate recording of energy use and generation is not possible. If there is no energy generation on the site or no energy exported to the grid, these metrics do not need to be recorded.

Frequency to report to the GLOBALG.A.P. Secretariat*	Monthly – at the end of a calendar month, the GLOBALG.A.P. Secretariat shall receive the energy abstraction and use information. Information can be aggregated per site per month if more accurate recording of energy use and generation is not possible. If there is no energy generation on the site or no energy exported to the grid, these metrics do not need to be recorded.
Type of output*	An individual historical report, a report with data of a single producer showing trends in energy use and generation over time: • Total amount of energy used per ha • Total amount of energy used per kg of product • Amount of energy used per source per ha • Amount of energy used per source per kg of product • Share of renewable energy in energy use • Amount of energy generated on the site • Amount of energy exported to the grid from the site A benchmarking or comparison report between peer producers, comparing amounts of energy used and generated by different producers near the producer's location. Comparison on a monthly level with peer producers' average consumption and the producer's energy use and generation intensity in terms of percentile. Within a peer group, the indicator provides a notion of the range of distribution of energy use and generation under similar circumstances. Peer producers are anonymized.

22.8 Quantitative biodiversity indicator

Metric	Biodiversity-related land use at the producer's site
Definition	This indicator describes the land use affecting biodiversity.
Purpose	Monitoring land use and its possible impacts on biodiversity at and around the producer's site
Information to be recorded	To record the biodiversity metrics, the producer shall record land use with the following data: • Total extension of natural or semi-natural ecosystems and habitats, or legally recognized protected areas (or areas effectively protected via other means) on 1 January of the CB audit year • Extension of areas converted to agricultural use or to other uses between 1 January 2008 and 1 January 2014 • Extension of area that has already been restored on 1 January of the CB audit year • Extension of area that is under restoration on 1 January of the CB audit year

	• Extension of area that is planned for binding restoration on 1 January of the CB audit year Each metric shall be indicated by an area unit and per site.
IDA-related information*	The data shall be recorded with a GLOBALG.A.P. approved FMS that will ensure that the data is transferred to the GLOBALG.A.P. Secretariat. The FMS shall enable the correct conversion of units so that the GLOBALG.A.P. Secretariat can receive the data.
Frequency to record	At any time of the year before the CB audit is carried out. All data points (information to be recorded) shall be recorded at the same time.
Frequency to report to the GLOBALG.A.P. Secretariat*	Monthly – at the end of a calendar month, the GLOBALG.A.P. Secretariat shall receive the biodiversity-related data. If there have been no changes, the producer's FMS can automatically report the current values to the GLOBALG.A.P. Secretariat at the start of each calendar month. This is to ease the reporting effort needed by the producer. The date can be set as the first day of each calendar month.
Type of output*	An individual historical report, a report with data of a single producer showing trends in land use for biodiversity: A benchmarking or comparison report between peer producers, comparing areas of land under protection, restoration, or agricultural use. Within a peer group, the indicator provides a notion of the range of distribution of land use for biodiversity and use under similar circumstances. Peer producers are anonymized.

22.9 Quantitative greenhouse gas indicator

Metric	Greenhouse gas emissions at the producer's site
Definition	This indicator describes the amount of greenhouse gases resulting from the producer's agricultural production.
Purpose	Monitoring the climate change impact that agricultural production has
Information to be recorded	To record the greenhouse gas metrics, the producer shall record the following data: • Carbon dioxide equivalents (CO2e) of the total energy use • Site where the energy consumption resulting in the emission has occurred • Date of the energy use that resulted in the emission (if a specific date cannot be given, the date can be the last date of the month)

IDA-related information*	The data shall be recorded with a GLOBALG.A.P. approved FMS that will ensure that the data is transferred to the GLOBALG.A.P. Secretariat. The FMS shall enable the correct conversion of units so that the GLOBALG.A.P. Secretariat can receive the data. The FMS shall convert energy use to CO_2e.
Frequency to record	At minimum on a monthly basis. Information can be aggregated per site per month if more accurate recording of greenhouse gas emissions is not possible.
Frequency to report to the GLOBALG.A.P. Secretariat*	Monthly – at the end of a calendar month, the GLOBALG.A.P. Secretariat shall receive the greenhouse gas emissions information. Information can be aggregated per site per month if more accurate recording of greenhouse gas emissions is not possible.
Type of output*	An individual historical report, a report with data of a single producer showing trends in greenhouse gas emissions: A benchmarking or comparison report between peer producers, comparing areas of land under protection, restoration, or agricultural use. Within a peer group, the indicator provides a notion of the range of distribution of greenhouse gas emissions under similar circumstances. Peer producers are anonymized.

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