Impact of Water Use and Reuse in Food Production and Processing on Food Safety at the Consumer Phase: Focus on the Fresh Fruit and Vegetable Products Sector

Organized by IAFP’s Water Safety and Quality PDG, International Food Protection Issues PDG, and Fruit and Vegetable Safety Quality PDG

Moderator: Leon Gorris, Food Safety Futures, Past Chair of Water Safety & Quality PDG

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Webinar Housekeeping

• It is important to note that all opinions and statements are those of the individual making the presentation and not necessarily the opinion or view of IAFP.

• All attendees are muted. Questions should be submitted to the presenters during the presentation via the Questions section at the right of the screen. Questions will be answered at the end of the presentations.

• This webinar is being recorded and will be available for access by IAFP members at www.foodprotection.org within one week.
Presenters

Zhou Kang - Development of international scientific advice on water (re-)use and food safety

Elisabetta Lambertini - Risk-based, fit-for-purpose water (re-)use in fresh fruit and vegetable supply chains

Rob de Jonge - Bringing the fit-for-purpose approach into operation; water (re-)use case studies

Ana Allende - Field testing the JEMRA guidance
Development of international scientific advice on water (re-)use and food safety

Dr Kang Zhou

Food Safety Officer
Food Systems and Food Safety Division
Food and Agriculture Organization of the United Nations (FAO)
Background on safety and quality use of water in food at the FAO

- Many Codex documents make reference to the use of *portable* or ‘*clean*’ water

  **Challenge**

  How to turn the Codex current definition clean water “*water which does not compromise the safety of food in the context of its use*” into operational guidance/target for *water use and re-use* by food producers and processors

- Water is a *dwindling resource* worldwide and not all food producers and processors have access to safe water sources, or this access may be limited.

- Codex Committee on Food Hygiene (CCFH) noted the importance of water quality in food production and processing (48th session in November 2016), requested JEMRA to provide guidance processing water, in particular, “clean water” for irrigation water, clean seawater, and on the safe reuse of water
**Joint FAO/WHO Scientific Advice Programme**

- **JEMRA**: Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment
  - Established in 2000
  - Scientific advice on microbiological risk assessment
  - Expert meetings based on requests from Codex (CCFH) and as we deem necessary
- **JECFA, JMPR, JEMNU, ad hoc**
Place a greater emphasis on a *risk-based approach to safe water* use.

Instead of specifying use of potable water (or in some instances other water quality types) a risk-based approach and assessment of the fitness of the water *for the purpose* intended should be articulated.

One size does not fit for all.
Pathway Forward

Workshop in Honduras to evaluate the decision tree and concepts from JEMRA, in October 2022.

Fit-for-purpose water, integrated risk-based approach, linking water source, risk assessment, treatment options and efficacy, water use and food safety.
➢ General Principles of Food Hygiene (2022)

➢ Guidelines for the safe use and reuse of water in food production and processing (2023)
  • Provide guidance for food business operators (FBOs) and competent authorities on the application of a risk-based approach for the use and reuse of water that is fit for purpose.
  • Provide practical guidance and tools (e.g. DTTs) and risk-based microbiological criteria as examples to help FBOs evaluate risks and potential interventions of water as part of their food hygiene system.
  • Annexes: fresh produce, fishery products, dairy products.
Risk-based, Fit-for-Purpose Water (Re)Use in Fresh Fruit and Vegetable Supply Chains
OUTLINE

• PRINCIPLES: What is “risk-based”? What is “fit-for-purpose”?
• RISK-BASED APPROACHES to assess “fit-for-purpose” quality
• DECISION TOOLS
PRINCIPLES
Risk-based standards

• Starting from a health risk target
• “back-calculating” how to achieve the target
Potable water quality (GDWQ, WHO 2022)

Health risk targets:

- **Microbial pathogens:**
  
  upper reference risk of \(10^{-6}\) DALY ppy (\(\sim 1\) case diarrhea per 1,000 people per year). Tiered approach towards target.

- **Chemical carcinogens:**
  
  upper limit cancer risk of 1 excess case per 100,000 people from lifetime exposure

- **Threshold chemicals:**
  
  no or lowest-observed-adverse-effect levels (NOAEL or LOAEL), benchmark dose (BMD), or lower confidence limit on benchmark dose (BMDL) (e.g. fluoride, copper)
What is **fit-for-purpose** (FFP) water quality?

“*does not compromise the safety of the final product for the consumer*”

- Does not increase risk from product consumption
- Water quality standard should be risk-based
Fit-for-purpose water quality

(MRA 37 - FAO and WHO; 2021)
RISK ASSESSMENT APPROACHES
Address risk management questions

Which water source should I use/reuse?

Should I treat the water? How much?

(UNEP 2009, FAO 2016)
Risk Assessment approaches

- Qualitative
- Semi-quantitative
- Quantitative

- SANITARY INSPECTION
- HACCP
- RISK CATEGORIZATION
- RISK RANKING
- QUANTITATIVE RISK ASSESSMENT
- SCREENING/IN-DEPTH

- Same best practices
- Can be complementary
Example 2: comparing hazards (semi-quantitative)

TABLE 34. Example of a Probability-Severity table for individual hazards (indicated by the numbers in the grid) per year (NIL = None, VLO = Very Low; Lo = Low; Med = Medium; Hi = High; VHI = Very High)

<table>
<thead>
<tr>
<th>Severity</th>
<th>VHI</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>13,2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI</td>
<td>14</td>
<td>15</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>MED</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>LO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLO</td>
<td>11</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>NIL</td>
<td>11</td>
<td>8,9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

(MRA 36, FAO and WHO 2021)
Example 3: scenario analysis (quantitative)

Comparing treatments for wastewater reuse for irrigation

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Unit</th>
<th>HAdV</th>
<th>NoV GII</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean 95%</td>
<td>Mean 95%</td>
</tr>
<tr>
<td>Concentration after tertiary treatment</td>
<td>GC/ml</td>
<td>6.70 x 10^9</td>
<td>6.45 x 10^2</td>
</tr>
<tr>
<td>Concentration at consumption</td>
<td>virus/g</td>
<td>2.33 x 10^5</td>
<td>8.64 x 10^3</td>
</tr>
<tr>
<td>Dose</td>
<td>pppd</td>
<td>4.51 x 10^4</td>
<td>1.14 x 10^3</td>
</tr>
<tr>
<td>Daily Probability of infection</td>
<td>pppd</td>
<td>2.86 x 10^4</td>
<td>7.45 x 10^4</td>
</tr>
<tr>
<td>Daily probability of disease</td>
<td>pppd</td>
<td>1.45 x 10^4</td>
<td>3.73 x 10^4</td>
</tr>
<tr>
<td>Yearly probability of disease</td>
<td>pppy</td>
<td>3.06 x 10^2</td>
<td>7.01 x 10^2</td>
</tr>
<tr>
<td>DALys</td>
<td>DALys/year</td>
<td>1.44 x 10^3</td>
<td>1.94 x 10^3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Unit</th>
<th>HAdV</th>
<th>NoV GII</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean 95%</td>
<td>Mean 95%</td>
</tr>
<tr>
<td>Concentration after tertiary treatment</td>
<td>GC/ml</td>
<td>9.40 x 10^1</td>
<td>2.50 x 10^0</td>
</tr>
<tr>
<td>Concentration at consumption</td>
<td>virus/g</td>
<td>3.27 x 10^6</td>
<td>7.60 x 10^6</td>
</tr>
<tr>
<td>Dose</td>
<td>pppd</td>
<td>6.27 x 10^5</td>
<td>6.95 x 10^3</td>
</tr>
<tr>
<td>Daily Probability of infection</td>
<td>pppd</td>
<td>4.02 x 10^5</td>
<td>4.49 x 10^5</td>
</tr>
<tr>
<td>Daily probability of disease</td>
<td>pppd</td>
<td>1.98 x 10^5</td>
<td>2.30 x 10^3</td>
</tr>
<tr>
<td>Yearly probability of disease</td>
<td>pppy</td>
<td>4.23 x 10^3</td>
<td>1.19 x 10^2</td>
</tr>
<tr>
<td>DALys</td>
<td>DALys/year</td>
<td>2.09 x 10^4</td>
<td>2.99 x 10^4</td>
</tr>
</tbody>
</table>

pppd: per person per day; pppy: per person per year; GC: genome copies

(Gonzales-Gustavson et al., 2019)
Risk-based standards

- Health risk targets (e.g. DALYs)
- Water quality standards (e.g. concentration of hazards, indicators)
- Performance standards (e.g. Log reduction needed)
- Prescribed technology (e.g. tertiary treatment)
Choosing a fit-for-purpose irrigation water source

<table>
<thead>
<tr>
<th>Intended use of produce</th>
<th>Contact with edible plant portions</th>
<th>Water source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wastewater</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surface and groundwater of unknown quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater collected from protected wells</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collected rainwater</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potable water Deep groundwater</td>
</tr>
<tr>
<td>READY-TO-EAT</td>
<td>contact with the edible portion</td>
<td>HR/?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HR/?</td>
</tr>
<tr>
<td></td>
<td>not contact with the edible portion</td>
<td>HR/?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LR</td>
</tr>
<tr>
<td>COOKED</td>
<td>contact with the edible portion</td>
<td>LR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LR</td>
</tr>
<tr>
<td></td>
<td>not contact with the edible portion</td>
<td>LR</td>
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<tr>
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</tbody>
</table>

(Figure 2. Matrix to support microbiological risk assessment of irrigation water used during pre-harvest of fresh produce)

(MRA33, FAO and WHO, 2019)
Decision trees: irrigation water quality

1. Will the produce always be cooked before consumption?
   - Yes: e.g. potatoes
     - No water testing required
   - No: Fresh fruits and vegetables: leafy greens, tomatoes, bulb stem vegetables, carrots, berries, melons, etc.
     - 2. Is the water treated so as to achieve microbiological standard?
       - Yes: What’s the water source?
         - Public/Municipal water (drinking)
         - (Treated) wastewater
         - Recirculated water, reservoirs
       - No:See if there are national standards for the treatment of municipal wastewater or industrial process water to be used for irrigation.
       - Analyze at a frequency in line with:
         a) A sanitizer agent: the supplier should provide guidance for that determination.
         b) The grower’s risk assessment: water source, irrigation method, contact of irrigation water with the IV (see question 3 and 4)
     - No: e.g. subsurface or drip irrigation
       - No: e.g. groundwater collected from deep wells, rain water
     - Yes: e.g. sprinkler irrigation
       - No: water testing required
   - 3. Does the agricultural water come into direct contact with the edible portion of the FFV (excluding root FFVs)?
     - Yes: water testing required
     - No: e.g. groundwater collected from deep wells, rain water
   - 4. Is the water source vulnerable to contamination?
Is the type of water used in the primary production (PP) known?

N

Y

Was waste water used?

Use CWC1 - CWC4

Y

Was surface water used?

Use CWC1 - CWC3

Y

Was shallow well water used?

Use CWC1 – CWC2

Y

Was deep well water used?

Use CWC1

Y

Was collected rain water used?

Use CWC1

Clean Water Categories (CWC):
The risk of microbial contamination of different water sources generally increases according to the following ranking, from low to high risk:

CWC1: rainwater,
CWC2: groundwater collected from deep wells,
CWC3: groundwater collected from shallow wells,
CWC4: surface waters, and raw or inadequately treated wastewater.
In summary

• “Fit-for-Purpose” water quality = does not increase risk (or better)

• Needs risk to be assessed

• Several risk assessment approaches are available

• Results of risk assessments can be translated into decision support tools

• Context of continuous improvement
THANK YOU

Elisabetta Lambertini, PhD
elambertini@gainhealth.org
Fit-for-Purpose into operation

The use of water that is FfP in the production and processing of fresh fruits and vegetables

Rob de Jonge
Water in the production and processing of FFV is used for:

- Irrigation
- Application of ppp/fertilizers
- Washing
- Transport
- Rinsing
Water consumption worldwide
OBJECTIVES

Primary production should be managed in a way that ensures that food is safe and suitable for its intended use. Where necessary, this will include:

• an assessment of the suitability of water used where it may pose a hazard, for example, crop irrigation, rinsing activities, etc.;
Suitability: Source of water
Suitability: Type of irrigation
Suitability: Type of crop
Water that is **Fit-for-Purpose**

### Table: Matrix to support microbiological risk assessment of irrigation water used during pre-harvest of fresh produce

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<thead>
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<td></td>
</tr>
<tr>
<td></td>
<td>contact with the edible portion</td>
<td>LR</td>
</tr>
<tr>
<td></td>
<td>not contact with the edible portion</td>
<td>LR</td>
</tr>
</tbody>
</table>

**FIGURE 2.** Matrix to support microbiological risk assessment of irrigation water used during pre-harvest of fresh produce.
Treated waste water that is **Fit-for-Purpose**

**Class A:** *E. coli*  
<100 cfu/L  
all types of irrigation/crops

**Class B:**  
<1000 cfu/L  
all types of irrigation/raw but no direct contact

**Class C:**  
<10,000 cfu/L  
drip irrigation/no contact with edible part/processed

**Class D:**  
<100,000 cfu/L  
all types of irrigation/crops restricted

More about use of waste water in primary production......
Handling and processing of FFV
The use of water that is F4P
Water, as well as ice and steam made from water, should be fit for its intended purpose based on a risk-based approach. They should not cause contamination of food. Water and ice should be stored and handled in a manner that does not result
.... should not cause contamination...

- Potable water:
  - as an ingredient
  - Ice making
  - For C&D
contact food) should have a separate system that does not connect with or allow reflux into the system for water that will contact food. Water recirculated for reuse and water recovered from e.g. food processing operations, by evaporation and/or filtration, should be treated, where necessary, to ensure that the water does not compromise the safety and suitability of food.

..., to ensure that water that is FfP.
Re-used water which has received no further treatment

...clean water could be used for initial washing stages, whereas water used for final rinses should be of potable quality. (CAC/RCP 53-2003)
Example: tomato processor

1. First wash
2. Final wash
3. Slicing
4. Combining/portioning
5. Packing

- Tomato juice extraction
  - Pasteurization of juice
  - Packing

- Tomato pulp concentration and water extraction
  - Commercial sterilization of paste
  - Packing
Example: tomato processor
Final rinse/reclaimed water $\rightarrow$ initial rinse $\rightarrow$ irrigation
Non-potable:  ... is possible  
... is allowed  
... could be useful

As long as:

Water quality criteria for use in FFV supply chains is **risk-based** and established within the framework of national food and water regulations, as long as water is FfP
Safety and quality of water
Field testing the JEMRA guidance

Ana Allende (CEBAS-CSIC)

Impact of Water Use and Reuse in Food Production and Processing on Food Safety at the Consumer Phase: Focus on the Fresh Fresh Fr

Thu, Dec 14, 2023 9:00 AM - 10:00 AM EST
The New Codex Alimentarius Framework for Safe Water Reuse in Food Production and Processing

6 Decision trees: Reports from the meeting breakout groups

d. Decision tree approach

For practical guidance, a decision tree (DT) approach with underlying risk assessment (RA) will be considered a useful decision support systems (DSS) tool to identify opportunities for levels of log microbial reduction required for water to be considered fit for purpose. In view of the importance of building on existing work, a review will be conducted of existing documents on this approach and key points relevant to food safety managers extracted.
6 Decision trees

6.1 Fresh produce pre- and post-harvest

Step 1. Context assessment

Is the crop eaten raw?

YES

Does irrigation water come into contact with the edible parts? (also liquid pesticides, agrochemicals, water for spray-cooling?)

YES

Is fit-for-irrigation purpose for your situation defined by national/local regulations or guidelines

YES

Comply with regulations

NO

Comply with GAPs (FAO)

NO

Can you perform an appropriate microbial risk assessment to evaluate your situation and select mitigation measures as per WHO 2006 and 2016?

YES

Conduct risk assessment, select mitigation measures

NO

What is the source of your water?

- Potentially high or unknown risk water (e.g. wastewater, surface water, shallow groundwater)
- Potentially medium risk water (e.g. collected rainfall)
- Potentially low risk water (e.g. potable water, deep groundwater)
Decision trees

- Key elements of DTs identified were:
  > characterization of water sources and the distribution and use systems to identify the risks linked to the site-specific water source;
  > identification of the risk based on the type of application (foliar or non-foliar) and the type of crop (e.g. leafy greens versus fruit trees);
  > testing/monitoring based on quantification of generic *E. coli*;
  > frequency and stringency of sampling, in some cases defined according to the identified potential risks.
Most DTs include simple yes/no answers. The most complex ones include identification of critical control points (CCPs) in water reuse systems.

DTs can be designed with additional information to help the growers understand the risks and the potential interventions that are available; this approach is highly recommended.
6 Decision trees

6.3 Reuse of water in a food establishment

**Purpose:**
- Not for food contact applications
- No microbiological requirements for consumer food safety

**Re-used water**
- Food contact applications (food or food contact surfaces)
- Microbiological Safety requirement: re-use water should not compromise

**Is contact of the reuse water (as reclaimed/recycled) with food materials impossible due to passive management, i.e. design and infrastructure of Food operation?**

**Are microbiological hazards absent in the reuse water or present at acceptable levels, i.e. levels that do not compromise the consumer food safety of the concerned ingredient/food?**

- **Fit-for-purpose for intentional and unintentional food contact applications**
- Build active management into your food safety management system, including validation of control measures as well as monitoring and verification of control during day-to-day operation

**Is active management feasible to consistently exclude contact of reuse water with food materials?**

**Can reuse water be treated to avoid presence of hazards or to control hazards to acceptable levels?**

- **N**
- **Y**

**Theory:**
- A → B

**Practice:**
- A + 123 → B
Theory: A → B

Practice: A → B
HONDURAS, October 2022
Taller del trabajo conjunto de la FAO/OMS sobre la inocuidad y calidad del agua utilizada en la producción y procesamiento de alimentos

AGENDA PROVISIONAL

Comayagua, Honduras, 11-13 de octubre de 2022
Visiting industries:

- Growers (Irrigation water)
- Producers (water reuse)
Questions made to the growers:

• Which is your source of water?
• Is the water re-circulated?
• Do you use any chlorine treatment?
• Which type of irrigation system you use?
• Is the crop in contact with irrigation or any other non-potable water in the field directly after harvest?
• Is there any risk of cross-contamination during handling and processing?
People was divided in 5 groups:

- Irrigation system in greenhouse (3 groups)
- Water-reuse (2 group)

Based on their notes they followed the DTs to assess the water source:

- Primary production
- Water reuse
## Context and Qualitative Risk Assessment: Irrigation Water

<table>
<thead>
<tr>
<th>Context Assessment</th>
<th>Algorithm</th>
<th>Then</th>
<th>Algorithm</th>
<th>Then</th>
<th>Algorithm</th>
<th>Then</th>
<th>Algorithm</th>
<th>Then</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the crop consumed raw?</td>
<td>NO</td>
<td>Comply with GAPs (FAO)</td>
<td>NO</td>
<td>Comply with GAPs (FAO)</td>
<td>NO</td>
<td>Comply with regulations and guidelines</td>
<td>NO</td>
<td>Can you perform a full MRA to evaluate your situation and select mitigation measures?</td>
</tr>
<tr>
<td></td>
<td>YES</td>
<td>Does the water come into contact with the edible parts?</td>
<td>NO</td>
<td>Is fit-for-purpose for your situation defined by national/local regulations or guidelines</td>
<td>YES</td>
<td>Conduct MRA</td>
<td>YES</td>
<td>Conduct MRA</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>Does the water come into contact with the edible parts?</td>
<td>YES</td>
<td>Conduct MRA</td>
<td>NO</td>
<td>What is the type of your water source?</td>
<td>NO</td>
<td>What is the type of your water source?</td>
</tr>
</tbody>
</table>
• The water source was groundwater and surface water collected in a water reservoir
• Most of the participants interpreted it as Potentially high or unknown risk water
• However, a chlorine treatment was given to the water before entering the greenhouse
• This control measure was not considered as this was not an option included in the DT.

Note: Although multiple options have been given in the DT, control measures applied at the water source have not been included in the first DT, which makes it difficult to classify those water sources.
<table>
<thead>
<tr>
<th>Risk mitigation options</th>
<th>Effectiveness rating</th>
<th>Step 2 cross-reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative water source such as deep well or potable water</td>
<td>· · · · ·</td>
<td>RR1</td>
</tr>
<tr>
<td>Change from raw eaten vegetables to boiled vegetables</td>
<td>· · · ·</td>
<td>RR2</td>
</tr>
<tr>
<td>Change from overhead irrigation (sprinklers, watering cans) to: Furrow irrigation</td>
<td>· · · ·</td>
<td>RR3</td>
</tr>
<tr>
<td>Drip irrigation</td>
<td>· · · ·</td>
<td></td>
</tr>
<tr>
<td>On-farm water treatment ponds with 18+ hrs sedimentation period</td>
<td>·</td>
<td>RR4</td>
</tr>
<tr>
<td>Water fetching without disturbing pond sediment</td>
<td>·</td>
<td></td>
</tr>
<tr>
<td>Filtering water before irrigation (e.g. fine sand, biochar)</td>
<td>·</td>
<td>RR4</td>
</tr>
<tr>
<td>Irrigation cessation for three days (no watering before harvest)</td>
<td>· · · ·</td>
<td>RR5</td>
</tr>
<tr>
<td>Note: in hot climates, prolonged irrigation cessation is not feasible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peeling fresh produce (e.g. root crops, fruits, removal of cabbage outer leaves)</td>
<td>· · · ·</td>
<td>RR5</td>
</tr>
<tr>
<td>Washing salad with running potable water</td>
<td>·</td>
<td>RR6</td>
</tr>
<tr>
<td>Washing salad with running potable water and added sanitizer</td>
<td>· · · ·</td>
<td></td>
</tr>
<tr>
<td>TARGET FOR RISK REDUCTION (RR)</td>
<td>· · · · · ·</td>
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<tr>
<td>Example: assuming a target of 6 stars, assuming reduction is additive</td>
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<tr>
<td>Filtering water + Drip irrigation + Produce washing with sanitizer = · · · · · · ·</td>
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</table>
GUIDELINES FOR THE SAFE USE AND RE-USE OF WATER IN FOOD PRODUCTION AND PROCESSING

Is the crop eaten raw?

Yes

No

Comply with Good Agricultural Practices

Does irrigation water come into contact with the edible parts? (also liquid pesticide, agrochemicals, water for spraying?)

Yes

No

Is it fit-for-irrigation purpose for your situation defined by national/local regulations or guidelines?

Yes

Comply with regulations

No

Do you have the capacity to perform a water fit for purpose assessment and implement mitigation measures?

Yes

No

Comply water fit-for-purpose assessment, and select mitigation measures

What is the source of your water?

Potentially high or unknown risk water (e.g., wastewater, surface water, shallow groundwater)

Potentially medium risk water (e.g., collected rainwater)

Potentially low risk water (e.g., potable water, deep groundwater)
Example of a decision tree for water testing frequency
## Context and Qualitative Risk Assessment of Water Reuse

### Decision tree for deciding if re-used water can be used in either a food contact or non-food contact application

1. Is contact of the reuse water with food materials impossible due to the design and infrastructure of the food business operation?
   - **YES** Fit-for-purpose for all not-for-food contact applications
   - **NO** Are validated control measures in place that consistently exclude contact of reuse water with food materials?
     - **YES** Fit-for-purpose for all not-for-food contact applications
     - **NO** Not fit for purpose

2. Are microbiological hazards absent in the reuse water or present in an acceptable level?
   - **YES** Fit-for-purpose for all not-for-food contact applications
   - **NO** Can reuse water be treated to avoid presence of hazards or to control hazards to acceptable levels?
     - **YES** Fit-for-purpose for food contact applications
     - **NO** Can reuse water be limited to applications other than as food ingredient?
       - **YES** Fit-for-purpose only for food applications other than as ingredient or final cleaning/washing
       - **NO** not-fit for purpose
Figure 2. Example of a potential option for water re-use in the fresh produce industry.
Conclusions

- All the participants found the decision tree for the water reuse very useful to identify areas where water can be reuse.
- The Decision Trees are useful for the classification of the water source but Control Measures should be integrated already before the final classification of the water source.
- SLIGHT ADAPTATIONS TO SPECIFIC CONTEXT MIGHT BE NECESSARY
- More initiatives to transmit the new framework would be welcome 😊
• Assessment of irrigation water interventions and controls on farms, especially those applicable to low resource settings.

• Data on the survival of various pathogens under real-world water quality conditions to support lab-based observations.

• Increase community empowerment and partnerships that support irrigation water management.

• **Improved education and training** for different stakeholders on irrigation and water quality management.
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