

**Five keys to growing safer fruits  
and vegetables:  
promoting health by decreasing  
microbial contamination**



World Health  
Organization

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## Safety of fruits and vegetables is a significant public health security issue

**WHO promotes integration of food safety education in nutrition and food security programmes**

The importance of fruits and vegetables in nutritious and healthy diets is well recognized, and in recent years consumers have been encouraged to eat more of these products. For many countries, particularly developing countries, these products have become a valuable commodity. At the same time, food safety problems linked to the consumption of fresh fruits and vegetables contaminated with microorganisms are increasing. Recent foodborne outbreaks linked to the consumption of leafy greens, tomatoes, sprouts and green peppers clearly demonstrate that the consumption of contaminated fruits and vegetables represents an important source of foodborne disease. Efforts to minimize the microbial contamination of fresh fruits and vegetables are essential and timely.

### The work of the World Health Organization (WHO)

As part of its strategy to decrease the burden of foodborne diseases, WHO develops risk assessments, recommends risk management options, and translates complex scientific knowledge into simple risk communication messages for stakeholders, including consumers. In 2001, WHO developed the *Five Keys to Safer Food*<sup>1</sup> global message and training materials to educate all food handlers, especially consumers preparing food for their families in the home. The *Five Keys to Safer Food* message is now recognized as an international reference source for conducting national food safety education programmes aimed at preventing foodborne diseases. WHO is now extending the *Five Keys to Safer Food* concept to cover additional groups across the farm to table continuum to promote safe food handling practices.

### The manual *Five keys to growing safer fruits and vegetables: promoting health by decreasing microbial contamination*

In 2008, a joint Food and Agriculture Organization of the United Nations (FAO)/WHO Expert Meeting on the microbiological hazards in fresh leafy vegetables and herbs reviewed the scientific data and made recommendations for limiting the risks associated with microbial contamination of these products<sup>2</sup>. An important recommendation from the meeting was that the WHO develop educational materials based on the *Five Keys to Safer Food* concept. This concept is that a simple global message based on scientific evidence must be easy to use, adopt and adapt so that community and health educators can tailor the training materials to meet local needs.

The manual *Five keys to growing safer fruits and vegetables* promotes understanding of the links between the health of humans, animals and the environment and how failures in good hygienic practices in one sector can affect the others.

**Education in food safety goes far beyond its goals**

The adoption of effective food safety behaviors when growing and handling fruits and vegetables will have impact on overall hygienic behaviors, which will contribute to improve community health and ultimately aid in achieving the UN Millennium Development Goals<sup>3</sup> that aim to reduce poverty, empower women, reduce child mortality and improve access to basic sanitation.

<sup>1</sup> The WHO *Five Keys to Safer Food* at [www.who.int/foodsafety/consumer/5keys/en](http://www.who.int/foodsafety/consumer/5keys/en)

<sup>2</sup> Microbiological hazards in fresh leafy vegetables and herbs at [www.who.int/foodsafety/publications/micro/mra\\_fruit-veges/en/](http://www.who.int/foodsafety/publications/micro/mra_fruit-veges/en/)

<sup>3</sup> UN Millenium Development Goals at [www.who.int/topics/millennium\\_development\\_goals/en/](http://www.who.int/topics/millennium_development_goals/en/)



## Target audience

The manual is designed to support food safety education of rural workers, including small farmers<sup>4</sup> who grow fresh fruits and vegetables for themselves, their families and for sale in local markets. The course is designed to be used by health educators conducting health promotional teaching in rural communities. However, the manual can also be used by sanitarians, producers, environmental engineers, agriculture school teachers and health professionals, or by rural workers themselves.

## Contents

The manual describes key practices to reduce microbial contamination of fresh fruits and vegetables during planting, growing, harvesting and storing.

The Five keys practices are:

1. Practice good personal hygiene
2. Protect fields from animal faecal contamination
3. Use treated faecal waste
4. Evaluate and manage risks from irrigation water
5. Keep harvest and storage equipment clean and dry

The Five keys practices presented in the manual aim at reducing microbial contamination only, thus do not address contamination by chemical or other hazards. It is important to note that the key practices discuss reducing rather than eliminating contamination of fruits and vegetables from dangerous microorganisms. Knowledge and technologies that can eliminate all food safety problems associated with the microbial contamination of fruits and vegetables do not exist.

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<sup>4</sup> Major industrial farmers would refer to the Good Agricultural Practices (GAP) developed by the FAO

**The manual is divided into three sections.**

**Section One** explains the basic concepts of microbial contamination which should be explained to the trainees.

**Section Two** presents the core information of the Five keys messages, the scientific rationale, the public health and environmental security aspects, and suggests how to communicate the messages.

**Section Three** contains information for the trainer related to planning the training sessions, and suggests training exercises and discussion points that emphasize and review the practices. Included in the manual is an example of evaluation form for the trainers.

A glossary of terms used in the manual is provided for reference.

### **Adaptation**

WHO encourages trainers to adapt the non-scientific content of the training materials and develop the most effective ways to deliver the messages and influence behavioral changes. WHO also recognizes that the health professionals are the most qualified to tailor this material and design a training session that is adapted to their local needs.

### **Validation of the course and acknowledgements**

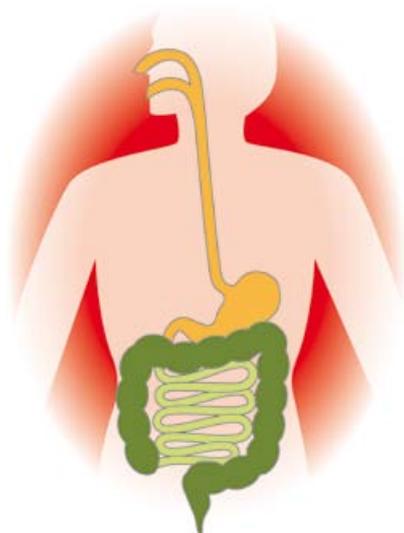
This course was developed by the WHO Department of Food Safety and Zoonoses with the technical contribution from the Water, Sanitation, Hygiene and Health unit. The support of the Pan American Health Organization (PAHO) and the governments of Belize, Guatemala and El Salvador in organizing three pilot-sessions to validate the manual is greatly acknowledged, as well as the contributions from the participants attending the pilot-sessions.

Thanks are also extended to the United States Food and Drug Administration (USFDA) for their technical and financial support.





## What is foodborne disease?



Every day, people all over the world get sick from the food they eat. This sickness is called foodborne disease and can be caused by dangerous microorganisms.

Eating fruits and vegetables contaminated with dangerous microorganisms is a source of foodborne disease.

Preventing microbial contamination is the best way to prevent disease and improve your health and that of your family and community.

### Training tip:

For simpler language, use the terms “germs” for microorganisms.

## What are microorganisms?

Microorganisms are very small living things. In fact, they are so small that they cannot be seen with the naked eye.

There are three different types of microorganisms: the good, the bad and the dangerous.

Good microorganisms are useful. They are used to:

- ◆ Make food and drinks (e.g. cheese, yoghurt, beer and wine)
- ◆ Make medicine (e.g. penicillin) ; and
- ◆ Help digest the food you eat

Bad microorganisms, or spoilage microorganisms, usually do not make people sick. However, they cause food to look, smell and taste bad.

Dangerous microorganisms make people sick and can even cause death. Bacteria, viruses, yeasts, moulds and parasites are all microorganisms.

Most dangerous microorganisms do not change the appearance of the food, so you usually can't tell that the food is contaminated with dangerous microorganisms by just looking, smelling or tasting it.

### Training tips:

Become familiar with dangerous microorganisms in your region. Stress that microorganisms cannot be seen.

Providing pictures or actual examples of mouldy fruit may add interest, but be sure to stress the important point that dangerous microorganisms may not always make the food smell, taste or look bad.



## How does microbial contamination occur?

### Microorganisms are everywhere.

All living things have microorganisms associated with them.

Animals including humans carry microorganisms in their mouths, gut and on their skin including hands and feet.

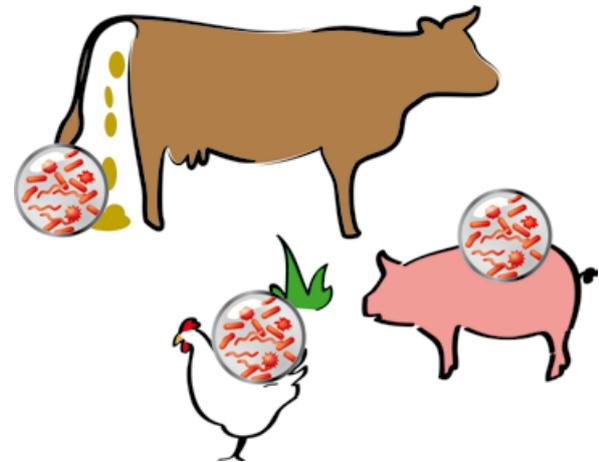
Many dangerous microorganisms are excreted in human and animal faeces.

Microorganisms rely on someone or something to move them around. The transfer of microorganisms from one surface to another is called "contamination".

Hands are a common vehicle of transferring dangerous microorganisms.

In the growing field, contamination with dangerous microorganisms comes directly from faecal material and indirectly from:

- ◆ Poor personal hygiene practices of workers
- ◆ Human and animal faeces, including bird droppings in the growing fields
- ◆ Untreated faecal waste used as fertilizer
- ◆ Contaminated water sources
- ◆ Use of dirty harvest equipment, containers, and storage facilities



#### Training tip:

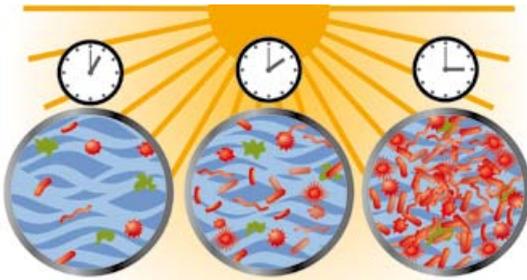
Give a demonstration of contamination by touching your hand to your face and then touching some food with that same hand.



## How do microorganisms grow?

Most microorganisms “grow” by multiplication. To multiply, microorganisms need:

- ◆ Food
- ◆ Water
- ◆ Time
- ◆ Warmth



One dangerous microorganism can become 2 in just 15 minutes. This means that within 6 hours, 1 bacterium can multiply to over 16 million.

To become harmful, some dangerous microorganisms need to grow to large numbers. Other dangerous microorganisms can cause illness when they are present in very low numbers.

Under favourable environmental conditions, dangerous microorganisms can survive and multiply for long periods of time (even months) on the surface of fruits and vegetables. This is particularly dangerous to health because fruits and vegetables are often eaten raw.

Dangerous microorganisms may be on the outside of the fruits or vegetables, in which case washing the fruits and vegetables with safe water before eating will remove some dangerous microorganisms.

In other instances, dangerous microorganisms are inside the fruits or vegetables, and cannot be removed by washing.

### Training tips:

Discuss local foods that do and do not provide the ideal conditions for growth of microorganisms.

Demonstrate the concept of microbial growth using dried beans, pebbles or other objects.

Start with one object. In 15 seconds make it two objects, in another 15 seconds make it 4 objects and in another 15 seconds make it 8 objects, etc. (double the number of objects you have every 15 seconds).

Note: For this demonstration, 15 seconds is used instead of 15 minutes, which is the actual time it takes for most bacteria to multiply. This enables you to show how dangerous microorganisms multiply, working within the time constraints of a training session.



Good microorganisms



Bad microorganisms



Dangerous microorganisms

## What are the symptoms of foodborne disease?

Every year, billions of people experience one or more episodes of foodborne disease, without ever knowing that it was caused by food.

The most common symptoms of foodborne disease are:

- ◆ Stomach pains
- ◆ Vomiting
- ◆ Diarrhoea

The symptoms depend on the cause of the disease. Symptoms may occur very quickly after eating the food, or may take days or even weeks to appear. For most foodborne diseases, symptoms occur 24 -72 hours after the food has been eaten.



It is estimated that 3% of foodborne disease cases can lead to long-term health problems. Very severe diseases, including arthritis and neurological disorders can be caused by contaminated food.

Some foodborne diseases can be transferred from person to person. Caregivers can become sick from family members with a foodborne disease.

For infants, the sick people, pregnant women and the elderly, the consequences of foodborne disease are usually more severe and more often fatal.

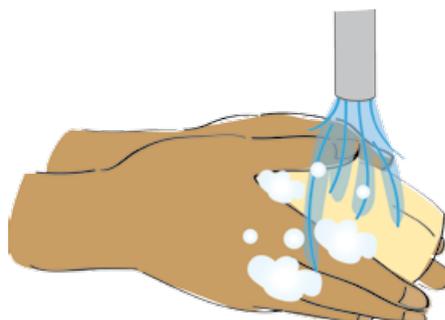
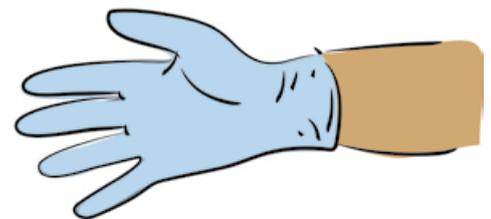
## What to do if you get sick?

Try not to handle or prepare food while you are sick, and for 48 hours after your symptoms stop. However, if this cannot be avoided, wash your hands with soap and water before and frequently during food preparation.

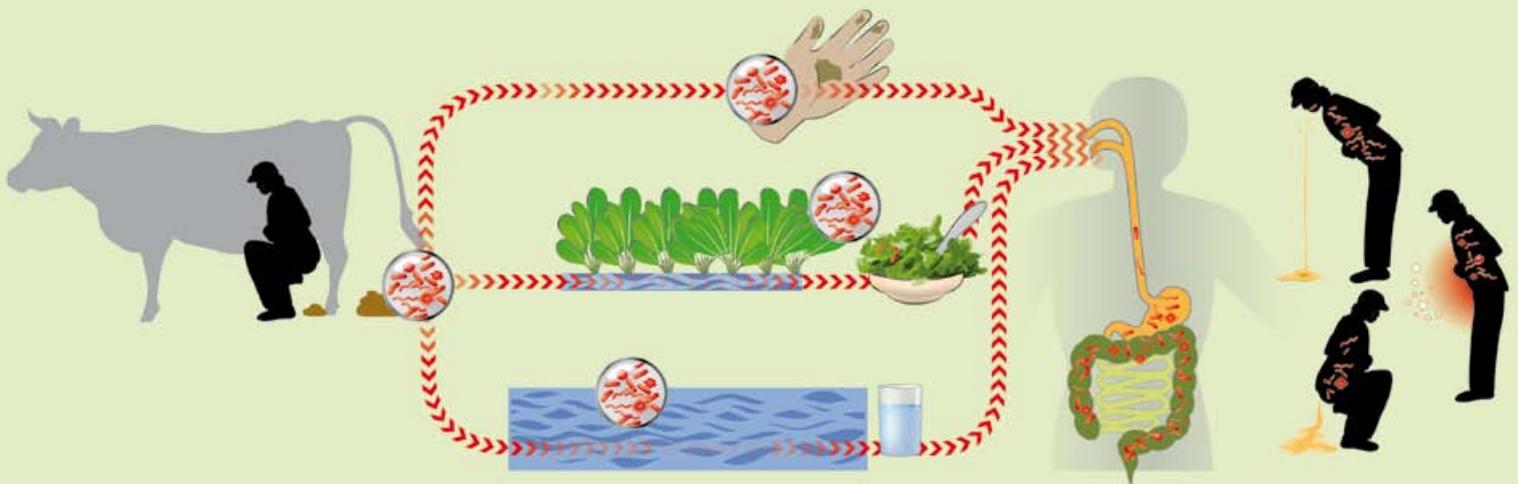
Mouth masks are recommended for people who may cough or sneeze while handling food. Gloves can be used to cover any cuts or lesions and should be changed frequently.

Advice on treatment of foodborne disease differs between countries and should be adapted to the local region.

However, as a general rule, one should drink plenty of fluids to maintain hydration during diarrhea and seek medical advice when bowel movements are very frequent, very watery or contain blood, or when symptoms last beyond 3 days.



## How microorganisms are spread

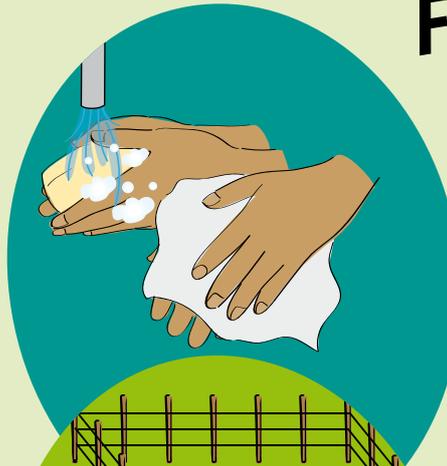


- ◆ Many dangerous microorganisms are excreted in human and animal faeces.
- ◆ Hands are a common vehicle for transferring dangerous microorganisms.
- ◆ Contaminated water applied directly to fruits and vegetables will spread dangerous microorganisms.
- ◆ Contaminated water directly consumed as drinking water will also contain dangerous microorganisms.

Following the *Five keys to growing safer fruits and vegetables* will contribute to prevent foodborne diseases.

# Five keys to growing safer fruits and vegetables

Promoting health by decreasing microbial contamination



## Practice good personal hygiene

- ◆ Wash and dry hands with a clean, dry towel after toileting, diapering a child and contact with animals
- ◆ Change clothes and bathe regularly
- ◆ Cover cuts, lesions and wounds
- ◆ Use a toilet or latrine to urinate and defaecate

**Why?** Dangerous microorganisms are found in human and animal faecal waste, and infected wounds, and can be transferred to fruits and other surfaces. Good personal hygiene practices help prevent the transfer of dangerous microorganisms to fruits and vegetables and decrease the risk of foodborne diseases.



## Protect fields from animal faecal contamination

- ◆ Keep animals from roaming in growing fields
- ◆ House livestock downhill from growing fields in a fenced area
- ◆ Remove trash from in and around growing fields

**Why?** Dangerous microorganisms in animal faeces can contaminate crops directly when animal defecate in fields - or indirectly when rainwater becomes contaminated with dangerous microorganisms and runs downhill into the growing fields. Trash, food and water in and around growing fields attract animals including wild birds.



## Use treated faecal waste

- ◆ Use faecal waste (manure and human excreta) that is properly treated
- ◆ Apply treated faecal waste to fields prior to planting
- ◆ Maximize the time between the application of treated faecal waste and harvest

**Why?** Properly treated faecal waste (manure and human excreta) is an effective and safe fertilizer. Dangerous microorganisms in human and animal faecal waste can survive for long period of time and contaminate fruits and vegetables. Faecal waste must be treated to kill the microorganisms.



## Evaluate and manage risks from irrigation water

- ◆ Identify all water sources relevant to your growing field
- ◆ Be aware of the risk of microbial contamination of water
- ◆ Protect water from faecal contamination
- ◆ Apply control measures when using water contaminated or of unknown quality

**Why?** Water is needed for humans, animals and agriculture. The risk of microbial contamination of different water sources varies. Dangerous microorganisms in faecal waste can contaminate water and then be transferred to soil and crops via irrigation. Water used for irrigation of fruits and vegetables must not introduce dangerous microorganisms.



## Keep harvest and storage equipment clean and dry

- ◆ Wash harvest and storage equipment with clean water and dry before use
- ◆ Keep containers off the ground before, during and after harvesting
- ◆ Remove visible dirt and debris from fruits and vegetables in the field
- ◆ Cool fruits and vegetables quickly
- ◆ Limit access of animals, children and other non-workers to the harvest and storage areas

**Why?** Fruits and vegetables can become contaminated with dangerous microorganisms during harvest by contact with contaminated hands, soil, harvest equipment and storage facilities. Wet or damp surfaces promote the growth of dangerous microorganisms.



World Health Organization



## Key 1 - Practice good personal hygiene

Core information	Why?
<ul style="list-style-type: none"> <li>◆ Wash and dry hands with a clean, dry towel after toileting, diapering a child and contact with animals</li> <li>◆ Change clothes and bathe regularly</li> <li>◆ Cover cuts, lesions and wounds</li> <li>◆ Use a toilet or latrine to urinate and defaecate</li> </ul>	<p>Dangerous microorganisms are found in human and animal faecal waste, and infected wounds, and can be transferred to fruits and vegetables by hands, clothing and other surfaces. Good personal hygiene practices help prevent the transfer of dangerous microorganisms to fruits and vegetables and decrease the risk of food-borne diseases.</p>

### Health and environmental security

Good personal hygiene prevents not only the spread of foodborne diseases but many infectious diseases. Therefore practicing the recommendations of this key extends beyond food safety to improve health in general.

### How to practice good personal hygiene

- ◆ Wash hands using the proper hand washing procedure before entering the field and frequently when working with food:
  1. Wet hands under clean, safe running water. Add soap
  2. Wash hands, wrists, in between fingers and under nails in clean, safe water using soap. Continue to rub hands together with soap for at least 20 seconds
  3. Rinse hands under clean, safe running water
  4. Dry hands thoroughly with a clean, dry towel. If possible, use a paper towel
- ◆ Trim and clean fingernails regularly
- ◆ Dispose of all used toilet tissue and feminine hygiene products in the toilet, latrine or covered bucket
- ◆ Avoid working in the fields when sick

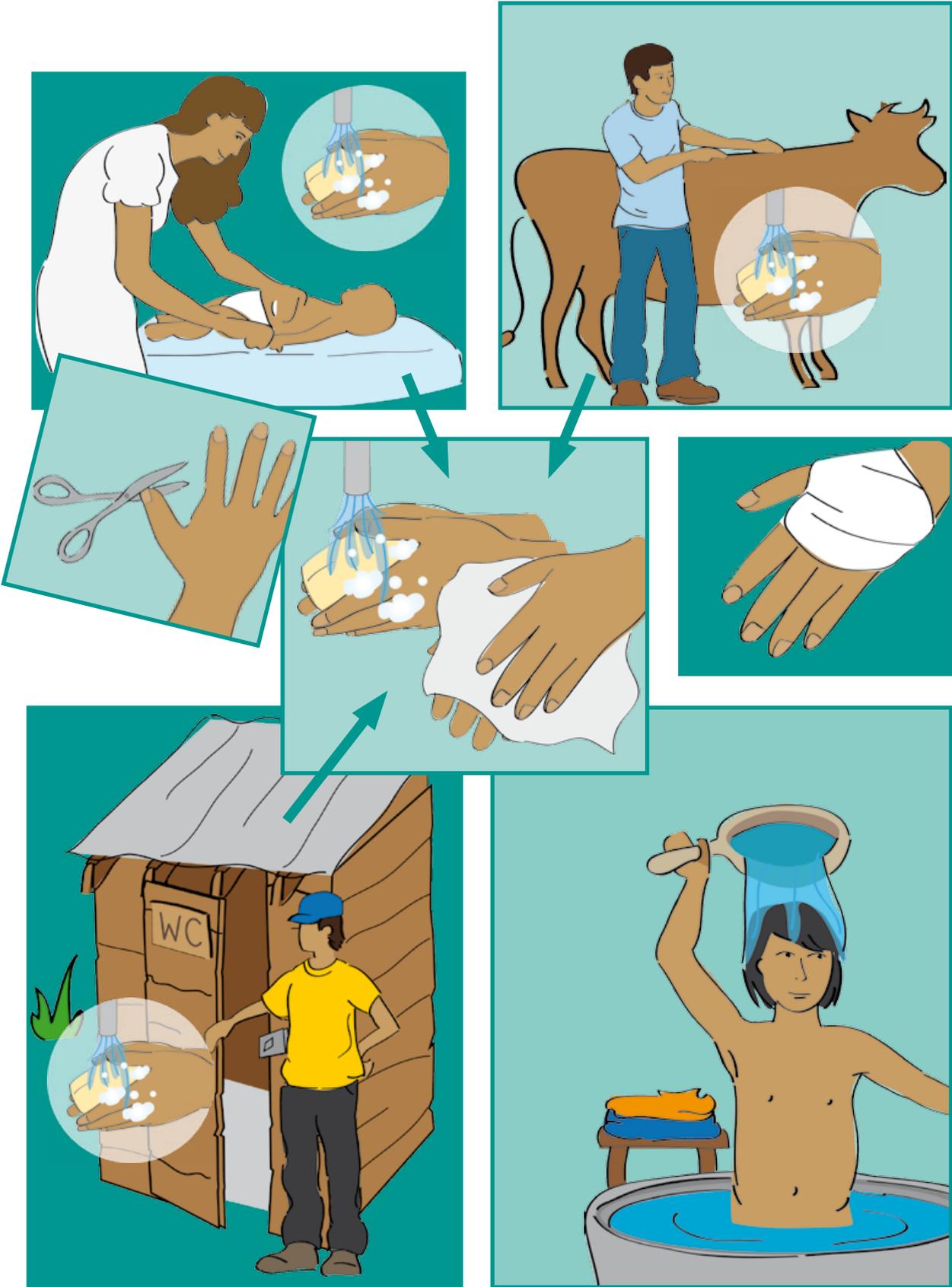
### Considerations for the trainer

*While washing with soap and water is ideal, many people do not have access to soap or detergent. Cool ash is commonly used as a substitute for soap. This method for handwashing is acceptable.*

*If toilet or latrine is not available, use a covered bucket designated for human excreta (sometimes called a "honey bucket"). Empty the honey bucket in areas away from the growing fields and water sources.*

*If one must work in the field when sick, employ additional hygienic measures including personal protective equipment (gloves, mouth masks,...) and frequent handwashing.*

Practice good personal hygiene





## Key 2 - Protect fields from animal faecal contamination

Core information	Why?
<ul style="list-style-type: none"><li>◆ Keep animals from roaming in growing fields</li><li>◆ House livestock downhill from growing fields in a fenced area</li><li>◆ Remove trash from in and around growing fields</li></ul>	<p>Dangerous microorganisms in animal faeces can contaminate crops directly when animal defaecate in fields - or indirectly when rainwater becomes contaminated with dangerous microorganisms and runs downhill into the growing fields. Trash, food and water in and around growing fields attract animals, including wild birds.</p>

### Health and environmental security

The dangerous microorganisms in animal faeces can survive for a long time up to several months. The risk of faecal contamination increases with the number of animals entering the field, the number of times they enter the field, and the length of time they remain in the field. Droppings from wild birds can contaminate fruits and vegetables and cause human illness.

### How to protect fields from animal faecal contamination

- ◆ Put animals in a fenced area or pen to prevent them from entering the growing fields
- ◆ Place items that look scary or make noise (such as a scarecrow or windmill) around the outside of crops to keep animals out of the growing fields
- ◆ Put shiny ribbons around the growing fields to scare away birds
- ◆ Keep animals out of the growing fields, especially close to harvest time
- ◆ If feasible, do not use livestock for harvesting fruits and vegetables that are eaten without cooking
- ◆ Remove trash from around the growing fields helps to keep animals and birds away

### Considerations for the trainer

*If it is not possible to prevent animals from entering the growing fields, limit the number of animals that enter the growing fields, the number of times that they enter, and the time they remain in the fields to minimize the risk of faecal contamination.*

## Protect fields from animal faecal contamination





## Key 3 - Use treated faecal waste

Core information	Why?
<ul style="list-style-type: none"><li>◆ Use faecal waste (manure and human excreta) that is properly treated</li><li>◆ Apply treated faecal waste to fields prior to planting</li><li>◆ Maximize the time between the application of treated faecal waste and harvest</li></ul>	<p>Properly treated faecal waste (manure and human excreta) is an effective and safe fertilizer. Dangerous microorganisms in human and animal faecal waste can survive for long period of time and contaminate fruits and vegetables. Faecal waste must be treated to kill the microorganisms.</p>

### Health and environmental security

Direct discharge of faecal waste (manure and human excreta) into surface waters (e.g. rivers, ponds, streams) harms human and animal health and causes environmental damage. Faecal waste should be properly treated in order to ensure that dangerous microorganisms will not contaminate fresh fruits and vegetables. Treatment can be combined with other measures such as applying treated faecal waste to fields prior to planting and maximizing the time between application and harvest.

### How to treat manure

Manure is a mixture of animal faeces, urine and vegetable waste.

- ◆ Ageing is one way to treat manure. The manure is simply stacked in a pile (away from the growing field and water sources) and left for a long period of time (up to one year) with no further additions of fresh manure. Dangerous microorganisms die due to natural heating.
- ◆ Another common treatment involves turning the manure pile. This is a practical and efficient way to inactivate dangerous microorganisms. The manure is placed in a pile or enclosed bin (away from the growing field and water sources) and periodically exposed to air to accelerate decay.
- ◆ Hand turning is the most common way to add air to manure. Manure on the outside is turned inside where it is subjected to higher temperatures. A cover can be placed on the bin to ensure the manure reaches appropriate temperatures (at least 55 °C) uniformly. The whole process should last at least 3 months.

### How to treat human excreta

Human excreta is a mixture of urine and faeces.

Use of human excreta as fertilizer is a greater health risk than manure because human faeces may contain bacteria, viruses and parasites that cause human-specific diseases. One method for treating human excreta is to prolong storage (without addition of new material) up to two years to ensure the death of dangerous microorganisms<sup>1</sup>.

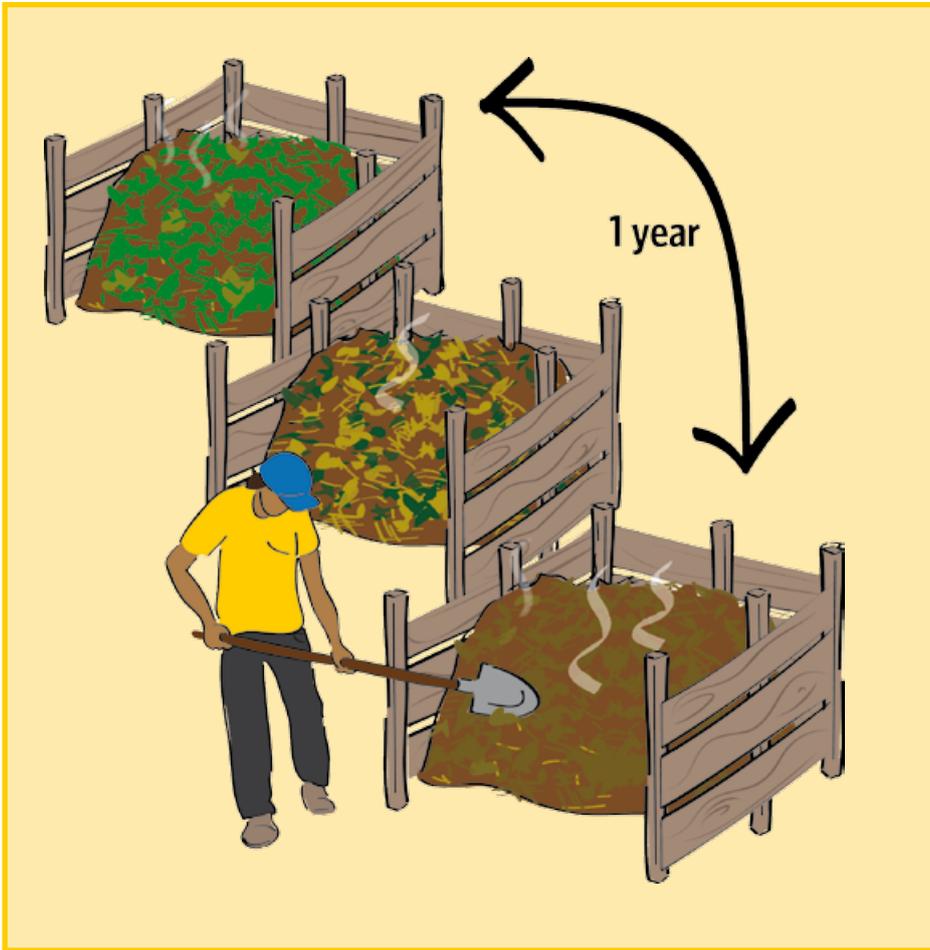
### Considerations for the trainer

*Most standards for the use of manure and human excreta in agriculture are based on plant nutrient requirements, not health concerns.*

*Since the length of time required for dangerous microorganisms to die depends on manure composition, temperature and moisture, the ageing of manure varies greatly from region to region.*

<sup>1</sup> WHO Guidelines for the use of wastewater, excreta and greywater (2006).  
Volume 4: Excreta and greywater use in agriculture at [www.who.int/water\\_sanitation\\_health/wastewater/gsuweg4/en](http://www.who.int/water_sanitation_health/wastewater/gsuweg4/en)

## Use treated faecal waste





## Key 4 - Evaluate and manage risks from irrigation water

Core information	Why?
<ul style="list-style-type: none"><li>◆ Identify all water sources relevant to your growing field</li><li>◆ Be aware of the risk of microbial contamination of water</li><li>◆ Protect water from faecal contamination</li><li>◆ Apply control measures when using water contaminated or of unknown quality</li></ul>	<p>Water is needed for humans, animals and agriculture.</p> <p>The risk of microbial contamination of different water sources varies.</p> <p>Dangerous microorganisms in faecal waste can contaminate water and then be transferred to soil and crops via irrigation. Water used for irrigation of fruits and vegetables must not introduce dangerous microorganisms.</p>

### Health and environmental security

Water contaminated with dangerous microorganisms is a major source of human illness when consumed directly or used in food production and preparation. Improving water quality is a primary public intervention needed to improve human health. When supplies are limited, use of water for basic human needs take precedence over all others, including agriculture uses.

The risk of microbial contamination of different water sources generally increases according to the following ranking, from low to high risk: 1) rainwater, 2) groundwater collected from deep wells, 3) groundwater collected from shallow wells, 4) surface waters, and 5) raw or inadequately treated wastewater.

Animal and human faecal waste can contaminate water with dangerous microorganisms, with surface waters especially prone to contamination. Measures need to be put in place to prevent such contamination passing to fruits and vegetables and impacting on human health. If the quality of water is poor, unknown or cannot be controlled, crop contamination is minimized by applying control measures.

### How to evaluate and manage risks from irrigation water

- ◆ Understand the source(s) of water used for irrigation and the steps in storage, transport and handling up to when it is used in your growing field
- ◆ Identify the risks at each step where contamination may be introduced
- ◆ Identify control measures that can reduce contamination entering the water or being transferred to crops
- ◆ If possible, test the water to verify its quality

### Examples of risk control measures

- ◆ Build a fence around water sources to prevent intrusion of animals
- ◆ Cover wells, build a concrete apron (1 meter radius) around them or hand pumps, and maintain them in good working condition to prevent contamination of groundwater
- ◆ Locate latrines and store manure, faecal waste and fertilizers downhill and at least 10 meters away from water sources to prevent contamination of groundwater

- ◆ Avoid washing soiled work clothes and diapers in water used for irrigation
- ◆ Collect and maintain good quality rainwater in well-designed harvesting systems with regular cleaning of catchments and gutters
- ◆ Protect openings of rainwater storage tanks with meshes to prevent contamination by debris, leaves, animals, and the breeding of insect vectors
- ◆ Minimize the direct contact of irrigation water with the edible parts of fruits and vegetables by avoiding use of overhead sprinklers or intentional flooding
- ◆ Use a drip or furrow irrigation system<sup>1,2</sup>, that delivers water directly to the soil and not onto the plants
- ◆ Maximize the interval between irrigation and harvest (at least one month when wastewater is used)

### Considerations for the trainer

If water of poor or uncontrolled quality is used in the growing field, a Sanitation Safety Plan should be adopted to minimize risks to farm workers, local communities and crop contamination. WHO has specified requirements to promote the safe use of wastewater and excreta in agriculture, including a risk management approach that can be established at a level that is realistic under local conditions<sup>3</sup>.

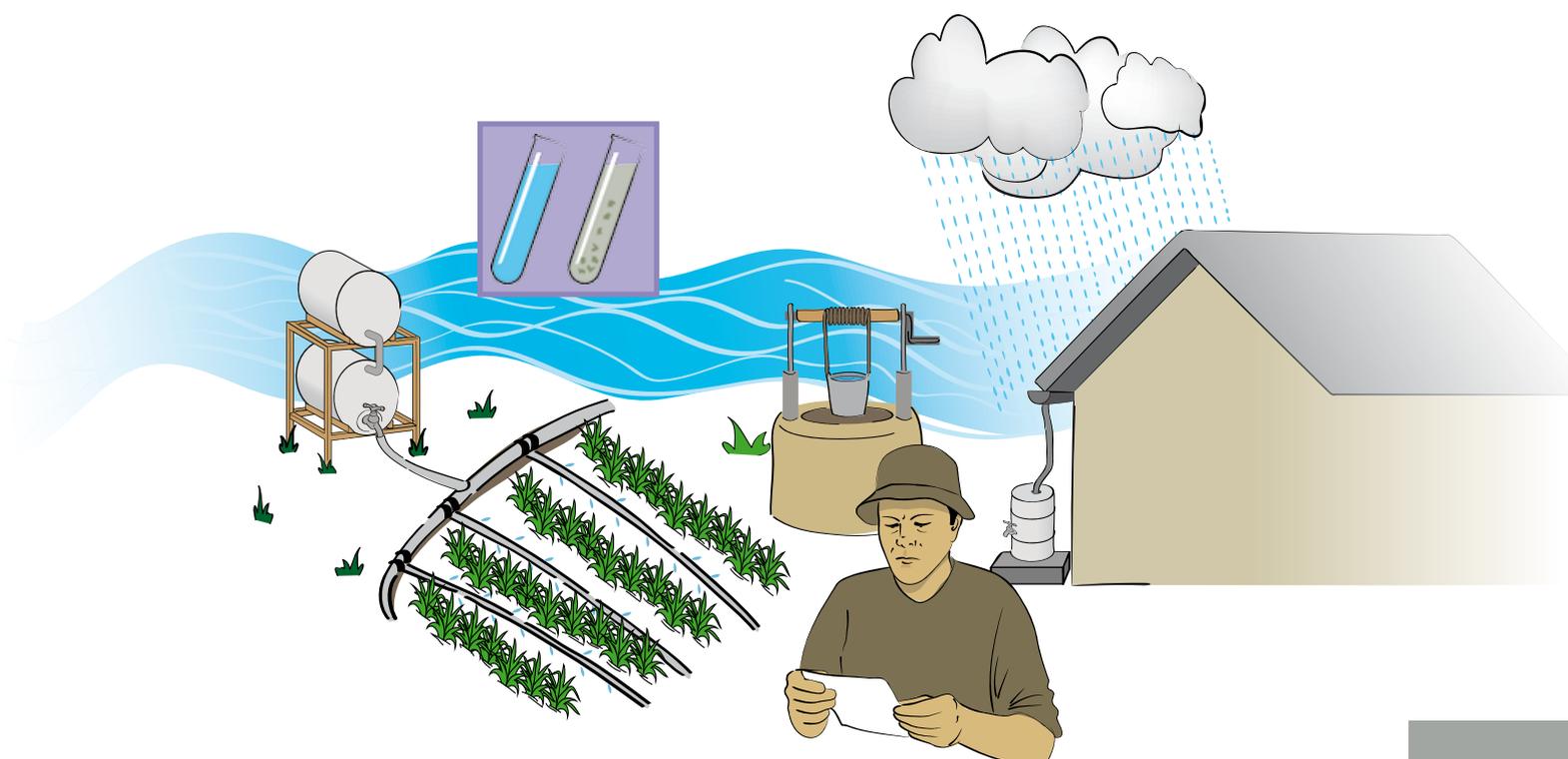
<sup>1</sup> Drip irrigation systems use valves, pipes and tubing to transport water and allow it to slowly drip to the root zone of the plants.

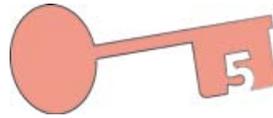
<sup>2</sup> A furrow irrigation system is created by digging channels across the field and planting crops in the ridges between the furrows.

<sup>3</sup> WHO Guidelines for the use of wastewater, excreta and greywater (2006).

Volume 2: Wastewater use in agriculture at [www.who.int/water\\_sanitation\\_health/wastewater/gsuweg2/en/](http://www.who.int/water_sanitation_health/wastewater/gsuweg2/en/), and Volume 4: Excreta and greywater use in agriculture at [www.who.int/water\\_sanitation\\_health/wastewater/gsuweg4/en/](http://www.who.int/water_sanitation_health/wastewater/gsuweg4/en/)

### Evaluate and manage risks from irrigation water





## Key 5 - Keep harvest and storage equipment clean and dry

Core information	Why?
<ul style="list-style-type: none"><li>◆ Wash harvest and storage equipment with clean water and dry before use</li><li>◆ Keep containers off the ground before, during and after harvesting</li><li>◆ Remove visible dirt and debris from fruits and vegetables in the field</li><li>◆ Cool fruits and vegetables quickly</li><li>◆ Limit access of animals, children and other non-workers to the harvest and storage areas</li></ul>	<p>Fruits and vegetables can become contaminated with dangerous microorganisms during harvest by contact with contaminated hands, soil, harvest equipment and storage facilities. Wet or damp surfaces promote the growth of dangerous microorganisms.</p>

### Health and environmental security

Dangerous microorganisms are present in the agricultural environment and associated with infected workers. Improper hygiene during harvest increases the risk of contamination by dangerous microorganisms.

Fruits and vegetables are often associated with foodborne disease because they support the growth of dangerous microorganisms to an infectious level and are often eaten without cooking.

### How to keep harvest and storage equipment clean and dry

- ◆ Limit access of animals, children and non-workers to the harvest and storage areas as they are a source of contamination
- ◆ Do not use harvest and storage containers for carrying materials other than harvested fruits and vegetables
- ◆ Specifically identify containers for waste, by products and damaged fruits and vegetables and separate them from harvest and storage containers
- ◆ Place fruits and vegetables unfit for human consumption in waste containers in the field
- ◆ Clean areas used for cleaning and sorting fruits and vegetables at the end of each day

### Considerations for the trainer

*Cool temperatures slow the growth of dangerous microorganisms and preserve the quality of fruits and vegetables. Harvested fruits and vegetables should be cooled quickly by putting them in the shade or a cool refrigerated structure.*

Keep harvest and storage equipment clean and dry



## Planning the Training Sessions

*This section provides suggestions for planning the training. Use it as a guide to understand your audience and prepare for your upcoming training session(s).*

### Learning about the participants

Learning about the participants — and being sensitive to their lives and situations — can help you be more effective in getting them to adopt safer practices for growing fruits and vegetables. By watching and listening to what is currently happening in the growing fields, you can offer solutions that make it easier for people to incorporate these practices in their daily lives.

- ◆ For example, if soap and clean, safe water are not located near toilet facilities, hand washing after toileting is not feasible or practical. In this instance, a solution would be to move the soap and clean, safe water near the toilet.

In order to get to know the participants, there are some basic questions to consider. Obtaining the answers to these questions will enable you to plan the most successful and effective training experience for the group. For example, you can explore:

Who are the members of the group?	→	Gender, employers, parents, spouses, workers
Where are they located?	→	Can they come to you, or do you need to go meet them in their location?
How many participants are attending?	→	Plan your space and materials accordingly
What language(s) do they speak?	→	Do you need someone to translate? Should you enlist a trainer that speaks a different language?
What is the group's reading level?	→	Can you use flyers/posters to invite community members? Or, are verbal invitations more appropriate?
To what organizations do they belong?	→	Do these organizations/groups have meeting space available? Will they welcome your presentation?

In some cases, you may be new to an area, or may be reaching out to a group within the community with whom you are less familiar. If so, exploratory neighborhood walks and speaking with the people and community leaders may help you get to know the participants and their neighborhoods better.

### Special sensitivities

Given the nature of health and hygiene education, the topics of this course may invoke special sensitivities. It is important to handle these sensitive topics carefully. Smaller sessions may be more effective for discussing issues such as toileting, hygiene, and the presence of children in the growing fields.

In addition, be aware that factors such as gender, customs, and role/position within the growing fields can affect the dynamics and comfort level of the group.

- ◆ Women may be less willing to speak openly about hygiene or child-rearing practices in front of men.
- ◆ Employees may hesitate to “speak up” in front of their employers.
- ◆ Various customs or special situations could impact effective communication with the participants.

For example: workplace issues, such as the ability to make changes to a farm's standard practices or equipment; or the willingness of people to change routines/adopt new practices during busy planting and harvesting times.

Be sure to choose a presentation method and approach that is appropriate for the audience and the available meeting space. In addition, take all potentially sensitive factors into account while planning your presentation(s):

- ◆ Longstanding practices, attitudes and social taboos
- ◆ Education and prior training
- ◆ Infants/children in the growing fields
- ◆ Diversity in the audience (cultural, social, traditional, gender-based)
- ◆ Education level
- ◆ Language/dialects
- ◆ Physical setting: making the actions realistic and easy to implement
- ◆ Willingness to raise awareness around symptoms and signs of disease
- ◆ Importance of training when new crops are being grown for the first time

Once you have reviewed the training manual/materials and considered the needs and sensitivities of the participants, you can tailor the training sessions to the local conditions and facilities, and needs/skill level of your audience.

## Training day agenda

*On training day, it is helpful to follow a specific agenda to ensure that all the important material is covered. The suggested agenda below follows the design of the manual and allows for the fullest use of the material. The programme is designed to be completed in one day; however, you can split it up into several short sessions if you prefer. Also, keep in mind that some of the more detailed keys, such as "Evaluate and manage risks from irrigation water quality" may take longer and lead to extended discussions.*

### 1. Welcome and introductions

Use the beginning of the training to introduce yourself and visit with your audience to make them feel comfortable. This will help make the course discussion and participation easier, and will facilitate learning. Have everyone introduce themselves. Conduct the Opening Exercise/Icebreaker.

### 2. Review the course objectives

Take time to briefly go over the objectives of the course so everyone has a common understanding of the purpose of the training. Stress the importance of the training for the health of the participants, their families, and the community.

#### Training Objectives

- ◆ Understand how contamination of fruits and vegetables occurs
- ◆ Learn safe hygienic practices to prevent contamination

### 3. Summarize basic concepts section

It is important to give an overview of what dangerous microorganisms are, where they come from and how they can contaminate fruits and vegetables in order to establish the relevance of the training. As the trainer, you should be familiar with all the information presented in the basic concepts section. This will enable you to answer questions that may come up during your training sessions. However, keep in mind that not all of the basic concepts material provided in this manual needs to be presented in the training. Depending on specific issues in your area, you may choose to spend more or less time on a particular basic concept.

### 4. Discuss the core information for each of the Five keys, then perform its related training exercise

Review the core information and why for each key with the group, and then perform the exercise related to each key. If the group is too large to complete the exercises effectively, break up into smaller groups to complete the exercises.

### 5. Hold a question and answer session after discussing each key

Make sure to give time for questions and answers after discussing each of the Five keys. This will help ensure that the participants fully understand the material. Do the same for all Five keys, and then summarize them with the group at the end.

If possible, make copies of the Five keys mini-poster and hand them out to each participant at the end of the training. Suggest that the participants post their copy somewhere near the growing fields, such as in a shed or storage facility, for use as a reminder.

## Training exercises

### Opening exercise/icebreaker: about me - fact or fiction?

*It is important to start the training session with an exercise which serves to help familiarize participants with each other and get them "chatting" comfortably. The proposed exercise also introduces the Fact or Fiction? approach that is the format used in later exercises.*

#### ————— **1** —————

Divide the participants into groups of four. Give each participant a small piece of paper and a pen/pencil.

#### ————— **2** —————

Invite each person to write down one true fact about themselves/their family. Then, have them write down one "myth," or lie, about themselves/their family. (Remind them that the lie should be something believable.)

#### ————— **3** —————

Have group members share their truths and lies with each other, and guess which is which. This is a great opportunity for participants to find out about each other, and share some camaraderie as they debate fact versus fiction.

#### ————— **4** —————

As a wrap up, go around the room and have each participant share their true statement with the group.

## KEY 1: Practice good personal hygiene

### Overview

*Hygiene practices are usually passed down from one generation to the next. When this happens, it's easy to overlook the effect these traditional practices have on the health of families and communities. It is important to know that simply by following good personal hygiene practices, people can help prevent the spread of disease directly and indirectly from contamination of food!*

**Learning Objectives:** This exercise will focus on current personal hygiene practices dealing with faeces and identify ways to improve these practices.

At the end of the exercise, participants will be able to:

- ◆ Explain the importance of good personal hygiene practices to prevent spread of disease
- ◆ Explain good personal hygiene practices
- ◆ Identify barriers to good personal hygiene practices
- ◆ Motivate family, friends and the community to adopt good personal hygiene practices

### Training Plan:

1. Review **Key 1: Practice good personal hygiene**
2. Have the participants talk about personal hygiene practices in their homes and communities describing washing facilities for hands and clothes, availability of soap, toilets and latrines. Encourage participants to talk about both good and poor practices and make a list of each.

Questions that can be used to start the discussion include:

- ◆ What hygiene practices have you witnessed/experienced in your homes or communities?  
For example: good practices versus those that could pose a health risk.
  - ◆ How might you reinforce good practices in your community?
  - ◆ How might you influence people to change the poor practices?
3. Restate the most important points and ask the group to identify barriers to practice good personal hygiene. Make a list of what they can do to improve personal hygiene and how they might reinforce good practices and influence those around them to change the poor practices.

## Key 2: Protect fields from animal faecal contamination

### Overview

*Allowing animals in the field or in the yard near a garden is a relatively common practice. However, doing so can have a serious impact on the safety of fruits and vegetables and the health of those consuming them. Keeping farm, domestic and wild animals and their faeces away from crops, helps prevent contamination of fruits and vegetables—and the spread of diseases.*

**Learning Objectives:** This exercise will focus on how to motivate family, friends and the community to understand the importance of keeping farm animals, domestic animals, and wildlife away from crops and strive to do so.

At the end of the exercise, participants will be able to:

- ◆ Explain proper location for animals in relation to the growing fields or backyard gardens
- ◆ Explain the importance of keeping animals out of the fields to prevent contamination
- ◆ Differentiate between proper and improper locations for animals

### Training Plan:

1. Review **Key 2: Protect fields from animal faecal contamination**
2. Explain that this is a simple Fact or Fiction? exercise. Participants should raise their hands to indicate a “fact” or “fiction” response to each question.
3. Read the Fact or Fiction? question aloud to the participants. Ask them to indicate “fact” or “fiction” by raising their hands.
4. Then, ask the group to discuss why it is “fact” or “fiction”. When appropriate, tie in other important safety points, such as good personal hygiene practices.

## FACT or FICTION?

### Questions for Exercise KEY 2

1. Dangerous microorganisms carried in animal faeces can survive in soil for months and eventually contaminate fruits and vegetables.

[**FACT.** Dangerous microorganisms in animal faeces can survive in soil and contaminate fruits and vegetables and cause foodborne diseases.]

2. It's a good idea to keep farm animals uphill from where the crops are, to keep them separated.

[**FICTION.** Faeces from animals can be washed downhill by rainwater, enter the field and can contaminate the crops.]

3. Livestock or poultry in the growing areas can directly contaminate fruits and vegetables.

[**FACT.** Crops should not come in contact with faeces. Faeces contain dangerous microorganisms that can cause diseases when contaminated fruits and vegetables are eaten.]

4. Since birds are not on the ground all the time, there is little chance that they will contaminate growing fruits and vegetables.

[**FICTION.** Birds flying overhead can drop faeces on crops. This has caused foodborne diseases.]

5. It is okay to have a dog in the field or in your home growing area.

[**FICTION.** Any animal faeces can contaminate fruits and vegetables.]

6. Trash should be removed from around the growing areas to prevent it from attracting domestic and wild animals.

[**FACT.** All efforts should be made to avoid drawing animals into or near the growing fields.]

## KEY 3: Use treated faecal waste

### Overview

*There is a lot of confusion about using of faecal waste on fruits and vegetables. Properly treated faecal waste is a good source of nutrients for fruits and vegetables. However, faecal waste must be properly treated to kill dangerous microorganisms. Helping participants understand the control measures needed to treat faecal waste is important for maintaining the safety of the fruits and vegetables.*

**Learning Objectives:** This Fact or Fiction? exercise will help participants understand how to handle using faecal waste safely.

At the end of the exercise, participants will be able to:

- ◆ Explain why they should not use untreated manure as fertilizer
- ◆ Explain when treated manure should be added to the soil
- ◆ Describe faecal treatment and how to do it safely

### Training Plan:

1. Review **Key 3: Use Treated Faecal Waste**
2. Explain that this is another Fact or Fiction? exercise. Participants should raise their hands to indicate a "fact" or "fiction" response to each question.
3. Read the Fact or Fiction? question aloud to the participants.  
Ask them to indicate "fact" or "fiction" by raising their hands.
4. Then, ask the group to discuss why it is "fact" or "fiction". When appropriate, tie in other important safety points, such as protecting fields from animal faecal contamination.

## FACT or FICTION?

### Questions for Exercise 3

1. Animal manure is a source of dangerous microorganisms that can contaminate fruits and vegetables.

[**FACT.** Manure contains dangerous microorganisms found in animal faeces.]

2. Vegetables that grow in the soil (such as root vegetables) are protected against dangerous microorganisms in animal manure because they are under the ground.

[**FICTION.** Root vegetable crops are the most susceptible to becoming contaminated by untreated faecal excreta.]

3. To minimize contamination, manure should be treated and decayed before applying it to the fields.

[**FACT.** Heat kills dangerous microorganisms; the length of time needed can vary by manure composition, temperature and moisture.]

4. It is best to apply manure to the soil when you are planting.

[**FICTION.** Aged or otherwise treated manure should be applied to fields prior to planting and after harvest.]

5. Ageing or otherwise treating manure can minimize the dangerous microorganisms found in faeces.

[**FACT.** With treatment, dangerous microorganisms die.]

6. Manure piles should be as close to the growing fields as possible.

[**FICTION.** Manure piles should be kept as far from the field as possible. It should be downhill from any crops to protect against "run off," and should be covered to prevent outside contamination by birds and other wildlife.]

7. Manure should not be placed directly on plants.

[**FACT.** Keeping manure from coming directly in contact with plants further reduces the risk of contamination by any remaining dangerous microorganisms in the treated manure.]

## KEY 4: Evaluate and manage risks from irrigation water

### Overview

*Dangerous microorganisms in animal and human faecal waste can contaminate water and be transferred to soil and crops via irrigation. It is important to understand the source(s) of water used for irrigation and the risks of its contamination. Based on this assessment, control measures can be applied to reduce the contamination. If the irrigation water quality is poor, unknown or cannot be controlled, crop contamination is minimized by applying control measures.*

**Learning Objectives:** This exercise will focus on the how to keep water safe from dangerous microorganisms that cause foodborne diseases or apply control measures that minimize the contamination of fruits and vegetables.

At the end of the exercise, participants will be able to:

- ◆ Explain safety of water source
- ◆ Know how to protect water sources
- ◆ Differentiate between safe methods of irrigation versus those that increase the potential for contamination

### Training Plan:

1. Review **Key 4: Evaluate and manage risks from irrigation water**
2. Divide participants into groups of 4 or 5. Have the participants describe their current water use practices in terms of the information presented in Key 4. For example: discuss the location of animals and washing clothes in streams used for irrigation.
3. Ask participants to discuss how they can manage their water to help keep fruits and vegetables safe. Allow groups 10 – 15 minutes for the participants to describe current water use practices and control measures. Make a list of measures they can use to help keep fruits and vegetables safe.
4. Bring the entire group back together and ask one member of the group to report on the discussion. Encourage participants to add to the points presented to foster a lively discussion. Write down the points given as each group presents.
5. Reinforce learning by using the information provided to emphasize the most important points. Discuss control measures that participants can practice and those which they can not. Use a different colored marker to check off the control measures they can practice versus the ones which they cannot practice. Discuss alternatives for control measures that can not be practiced.

## KEY 5: Keep harvest and storage equipment clean and dry

### Overview

*There are several instances, practices, and places where fruits and vegetables can become contaminated as they make their way from the field to consumption. Fruits and vegetables can come in contact with dangerous microorganisms from equipment and containers during harvest and storage.*

**Learning Objectives:** This exercise will review the harvest and storage practices needed to minimize the chance of the contamination of fruits and vegetables during harvest and storage.

At the end of the exercise, participants will be able to:

- ◆ Explain practices that can help keep fruits and vegetables safe/uncontaminated during the harvesting and storage processes
- ◆ Explain why they should keep harvesting and packing equipment and facilities clean
- ◆ Discuss potential risks to fruits and vegetables that can occur during harvesting and storage

### Training Plan:

1. Review **Key 5: Keep harvest and storage equipment clean and dry**
2. Divide participants into groups of 4 or 5. Allow groups 10 – 15 minutes for the participants to describe to describe their harvest and storage practices and list those practices that could cause contamination during harvest and storage.
3. Bring the entire group back together and ask one member of the group to report on the discussion. Encourage participants to add to the points given to foster a lively discussion. Write the points given as each group presents.
4. Reinforce practices that prevent contamination during harvest and storage.

## Example of evaluation form

A good way to assess the benefit of training is by visiting the farm and observing practices. Ideally, the evaluator will visit the farm several times and be able to observe changes in practices that promote the safety of fruits and vegetables. Completing a separate evaluation form after each visit is a good way to monitor understanding and progress. You may not be able to answer all the questions during each farm visit and some answers may change depending on the timing of the visit and the stage of the growing season.

### Description of farm

1. Size of farm (estimated) \_\_\_\_\_
2. Size of area planted with crops (estimated) \_\_\_\_\_
3. Type of crops planted \_\_\_\_\_
4. Number and type of animals on farm \_\_\_\_\_
5. Source of drinking water:  well       water bottles filled from city water pipes  
Other \_\_\_\_\_
6. Type of water used for irrigation:  well       river  
Other \_\_\_\_\_

## Observation of farm activities

### Hygiene

7. Do family members wash and dry hands with a clean, dry towel after toileting, diapering a child and contact with animals?
- Yes     No     Don't Know
8. Do family members change clothes and bathe regularly?
- Yes     No     Don't Know
9. Are cuts, lesions and wounds covered with a glove or bandage when working in fields?
- Yes     No     Don't Know
10. Is there a latrine conveniently located near growing fields?
- Yes     No     Don't Know
11. Is the latrine located downhill or away from growing fields?
- Yes     No     Don't Know

### Animals

12. Are domestic animals, including poultry and pets, prevented from roaming in growing fields?
- Yes     No     Don't Know
13. Are animals separated from the growing fields with a fence or pen?
- Yes     No     Don't Know
14. Is the livestock kept downhill from growing fields?
- Yes     No     Don't Know
15. Is the trash removed from around the growing fields?
- Yes     No     Don't Know

### Manure

16. Is the faecal waste well-aged or properly treated?
- Yes     No     Don't Know
17. Was the treated faecal waste applied to growing fields prior to planting?
- Yes     No     Don't Know
18. Was the time between the application of treated faecal waste and harvest maximized?
- Yes     No     Don't Know

### Water

19. Are there fences or other means to keep poultry or cattle from defecating in water sources?
- Yes     No     Don't Know
20. Are the manure, fecal waste and fertilizers stored away from water sources?
- Yes     No     Don't Know
21. Is the latrine located downhill or away from water sources?
- Yes     No     Don't Know
22. Is the family applying control measures when using contaminated water?
- Yes     No     Don't Know

### Harvest

23. Were harvest equipment and storage containers washed with clean water and dried before harvesting crops?
- Yes     No     Don't Know
24. Were packing containers kept off the ground during and after harvest?
- Yes     No     Don't Know
25. Was the visible dirt and debris on the fruits and vegetables removed in the growing field?
- Yes     No     Don't Know
26. Were animals, children and other non-workers kept away from the harvest equipment and storage areas?
- Yes     No     Don't Know

## GLOSSARY

Diapering	Removing a wet or soiled diaper from a child and replacing it with a clean diaper.
Diarrhoea	A disorder of the intestine marked by abnormally frequent and fluid evacuation of the bowels.
Excretion	The discharge or elimination of a substance, or of a waste product, via some tissue of the body and its appearance in urine, faeces, or other products normally leaving the body.
Faeces	Waste matter or excrement eliminated from humans and animals.
Food safety	All measures to ensure that food will not cause harm to the consumer when it is produced, prepared and/or consumed according to its intended use.
Foodborne disease	A general term used to describe any disease or illness caused by eating contaminated food or drink. Traditionally referred to as “food poisoning”.
Groundwater	Water captured in underground reservoirs.
Irrigation	Method of watering crops in dry areas through ditches, channels or streams.
Latrine	A standalone apparatus or receptacle, such as a pit in the earth, designed for urination and defaecation.
Manure	A mixture of animal faeces, urine and vegetable waste.
Microbial contamination	The introduction of any microorganism not intentionally added to food that may compromise food safety or suitability and cause disease.
Microorganisms	Microscopic organisms such as bacteria, yeasts, moulds, viruses and parasites, which may be found in the environment, in foods and in or on animals.
Personal protective equipment	Clothing or other garment or equipment to prevent contact of substances with the wearer’s body.
Refrigeration	The process of cooling or freezing (e.g. food) to delay spoilage.
Risk	The severity and likelihood of harm resulting from exposure to a hazard.
Safe water	Water that is free from dangerous microorganisms and toxic chemicals at levels that could cause illness and/or disease.
Surface water	All water naturally open to the atmosphere (e.g. rivers, streams, lakes and reservoirs).
Toilet	A system equipped with plumbing and a removal mechanism in which one urinates or defaecates.
Toileting	Urinating or defaecating in an area or sanitary facility followed by wiping and hand washing.
Wastewater	Liquid waste discharged from homes, commercial premises and similar sources to individual disposal systems or to municipal sewer pipes, and which contains mainly human excreta and used water.

More information regarding the work of WHO in Food Safety is available at  
**[www.who.int/foodsafety](http://www.who.int/foodsafety)**

### Implementation of Food Safety educational projects in countries

WHO regional advisors and WHO country representatives play a crucial role in creating and promoting WHO policies and practices at the regional and national levels. They may be contacted directly for assistance and advice in the implementation of the *Five keys to growing safer fruits and vegetables*.

Contact details can be found at: [www.who.int/foodsafety/contact/en](http://www.who.int/foodsafety/contact/en)

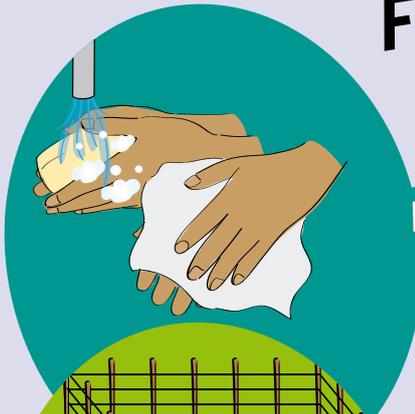


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# Five keys to growing safer fruits and vegetables

Promoting health by decreasing microbial contamination



## Practice good personal hygiene

- ◆ Wash and dry hands with a clean, dry towel after toileting, diapering a child and contact with animals
- ◆ Change clothes and bathe regularly
- ◆ Cover cuts, lesions and wounds
- ◆ Use a toilet or latrine to urinate and defaecate

**Why?** Dangerous microorganisms are found in human and animal faecal waste, and infected wounds, and can be transferred to fruits and vegetables by hands, clothing and other surfaces. Good personal hygiene practices help prevent the transfer of dangerous microorganisms to fruits and vegetables and decrease the risk of foodborne diseases.



## Protect fields from animal faecal contamination

- ◆ Keep animals from roaming in growing fields
- ◆ House livestock downhill from growing fields in a fenced area
- ◆ Remove trash from in and around growing fields

**Why?** Dangerous microorganisms in animal faeces can contaminate crops directly when animal defecate in fields - or indirectly when rainwater becomes contaminated with dangerous microorganisms and runs downhill into the growing fields. Trash, food and water in and around growing fields attract animals including wild birds.



## Use treated faecal waste

- ◆ Use faecal waste (manure and human excreta) that is properly treated
- ◆ Apply treated faecal waste to fields prior to planting
- ◆ Maximize the time between the application of treated faecal waste and harvest

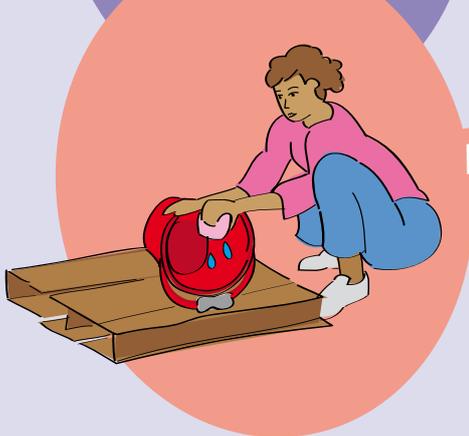
**Why?** Properly treated faecal waste (manure and human excreta) is an effective and safe fertilizer. Dangerous microorganisms in human and animal faecal waste can survive for long period of time and contaminate fruits and vegetables. Faecal waste must be treated to kill the microorganisms.



## Evaluate and manage risks from irrigation water

- ◆ Identify all water sources relevant to your growing field
- ◆ Be aware of the risk of microbial contamination of water
- ◆ Protect water from faecal contamination
- ◆ Apply control measures when using water contaminated or of unknown quality

**Why?** Water is needed for humans, animals and agriculture. The risk of microbial contamination of different water sources varies. Dangerous microorganisms in faecal waste can contaminate water and then be transferred to soil and crops via irrigation. Water used for irrigation of fruits and vegetables must not introduce dangerous microorganisms.



## Keep harvest and storage equipment clean and dry

- ◆ Wash harvest and storage equipment with clean water and dry before use
- ◆ Keep containers off the ground before, during and after harvesting
- ◆ Remove visible dirt and debris from fruits and vegetables in the field
- ◆ Cool fruits and vegetables quickly
- ◆ Limit access of animals, children and other non-workers to the harvest and storage areas

**Why?** Fruits and vegetables can become contaminated with dangerous microorganisms during harvest by contact with contaminated hands, soil, harvest equipment and storage facilities. Wet or damp surfaces promote the growth of dangerous microorganisms.



World Health Organization

