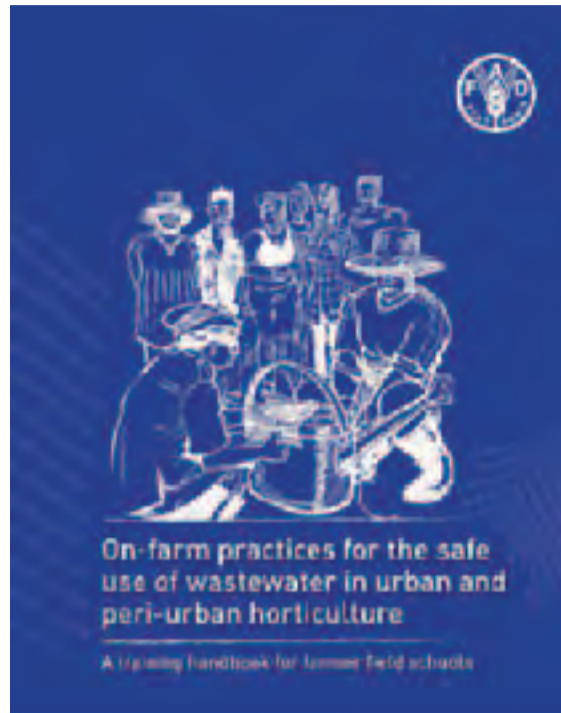


# SAFER IRRIGATION PRACTICES FOR REDUCING VEGETABLE CONTAMINATION IN URBAN SUB-SAHARAN AFRICA

## AN ILLUSTRATED GUIDE FOR FARMERS AND EXTENSION OFFICERS



We recommend using this guide together with the FAO Farmer Field School handbook shown below ([www.fao.org](http://www.fao.org)).



## ILLUSTRATION 2

Let us learn how Abu/Amina can reduce contamination of vegetables in their farm where the water used for irrigation comes from the city, and may not be as clean as we all would like it to be.

### NOTE TO THE EXTENSION OFFICER

Ask the farmers the following questions:

1. What do you see in the illustration?
2. What vegetables are grown in Abu's/Amina's farm?
3. Why does Abu/Amina grow the exotic (European) vegetables?
  - Discuss with farmers how the vegetables are used in diets.
  - Emphasise why and when the vegetables are eaten raw.

### ANSWERS:

1. A vegetable farm, a pond with watering can, a man and a woman (farmers) and an extension officer (main picture). The smaller pictures show Amina selling her crops and the buyer washing it in a bowl.
2. Abu/Amina grows lettuce, cabbage and spring onions. These are exotic vegetables that are usually eaten raw or partially cooked, for example in street restaurants.
3. They grow exotic vegetables because they are high value crops that fetch a good price in the market. As a result, it enhances their monthly income.

Vegetable production is also an important means of attaining balanced diets and contributes to urban food security.



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## ILLUSTRATION 3

**The extension officer meets with a group of vegetable farmers. She discusses the effects of irrigating exotic vegetables with polluted water**

### NOTE TO THE EXTENSION OFFICER

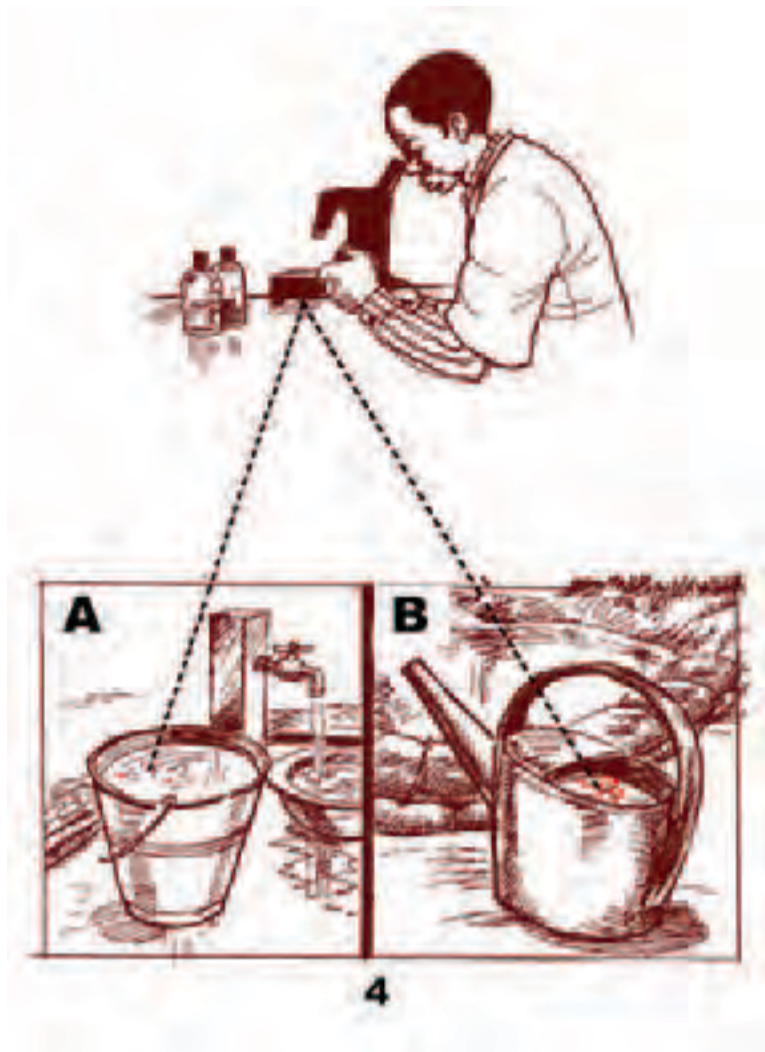
1. Explain to the farmers how irrigation water is polluted.
  - a) Sources of pollution
  - b) Contents of polluted water
2. Discuss with the farmers why they use polluted water for irrigation.
3. Discuss the possible effects of irrigating vegetables with polluted water.
4. Ask farmers: Who may be affected when contaminated vegetables are sold?

### ANSWERS:

1.
  - a) Outflow from bathrooms, kitchens, toilets/latrines and street run-off.
  - b) Pathogens, chemicals, and nutrient rich water.
2. Possible answers:
  - No other water source nearby
  - No cheaper water source available
  - No other reliable water source for daily irrigation
3. Potential for transmission of excreta-related diseases to humans is high. These may be typhoid, cholera and/or worm infestations which may result in diarrhoea.
4. Everyone eating raw vegetables in the street, dining halls or at home:
  - School children and college/university students
  - Many working persons (taking lunch in canteens or the street)
  - Vegetable farmers and their families
  - Market women and workers of the fast food sector
  - Resident foreigners and tourists



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## ILLUSTRATION 4

**The extension officer explains what germs (pathogens) are and their harmful effects**

### NOTE TO THE EXTENSION OFFICER

1. Ask farmers whether they know about germs. List their responses/examples.
2. Ask farmers to compare illustrations 'A' and 'B'.
3. Explain to farmers what germs are and their harmful effects.

### ANSWERS:

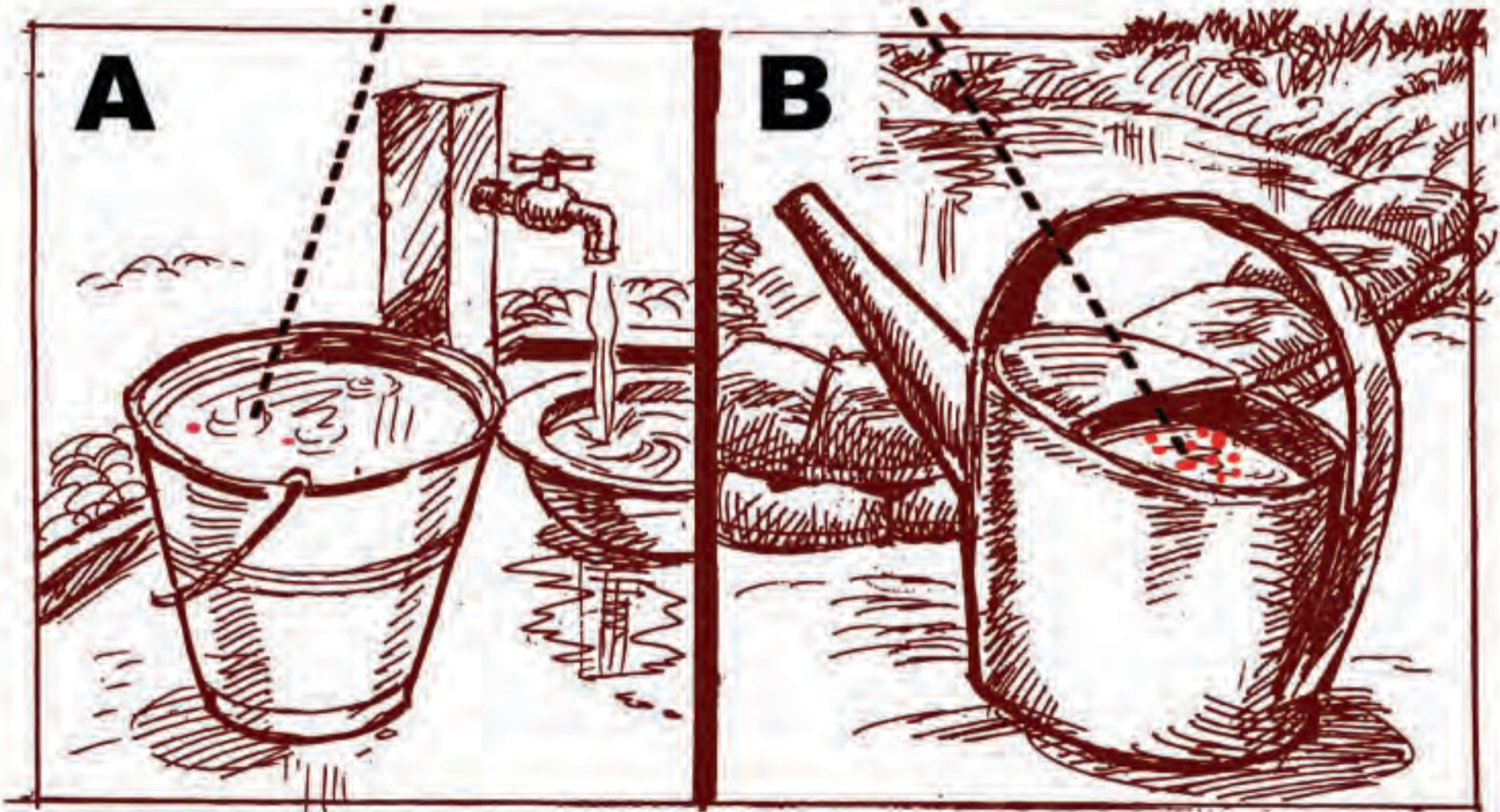
1. Illustration 'A' shows a bucket of water from the stand pipe with no or only a few germs (The red dots represent germs).

Illustration 'B' shows a watering can full of water from a pond with high level of germs.

2. Germs are tiny organisms that are too small to be seen with the naked eye. However, they can be observed using a microscope.

All those who ingest germs can become very sick, and will need to see a doctor for medication.

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## ILLUSTRATION 5

**The extension officer creates awareness on some irrigation practices that reduce health risks**

### NOTE TO THE EXTENSION OFFICER

1. Ask farmers to explain how they protect themselves. List their examples.
2. Ask farmers whether they know about any safer irrigation practices. List their examples.

### ANSWERS:

1. Self protection: boots, gloves, minimum contact with water, foot and hand washing with soap and careful washing of vegetables before eating.

At home, vegetables can be washed with either

- one teaspoon of bleach (Eau de Javel) in 5 liters of water  
or
- one knife tip of PotPerm (the purple potassium permanganate) in 5 liters of water (PotPerm is available in most pharmacies and is very cheap)

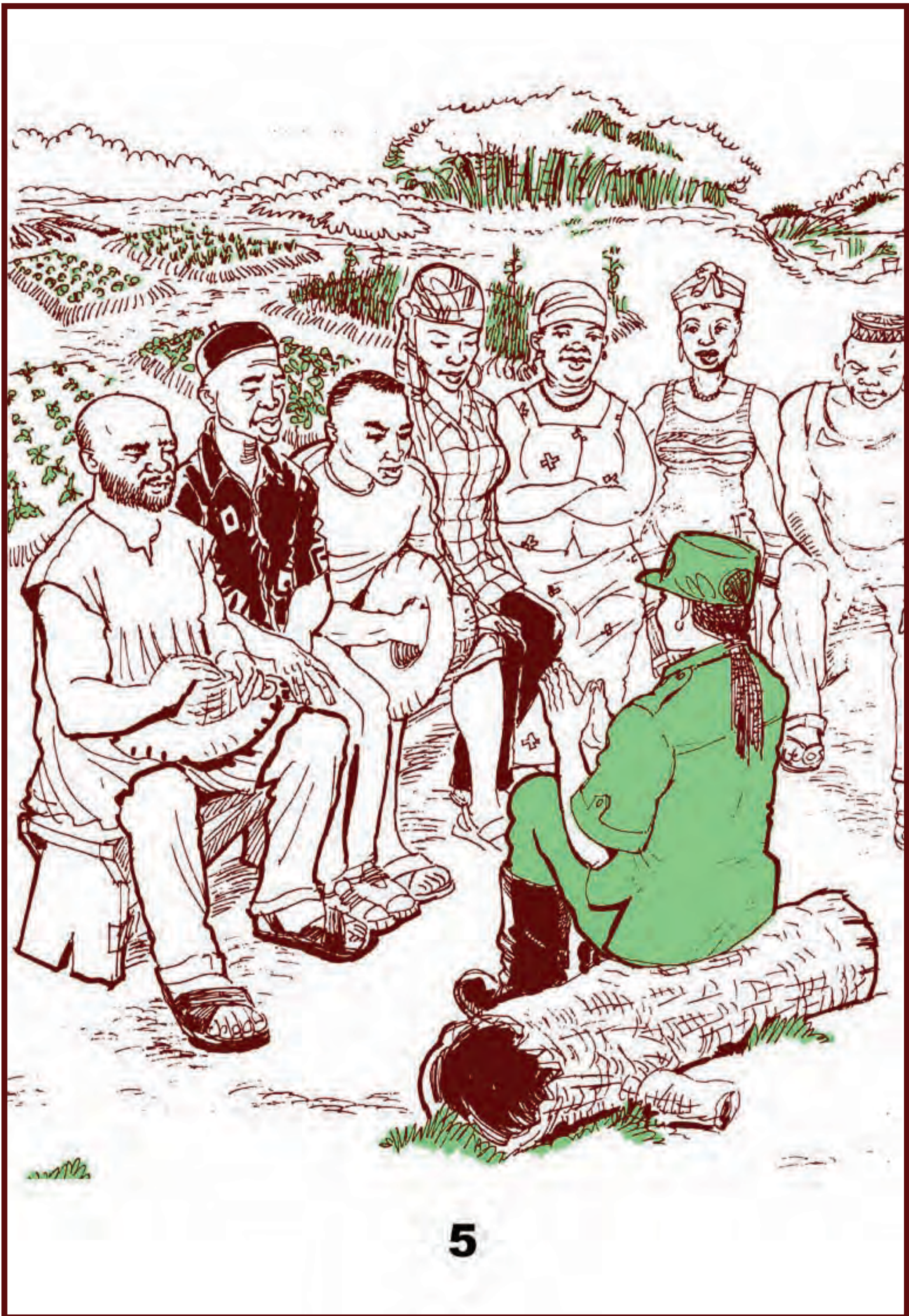
Salt or vinegar is only effective in very high concentrations and therefore can be expensive.

2. Answers will depend on whether farmers have been exposed to awareness programs conducted through projects or extension. Solicit responses and compare with following pages.

*Several options for safer irrigation and farming practices will be discussed in the following pages. Explain that each good practice will help reduce the number of germs on vegetables to a great extent. But best is a combination of two or more on-farm practices to reduce the germ load significantly! The options to combine can vary and will depend on local possibilities.*

*Very important is vegetable washing before consumption; see page 28/29.*







## ILLUSTRATION 6

The extension officer discusses the consequences of disturbing the sediment that contains worm eggs, when collecting water with a watering can

### NOTE TO THE EXTENSION OFFICER

1. Ask farmers: What is the difference between illustrations 'A' and 'B'?
2. Explain the consequence of disturbing the sediment of a pond when collecting water with a watering can.

### ANSWERS:

1. Illustration 'A' shows
  - The farmer fetching water from a pond
  - He is standing in the pond to fetch water

Illustration 'B' shows

- The farmer fetching water from the pond
- He is standing on the bund of the pond to fetch water

2. Usually, the debris and worm eggs settle at the bottom of a pond as they are heavier than water. Stepping into a pond or touching the bottom of a pond with feet or the watering can disturbs the sediment that has worm eggs. When the sediment is disturbed the debris and worm eggs reach the upper surface again and can be picked up with the watering can. Watering vegetables with this water increases the level of contamination. People who consume the vegetables can get infected with worms.

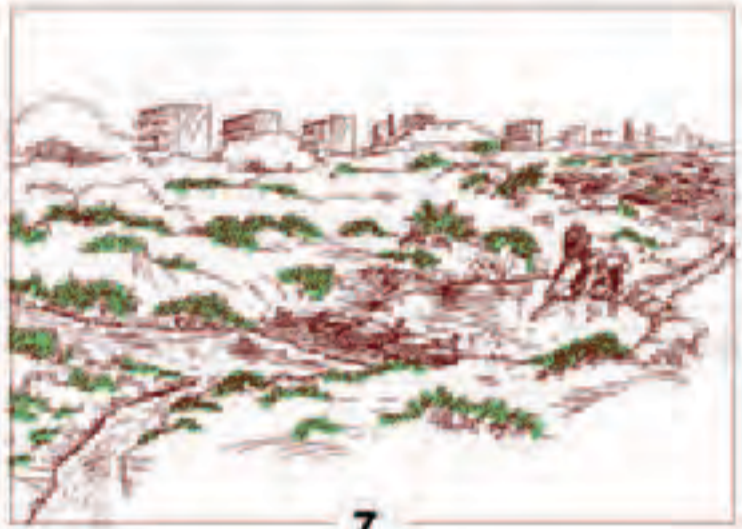
***Do not touch the bottom of the pond with your feet or watering can!***

**A**



**B**





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## ILLUSTRATION 7

**The extension officer explains the technique of filtering polluted water by placing sandbags at the inlet of a pond or stream**

### NOTE TO THE EXTENSION OFFICER

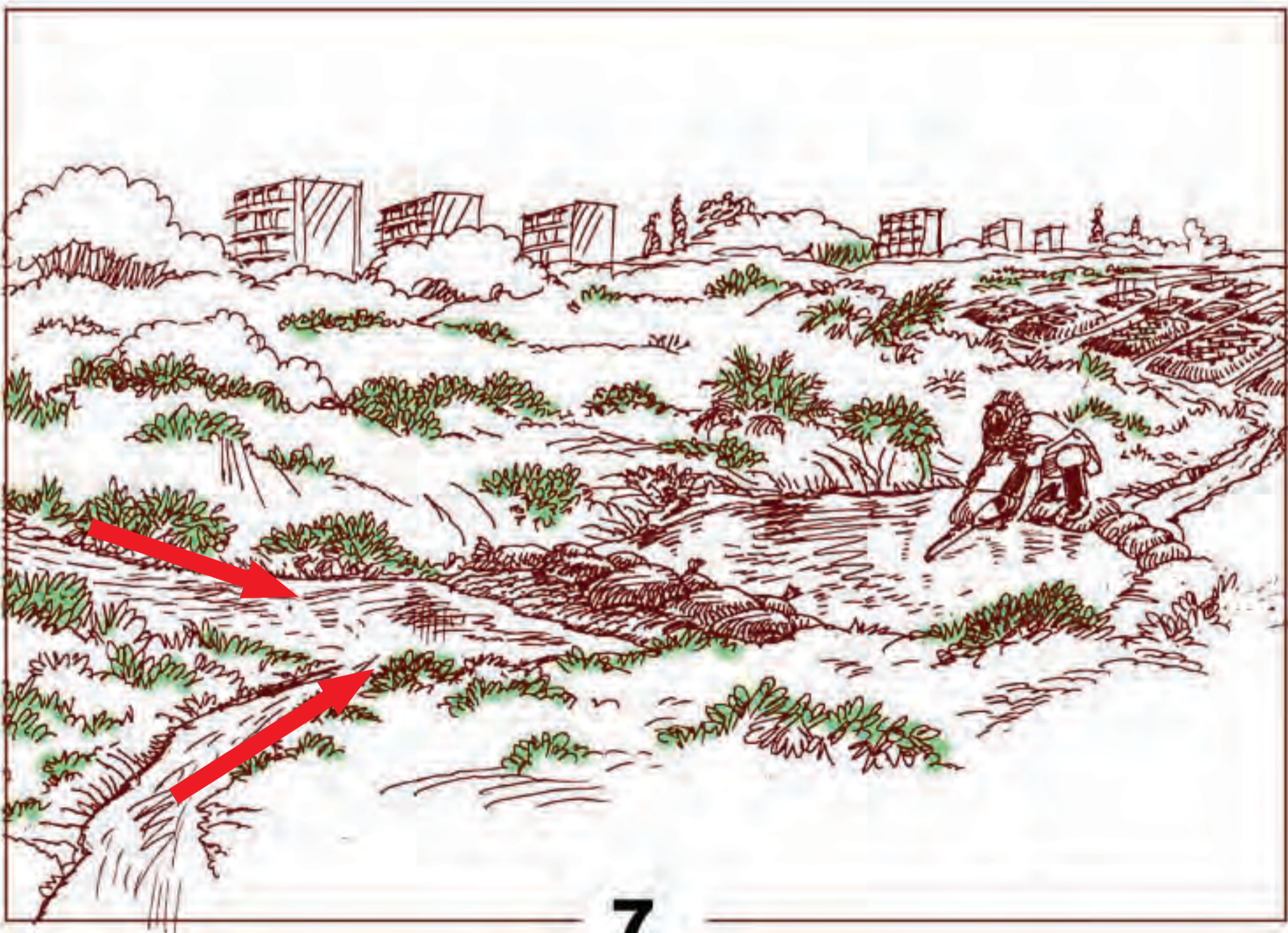
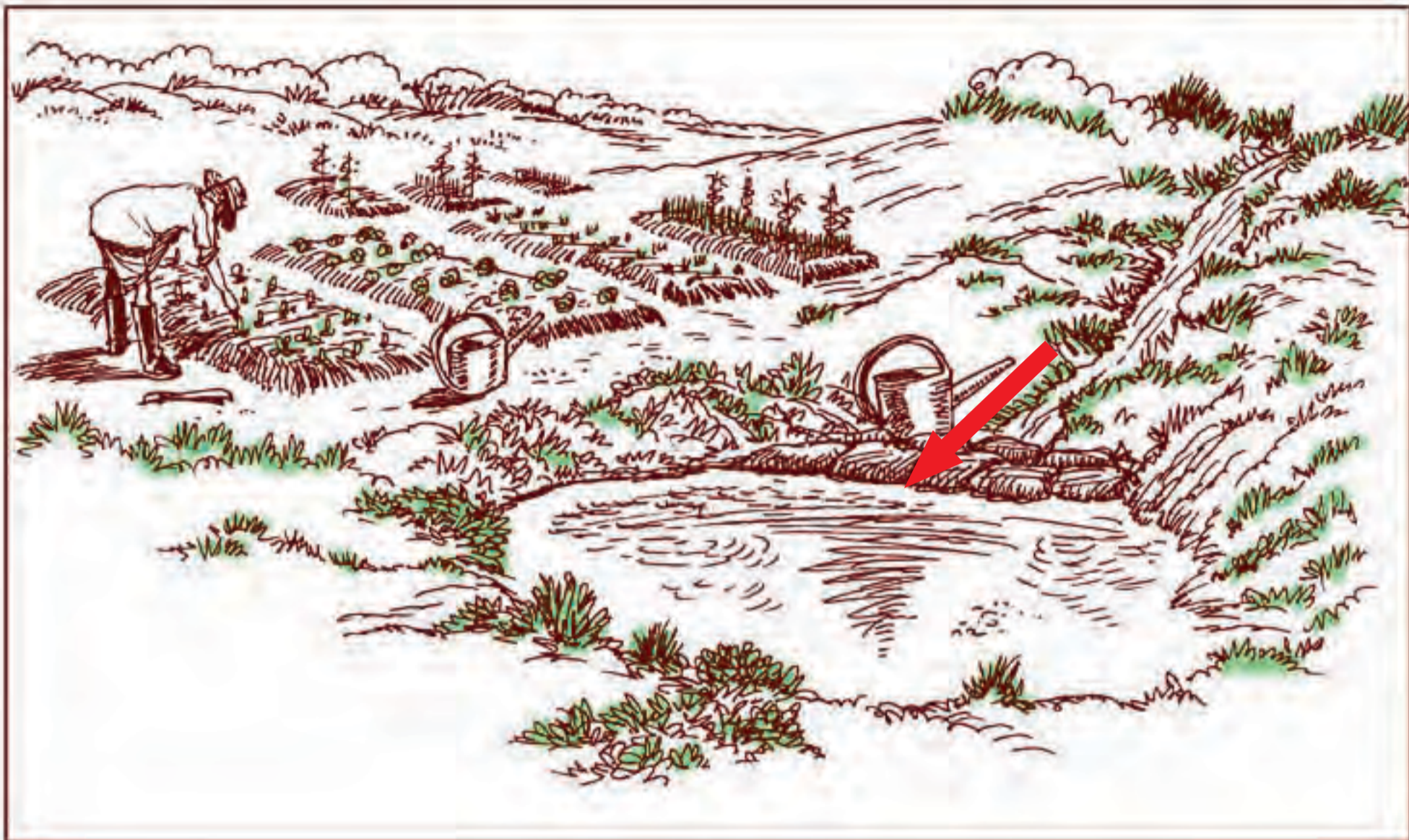
1. Ask farmers: What do you see in the illustrations?
2. Ask farmers why sandbags are placed at the inlet of a pond or in the stream.
3. Explain to farmers the need to sediment worm eggs (see below).

### ANSWERS:

1. A vegetable farm, a pond, a farmer, water entering a pond is blocked by sandbags (picture above) and two rows of sandbags blocking a stream which flows from left to right (picture below).
2. Sandbags can remove some pathogens (germs) by functioning as a barrier. Sandbags help to hold the water allowing dirt and especially worm eggs to settle.
3. Placing sandbags at the inlet of a pond will filter pathogens out of the run-off water flowing into a pond (picture above).

Also, in a stream (picture below), the dirt settles at the first (left) row of bags. The water collecting in the pool is now much safer for irrigation. A second row of sandbags (right), allows the water to accumulate in the pond and filters the water further making it safer for downstream use.

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## ILLUSTRATION 8

The extension officer explains the technique of filtering polluted water by covering the opening at the top of the watering can with a cloth or mosquito

### NOTE TO THE EXTENSION OFFICER

1. The Extension Officer demonstrates the technique to the farmers.
  - Show farmers how to cover the opening at the top of the watering can with a piece of cloth or mosquito netting
  - Ask Abu to fill the watering can with water from the pond
  - Ask farmers what equipment/s is needed to filter polluted water
2. Solicit answers by asking what they see trapped on the piece of cloth or mosquito net.
3. Explain to farmers the need for a filtering technique.

### ANSWERS:

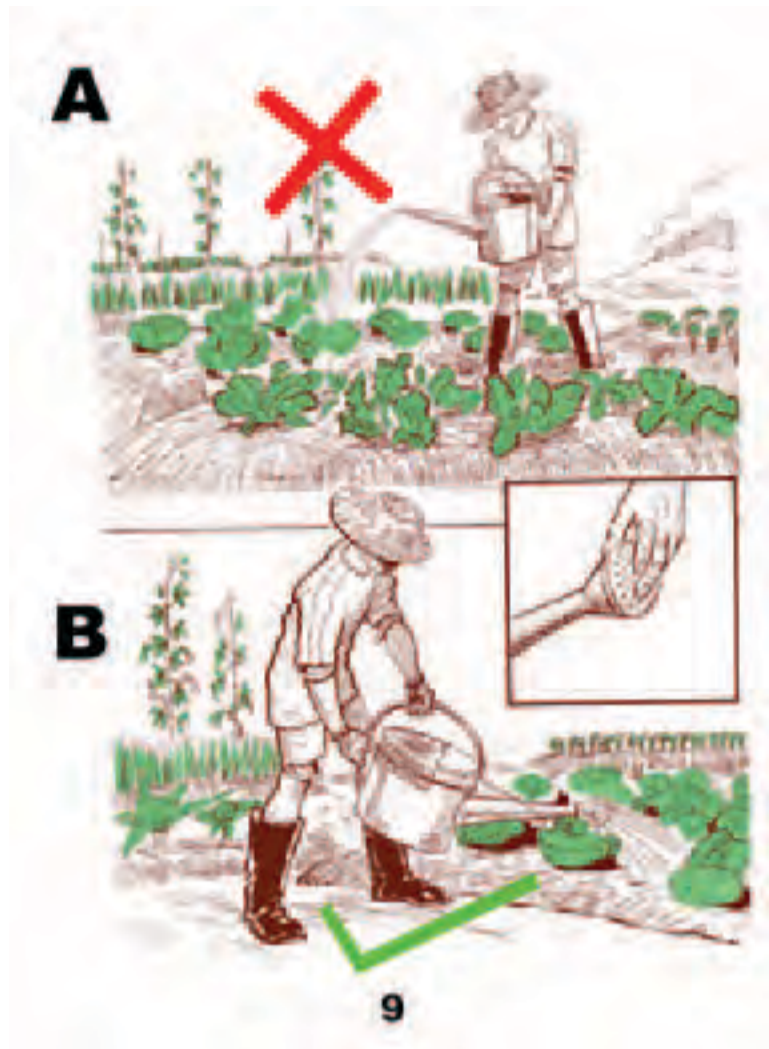
1. You need the following to demonstrate the technique.
  - Watering can
  - Piece of cloth or mosquito netting
  - String or rubber band
3. The piece of cloth or mosquito netting holds back debris from the water (remember to discard filtered debris away from the pond).

Covering the opening at the top of the watering can with a piece of cloth or mosquito netting will:

- Hold back organic waste and debris and debris-attached pathogens.
- Reduce vegetable contamination (less germs in vegetables) to some extent, but by far not fully.



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## ILLUSTRATION 9

The extension officer explains the technique of holding the watering can close to the ground and using a shower cap on its spout

### NOTE TO THE EXTENSION OFFICER

1. Compare illustrations A and B. What do you see? Solicit answers on what they notice about the watering can.
2. Let Abu fill the can with water and demonstrate the placement of a shower cap on the spout of the watering can. Demonstrate holding the watering can close to the ground when watering.
3. Explain and discuss with farmers how both methods reduce contamination of vegetables.

### ANSWERS:

1. In A: Abu's watering can is without a shower cap and he holds it very high to reach far.  
In B: the can is covered with a shower cap and held low.
2. Placement of a shower cap on the mouth of the watering can and holding the can close to the ground, reduces the force of the water landing on the ground. This reduces splash from the contaminated soil back on the leaves of the crop.



**A**



**B**





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## ILLUSTRATION 10

**The extension officer explains the technique of furrow irrigation**

### NOTE TO THE EXTENSION OFFICER

1. Find out how many farmers use furrow irrigation and why they use or do not use furrow irrigation.
2. Explain to farmers the importance of reducing crop-water contact through furrow irrigation.

### ANSWERS:

1. The use of furrow irrigation is possible where land has a slight slope to allow water flow by gravity. Pumps can also be used. This system does not work very well on sandy soils.
  2. The use of furrow irrigation reduces crop-water contact resulting in less vegetable contamination with pathogens /germs.
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## ILLUSTRATION 11

**The extension officer creates awareness about the use of drip irrigation kits to reduce crop contamination**

### NOTE TO THE EXTENSION OFFICER

1. Find out how many farmers know about drip irrigation and why they use or do not use drip irrigation.
2. Explain to farmers the importance of reducing crop-water contact through drip irrigation.

### ANSWERS:

2. The use of drip irrigation reduces contact between water and leaves resulting in the reduction of contamination by germs. It can significantly reduce labor inputs as large areas can be irrigated using a network of fine tubes close to the plant. Moreover, water losses are minimized, and are ideal for areas where the water is scarce. This method allows high planting densities, increasing economic gains.

A point to remember is, if poor quality water (with debris) is used, the pipes can get clogged, therefore, filter the water with a cloth/netting before filling the storage container.

*FAO and the local Ministry of Agriculture can help find a low-cost drip kit. See how a drip kit works by visiting for example the following website - <http://www.ideorg.org/OurTechnologies/DripIrrigation.aspx>*





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## ILLUSTRATION 12

**The extension officer explains the technique of stopping irrigation before harvest**

### NOTE TO THE EXTENSION OFFICER

1. Explain the technique of stopping irrigation before harvesting.
2. Discuss how the technique reduces contamination of vegetables.
3. Discuss some challenges farmers will face when they adopt the technique.

### ANSWERS:

1. The day of harvesting has to be planned in advance by discussing with vegetable traders. Accordingly, irrigation of vegetables should be stopped as many days as possible before harvesting.
  2. The technique of stopping irrigation before harvesting helps natural bacterial die-off and reduces fresh bacterial contamination. Not irrigating the last 2 – 4 days reduces bacterial counts to a certain extent, better it not to irrigate 7 or more days if the climate allows.
  3. A challenge that a farmer faces adopting this method could be that leafy vegetables may look less fresh or even some loss in yield depending on the local climate and number of days without irrigation.
-



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## ILLUSTRATION 13

*In countries like Ghana, the vegetables sold in the market place are collected from farms by the market women (traders). Some vegetables like lettuce are still being washed on-farm with easily accessible water, which is not always clean.*

The extension officer explains to the traders, the ill effects of using local pond or stream water and stresses the importance of using clean water to wash vegetables.

### NOTE TO THE EXTENSION OFFICER

1. Ask farmers/traders what they see in the illustration.
2. Discuss that washing the crops after harvest with the local irrigation water might remove visible dirt but increase crop contamination with invisible germs.
3. Explain the need for traders to wash off dirt on vegetable crops with clean (tap) water.

### ANSWERS:

1. Illustration 'A' shows the trader washing the harvested vegetables with the local irrigation water. Illustration 'B' shows the trader washing the harvested vegetables with clean water from a stand pipe. She pours away the water after washing and rinses them again with clean water.
2. Washing the harvest with polluted irrigation water, **negates all efforts the farmer has taken to reduce on-farm contamination**, as it would remove sand particles but put all the germs back on the leaves.  
Traders should clean vegetables at any other place where safe water is available.
3. The harvested vegetables should always be washed with clean water, if possible tap water. Be mindful that this water will get dirty (with germs) with every new head of lettuce. Therefore, the water has to be changed between batches of vegetables to avoid carry over of germs.

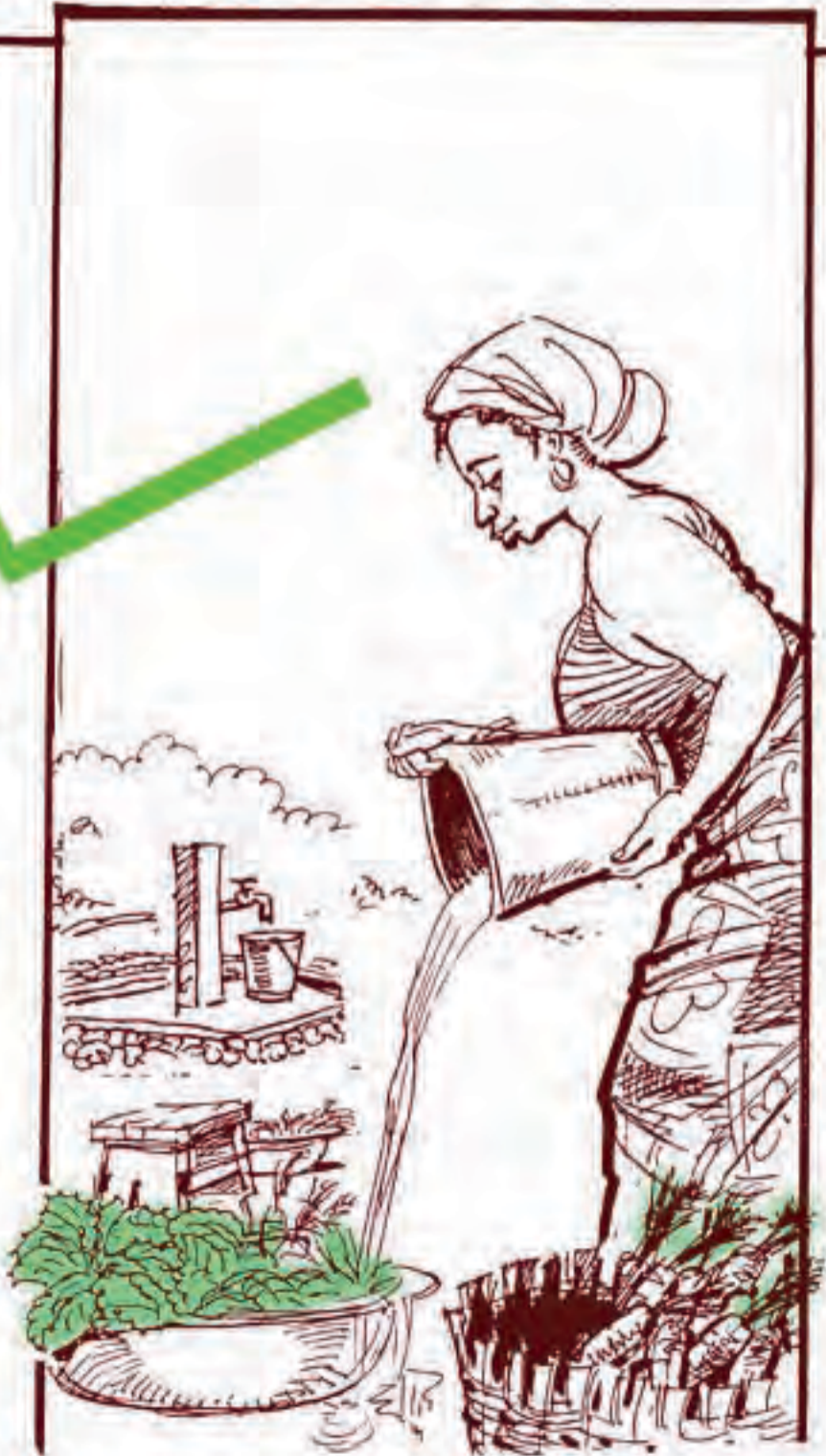
*Washing vegetables with polluted irrigation water after harvesting increases crop contamination. Washing off dirt should be done with clean water.*



**A**



**B**





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## ILLUSTRATION 14

The extension officer discusses the use of the right poultry manure on vegetable plots

### NOTE TO THE EXTENSION OFFICER

1. Find out from the farmers what they think is the difference between the two heaps of manure (upper two pictures).
2. Ask farmers which of the two manure heaps Abu should use and why?
3. Explain to farmers the importance of using mature manure.

### ANSWERS:

1. One heap looks 'steaming' and fresh. The other heap looks mature and old.
2. Abu should use the mature manure but not the fresh manure where germs are still alive.
3. Mature manure has less live germs and is safer to use. Also, it will not burn young seedlings and will provide plants with the required nutrients.

*Turn the fresh manure heap upside down once a week and use it after 6 weeks only*

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**Fresh poultry manure heap**



**Matured poultry manure heap**



# The most important additional pre-caution is to wash raw vegetables the right way if you do not know the quality of their irrigation water

## Core information

- ◆ Use 0.5 to 1 tablet of chlorine in 5 litres of water to wash salad greens. These are special chlorine tablets for salad washing.
- ◆ Or use a knife tip or 1 small tablet of the purple 'potassium permanganate' (which can be bought in many pharmacies) in 5 litres of water.
- ◆ Or use one part of vinegar in 5 parts of clean water (e.g. 1 litre in 5 litres).
- ◆ If the options above are not available you can also use a tea spoon (not more!) of common household bleach ("Eau de Javel") in 5 litres of water.

These solutions can be used about 25 times before they have to be renewed. Each time, the vegetables should be soaked for 5-10 minutes (not less!) and then rinsed with clean water.

## Why?

In many sub-Saharan African countries, water sources used for irrigation are polluted and vegetables can contain a dangerous amount of microorganisms (germs) on their surface.

While some vegetables are cooked which kills microorganisms, many salad greens or fruits from irrigated farming are eaten raw and require thorough washing or peeling to reduce health risks.

For washing, many people use salt or vinegar, but often at too low concentrations which will not kill the harmful microorganisms.

There are several options (see left) how to destroy microorganism which can otherwise make you sick.

## Considerations and suggestions for the trainer

- ◆ There are different options to wash raw-eaten vegetables thoroughly. Become familiar with the different practices and discuss with the trainees/students which methods are convenient for different kitchens (private, business) as their local availability and costs might vary.
- ◆ Inform the trainees/students that common procedures like adding a bit of salt, lemon or vinegar are not effective to kill pathogens. Only the correct concentration is effective.
- ◆ Provide examples of foods (e.g. lettuce, cabbage, spring onions) and dishes (e.g. salad) commonly eaten in the region. Prepare these dishes using the recommended methods, and allow trainees to repeat the procedures, especially to get a feeling for the amount (knife tip, 5 litres, ...).

## Considerations and suggestions for the trainer

- ◆ Chlorine tablets (examples)



There are not many brands yet on the African market. One brand promoted e.g. in Ghana is "foodsaf". It is available in selected supermarkets and pharmacies. For about 1 USD about 500 heads of lettuce can be disinfected before the solution has to be renewed. Pack sizes and prices vary.

## Additional information on different washing methods

### ◆ “Potassium permanganate”



- ◆ Potassium Permanganate exists as local and imported product and is available in many pharmacies as purple powder or in small particles/tablets.

For USD 1 about 300 to 750 (depending on the brand) heads of lettuce can be disinfected.

### ◆ “Eau de Javel” (bleach)\*



- ◆ Bleach is known in most countries under various brands.

It is available in smaller and larger supermarkets and filling station shops.

For USD 1 about 1200 heads of lettuce can be disinfected.

### ◆ “Vinegar”



- ◆ Vinegar has to be added in high concentration (1 part vinegar in 5 parts of water) in order to kill harmful microorganisms. This method might be suitable for hotels but is relatively expensive for use in households or small enterprises.

For USD 1 (= one bottle) only 25 heads of lettuce can be sanitized.

Make sure that vegetables are not exposed to other sources of contamination after washing. Only a combination of good practices can ensure safe food.

### **\*Note of caution:**

While in Francophone West Africa the use of bleach (Eau de Javel) for disinfecting salad is common practice, it might surprise others to use a ‘sanitary cleaner’ for foodstuff. Bleach, like Chlorine tablets, is based on the ability of chlorine to destroy pathogens. The concentrations suggested here do not pose any health threats, especially if the vegetables are rinsed with water after treatment. But the recommended concentrations should not be exceeded and the containers should not be in reach of children. Any chlorine based product is harmful if swallowed. It is also harmful for fish; do not deposit the washing solution into natural water bodies.

### **Disclaimer**

All displayed brand names on page 28 and 29 are only examples and not particularly recommended.

For further information please contact local food safety authorities or our project via Philip Amoah at [p.amoah@cgiar.org](mailto:p.amoah@cgiar.org)



**Let us learn how Abu and Amina can reduce contamination of vegetables in their farm where the water used for irrigation comes from the city, and may not be as clean as we all would like it to be.**

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## HOW TO USE THE BOOKLET

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1. The booklet is designed to stimulate interaction with the farmers. Encourage the farmers to ask questions and make comments.
2. The questions in the text will help you to guide the discussion. Possible answers to these questions are included so that you can supplement the farmers' comments.
3. The booklet is more effective when used with a small audience (up to 5 persons). If you work with more than 5 farmers, have two or more sessions.
4. Select a comfortable place and make sure everybody can see the booklet well, or prepare extra copies.
5. Demonstrate as much as possible using watering cans etc.
6. Let the audience summarise the major points of the day's discussions.

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### Acknowledgements, reproduction, citation:

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