



# CODE OF HYGIENIC PRACTICE FOR TOMATOES

PNS/BAFS 211:2017  
EXPLANATORY MANUAL







## Code of Hygienic Practice for Tomatoes (PNS/BAFS 211:2017)

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Published by:  
Bureau of Agriculture and Fisheries Standards  
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ISBN 978-621-455-462-1 (PDF)

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# Introductory Note

The Philippine National Standard (PNS) Code of Hygienic Practice (COHP) for Tomatoes was developed in response to the development of an Annex on Tomatoes to the Codex COHP for Fruits and Vegetables (CAC/RCP 53-2003) by the Codex Committee on Food Hygiene in 2012.

This Code aims to ensure that tomatoes produced in the Philippines are safe from microbiological hazards and comply with regulatory requirements. This Code also addresses the essential principles of food safety applicable to primary production, postharvest, distribution, and consumption of fresh tomatoes. It encompasses Good Agricultural Practices (GAP), Good Hygienic Practices (GHP), and Good Manufacturing Practices (GMP) that will help minimize microbiological hazards associated with all stages of production to consumption of tomatoes.

Consequently, the Explanatory Manual on COHP for Tomatoes is developed to harmonize the interpretation of the standard through examples, anecdotal experiences, and supplementary images provided in the box of explanatory notes. This is to facilitate better appreciation and adoption of minimum requirements in the standards. The explanatory notes are guidance only and shall not be construed as mandatory requirements unless otherwise specified by the regulatory agency implementing the said standard.

For more information, please visit our website <http://www.bafs.da.gov.ph> and Facebook page (<https://www.facebook.com/da.bafs>).

# Director's Message



**VIVENCIO R. MAMARIL, PhD**  
Director IV

As the saying goes, '*Food safety is everyone's business*'; everyone in the food supply chain has a responsibility to ensure that what we eat is safe to consume and of good quality. Much of the work lies with the primary producers, especially vegetable commodities such as tomatoes.

In the PNS/BAFS 211:2017 Code of Hygienic Practice for Tomatoes, the Bureau presented the recommended practices in tomato production, including its post-production. As tomato is a high-risk commodity, hygienic practices should be observed throughout the value chain – from primary production to retail.

This time, BAFS developed an Explanatory Manual (EM) for the PNS to explain its provisions further. The EM contains notes and photographs/illustrations for identified practices, which were closely drafted and documented by the BAFS project managers in collaboration with the established Technical Working Group (TWG).

With this, we hope the document will contribute to ensuring food safety and quality of tomatoes. Let us join hands in producing *safer food for better health!*



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# Objectives





## 1 Objectives

The objective of this PNS/BAFS is to provide specific guidance on how to minimize *microbiological hazards* during primary production, postharvest, distribution and consumption of fresh tomatoes. It adopts to the general hygienic recommendations for the primary production of fresh fruits based on *Codex Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

# Scope, Use, Normative References

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box.





## 2.1 Scope

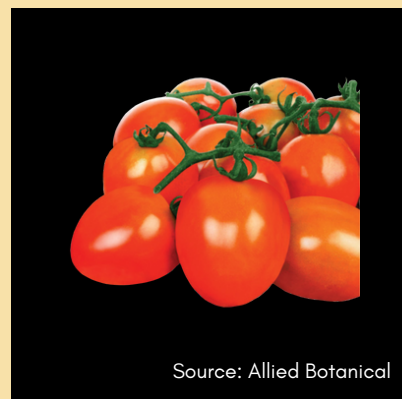
This Code covers specific guidance related to all areas from primary production to consumption of tomatoes that are intended to be consumed raw and/or are processed without a step.

### Explanatory Note:

The Standard covers the following tomato varieties but not limited to:



'Agatona Improved'



'Atlas F1'



'Cherrys'



'Diamante Max F1'



'Golden Globe'



'Super Pope'

*Disclaimer: Photos above are not scaled according to its actual size.*

## 2.2 Use

This Code adopts and follows the general format of the *Codex Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RP 53-2003). Only the specific sections of the *Codex Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-003) that relate to the microbiological safety of tomatoes are discussed in this Code. Therefore, this Code should be read in conjunction with the *Codex Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003), the *Codex Recommended International Code of Practice-General Principles of Food Hygiene* (CAC/RCP 1-1969, Rev.4-2003) and other applicable codes.

This Code supplements the *Philippines National Standard: Code of Good Agricultural Practices for Fruits and Vegetable (GAP-FV) Farming* (PNS/BAFPS 49:2007/2011 ICS 65.020.20), which is the basis for the granting of the *Philippine Good Agricultural Practices (PhilGAP)* certification of tomato farms.

## 2.3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies:

CAC/GL 60-2006, *Codex Principles for Traceability/Product Tracing as a Tool within a Food Inspection and Certification System*

CAC/GL 79-2012, *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food*

CAC/RCP 1-1969, Rev.4-2003, *Codex Recommended International Code of Practice - General Principles of Food Hygiene*

CAC/RCP 8-1976, *Code of Practice for the Processing and Handling of Quick Frozen Foods*

CAC/RCP 53-2003, *Codex Code of Hygienic Practice for Fruits and Vegetables*

PNS/BAFS 198: 2017, *Philippine National Standard: Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables*

PNS/BAFPS 49:2011, *Philippine National Standard: Code of Good Agricultural Practices for Fruits and Vegetable (GAP-FV)*



# **Terms and Definitions**





For the purpose of this Code, the following terms are operationally defined:

**3.1****biofilm**

microbial consortium adhering to a surface

**3.2****biosolids**

sludge and other residue deposits obtained from sewage treatment plants and from treatment applied to urban and industrial wastes (food industries or other types of industry)

**3.3****clean water**

water that does not compromise food safety in the circumstances of its use

**3.4****cross-contamination**

transfer of harmful microorganisms from one item of food to another via a nonfood surface such as human hands, equipment, or utensils

**3.5****grower/agricultural worker**

any person who undertakes one or more of the following: production, harvesting and packing of tomatoes

**3.6****natural fertilizer**

substances that provide vital plant nutrients derived and/or extracted from plants, animals, marines and minerals that are minimally processed as opposed to being produced synthetically

**3.7****potable water**

water which meets the quality standards of drinking water such as described in the World Health Organization Guidelines for Drinking Water Quality

**3.8****reclaimed wastewater**

water taken from industrial wastewater and treated to a level suitable for its intended use

**3.9****surface water**

water sources such as in a stream, river, lake, wetland, or ocean



# Primary Production

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box. Photos without indicated sources were taken by the BAFS personnel during the field data-gathering activities.



## 4 Environmental hygiene

### 4.1 Location of production site

The following should be considered in the location of production sites for tomatoes:

- Slope and potential for run-off from nearby fields;
- History of the land or previous usage of land;
- Flood risks as well as hydrological features of nearby sites in relation to the production site; and
- Proximity to high risk production sites (animal production facilities, hazardous waste sites and waste treatment facilities).

#### Explanatory Note:

The risk of contaminating produce is assessed by identifying the previous use of the site and the likelihood of biological or chemical contamination of the soil leading to contamination of the produce to be grown [1]. Prior uses that can be a source of contamination include:

- storage of animal manure
- intensive animal grazing
- treatment or storage of human sewage and biosolids
- treatment or storage of reclaimed water
- dumping of excess chemicals
- treatment with chemicals to control pests
- landfill
- industrial factory
- war zone



Image 1. **Areas not suitable for crop production**



Measures to mitigate the risks associated with runoff and flooding include mapping the production field, terracing, construction of shallow ditch to prevent runoff from entering the fields.

#### Explanatory Note:



**Image 2. Shallow ditches constructed in between rows of crops**

Postpone harvesting of tomatoes during heavy rains and flooding which will increase exposure of vegetable to pathogens. Wet tomatoes are very susceptible to spoilage.

#### Explanatory Note:

Floodwaters contain contaminants such as sewage, chemicals, heavy metals, microbial pathogens, and fungi that can hasten the spoilage of tomatoes and pose food safety issues [2, 3].

If a harvestable tomato is exposed to flood waters, it is considered contaminated. There is no practical method of reconditioning these tomatoes that will reasonably ensure food safety [2]. Removal and physical separation of flood-contaminated tomatoes from uncontaminated tomatoes is strategy to avoid cross-contamination.

Contaminated tomatoes are to be placed in appropriate waste containers for collection and subsequent disposal in local landfills.

Contaminated tomatoes are not recommended for further processing or composting due to the presence of contaminants [3, 4].

For crops that were in or near flooded areas but where flood waters did not come in contact with the harvestable produce, it is best to evaluate its safety for human consumption on a case-by-case basis for possible contamination [2].



Source: University of Massachusetts, 2013

**Image 3. Tomato crops exposed to flood waters should be disposed**

Neighboring sites such as animal production facilities, hazardous wastes sites, and waste treatment facilities have the potential to contaminate tomato production fields or its water sources through run-off, fecal material, aerosols, and other means of contamination.

When the risks are serious, the location should not be used for tomato production until corrective or control measures are carried out.

### Explanatory Note:

The present use of adjoining land also needs to be considered [1]:

- Has it been used for landfill or waste?
- Has it been used recently for intensive animal production, such as a feedlot?
- Do animals have access to this area?
- Does it have a septic sewage system, and can it contaminate the proposed site?
- Is it a storage or dumping area for chemicals?
- Is it an industrial or urban site?



Image 4. Potential sources of contamination - (a) composting area, (b) livestock area, (c) chemical storage, and (d) industrial area



## 4.2 Wild and domestic animals and human activity

Many wild and domestic animals are potential carriers of foodborne pathogens. Domestic and wild animals and human activity present a risk from direct contamination of the tomatoes and soil, as well as from contamination of surface water sources, and other inputs.

The following should be considered:

- a. Domestic and wild animals should be excluded from the tomato production area to the extent possible, in compliance with the local and national environmental and animal protection regulations;
- b. Minimize standing water in fields;
- c. Restrict access by animals to water sources (based on local ordinances for public irrigation systems); and
- d. Keep tomato production sites free of wastes and clutter.

### Explanatory Note:

Measures to minimize wildlife presence may include using barriers or other deterrents, minimizing wildlife attractants and opportunities for harborage, redirecting wildlife to non-sensitive areas, and/or other methods identified by wildlife experts. Animals in the production area is a potential source of contamination.



*Image 5. Sample measures for deterring animal entry: installing nylon nets (left image), or a separate fenced area for livestock (right image)*

## 5 Hygienic primary production of tomatoes

The high moisture content and soft skin of tomatoes make them more susceptible to physical damage that accelerates deterioration of tomatoes by increasing water loss, and providing conditions for contamination during production, harvest, and transport. Tomatoes may be physically damaged during harvesting from the use of sharp-edged storage containers, improper field packing procedure or through poor handling. Rodents, insects and birds may also damage tomatoes that lead to increased microbiological spoilage and potential transmission of foodborne pathogens.

Some tomatoes get in contact with the soil during growth and/or harvesting. Bird droppings and airborne contaminants (i.e. birds nesting around the packing area, nearby livestock, and poultry areas, or manure storage or treatment facilities, etc.) may also pose risks of contamination of tomatoes.

### Explanatory Note:

Contamination of sound produce is avoided by having different workers handling the discards in the field [6].

The following are generally recommended to:

- a. Reduce the extent of damaged fruits during production;
- b. Use proper production practices (e.g. site selection, wind breaks) to minimize contact of tomatoes with airborne contaminants;
- c. Avoid contact of tomatoes to animal droppings, soil amendments (including natural fertilizers) and irrigation water;
- d. Use mulch (e.g. rice straw, plastic mulch, grass clippings) and trellis, if applicable, to minimize contact of tomatoes with the soil during growing period.
- e. Use clean plastic (e.g. leaves or papers as liners of biodegradable baskets) during collection of harvested fruits; and
- f. Prohibit the use of newspapers and papers with print as liners.

If biodegradable materials are used, the following are recommended to:

- a. Ensure that materials are clean and sanitary; and
- b. Use materials only once to prevent cross-contamination.

**Explanatory Note:**

Farm implements such as trellises and plastic mulches can be used to ensure that tomato crops are maintained upright, and tomatoes do not come in contact with the soil.



*Image 6. Trellises and plastic mulch installed in tomato farms*

Using newspapers as liners may cause the adherence of ink to the produce. The ink used to print consists of components such as lead and naphthylamine hydrocarbons that may cause health complications. Manila paper, kraft paper, or any clean paper are suitable alternatives [7].



*Image 7. Plastic crate lined with Manila paper*



*Image 8. Banana leaves can also be used as a liner*

## 5.1 Water for primary production

Only clean water should be used for tomato production. Sources of water should be identified. Growers/agricultural workers should seek assistance of competent authorities (e.g. from Local Government Unit or LGU) to assess and manage the microbiological risk of contamination of the water source, which are as follows:

- a. Assess the microbiological quality of the sources of water used on the farm for the presence of foodborne pathogens. This should include a documented check detailing the potential for microbiological contamination from all possible human and/or animal feces sources of contamination (e.g. from animals, human habitation, leaks from sanitary facilities on field, sewage treatment, manure and composting operations) and the water's suitability for its intended use. When contamination sources of the water are identified, corrective actions should be taken to minimize the risk of contamination. The effectiveness of corrective actions should be verified;
- b. Identify and implement corrective actions to prevent and minimize contamination such as, proper maintenance of wells, filtering water, not stirring the sediment when drawing water, building settling or holding ponds, and use of water treatment facilities. If water treatment is needed, consult with water safety experts;
- c. Determine if microbiological and chemical testing should be done by local authorities such as the LGU and the Bureau of Soils and Water Management (BSWM) to evaluate the suitability of water for each intended use. Analytical testing may be necessary after a change in irrigation water source, flooding, or a heavy rainfall when water is at a higher risk of contamination. If testing is conducted the following should be documented:
  - What tests need to be performed, (e.g., which foodborne pathogens and/or sanitary indicators);
  - Which parameters should be noted (e.g., temperature of water sample, water source location, and/or weather description);
  - How often tests should be conducted;
  - What the test outcomes indicate; and
  - How tests will be used to define corrective actions.
- d. Determine the frequency of water testing depending on the source of the irrigation water (less for adequately maintained deep wells, more for surface waters) and the risk of environmental contamination, including intermittent or temporary contamination (e.g., heavy rain, flooding, etc.);

If water testing is limited to non-pathogenic indicators (such as coliforms, Aerobic Plate Count or APC, etc.), conduct frequent water tests to establish the baseline water quality so that subsequent changes in the levels of contamination can be identified; and

If the water source is found to have unacceptable levels of indicator organisms (such as *E. coli*) or is contaminated with foodborne pathogens, undertake corrective actions to ensure that the water is suitable for its intended use. Testing frequency should be increased until consecutive results are within the acceptable range.



Reassessment of the potential for microbiological contamination is necessary when events or other conditions indicate that water quality may have changed.

### Explanatory Note:

According to the Department of Environment and Natural Resources (DENR), Administrative Order No. 2016-08, or the Water Quality Guidelines and General Effluent Standards of 2016, the water used for irrigation is classified as a "Class C" water body as it is used for agricultural purposes. For Class C water bodies, the DENR AO has set the required minimum water quality parameters as follows:

**Table 1.** Water Quality Guidelines for Primary Parameters of Irrigation Water (adapted from DENR A.O. No. 2016-18)

Parameter	Unit	Value
BOD	mg/L	15
Chloride	mg/L	400
Color	TCU	150
Dissolved oxygen (minimum)	mg/L	2
Thermotolerant coliform (Fecal coliform)	MPN/100mL	400
Nitrate as NO <sup>-3</sup> -N	mg/L	15
pH (range)		6.0-9.0
Phosphate	mg/L	5
Temperature	°C	25-32
Total suspended solids	mg/L	110

Note: MPN/100mL - Most Probable Number per 100 milliliter; TCU - True Color Unit

As for potable water, the Department of Health (DOH) issued the Philippine National Standards (PNS) for Drinking Water of 2017 (DOH Administrative Order No. 2017-0010). The parameters and corresponding standard values for potable water quality are presented in Table 2.

**Table 2.** Standard values for the microbiological quality parameter of potable water (adapted from DOH A.O. No. 2017-0010)

Parameter	Standard Values
1. Total Coliform	MTFT: < 1.1 MPN/100 mL
	EST: Absent or < 1 MPN/100 mL
	MFT: < 1 total coliform colonies/100 mL
2. Thermotolerant Coliform/ <i>E.coli</i>	MTFT: < 1.1 MPN/100 mL
	EST: Absent or <1 MPN/100 mL
	MFT: < 1 thermotolerant coliform colonies/100 mL
3. Heterotrophic Plate Count (HPC)	< 500 CFU/mL

*Note: MTFT - Multiple Tube Fermentation Technique, MPN - Most Probable Number, EST - Enzyme Substrate Test, CFU - Colony Forming Units, MFT - Membrane Filtration Technique*

The DOH regularly monitors and audits drinking water service providers for the effectiveness of their implementation of the Water Safety Plan (WSP) [10].

Analyses of water samples (*i.e.*, microbiological and physicochemical) are performed by DOH-accredited Laboratories for Drinking Water Analysis (LDWA). The list of accredited laboratories can be accessed on the website of DOH - Health Facilities and Services Regulatory Bureau's (HFSRB) [10].

## 5.2 Manure, biosolids and other natural fertilizers

- a. Growers/agricultural workers should prohibit use of untreated manure and liquid manure to the extent possible since foodborne pathogens can persist in soil for long periods of time and some tomatoes have short production cycle;
- b. Animal manure/plant waste materials are allowed only when fully decomposed; and
- c. Human manure and urine are not allowed.

Obtain documentation from the supplier that identifies the origin, treatment used, tests performed and the results thereof, and evaluate information when necessary for those manure, biosolids and other natural fertilizers that have been treated to reduce microbiological and chemical contaminants.

### Explanatory Note:

Animal manure or plant waste materials are decomposed at a temperature of at least 60°C to kill pathogenic bacteria and produce organic fertilizers with no more than 35% moisture level. Fully decomposed organic fertilizers do not emit a foul odor (*i.e.*, ammonia, rotting, or fermentation smell) [11, 12].

## 5.3 Personal health, hygiene and sanitary facilities

The following should be considered:

- a. Whenever possible, reduce tomato handling during harvesting, packing and inspection operations;
- b. All growers/agricultural workers should properly wash their hands using soap and clean running water and dry their hands before handling tomatoes, particularly during harvesting and postharvest handling;
- c. If gloves are used, a procedure for glove use in the field should be documented and followed. If the gloves are reusable, they should be made of materials that are easily cleaned and disinfected, and they should be cleaned regularly and stored in a clean area. If disposable gloves are used, they should be discarded when they become torn, soiled, or otherwise contaminated. Glove use alone is not a suitable substitute for good hand washing practices;
- d. Where appropriate, each farm should have written Sanitation Standard Operating Procedures (SSOP) that relate to health, hygiene, and sanitary facilities. The SSOP should address training, facilities, and supplies to enable growers/agricultural workers to practice proper hygiene, and company policies that relate to worker hygiene and illness reporting; and
- e. Non-essential persons, casual visitors, and to the extent possible, young children, should not be allowed in the harvest area, as they may present an increased risk of contamination.



**Explanatory Note:**

Clean and suitable outer garments are recommended for employees, visitors, and other field personnel. The following may also be worn, depending on the operation: hair restraints, plastic aprons, and sleeves.

Personal Protective Equipment (PPE), such as gloves, used during harvesting protects the personnel and the produce against contamination. Plastic (non-powdered latex) and knitted gloves also protect the tomatoes against mechanical damages.



*Image 9. Workers wearing PPE and gloves when handling tomatoes*

### 5.3.1 Personal hygiene and sanitary facilities

The following should be considered:

- Provide areas away from the field and packing area for taking breaks and meals. These areas should provide access to clean toilet and hand-washing facilities;
- Sanitary facilities should be readily accessible to the work area, encouraging their use and prohibit the growers/agricultural workers to relieve themselves in the field or in the production site;
- Prohibit the growers/agricultural workers to do the following: disposal of waste, eating, smoking, spitting, and any activity that will introduce contamination;
- Sanitary facilities should be present in sufficient number in relation to the number of workers (refer to the Code on Sanitation of the Philippines);
- Portable sanitary facilities should not be located or cleaned in cultivation areas or near irrigation water sources or conveyance systems. Growers/agricultural workers should identify the areas where it is safe to put portable facilities. Sanitary facilities should include clean running water, soap, toilet paper or equivalent, single use paper towels or equivalent. Multiple use cloth drying towels should not be used. Hand sanitizers should not replace hand washing and should only be used only after hands have been washed; and
- If clean running water is not available, an acceptable alternative hand washing method should be recommended by the relevant competent authority.

When necessary, consult competent authorities with regards to personnel hygiene and sanitation.

#### Explanatory Note:



Image 10. Toilet and handwashing facilities



Source: DA-FDC

Image 11. Locker room and resting area for employees

### 5.3.2 Health status

The following should be considered:

- Growers/agricultural workers should be encouraged (with appropriate incentives, if feasible) to note and report symptoms of diarrhea or food-transmissible, communicable diseases. Reassign growers/agricultural workers with health problems, as appropriate; and
- Medical examination of growers/agricultural workers should be carried out if clinically or epidemiologically indicated.

#### Explanatory Note:

The produce is protected from exposure from employees who display symptoms of illness through the wearing of gloves or masks and other appropriate measures (e.g., disallowed from coming in contact with the produce or any equipment that will come in contact with the produce)

Sending sick workers home or restricting entry of visitors is the best option for workers who have recently had an intestinal disease or those showing symptoms of infectious and communicable diseases (e.g., COVID-19). If workers or field personnel will be allowed to work at all, non-handling work assignments or restrictions from working with or within the vicinity of tomatoes or tomato contact surfaces will prevent the contamination of the produce [6].

Warning signs (e.g. not coming to work while sick or prohibiting smoking or spitting in the workplace) placed in noticeable or conspicuous areas will help alert the employees. Its translation to the predominant languages of the employees will facilitate better understanding [13].

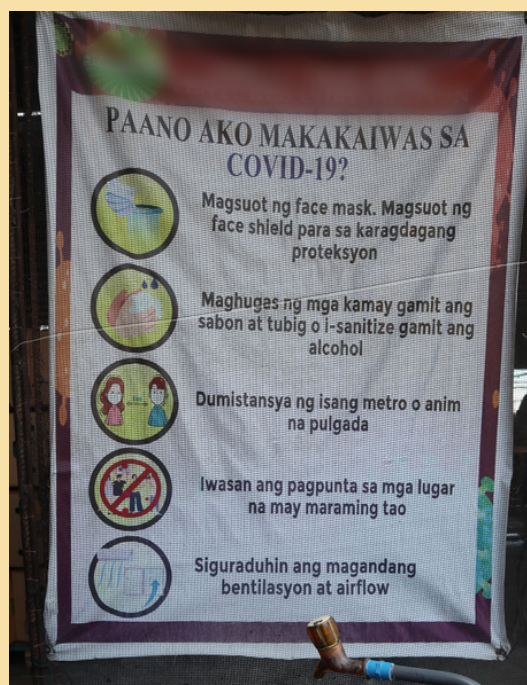


Image 12. Sample warning sign

### 5.3.3 Personal Cleanliness

When growers/agricultural workers are permitted to continue working with cuts and wound covered by waterproof dressings, they should wear clean gloves to cover bandages thereby providing a second barrier between them and the tomatoes they handle. Otherwise, reassign the concerned growers/ agricultural workers to another working area where there is no direct handling of tomatoes.

### 5.4 Equipment associated with growing and harvesting

Sanitation Standard Operating Procedures (SSOP) should be developed for the maintenance, cleaning and disinfecting operations of growing and harvesting equipment. The following are recommended:

- Containers used repeatedly during harvest should be cleaned after each load;
- Containers (including liners of containers made from biodegradable materials) that are no longer cleanable should be properly disposed to minimize the risk of microbiological contamination of tomatoes;
- Harvest containers should not be placed directly on the ground as much as possible;
- If containers are stored outside, they should be cleaned and disinfected before being used to transport tomatoes; and
- Establish routine cleaning and sanitizing procedures and document these standard operating procedures into writing.

#### Explanatory Note:

Cleaning removes dirt, dust, crumbs, and germs from surfaces or objects using soap or detergent, while disinfecting uses chemicals (disinfectants) to kill germs on surfaces and objects. Sanitizing could be done by either cleaning, disinfecting, or both. Sanitizing means that you are lowering the number of germs to a safe level [14].



**Image 13. Clean crates stacked up and stored in a storage room**

Equipment, reusable harvesting containers, and harvesting tools that come in contact with the produce are made of non-toxic materials and are easily cleaned and disinfected.

Cross-contamination can occur if the same equipment and containers are used for hauling or storing agricultural chemicals, lubricants, oil, cleaning chemicals, plant or other debris, tools, and others [13]. It can also occur if the harvesting equipment is stored in the same area where chemicals, fertilizers, and soil additives are stored.

Implementing pest control measures in the storage area helps avoid contamination.



A sanitizer can help reduce the number of microbes but will not kill all of them. It can reduce microbial loads of up to 1-2 log orders for bacteria, yeasts, and molds and up to 50% reduction for protozoa and worms.

Chlorine sanitizers are the most commonly used sanitizing agent as it is inexpensive, has a broad spectrum, and leave no residue on contact surfaces. For sanitizing tools and equipment, a sanitizing solution with 100 ppm chlorine concentration is recommended. Commercially available sodium hypochlorite (NaOCl) solution with 5.25% concentration, *i.e.*, household bleach, can be used to prepare chlorine sanitizers [15]. Table 3 below shows the amount of 5.25% NaOCl solution needed to be mixed with water to prepare a chlorine sanitizer.

**Table 3.** Amount of commercially available NaOCl solution for preparing the desired concentration of chlorine sanitizer (adapted from Ritenour et al., 2002))

Concentration (parts per million (ppm))	Volume (mL) of 5.25% NaOCl solution per 5 L water
50	4.75 (or 1 teaspoon)
75	7.15 (or 1 1/2 teaspoons)
100	9.53 (or about 2 teaspoons)

The following shows how to prepare a 0.1% (1000ppm) chlorine sanitizer (based on US Center for Disease Control):

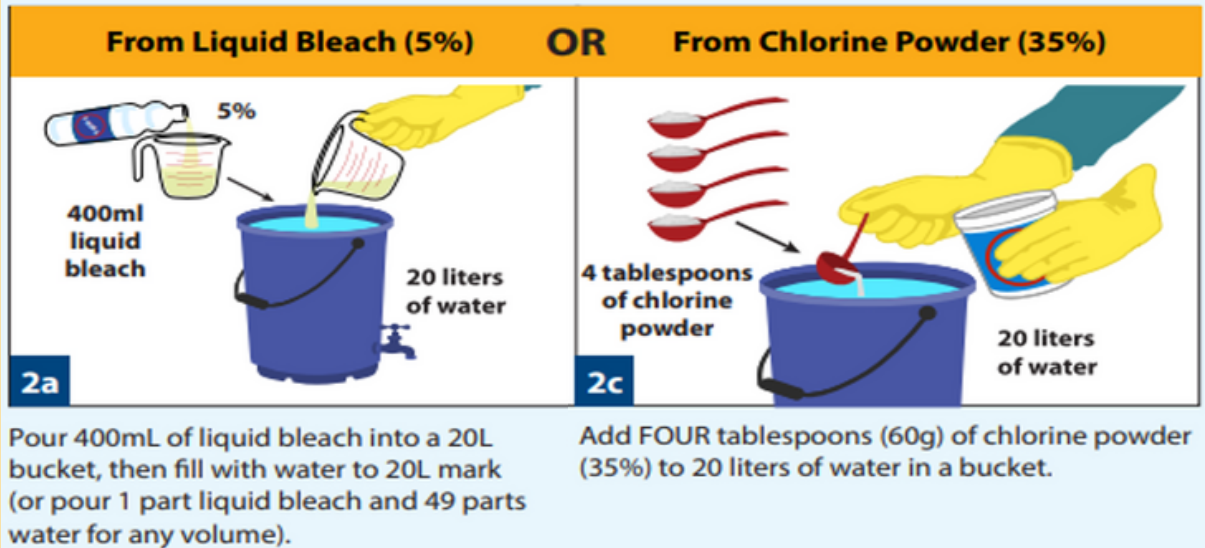


Image 14. Illustration of chlorine sanitizer preparation

When preparing chlorine sanitizers, the following should be considered:

- wear clean gloves when handling chlorine products (liquid bleach or chlorine powder);
- ensure proper ventilation in the preparation room;
- use clean and potable water;
- Chlorine should be added to water and not the other way around; and
- Chlorine sanitizers should always be freshly prepared.

Other sanitizers can also be used. The corresponding recommended concentrations can be seen in Table 4.

**Table 4.** Commonly used sanitizers

Sanitizer	Concentration
Chlorine	75 – 100 ppm
Chlorine dioxide	1 – 5 ppm
Hydrogen peroxide	0.27 – 0.54%
Peroxyacetic acid	Should not exceed 80 ppm
Ozone	0.5 – 2.0 ppm

## 6 Handling, storage and transport

Some tomatoes may have high respiration rates and high moisture content making them more perishable. Enzymes and biochemical reactions may play an important role in the ripening process, but also accelerate spoilage of damaged fruits and increase susceptibility of tomatoes to microbiological contamination. Do not expose harvested tomatoes under the sun to prevent sun scalding.

During harvesting, the following should be considered:

- Avoid over-handling of tomatoes as this may damage and affect fruit quality;
- Avoid harvesting in adverse temperatures (hot/and or humid weathers), which decrease quality and may affect food safety due to fruit damage that may spread contamination of healthy fruits. Have a responsible person to supervise harvesting at all times to insure proper hand washing and follow procedures not to harvest wet, bruised and/or damaged fruits. Tomatoes that have fallen on the ground should also be discarded unless they are processed with a microbiocidal step; and
- Train growers/agricultural workers on safe handling, transport and storage practices to ensure that tomatoes are immediately cooled after harvesting.

### Explanatory Note:

To prevent quality deterioration, harvested tomatoes are placed under shade or any covered area, especially if the transport is delayed. Another strategy to remove field heat and prevent quality deterioration is by pre-cooling the tomatoes in separate clean storage areas using the room cooling method (*i.e.*, placing stacks of produce in a refrigerated space) or forced air cooling (*i.e.*, forcing cool air to move through containers) [13, 15].



Image 15. Reefer vans used for storing commodities



Image 16. Tomatoes that are packed and handled directly in the field are removed and transported or stored as quickly as possible to prevent contamination and post-harvest losses

Proper temperature control is critical to maintaining the quality, and prolonging the shelf life of tomatoes. Generally, the recommended storage temperature for tomatoes is 10–16°C. However, tomatoes are very sensitive to chilling injury. The recommended storage temperature varies with the maturity of the tomato. The table below summarizes the recommended storage temperatures [15]:

**Table 5.** Recommended storage temperatures for tomatoes based on maturity stage

Maturity stage	Recommended storage temperature (°C)
Mature green tomatoes	< 14–16
Light red tomatoes	< 10–14
Ripe tomatoes	4–10

Mature green tomatoes cannot be held at temperatures that delay ripening. When stored for several weeks at 12°C or below, they may start to decay due to chilling injury and fail to ripen properly. To slow down the ripening of mature green tomatoes while preventing decay, a temperature of 15–16°C is recommended.

Papaya and ripe bananas are ethylene-producing commodities or ripening fruits.

Storing tomatoes with these commodities can hasten the ripening process. Green tomatoes are sensitive to ethylene and will begin ripening if exposed; however, ripe tomatoes are not highly sensitive to ethylene.

If handled and stored properly, tomatoes generally have a storage life of 7 to 10 days at ambient temperatures [15]. Storage life, however, may also vary depending on the tomato variety/cultivar and the maturity stage of the tomato at harvest. Fruits of different varieties/cultivars may differ in storage potential. Harvesting tomatoes at the mature green stage is advisable to give producers enough time, especially for long-distance transport and marketing [18].



## 6.1 Prevention of cross-contamination

The following should be considered for the pre-harvesting, harvesting and postharvest handling of tomatoes:

- Growers/agricultural workers should take measures to improve sorting and selection of tomatoes as the extent of soil and extraneous matter/debris during and after harvesting may pose a risk of contamination;
- Growers/agricultural workers should not handle culled fruit (e.g., injured/damaged, soft, or decayed fruit) in the field in order to prevent cross-contaminating healthy tomatoes during harvest. It is recommended that culls be removed from the field by growers/agricultural workers who are not harvesting healthy fruits; and
- Growers/agricultural workers should continually reinforce the importance of good hygienic practices since poor hygienic practices can significantly increase the risk of contaminating tomatoes.

## 6.2 Field Packing

Preference should be given to the field packing into consumer-ready containers of tomatoes that will not be washed after harvest, to minimize the possibility of microbiological contamination through the additional handling steps.

Growers/agricultural workers should ensure that clean pallets and containers (disinfected when necessary) are used and that containers do not come in contact with soil and manure during field packing operations.

### Explanatory Note:

Containers that may be used for field packing tomatoes include wooden crates, plastic crates, or corrugated boxes. These containers are sometimes with or without liners. Liners may be paper or banana leaves.

Pallets, when used, ideally have a height of at least 15 cm (6 inches) from the floor/ground [19].



Image 17. Clean pail and wooden/plastic crates used in field packing



Establishment:

### **Design and Facilities**

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box. Photos without indicated sources were taken by the BAFS personnel during the field data-gathering activities.



Refer to the *Codex Recommended International Code of Practice –General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 4-2003)*.

## 7 Location

### 7.1 Equipment

Whenever possible, equipment should be designed and placed to facilitate cleaning and disinfection, and to prevent build-up of biofilms that may contain foodborne pathogens of concern.

#### Explanatory Note:



**Image 18. Common tools and equipment that should be washed thoroughly every after use**

## 8 Premises and rooms

### 8.1 Design and layout

Premises and rooms should be designed to separate the area for incoming tomatoes from the field to the area of handling. This can be accomplished in a number of ways, including linear product flow.

Where feasible, raw material handling areas should be separated from packing areas.

Within each of these areas, cleaning operations should be conducted separately to avoid cross-contamination between equipment and utensils in each operation.

For products that are not immediately packed (i.e. the tomatoes are exposed to contaminants from the environment), the rooms where final products are packaged and stored should be designed and maintained to be as dry as possible. The use of water or having a wet environment enhances the growth and spread of foodborne pathogens.

Tomato packing establishments may be seasonal, and used only for a few months per year. The facilities may be dormant for many months, leaving them susceptible to pest infestations. Measures to minimize pest infestations should be put in place. The design should allow thorough cleaning and disinfection of food contact surfaces.

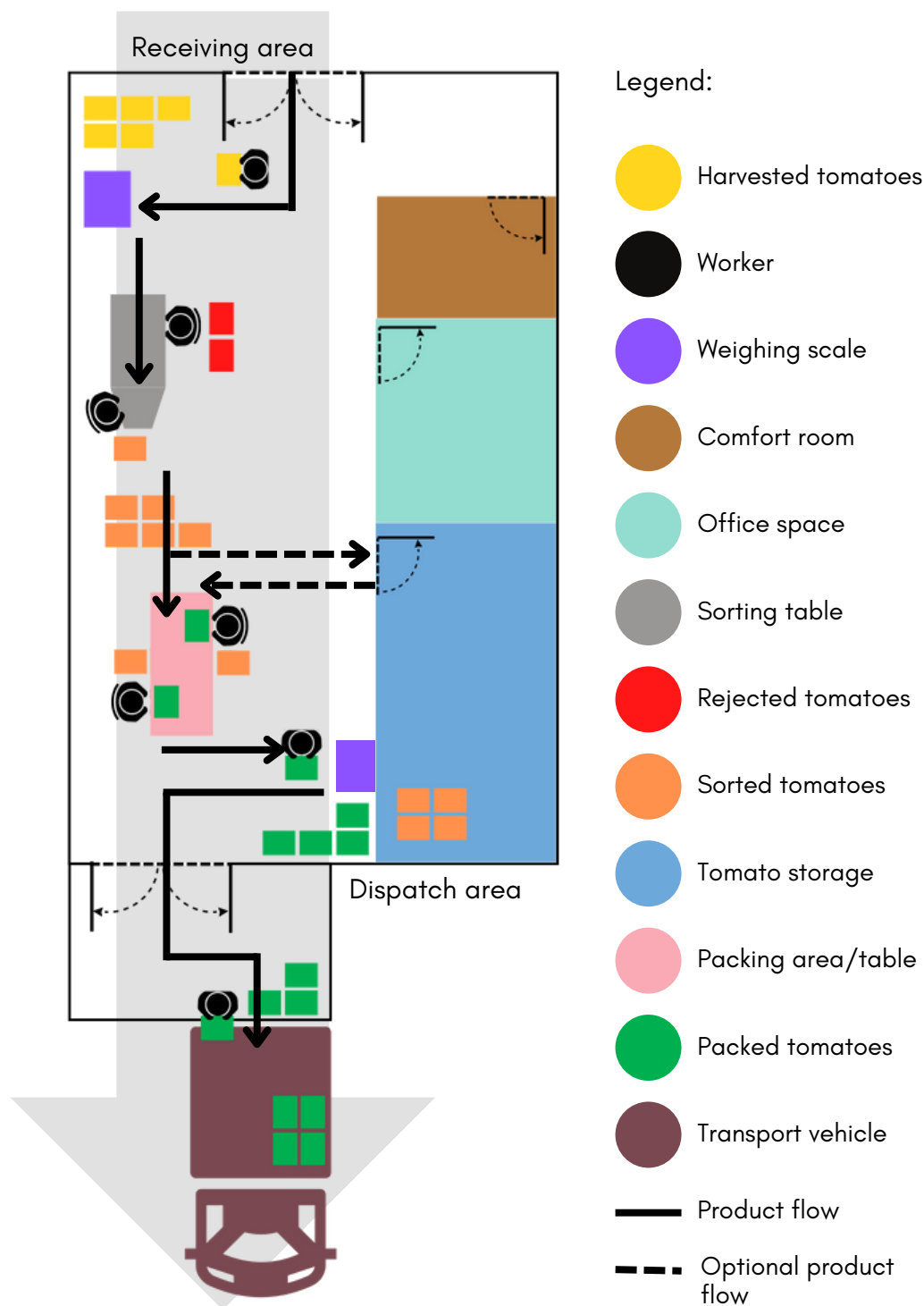


**Explanatory Note:****Table 6.** Potential sources of contamination inside packing and storage facilities and corresponding mitigating measures (based on Fresh Produce Safety Centre Australia & New Zealand, 2019)

Sources	Potential type of contamination	Mitigating measures
Structures e.g. walls, ceilings, posts, bearers, mezzanine floors, walkways, stairs	<ul style="list-style-type: none"> <li>• Paint flakes, rust and dirt on structures fall into open containers or packed product</li> <li>• Feces of birds, rodents and other animals accumulate on structures and drop onto produce, equipment, containers and packaging.</li> <li>• Water drips or splashes from structures during cleaning, due to condensation or from leaks during heavy rain.</li> <li>• Electric insect killers attract and kill flying insects which then drop into grading equipment or onto produce.</li> </ul>	<ul style="list-style-type: none"> <li>• Floors, walls, ceilings, and other structures should be cleaned and/or maintained regularly.</li> <li>• When using electric insect traps, make sure to have a well protected and secure receptacle for dead insects.</li> </ul>
Cooling rooms, ripening rooms	<ul style="list-style-type: none"> <li>• Dripping of water from dirty ceilings, walls and cooling units open containers</li> <li>• Splashing of water onto produce during cleaning</li> </ul>	Cooling/ripening rooms should be cleaned and/or maintained regularly.
Lights	Glass from broken lights falling onto produce, equipment, containers or packaging materials	Lighting fixtures should, where appropriate, be protected to ensure that produce is not contaminated by breakages.
Storage of equipment and materials	<ul style="list-style-type: none"> <li>• Feces of birds, rodents and other animals accumulating in storage areas</li> <li>• Glass, hard or brittle plastic, ceramic or similar materials falling onto produce, equipment, containers and packaging</li> </ul>	Equipment storage should be cleaned and/or maintained regularly.

**Table 6.** (continued)

Sources	Potential type of contamination	Mitigating measures
Chemical and fertilizer storage	Spillage or leakage of chemicals or fertilizers into areas where produce is handled and/or packaging is stored	Chemical and fertilizer storage should be separate from tomato handling areas, and cleaned and/or maintained regularly.
Storage of fuel, oil and grease	Spillage or leakage of fuel, oil and grease into areas where produce is handled and/or packaging is stored	Storage of fuel, oil and grease should be separate from tomato handling areas, and cleaned and/or maintained regularly.
Stray animals	Manure, soils, dirt, hair, plant debris, and pests	Animals should be excluded from tomato handling areas.
Workers	Jewelry, hair, adhesive bandages	<ul style="list-style-type: none"> <li>Workers should not be allowed to wear jewelries or other accessories when handling tomatoes.</li> <li>Wearing hair restraints (e.g. hairnet) is recommended.</li> <li>Any worker with an open cut or wound should be assigned to perform task not related to handling of tomatoes.</li> </ul>



*Image 19. Sample layout of a straight-line configuration product flow in a tomato packinghouse*

# Control of Operations

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box. Photos without indicated sources were taken by the BAFS personnel during the field data-gathering activities.





Refer to the *Codex Recommended International Code of Practice –General Principles of Food Hygiene* (CAC/RCP 1-1969, Rev. 4-2003) in conjunction with the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CAC/GL 79-2012) and the *Code of Practice for the Processing and Handling of Quick Frozen Foods* (CAC/RCP 8-1976).

## 9 Control of food hazards

Prevention of microbiological contamination is a key control point for tomato operations. Establishment should carefully consider product flow and segregation of incoming soiled and/or damaged, and outgoing tomatoes to avoid cross-contamination.

Care should be taken to ensure that tomatoes are not damaged and do not become cross-contaminated during transport and handling. Prior to packing, tomatoes that are soiled, come with debris (e.g., insects), or are damaged, should be inspected and culled.

Culled tomatoes should be removed from the field or packing facility and disposed of to prevent contamination of other fruit. Culled fruit should be hygienically disposed of to avoid it from attracting pests.

### Explanatory Note:



**Image 20. Tomatoes with damage/defect are culled out in a sorting table. Clean gloves are worn when sorting to avoid damaging good quality tomatoes.**



**Image 21. Culled tomato are placed in a proper container before disposal**

## 10 Key aspects of hygiene control systems

### 10.1 Specific process steps

#### 10.1.1 Post-Harvest water use

Most tomatoes intended for direct consumption are generally not washed after harvest. However, for tomatoes that are washed after harvest, clean or preferably potable water should be used. It is recommended that the quality of the water used in packing establishments be controlled and monitored (i.e., record testing for indicator organisms and/or foodborne pathogens).

If water is used in pre-washing and washing tanks, additional controls (e.g. changing water whenever necessary and controlling of product throughput capacity) and monitoring (e.g. recording the pH, temperature, turbidity, and water hardness) should be adopted. Potable water should be used for final rinses. Untreated surface waters are not permitted for any use in packing houses or other post-harvest contact.

Washing tanks should be cleaned and the water changed frequently. Any antimicrobial agents used in the water should be maintained at sufficient levels to ensure that water used in pre-washing and washing tanks does not act as a source of contamination for tomatoes, and to prevent antimicrobial agents from damaging fruit skin structure.

Any antimicrobials and/or disinfectants are used to control foodborne pathogens in post-harvest water, the efficacy of the treatment should be demonstrated/validated against a target organism under appropriate conditions (see Section 10.3).

#### **Explanatory Note:**

Aside from washing, wiping tomatoes with a clean cloth also removes dirt such as sooty molds.



**Image 22. Wiping of tomatoes to remove dirt and other residues**

10.2 Microbiological and other specifications

Microbiological testing of an environment, process and specific product lot should be performed to evaluate and validate the safety and effectiveness of cleaning practices, methodology and sampling plan.

Explanatory Note:

Tomatoes are subjected to microbiological analyses to test for the presence of pathogenic microorganisms such as coliforms, *Salmonella* spp., *Escherichia coli*, and *Listeria monocytogenes*.

The following laboratories can analyze the samples for the above-enumerated microorganisms:

- DA-Food Development Center (FDC)
- UP-Natural Sciences Research Institute (NSRI)
- DOST-Food and Nutrition Research Institute (FNRI)
- Other DOST regional testing laboratories

**Table 7.** Microorganisms commonly tested for presence in tomatoes, including the sources and illness/disease caused (adapted from FDA's Bad Bug Book, 2012)

Microorganism	Description	Sources	Illness/ Disease
Thermotolerant coliforms	Thermotolerant coliforms are normal bacterial inhabitants of the intestines of warm-blooded animals.	They are generally present in high numbers in human and animal feces and may be used as an indicator of fecal contamination.	Gastroenteritis

Table 7. (continued)

Microorganism	Description	Sources	Disease
<i>Escherichia coli</i> ( <i>E.coli</i> )			
Enterotoxigenic <i>E.coli</i> (ETEC)	Highly motile, Gram-negative, rod-shaped bacteria.	Most ETEC outbreaks are linked to consumption of contaminated food or water. ETEC is often found in feces of asymptomatic carriers, and humans appear to be the most likely source of ETEC.	Gastroenteritis, Infantile diarrhea
Enteropathogenic <i>E.coli</i> (EPEC)	Gram-negative, rod-shaped bacteria.	Foods implicated in past EPEC outbreaks have included raw beef and chicken, but any food exposed to fecal contamination is strongly suspect.	Infantile diarrhea
Enterohemorrhagic <i>E.coli</i> (EHEC)	Gram-negative, rod-shaped bacteria characterized by the production of Shiga toxins (Stx).	Raw or undercooked ground beef and beef products as well as raw milk are the vehicles most often implicated.	HUS - Hemolytic Uremic Syndrome for <i>E.coli</i> O157:H7



**Table 7.** (continued)

Microorganism	Description	Sources	Disease and complications
<i>Escherichia coli</i> ( <i>E.coli</i> )			
Enteroinvasive <i>E.coli</i> (EIEC)	Gram-negative, rod-shaped, enterotoxin-producing bacterium that closely resembles <i>Shigella</i> .	Most ETEC outbreaks are linked to consumption of contaminated food or water. ETEC is often found in feces of asymptomatic carriers, and humans appear to be the most likely source of ETEC.	Mild form of bacillary dysentery
<i>Listeria monocytogenes</i>	Gram-positive, rod-shaped, facultative bacterium, motile by means of flagella, that is among the leading causes of death from foodborne illness.	Potential contamination sources include food workers, incoming air, raw materials, and food-processing environments.	Listeriosis, gastroenteritis, infected pregnant women may experience abortion

Table 7. (continued)

Microorganism	Description	Sources	Disease
<i>Salmonella</i> spp.	<p>Motile, non-sporeforming, Gram-negative, rod-shaped bacterium in the family Enterobacteriaceae and the tribe Salmonellae. Non-motile variants include <i>S. Gallinarum</i> and <i>S. Pullorum</i>.</p> <p>The genus <i>Salmonella</i> is divided into two species that can cause illness in humans:</p> <ul style="list-style-type: none"><li>• <i>S. enterica</i></li><li>• <i>S. bongori</i></li></ul>	<p>Widely dispersed in nature. It can colonize the intestinal tracts of vertebrates, including livestock, wildlife, domestic pets, and humans, and may also live in environments such as pond-water sediment. It is spread through the fecal-oral route and through contact with contaminated water.</p>	<p>Nontyphoidal salmonellosis, typhoid fever</p>

**Table 8.** Microbiological quality guidelines based on FSANZ (adapted from Microbiological quality of fruit and vegetables in Western Australian retail outlets, 2005)

Microorganism	Microbiological Quality (CFU/g)			
	Satisfactory	Marginal	Unsatisfactory	Potentially Hazardous
<i>E.coli</i> /g (indicator microorganisms)	< 3	3 - 100	≥ 100	**
<i>Salmonella</i> spp. /25g	Not detected in 25g	-	-	Detected
<i>Listeria monocytogenes</i> /25g	Not detected in 25g	Detected but < 10 <sup>2</sup> ++	-	> 10 <sup>2</sup> ##

### 10.3 Microbiological cross-contamination

Tomatoes that have undergone cleaning and/or chemical treatment should be effectively separated, either physically or by time, from raw material and environmental contaminants.

Prevent cross-contamination by segregation of washed and unwashed tomatoes. Avoid contamination of washed tomatoes from wash water, rinse water, equipment, utensils, packaging materials and vehicles.

Only growers/agricultural workers who have been trained on hygienic handling should be assigned to pack tomatoes.

## 11 Incoming material requirements

The following are recommended:

- a. For tomatoes that are intended to be consumed raw, sorting and grading should be implemented to avoid using tomatoes that have visible signs of decay or damage due to the increased risk of microbiological contamination; and
- b. Tomatoes should be cooled and stored as soon as possible under temperature (check) controls within the processes.

### Explanatory Note:

Harvested tomatoes are usually classified based on quality and size [23].

Tomatoes can be classified as Grades 1, 2, Combination, or 3 based on their type, general appearance, quality, and condition. The minimum requirements for a tomato include the following:

- with similar varietal characteristics;
- mature;
- not overripe or soft;
- clean;
- well-developed;
- well-formed;
- fairly smooth;
- free from decay; and
- free from freezing injury, sunscald or other physical damage.



Image 23. **Some defects or damages in tomatoes**



**Explanatory Note:**

Tomatoes are also classified based on size, *i.e.*, diameter. The table below shows the size classification of tomatoes.

**Table 9.** Size classification of tomato (based on PNS/BAFPS 26:2006)

Classification size/type	Diameter (cm)				
	Table			Cherry	Beef
	Round	Oblong	Ribbed		
Small	3.5–4.0	3.0–3.5	3.5–4.0	2.0–2.9	5.7–6.7
Medium	4.1–4.7	3.6–4.0	4.1–4.7	3.0–3.4	6.8–8.2
Large	4.8–5.7	4.1–4.7	4.8–5.7	3.5–3.9	8.3–10.2
Jumbo	5.7–6.7	4.8–5.7	5.7–6.7	–	10.3–12.2



Image 24. Sample size classification of round table tomatoes from jumbo to small

12 Documentation and records

Where practicable, a written food safety control plan that includes a written description of each of the hazards identified in assessing environmental hygiene, as well as the steps that will be implemented to address each hazard, should be prepared by the business operating the primary production. The description should include the following:

- a. Evaluation of the production site
- b. Water and distribution system
- c. Manure and compost use and their corresponding procedures
- d. Personnel illness reporting policy
- e. Sanitation procedures
- f. Training programs

The following are the types of records that should be retained:

- a. Microbiological testing results and trend analyses
- b. Water quality monitoring and test results
- c. Storage room temperature levels
- d. Employee training records
- e. Pest control records
- f. Cleaning and sanitation reports
- g. Equipment monitoring and maintenance records
- h. Inspection/audit records
- i. Corrective action reports

Explanatory Note:

Records of production, processing, and distribution are crucial during an investigation of foodborne disease outbreaks or food recall. Thus, keeping and maintaining records are important. Records should be maintained for at least 2 years [13].

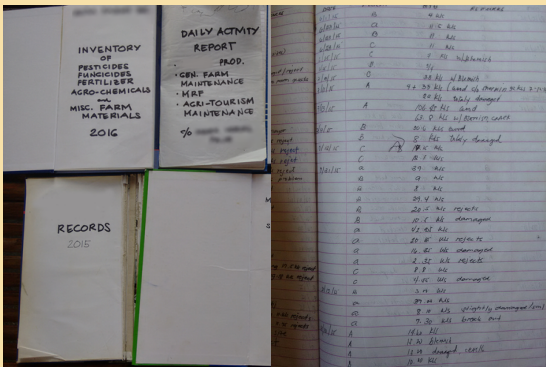


Image 25. Sample records of tomato production

FOOD SAFETY PLAN						
Company Name: _____						
Location: _____						
Crop(s): _____						
Process Flow/Steps	Potential Hazard(s)	Control Measures	CCPS (Critical Limit)	Monitoring	Preventative/ Corrective Actions	Verification
Farm Operations						
Pesticide Application	Chemical contamination from overused plant protection product (pesticide residue)  <i>Chemical Hazard</i>	Proper implementation of the established procedures  - judicious use of pesticides/ Recommended dosage/rate	MRL for Pesticides used  <i>Ex: Chlorpyrifos - 2.0 ppm</i>	Monthly Collection of fruit samples for laboratory testing (self-monitoring)  Monitoring of MRL	- Trained workers/sprayer only permitted to use chemicals for spraying. - Chemical records are kept on file.	Daily inspection and review of records for application of pesticides/ Pesticide Management Manual  Results of Pesticide Residue Analysis
Packing Facility Operations						

Image 26. Sample food safety plan

### 13 Recall Procedures

In the event of a foodborne illness outbreak associated with tomatoes, maintaining appropriate records of production, packaging, and distribution may help to identify the source of contamination in the tomato food chain and facilitate product recalls. Growers/agricultural workers/distributors should consider developing and maintaining a traceability/product tracing system. The traceability/ product tracing system should be designed and implemented according to the *Codex Principles for Traceability/Product Tracing as a Tool within a Food Inspection and Certification System* (CAC/GL 60-2006), especially to enable the withdrawal of the products, where necessary.

Detailed records should be kept that link each supplier of the product with the immediate subsequent recipient of the tomatoes throughout the food chain. The information needed to link each supplier should include, if available, the packer name, address, phone number, date packed, date released, type of tomatoes including brand name, lot identification and number of lots and transporter.

Recall of products should follow established or adopted procedure by the competent authority.

#### Explanatory Note:

According to PNS/BAFS 26:2006 Fresh vegetables – Tomato – Specification, the container of packed produce shall be legibly labeled with the following information:

1. Name of the product
2. Grade, type and size classification
3. Net weight in kilograms
4. Brand name
5. Name of producer
6. The words "Product of the Philippines"
7. Lot number

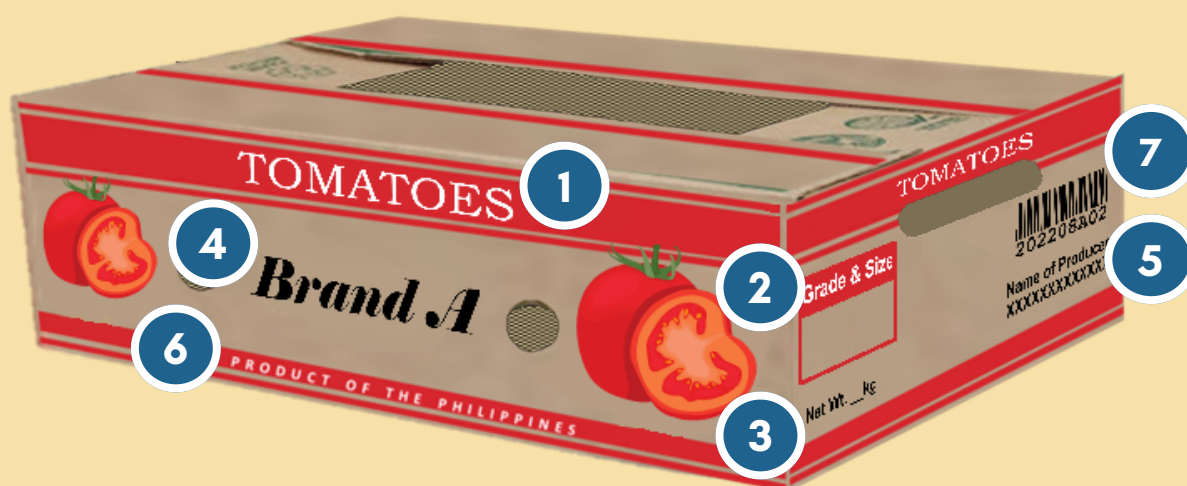


Image 27. Sample packaging box for tomatoes



Establishment:

# Maintenance and Sanitation

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box.



## 14 Maintenance and cleaning

### 14.1 General

Food contact surfaces should be cleaned and disinfected before the start of the season and throughout the tomato season to ensure that foodborne pathogens do not become established in the facility or on the equipment.

### 14.2 Cleaning procedures and methods

Written Sanitation Standard Operating Procedures (SSOP), should be developed and implemented for the cleaning and disinfection of equipment used for post-harvest treatment.

#### Explanatory Note:

SSOPs for cleaning and sanitation are developed for specific equipment that requires cleaning regularly. This assures that equipment is properly cleaned regardless of the specific worker assigned to perform the task [24].

SSOPs identify the following:

- what – identifies the task;
- why – describes the purpose of the task;
- when – frequency of the task;
- who – identifies the person responsible for the task and
- how – lists and describes the steps for completing the task.

For sorting, grading, and packing, equipment that comes in direct contact with fresh produce is cleaned daily.

Containers are inspected regularly, and an SSOP for cleaning and sanitizing are available.

Example of SSOP:

- Clean the container with detergent, then rinse.
- Sanitize with a chlorine solution using a high-pressure jet of water. As this can produce aerosols, sanitizing should be done outdoors in a clean area. The containers should not come in contact with soil.
- Air-dry containers before storing; sun-drying is recommended.

### Establishment: **Personal Hygiene**

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box. Photos without indicated sources were taken by the BAFS personnel during the field data-gathering activities.





Refer to the Codex Recommended International Code of Practice- General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 4-2003).

### Explanatory Note:

Workers having appropriate knowledge and training in personal hygiene practices are important.

The compliance of farm workers with farm hygiene regulations, such as observance of personal cleanliness and appropriate clothing (i.e., hand washing, wearing of jewelry and fingernail length and cleaning, etc.) and personal behavior (i.e., no smoking, spitting, eating, chewing, etc.) are likewise crucial in ensuring the safety of produce being handled.



**Image 28. Handwashing station and signages on hygienic production should be available in the farm**

Having fixed or mobile toilets and hand washing facilities that are properly maintained, in good condition, accessible to workers, and located in appropriate areas will help ensure that they comply with the farm hygiene regulations [13].



# Transportation

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box.





Refer to the *Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables* (PNS/BAFS 198:2017).

### Explanatory Note:

Contamination can happen during transport. Because of this, transport vehicles are checked for cleanliness, chemical spills, foreign objects, and pest infestation before use. Cleaning is critical if the transport vehicle poses a significant risk of damaging and contaminating the produce.

During transport, it is also crucial to ensure that harvested produce is transported separately from goods that are potential sources of chemical contamination and causes of biological and physical hazards. Another factor to be considered during transport is mixing tomatoes with non-compatible produce [13]. Tomatoes are sensitive to ethylene, which must be remembered to avoid accelerated ripening of harvested tomatoes.



**Image 29. Transport vehicle should be cleaned prior to loading containers with tomatoes**



# Product Information and Consumer Awareness

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box.





## 15 Consumer education

Refer to the “WHO Five Keys to Safer Food” message and its supporting materials for simple and clear guidance for food handlers including consumers on safe food handling.

The following are applicable to tomato production:

1. Keep Clean
  - a. Wash your hands before handling tomatoes and often during cutting/slicing of tomatoes
  - b. Wash your hands after going to the toilet
  - c. Wash and sanitize all surfaces and equipment used for tomatoes
  - d. Protect tomato preparation areas from insects, pests and other animals

### Explanatory Note:

Potentially hazardous microorganisms are widely found in soil, water, animals, and people. These microorganisms are carried on hands, wiping cloths and utensils, especially cutting boards, and the slightest contact can transfer them to food and cause foodborne diseases [25].

2. Separate Raw and Cooked
  - a. Separate tomatoes from raw meat, poultry and seafoods
  - b. Use separate equipment and utensils such as knives and cutting boards for handling tomatoes
  - c. Store tomatoes in containers to avoid contact with prepared foods

### Explanatory Note:

Raw food, especially meat, poultry, and seafood, and their juices, can contain potentially hazardous microorganisms which may be transferred onto other foods during food preparation and storage [25].

3. Keep Food at Safe Temperatures
  - a. Refrigerate tomatoes preferably below 4°C to prevent growth of *Listeria monocytogenes* (Note: the recommended storage temperature is 13–15°C) in another refrigerator it is 55–70°F
  - b. Do not store tomatoes too long in the refrigerator

### Explanatory Note:

Chilling injury occurs in tomatoes at temperatures below 10°C if held longer than two weeks [26].



4. Use Safe Water and Raw Materials
  - a. Use safe water
  - b. Select fresh tomatoes
  - c. Wash tomatoes with potable water

**Explanatory Note:**

Safe (Drinking) Water is water free of microorganisms or disease-producing bacteria (pathogens). In addition, the water should not possess undesirable tastes, odors, color, levels of radioactivity, turbidity, or chemicals, and it should pass the Philippine National Standards for Drinking Water [27].

Raw materials, including water and ice, may be contaminated with potentially hazardous microorganisms and chemicals. Toxic chemicals may be formed in damaged and moldy foods. Care in selecting raw materials and simple measures such as washing may reduce the risk [25].

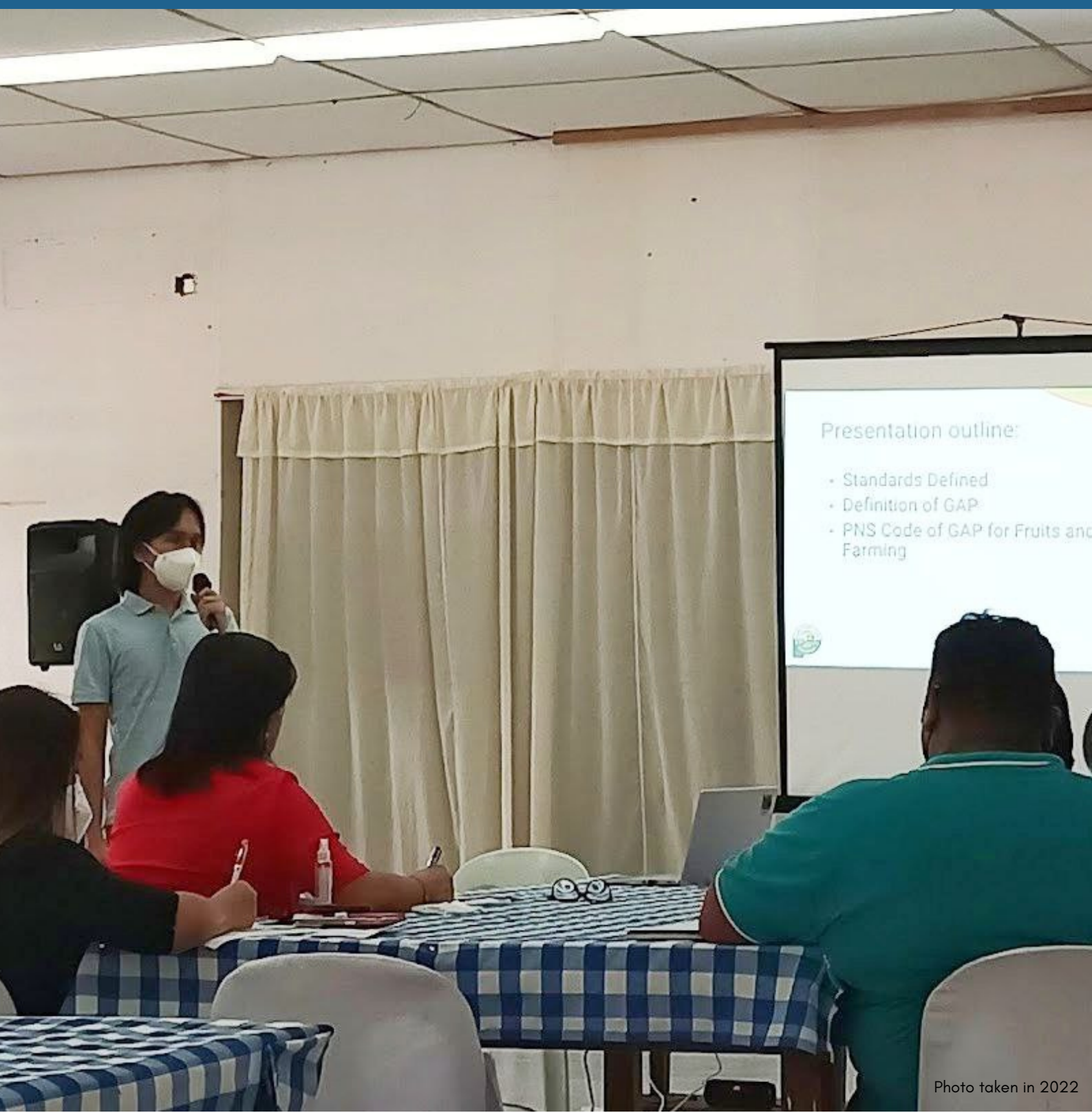
Relevant stakeholders (government, industry, consumer organizations and the media) should work together to communicate clear consistent messages on handling tomatoes safely.

Consumer information on handling tomatoes safely should cover the following:

- a. Avoid the purchase of trays or cases with damaged or rotten tomatoes;
- b. Keep tomatoes in lined containers during transport. Tomatoes should be preferably stored in a cool environment. All pre-packaged tomatoes should be refrigerated as soon as possible;
- c. Once removed from the refrigerator, tomatoes should be consumed as soon as possible;
- d. Practice correct hand washing methods (based on the WHO Guidelines on Hand Hygiene in Health Care)
- e. Handle, prepare and store tomatoes safely to avoid cross-contamination with foodborne pathogens from various sources (e.g. hands, sinks, cutting boards, utensils, raw meats); and
- f. Wash tomatoes with potable water before consuming.

# Training

Additional information, such as notes and images, are provided as Explanatory Notes inside a yellow box.



## 16 Training Programs

Since producing tomatoes for direct consumption is labor intensive, which increases the risk of contamination from manipulation, special attention is needed to properly select and train all growers/agricultural workers involved in primary production, packing, processing or transport operations of tomatoes that are intended to be consumed. Ensure that only experienced pickers harvest tomatoes that are intended for direct consumption. All growers/agricultural workers should receive training appropriate to their tasks and should be periodically assessed while performing their duties to ensure tasks are being completed correctly.

Specific employee training programs should include the following:

- a. Importance of sorting and grading tomatoes;
- b. Orientation on and implementation of Sanitation Standard Operating Procedures (SSOP), Good Agricultural Practices (GAP), Good Hygiene (GHP) and Good Manufacturing Practices (GMP); and
- c. Cold chain logistics and management, in line with advancing knowledge and technologies for both refrigeration and temperature monitoring, and expanding international trade.

Growers/agricultural workers should be trained before immersion to actual operations. Training activities of growers/agricultural workers should be documented.

Training should be delivered in a language and manner that facilitate understanding of what is expected of the trainees and why. It should emphasize the importance of using hygienic practices. A well-designed training program considers the barriers to learning of the trainees (such as dialect) and develops training methods and materials to overcome those barriers. Training programs should be repeated periodically and updated whenever there is a change in the product, process or staff. Training program should be monitored for effectiveness and modified when necessary.

### Explanatory Note:

The following organizations provides seminars or trainings on the following topics:

Organization	Topic
Department of Agriculture (DA) - Agricultural Training Institute (ATI)	COHP and GAP
DA - Bureau of Plant Industry (BPI)	COHP and GAP
DA - Food Development Center (FDC)	SSOP, GMP, and Hazard Analysis Critical Control Point (HACCP)

Organization	Topic
University of the Philippines - Los Baños - Postharvest Horticulture Training and Research Center (UPLB-PHTRC)	Proper postharvest handling practices



Source: DA-FDC

**Image 30. The DA-FDC conduct trainings on SSOP, GMP and HACCP**



# References



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This Explanatory Manual (EM) serves as a supplementary learning material for the Philippine National Standard (PNS) Code of Hygienic Practice (COHP) for Tomatoes (PNS/BAFS 211:2017). The EM aims to aid stakeholders by promoting uniform understanding and interpretation of the PNS to ensure efficient adoption and implementation of the Standard.


PNS/BAFS 211:2017 was developed to support Filipino farmer and to promote sustainable farming.

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