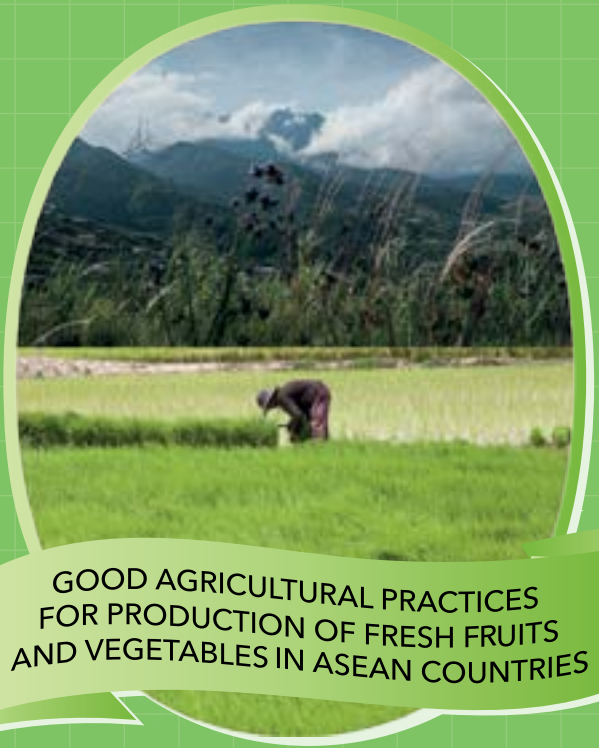
ENVIRONMENTAL MANAGEMENT MODULE



GOOD AGRICULTURAL PRACTICES FOR PRODUCTION OF FRESH FRUITS AND VEGETABLES IN ASEAN COUNTRIES

one vision
one identity
one community

Environmental Management Module

Good Agricultural Practices for Production of Fresh Fruits and Vegetables in ASEAN Countries

The ASEAN Secretariat
Jakarta

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The Member States of the Association are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam. The ASEAN Secretariat is based in Jakarta, Indonesia.

For inquiries, contact:
The ASEAN Secretariat
Public Outreach and Civil Society Division
70A Jalan Sisingamangaraja
Jakarta 12110
Indonesia
Phone : (62 21) 724-3372, 726-2991
Fax : (62 21) 739-8234, 724-3504
E-mail : public@asean.org

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Contents

Acknowledgements

Editors

- Mr. Scott Ledger, Department of Primary Industries and Fisheries, Queensland, Australia
- Dr. Robert Premier, Department of Primary Industries, Victoria, Australia

Working group

This publication was prepared by a working group involving representatives from all ASEAN member countries and the editors of this guide. The representatives from the ASEAN countries were:

- Mr. Jamalludin Haji Mohd Yusoff, Department of Agriculture, Brunei Darussalam
- Ms. Hajjah Aidah binti Hj. Hanifah, Department of Agriculture, Brunei Darussalam
- Mr. Ly Sereivuth, Dept. of Agronomy & Agricultural Land Improvement, Cambodia
- Mr. Mean Chetna, Dept. of Agronomy & Agricultural Land Improvement, Cambodia
- Ms. Dwi Iswari, Directorate of Fruit Crops, Indonesia
- Ms. Susiami, Directorate of Fruit, Indonesia
- Mrs. Khamphoui Louanglath, Department of Agriculture, Lao PDR
- Mr. Kham Sanatem, Department of Agriculture, Lao PDR
- Mr. Mohd Khairuddin Mohd Tahir, Department of Agriculture, Malaysia
- Ms. Norma Othman, Department of Agriculture, Malaysia
- Mr. Mohd Hussin Yunnus, Department of Agriculture, Malaysia
- Mr. U Kyaw Win, Myanmar Agricultural Service, Myanmar
- Mr. Ko Ko, Myanmar Agricultural Service, Myanmar
- Mr. Gilberto F. Layese, Department of Agriculture, Philippines
- Ms. Mary Grace Rivere Mandigma, Department of Agriculture, Philippines
- Dr. Paul Chiew King Tiong, Agri-Food & Veterinary Authority of Singapore
- Ms. Khoo Gek Hoon, Agri-Food & Veterinary Authority of Singapore
- Dr. Supranee Impithuksa, Department of Agriculture, Thailand
- Dr. Surmsuk Salakpetch, Department of Agriculture, Thailand

- Mrs. Psyanoot Naka, Department of Agriculture, Thailand
- Dr. Nguyen Munh Chau, Southern Fruit Research Institute, Viet Nam
- Ms. Nguyen Thu Hang, Ministry of Agriculture & Rural Development, Viet Nam

References

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1. Introduction

1.1 Purpose and scope of guide

ASEAN GAP is a standard for good agricultural practices to control hazards during the production, harvesting and postharvest handling of fresh fruit and vegetables in the ASEAN Member States. ASEAN GAP is divided into four modules – 1. Food safety, 2. Environmental management, 3. Worker health, safety and welfare and 4. Produce quality.

ASEAN GAP has been developed to enhance the harmonisation of GAP programs amongst ASEAN Member States. It covers the production, harvesting and postharvest handling of fresh fruit and vegetables on farm and postharvest handling in locations where produce is packed for sale.

This interpretive guide was designed to assist producers, packers, supply chain businesses, trainers, government representatives and others to understand the practices required for implementing the Environmental Management Module of ASEAN GAP. It provides guidance on "what has to be done" to implement the required practices. Separate interpretive guides are available for the other ASEAN GAP modules.

ASEAN GAP may be used for all types of productions systems but it is not a standard for certification of organic products or GMO free products.

1.2 Guide sections

The guide contains background information on types of environmental hazards, guidance on implementing the GAP requirements, a self-assessment checklist to review compliance with the requirements, examples of documents and records, a glossary of terms and references and additional information.

Section 2. Environmental hazards

This section provides information about the potential environmental hazards. Environmental hazards are negatives impacts that occur to the environment on and off the property as a result of the production, harvesting and postharvest handling of fruit and vegetables. While there are many common hazards associated with farms and packing sheds, every property is different. The particular circumstances of each property need to be considered when managing potential environmental hazards.

Section 3. GAP requirements

The good agricultural practices for controlling environmental hazards are grouped into 13 elements. Each element has background information to explain how environmental harm can occur. Specific information is then provided for each practice to explain what is required to implement the practice. In some cases, two or more practices are grouped together as the guidance information is the same for both practices.

Section 4. Self-assessment checklist

The self-assessment checklist enables the level of compliance with the good agricultural practices contained in the environmental management module to be checked. The relevance of the practices will depend on the location of the farm, type of produce, and the systems used for production, harvesting, handling, packing, storage and transport. The person assesses whether the practice is done correctly or if attention is needed or if the practice is not relevant. If attention is needed, the actions required are identified and recorded.

Section 5. Examples of documents and records

The section contains examples of documents and record forms that are required to implement various practices in the environmental management module. The documents and record forms are examples only and other methods and formats can be used. ASEAN GAP specifies the information that has to be documented and the records to keep, but does not specify how to document information and keep records.

Appendix 1. Glossary of terms

This appendix contains definitions for the abbreviations and terms used in the guide.

Appendix 2. References and additional information

This appendix contains references and additional information on control of environmental hazards for fresh produce.

2. Environmental hazards

Environmental hazards are negatives impacts that occur to the environment on and off the property as a result of the production, harvesting and postharvest handling of fruit and vegetables. While there are many common hazards associated with farms and packing sheds, every property is different. The particular circumstances of each property need to be considered when managing potential environmental hazards.

The steps to controlling environmental hazards are as follows:

1. Identify the hazards – What can happen to the environment on and off the property if something goes wrong?
2. Assess the risk – What is the likelihood and consequence of the hazard occurring?
3. Control the hazard – What good agricultural practices are required to prevent or minimise the risk of significant hazards?
4. Monitor and review hazards – Are the good agricultural practices working and have there been any changes that introduce new hazards?

The table below contains a list of potential environmental hazards and examples of environmental impacts. The hazards are grouped into categories associated with land and soil, water, chemicals, nutrients, biodiversity of fauna and flora, waste, air and energy. Section 3 describes the good agricultural practices required to control the hazards.

Category	Hazard	Examples of environmental impacts
Land and soil	Soil erosion	Sedimentation of rivers and waterways Nutrients and chemicals entering rivers and waterways – eutrophication
	Poor soil structure	Compaction of the soil Increased run-off Nutrient depletion
	Salinity	Reduction of arable land Loss of biodiversity
	Soil acidity and alkalinity	Loss of productivity Reduction of arable land
	Sodicity (high sodium levels)	Reduction of arable land Soil waterlogging
Water	Depletion of water resources	Insufficient water supply and environmental flow Depletion of water table Rising water table and waterlogging
	Poor water quality	Contamination of water by fertilisers, chemicals, fuels, oils and sedimentation

Category	Hazard	Examples of environmental impacts
Chemicals	Contamination of environment from inappropriate storage, application and disposal of chemicals	Contamination of surface and groundwater Contamination of drinking water Loss of biodiversity Soil contamination Adverse impact on other crops and adjacent properties
	Spray drift	Adverse affect on surrounding crops Disruption of Integrate Pest Management strategies Health risks for local residents
Nutrients	Degradation of soil and water	Soil acidification Reduction of water quality – eutrophication Loss of biodiversity
Biodiversity	Loss of biodiversity	Reduction of wildlife corridors Loss of aquatic habitats Changes in pest species
Waste	Degradation of soil, water and air	Contamination of soil and water Greenhouse gas emission Inconvenience to local residents
	Depletion of natural resources	Wasting non-renewable resources Waste disposal sites required (landfill)

Category	Hazard	Examples of environmental impacts
Air	Dust	Sedimentation of waterways Inconvenience for local residents
	Smoke	Creation of greenhouse gases Inconvenience for local residents
	Greenhouse gases	Global warming and climate change
	Noise	Inconvenience for local residents Loss of biodiversity
Energy	Depletion of natural resources	Wasting non-renewable resources Creation of greenhouse gases

Source: Guidelines for Environmental Assurance in Australian Horticulture, Horticulture Australia Limited., www.horticulture.com.au

3. GAP requirements

The good agricultural practices for controlling environmental hazards are grouped into 13 elements. For each element, the potential causes for environmental harm are described and specific information is then provided for each practice to explain what is required to implement the practice. In some cases, two or more practices are grouped together as the guidance information is the same for both practices.

3.1 Site history and management

The location and management of the site can have negative impacts on the environment, both on and off the site. When choosing a new site for production and postharvest handling, the risk of causing environmental harm must be assessed and practices implemented to prevent or minimise the risk of significant hazards occurring. The site selected should not directly affect the land and water resources, flora and fauna, and the community.

For existing sites, highly graded areas must be managed to minimise further degradation and management of site activities must conform to country environmental legislation.

Practice 1. *Sites used for production comply with country regulations that restrict production at high altitudes or on steep slopes.*

In some ASEAN countries there are restrictions on the altitude at which farming can be practiced. The restrictions have been introduced to reduce the risk of environmental harm inherent in farming land situated in high altitudes. Farming at high altitude exposes the land to soil erosion, which can lead to silting of river systems and lakes. The high altitudes in ASEAN countries are also rich in diversity of native flora and fauna, which is at risk of being lost.

Figure 1. In some ASEAN countries there are restrictions on the altitude at which farming can be undertaken.

It is important to check for laws that may restrict farming operations at high altitude. For example, in Malaysia new farms are not permitted at altitudes above 1000 metres.

Practice 2. *For new sites, the risk of causing environmental harm on and off the site is assessed for the proposed use and a record is kept of all potential hazards identified. The risk assessment shall consider:*

- *the prior use of the site,*
- *potential impacts of crop production and postharvest handling on and off the site, and*
- *potential impacts of adjacent sites on the new site.*

For new sites the risk of causing environmental harm must be assessed. The prior use of the site should be investigated and the site checked for the presence of any existing degradation. The proposed use of the site needs to consider potential impacts on the environment such as soil erosion and run-off or leaching of nutrients and chemicals into adjoining water supplies. The use of adjacent sites also needs to be considered as it may impact on production and postharvest practices.

A record of any significant hazards identified must be kept. The information to record includes the location of the site, the proposed use of the site, a list of significant hazards and the reasons why they may occur, date of the assessment, and the person who did the assessment.

Practice 3. *Where a significant risk is identified, either the site is not used for crop production and postharvest handling or measures are taken to prevent or minimise the potential hazards.*

If the risk of environmental harm is too high and cannot be controlled, the site must not be used for production and postharvest handling of produce. An alternative site should be selected and assessed for risks. Where appropriate risk management practices can be implemented, the cost of implementation needs to be considered as part of the cost of establishing the farming and/or packing operation. Measures for preventing and minimising environmental harm are described throughout this section.

Practice 4. *A property layout map is available showing the location of:*

a. crop production sites,
b. environmentally sensitive areas and highly degraded areas,
c. chemical storage and mixing areas, chemical application equipment cleaning areas, and postharvest chemical treatment areas,
d. areas or facilities for storage, mixing and composting of fertilisers and soil additives
e. water courses, storage sites, and significant drainage lines, run-off areas and discharge points, and
f. property buildings, structures and roads.

A map with the layout of the property must be prepared. The map identifies production sites, areas for storage and use of chemicals and fertilisers, buildings, structures and roads, water courses, drainage, and storage sites and environmental sensitive and highly degraded areas. Examples of environmentally sensitive areas are areas prone to soil erosion, waterways and nature wildlife reserves and corridors.

The property map can be as simple as a line drawing or a more detailed aerial map with overlays to show the required features. An example of a property map is contained in Section 5 Example documents and records.

Practice 5. *Highly degraded areas are managed to minimise further degradation.*

Highly degraded sites must be identified and a management plan developed to minimise further degradation. For example, if a production site has severe soil erosion, planting grass on the headlands and installing cut-off drains and diversion banks will slow the water flow and divert water away from cultivated areas. Control measures should be monitored to check that further degradation is not occurring.

Figure 2. Highly degraded areas must be managed to minimise further degradation

Practice 6. *Management of site activities conforms to country environmental legislation covering air, water, noise, soil, biodiversity and other environmental issues.*

Environmental legislation varies between the ASEAN member countries. It is important to check for legislation covering the protection of air, water, soil, biodiversity, noise levels and any other environmental issue.

For example there may be legislation restricting the clearing of vegetation or the drawing of water from rivers or the building of farm dams and structures.

3.2 Planting material

Practice 7. *To minimise chemical usage and nutrient runoff, planting material is selected for disease resistance and compatibility with site properties such as soil type and nutrient levels.*

The selection of planting material can impact on the environment. Selecting material that has resistance to pest and diseases will reduce the need for chemical pesticides and the risk of chemical contamination of the environment. Selecting planting material that is compatible with the climate and soil conditions will reduce the pest and disease pressure, minimise water use and reduce the risk of excessive fertilising and leaching of nutrients into the surrounding environment.

Recommendations for planting material such as varieties and rootstocks are typically available in industry publications produced by competent authorities such as the Department of Agriculture. Further advice can be obtained from advisers such as extension officers, consultants and resellers.

3.3 Soil and substrates

The objective for managing the soil and substrates is to minimise soil degradation and loss from the property. Soil degradation can occur through soil erosion from water and wind, loss of soil structure, and increased soil salinity, acidity, alkalinity and sodicity (high sodium levels)

Good agricultural practices are aimed at:

- minimising the potential for water and wind to erode soil on the property,
- maintaining a soil structure that is suitable for root growth, water infiltration, aeration and drainage needs of the crop,
- ensuring soil and water salinity problems are not created or made worse on the property or contribute to local, catchment or regional salinity problems,

- maintaining the soil pH within the optimum range for crop production, and
- improving sodic soils where applicable.

Good soil management practices are based on maintaining soil cover, minimising cultivation and compaction, returning large amounts of organic matter to the soil, improving water infiltration and surface drainage and minimising the use of soil fumigants.

Practice 8. *The intended production practices are suitable to the soil type and do not increase the risk of environmental degradation.*

Good soil structure is vital for maximising water intake and plant growth and minimising soil erosion. Soil structure varies with the different soil types. A good structured soil has pores, channels and spaces between aggregates. Water can drain quickly, roots can grow through the soil easily and there is no hard crusting on drying.

A degraded soil has a high proportion of small particles with few water stable aggregates. The reduction of poor size results in massive blocks that restrict root growth and plant productivity. Compacted soil requires more cultivation to prepare a seedbed, which causes further degradation in soil structure.

The intended production practices must be suitable for the soil type. For soils with good structure, the practices are aimed at maintaining the soil structure. For soils with poor structure, the aim is improve the soil structure to minimise the risk of degradation.

Examples of practices that minimise the risk of degradation are:

- avoid cultivation during times of the year when heavy rainfall is likely
- use permanent bed systems that improve soil structure and stability
- plant cover crops between commercial crops to cover the soil and improve soil organic matter levels
- establish permanent grass or vegetation cover on areas that are not cropped
- using natural contour lines of the property
- apply organic mulches and use crop rotations to improve soil structure

- minimise vehicle and equipment traffic through the block
- install irrigation systems that use water efficiently
- apply lime or gypsum to correct acid soils

Practice 9. *Where available, soil maps are used to plan rotation and production programs.*

Soil maps are useful for planning production programs for property. The maps describe the soil types present in the region and important characteristics about the soils. Soil maps are typically available from Departments of Agriculture or Land and Water Resources. If soil types vary on the property, the property map can be used to indicate the location of the different soils.

Knowledge about the soil types enables the production program to be managed to minimise the risk of environmental harm. For example, crop rotation can be planned to maximise soil cover, increase the organic matter levels, and minimise nutrient depletion.

Practice 10. *Cultivation practices that improve or maintain soil structure and minimise soil compaction and erosion are used.*

The cultivation methods used must maintain the soil structure and if possible, improve the structure. Frequent cultivation passes, fast ground speed of tractors and machinery and concentration of tractor and machinery weight all contribute to soil structure damage by breaking up the soil aggregates and breaking down stabilising organic matter.

Working on soil that is too wet or too dry accentuates the problem. Where the water content is too great, the soil acts like plasticine, smearing and compacting with cultivation and traffic. Soils that are too dry require excessive amounts of energy to produce a planting bed. Check the soil moisture content by working soil soil from the plough layer in your hands. If the soil is too wet, it will work like plasticine whicle if it is too dry, it will be hard to work and tend to shatter to dust.

Most tillage for fruit and vegetable crops occurs prior to planting to enable suitable contact between the soil and the planted material. This primary tillage is an important part of initial land preparation and often can not be

avoided. Secondary tillage operations after planting should be minimised where possible.

Figure 3. Good cultivation practices must be used to maintain soil structure and minimise soil erosion and compaction.

Examples of good cultivation practices are:

- minimise the number of soil workings
- avoid cultivation during times of the year when heavy rainfall is likely
- cultivate rows across the slope rather than up and down the slope
- avoid cultivating when the soil is to wet or dry
- reduce vehicle and machinery flow through the block
- use rotary hoes and disc cultivators sparingly as possible as they pulverise the soil
- use sharp and correctly-adjusted tools to till the soil as blunt tools can add to compaction
- use implements that mainly have an upward force to the soil
- avoid overworking with powered implements
- if using tractors, fit them with radial tyres that can run on low pressures
- if a hard pan or compaction layer is present, deep rip to shatter the pan and loosen and break clods that will break down further when exposed to the weather (if shallow sodic subsoils are present do not deep rip as it can bring the sodic soil to the surface and create problems with surface crusting)
- use minimum tillage systems such as semi-permanent beds.

Practice 11. *The use of chemical fumigants to sterilise soils and substrates is justified and a record is kept of the location, date, product, application rate and method, and operator name.*

The use of chemical fumigants must be justified. Excessive use of chemical fumigants to sterilise soils and substrates can cause environmental harm through killing of beneficial organisms that improve soil structure and contamination of the site or substrate from persistent chemicals.

A record of the chemical used must be must be kept to show that the fumigant has been applied correctly and for traceability in the event of contamination being detected. The records enable possible causes of the contamination to be investigated.

The information to record includes the fumigant name, the location where used, date of application, application rate and method, and operator name. This information can be recorded in a log book or on a record form. Examples of records for obtaining and applying chemicals are contained in Section 5. Examples of documents and records.

Figure 4. The use of chemical fumigants to sterilise soils and substrates is justified.

3.4 Fertilisers and soil additives

Fertilisers are used to provide nutrients for plant growth and soil additives are used to improve soil structure. Some examples of soil additives are gypsum, animal and plant manures, sawdust and coconut pulp. By managing nutrient application and soil fertility, production targest can be achieved without environmental harm.

If wrongly used, fertilisers and soil additives may contribute to off-site degradation of groundwater and waterways, increased soil salinity, acidity and sodicity problems and contaminate the soil with heavy metals.

Fertilisers may be lost from the production site through:

- inaccurate application,
- leaching past the root zone and into groundwater,
- moving as dissolved nutrients in surface water leaving production areas,
- attaching to soil sediments and within organic particles in surface water leaving production areas,
- attaching to wind eroded soil particles, and
- evaporating into the atmosphere.

Losses of nutrients from fertilisers and soil additives will potentially have downstream or off-site impacts on the environment. The nutrients most at risk of causing off-site impacts are nitrogen and phosphorus. Excessive amounts of these nutrients can result in eutrophication, the enrichment of water by nitrogen or phosphorus, causing algae and higher forms of plant life to grow too fast. This disturbs the balance of organisms present in water and the quality of the water.

Nitrogen is a highly soluble element and is easily leached from the soil profile, dissolved in run-off water or evaporated into the atmosphere. Phosphorus binds strongly to soil particles and can be lost by soil erosion through water and wind. Significant quantities of phosphorus can also be dissolved in run-off water when soil phosphorus levels are high.

Good nutrient management involves:

- effectively managing nutrient inputs to meet crop requirements and soil characteristics, and
- ensuring fertiliser and soil additive application methods and timing and storage maximise the benefits to the crop and minimise potential negative environmental impacts.

Practice 12. Nutrient application is based on recommendations from a competent authority or on soil, leaf or sap testing to minimise nutrient runoff and leaching.

Nutrient requirements vary depending on the type of produce grown, the production method, the soil type and characteristics, seasonal conditions and the previous application of fertilisers and soil additives. Nutrient application must be based on the nutritional requirements of the crop and recommendations from a competent authority or on soil or leaf or sap testing.

Incorrect use of fertilisers and soil additives is not only an unnecessary cost, but can caused reduce yields through toxic levels of the nutrients and induced deficiency through nutrient imbalance, and degradation of soil and water on and off the site.

Training in how to estimate the quantity and type of fertiliser to use will help plan an appropriate nutrition program. Recommendations for fertiliser application are typically available in industry publications produced by competent authorities such as the Department of Agriculture.

Further advice can be obtained from advisers such as extension officers, consultants and agronomists. Before using an adviser, request them to show proof of their competence. Examples of proof are qualifications from an education institution, statement of knowledge and experience from a competent authority, and a training course certificate.

Soil testing is done to check the availability of nutrients in the soil while leaf or sap testing is done to check the level of nutrients in the plant. Soil tests measure soil properties that influence nutrient availability to the plant. These include measurement of pH, electrical conductivity (a measure of salt content), organic carbon, individual macro and micronutrients, and other elements.

For soil test results to be meaningful, the sample must be carefully collected. When collecting a sample, make sure it represents the site being tested, by taking into account the total area of the block, soil type (there maybe different types in one block) and the depth of sampling. At least 10 bulk samples should be collected from over the block and should not include any unusual areas such as wet spots. It is important to sample all depths equally. A sub-sample of this soil should be sent in for testing.

Soil test results and targets for optimum soil nutrient levels should be discussed with an appropriately qualified person, such as an agronomist, soil consultant or extension officer. Based on this interpretation and consideration of soil type, cropping history and crop agronomy, a fertiliser recommendation can be prepared.

Soil testing and analysis needs to be completed early enough to allow all nutrients to be applied in a timely manner. For instance, alteration of soil pH by lime application takes considerable time to occur. Soil testing, plant tissue testing and sap testing can all be used post-planting to monitor nutrient availability and determine an appropriate post-planting fertiliser program.

Practice 13. Areas or facilities for storage, mixing and loading of fertilisers and soil additives and for composting of organic matter are located, constructed and maintained to minimise the risk of environmental harm on and off the site.

Fertilisers and soil additives should be stored in a way that prevents nutrient leaching into surface waterways and groundwater. Inorganic fertilisers should be stored in a covered area away from waterways and manure heaps covered to reduce leaching through rain.

Storage areas should be:

- protected from direct sunlight and rain,
- well ventilated with fresh air to keep fertiliser dry,
- designed to minimise pest infestation, mould growth and damage, and
- designed to keep any spillage to one place and be easy to clean up.

Storage, mixing and loading areas should be positioned to minimise the risk of accidental pollution of waterways and seepage into groundwater.

Fertilisers should be stored separately from agricultural chemicals except where they are applied with the agricultural chemical. Storage areas for liquid fertilisers should be bunded to prevent run-off into waterways.

Store fertilisers in a covered area

Locate compost away from waterways

Figure 5. Fertilisers and soil additives should be stored in a way that prevents nutrient leaching into surface waterways and groundwater.

Practice 14. Equipment used to apply fertilisers and soil additives is maintained in working condition and checked for effective operation at least annually by a technically competent person.

Equipment for applying fertilisers and soil additives must be carefully calibrated and maintained to ensure that fertilisers are evenly spread at the correct rate. Faulty operation of equipment may lead to insufficient or excessive application of fertilisers and soil additives.

Accurate application of fertilisers enables the plants to access the nutrients required. Choose the right equipment and adjust it correctly to make sure the fertiliser or soil additive is applied on the area where it will do the most good. Applying small amounts of fertiliser near the root zone can make it easier for plants to take up the nutrients.

Methods for applying fertilisers include:

- broadcast before planting or as a side dressing after planting,
- fertigation (application through irrigation system), and
- foliar application (sprayed onto plants)

Equipment must be checked by a technically competent person at least annually to ensure that application rates are within the acceptable range. A technically competent person can be the farmer or a worker who is skilled in operating the equipment or an adviser such as a representative from the equipment supplier.

Practice 15. *The application of fertilisers and soil additives is recorded, detailing the name of the product or material, date, treatment location, application rate and method, and operator name.*

Keeping a record of fertilisers and soil additives applied is useful for planning the nutrition program for each crop grown and provides a history of application for future plantings. The records also enable a contamination event such as degradation of waterways and underground water to be investigated for possible causes.

All methods of application must be recorded – broadcast, fertigation, and foliar.

The record of the application of fertilisers and soil additives can be recorded in a log book or on a record form. An example of record form is contained in Section 5. Examples of documents and records.

A record of maintenance and calibration of fertiliser application equipment is also useful. The information to record is the type of equipment, date on which calibration or maintenance was performed, list of significant repairs and maintenance undertaken, and the person who performed the work.

Practice 16. *For hydroponic production systems, the mixing, application and disposal of the nutrient solution is monitored and recorded.*

In hydroponic production systems, large volumes of water containing high levels of nutrients are used. All solutions must be monitored for nutrient levels and disposed in a way that does not cause degradation of land, waterways and underground water. The types of nutrients, application rates, monitoring results and the method of disposal must be recorded.

3.5 Water

Water is a valuable resource and in many areas is becoming a scarce resource. Management of water is essential to maximise yields and product quality and prevent degradation of waterways and underground water. Water availability is increasingly being regulated by governments

to ensure sufficient and sustainable water levels remain for the future and to protect the health of water environments.

Water management considers the water demand of the crop and the amount of water available. It also involves management of irrigation to maximise efficient use of water applied. Drainage water and run-off must be managed to avoid negative impacts on the quality of groundwater, waterways and wetlands.

There are two aspects of water quality that need to be considered. The first is ensure that the water quality used is suitable for the intended purpose (for example irrigation); and the second is to protect the quality of water leaving the property for downstream users and the environment. Managing all waste and run-off water from production areas and packing sheds is important to minimise the release of polluted waste water into the environment.

Practice 17. *Irrigation use is based on crop water requirements, water availability, soil moisture levels, and consideration of environmental impact on and off the site.*

The need for irrigation varies with each type of produce grown, the location, seasonal conditions, and production method. Irrigation should be used efficiently to achieve uniform application of water to match crop needs and to manage drainage impacts on the environment on and off the site.

The important factors to consider are crop water requirements, water availability and soil moisture levels. Knowledge of these factors enables an irrigation plan to be developed, implemented and modified based on monitoring of irrigation application, rainfall and soil water levels.

Soil characteristics such as water holding capacity are important in determining how much water to apply. Soil moisture levels can be measured by a simple method such as digging a hole in the soil or by using equipment such as tensiometers and soil moisture probes.

Recording of weather information is important in deciding when and how much to irrigate. Data can be collected on rainfall, evaporation and transpiration (water lost from the leaf/plant surfaces). Irrigation water is then only when there has not been enough rainfall to replace the water lost from the soil through evaporation and transpiration.

Recommendations for irrigation use are typically available in industry publications produced by competent authorities such as the Department of Agriculture. Further advice can be obtained from advisers such as extension officers, consultants and agronomists. Before using an adviser, request them to show proof of their competence. Examples of proof are qualifications from an education institution, statement of knowledge and experience from a competent authority, and a training course certificate.

Practice 18. An efficient irrigation system is used to minimise wastage of water and the risk of environmental harm on and off the site.

The irrigation method used must match the amount of water delivered with the soil type and water demand of the crop. It must also protect the environment by not wasting water through either excess or uneven irrigation or applying water in the wrong area for uptake by plants.

The irrigation system options include:

- watering by hand with a bucket or watering can
- drip or trickle irrigation (both surface and sub-surface buried tape)
- micro-sprinklers
- capillary bed for seedlings in containers
- sprinkler irrigation
- travelling gun irrigation
- centre point and linear move irrigation
- surface (flood or furrow) irrigation

In general, pressurised systems are a more efficient form of water delivery than surface irrigation. The table below provides a range of expected efficiencies for different irrigation systems.

Irrigation system	Efficiency %
Travelling gun	50-75
Fixed sprinkler	65-85
Centre pivot and linear move	75-90
Drip or trickle	80-90

There are many other factors as well as efficiency to consider in determining the most suitable irrigation systems. Examples of these factors are:

- availability of water
- soil types and variation
- topography (slope of the land)
- cost to install and maintain the system
- water quality
- climate and rainfall
- the need for frost protection or crop cooling

People or companies involved in advising on irrigation systems should be experienced in irrigation design and installation.

Sprinkler irrigation

Drip or trickle irrigation

Figure 6. An efficient irrigation system must be used to minimise wastage of water and the risk of environmental harm on and off the site.

Practice 19. The irrigation system is checked for operational efficiency during each use, according to manufacturer's instructions or other appropriate methods, and maintained to ensure efficient delivery.

The irrigation system must be checked regularly and maintained to ensure it is operating correctly and delivery the right amount of water. Checks that should be done include:

- presence of cuts, blockages and leaks in pipes and dripper lines
- sprinkler or dripper malfunction
- blockage of filters
- faulty operation of pumps
- discharge or flow rate variation
- uniformity of water distribution
- pressure variation

It is important to check uniformity of output and distribution. Uneven distribution causes areas of over and under irrigation. Manufacturer's instructions or advice from irrigation specialist should be followed when check operational efficiency.

Practice 20. *A record is kept of irrigation use, detailing crop, date, location, volume of water applied or duration of irrigation, and name of person who managed the irrigation activity.*

Keeping a record of irrigation schedules and the amount of water applied, rainfall and soil moisture levels is important for irrigation management. The records also enable a contamination event such as degradation of waterways and underground water to be investigated for possible causes.

The record should detail the crop, date of irrigation and location of the production site and either the volume of water applied or the duration of irrigation. Some irrigation systems are automated and work on a set time schedule. In this case the duration and volume of irrigation is set so only the crop, date of irrigation and location has to be recorded. A record of rainfall should also be kept.

The record of irrigation use can be recorded in a log book or on a record form. An example of a record form is contained in Section 5. Examples of documents and records.

Practice 21. *Water collection, storage, and use is managed to comply with country regulatory requirements.*

Regulatory requirements for water collection, storage and use vary between the ASEAN member countries. It is important to check for regulatory requirements before installing irrigation and water storage systems. For example there may be legislation restricting the drawing of water from rivers and water supply systems or the building of farm dams and structures.

Practice 22. *Water used from sources that may cause environmental harm to land and soil, waterways and sensitive areas is managed or treated to minimise the risk of environmental harm.*

Water may be available from a range of sources – farm dams, underground bores, rivers and waterways, irrigation schemes and rainwater tanks. The quality of the water used must be suitable for the intended purpose – for example for irrigation, spraying crops, washing and treating produce in the packing shed. The risk of causing environmental harm on and off the property due to poor quality of the source water must also be managed.

Problems caused on the property by using poor quality water include:

- salinity (high total soluble salt content)
- sodicity (high sodium content)
- toxicity to crop (high concentration of specific salts in the soil)
- growth of blue-green algae toxic to animals and humans
- clogging and corrosion of pipes and other equipment

One of the factors to consider for irrigation is the proportion of dissolved mineral salts in the water. All groundwater and surface water contains dissolved mineral salts. When irrigation water is used, the mineral salts are either taken up by the crop, left in the soil, leached down past the root zone or washed out with run-off. Most of the mineral salts are beneficial, but in some cases they may be harmful to the long term sustainability of the property and the surrounding environment.

Salts dissolved in water can be easily measured by testing the electrical conductivity (EC). If the irrigation water exceeds an EC of 0.8 dS/m (equivalent to 500ppm of salt), a full chemical analysis should be undertaken and expert advice sought on interpreting the results and irrigation management.

Water quality can also be unsuitable due to contamination from heavy metals and agricultural and industrial chemicals.

Practice 23. *Water from toilets and drainage systems are disposed of in a manner that minimises the risk of environmental harm on and off the site.*

Practice 24. Water discharged from the property, including waste water from harvesting, cleaning and handling operations, is managed or treated to minimise off site environmental harm.

Managing all waste and run-off water from the property is important to minimise the released of polluted waste water into the environment. This is particularly the case with nursery operations, hydroponic production systems and packing sheds.

Collecting and recyling waste water should be undertaken where possible as it saves water and reduces costs as well as reduces the risk of causing environmental harm.

Packing sheds that use large of amounts of water or apply chemical treatments to produce should take steps to ensure that waste water is safe to release into the surrounding environment, particularly close to waterways. This can be achieved by regular monitoring and if necessary filtering or treating the water to remove organic material and chemicals. Organic matter in water affects the amount of oxygen available and can have significant impact on fish and other aquatic life.

Septic tanks and sewage systems should be located well away from waterways, underground bores and dams and regularly maintained to prevent leakages. Water from toilets must not be discharged close to surface water or underground bores.

3.6 Chemicals

Agrochemicals

Chemicals are used during the production of fresh produce for control of pests (pesticides), regulation of growth and thinning of crops, and after harvest for treating produce for disease and insect control, applying surface coatings to reduce moisture loss or improve appearance, and for sanitising water and equipment surfaces.

Chemicals can impact on natural ecosystems if they move off the site via water, air or soil. Of particular concern is the effect of chemical residues on sensitive neighbouring or downstream ecosystems such as wetlands, freshwater and marine habitats, and national parks and reserves. Spray drift is a potential source of friction between farmers and their neighbours.

To minimise harm to the environment, all aspects of chemical use, from justification for using chemicals to storage, handling and disposal of empty containers, need to be considered.

Practice 25. Employers and workers have been trained to a level appropriate to their area of responsibility for chemical application.

Incorrect selection, mixing, and application of chemicals can lead to contamination of soil and water on and off the site, particularly if chemical residues are allowed to build up over time. Training is important to ensure that employers and workers have the appropriate level of knowledge and skills, which may vary with area of responsibility. For example, the person who has overall responsibility for chemical use must have knowledge about all aspects and be able to train workers. A worker who applies the chemical must have knowledge and skills on preparing the formulation and the operation of equipment.

Evidence is required to show that people have been trained to the appropriate level. This may vary from a certificate from a formal training course to a note in a log book. The information to record is the person's name, date of training and topics covered.

Figure 7. Employers and workers must be trained in chemical use to a level appropriate to their area of responsibility.

Practice 26. *If the choice of chemical products is made by advisers, proof of their technical competence is available.*

Advisers used to select chemicals must show proof of their competence. Examples of proof are qualifications from an education institution, statement of knowledge and experience from a competent authority, and a training course certificate.

Practice 27. *Crop protection measures are appropriate for the control of pests and based on recommendations from a competent authority or monitoring of crop pests.*

The crop protection measures required vary with the type of produce grown, the production system, pest pressure and environmental conditions. Recommendations for crop protection are typically available in industry publications produced by competent authorities such as the Department of Agriculture.

Further advice can be obtained from advisers such as extension officers, consultants and resellers. Before using an adviser, request them to show proof of their competence. Examples of proof are qualifications from an education institution, statement of knowledge and experience from a competent authority, and a training course certificate.

Practice 28. *Integrated pest management systems are used where possible to minimise the use of chemicals.*

An integrated pest management (IPM) system integrates multiple strategies for managing pests to minimise the use of synthetic pesticides. The strategies include encouraging beneficial insects and microorganisms to flourish, good crop hygiene and plant health, regular monitoring of crops for pests, using biological control agents, and selective use of synthetic pesticides.

Evidence is required to show that an IPM system is used. Examples of evidence are records of crop protection practices such as pest monitoring results, use of biological control agents, and spray application. An example of a pest monitoring record is contained in Appendix 5. Examples of documents and records.

Practice 29. Chemicals are only obtained from licensed suppliers.

Chemicals obtained from unlicensed suppliers may be incorrectly identified or not true to the label contents or may contain impurities. Their use may lead to contamination of soil or water through the use of unapproved chemicals or excessive residues.

Practice 30. Chemicals used are approved for the targeted crop by a competent authority in the country of application, and up to date documentation is available to demonstrate the current approval status.

Most countries have authorities responsible for registering the use of chemicals on farms and for setting and monitoring chemical MRLs. In some countries one authority may be responsible for both functions and in others the functions may be the responsibility of separate authorities. Approval to use the chemical may be listed on the label or a permit may be issued for its use.

Chemicals are typically approved for a particular purpose for specified crops. The approved use and MRL must be confirmed for not only the country where the produce is grown but also for where the produce is intended to be traded. It is possible that a chemical may be approved with a particular MRL in the country where the produce is grown but is banned or has a different MRL where the produce is to be traded. Biopesticides, which are made from biological sources, must also be approved for use on the produce grown.

Documented lists of approved chemicals and MRLs can be obtained from publications or downloaded from websites or direct contact with the appropriate authorities. The Codex Alimentarius Commission (www.codexalimentarius.net) provides standards for MRLs that many countries have adopted.

Practice 31 Chemicals are applied according to label directions or a permit issued by a competent authority.

Chemicals must be applied according to the label or permit directions. Excessive residues can occur in soil and water if mixing is incorrect and the application rate is too high. Chemicals may build up in the soil from excessive use or chemicals may leach into surface or ground

water. Labels that are written in a foreign language must be translated accurately to ensure that mixing and application rates are correct.

Practice 32. A rotation strategy for chemical application and other crop protection measures are used to avoid pest resistance.

If pests develop resistance to chemicals, they cannot be controlled with standard applications of chemicals and more chemical or a harsher chemical may be required to control pests. By rotating crops the resistance can be minimised resulting in better environmental outcomes for the farm and surrounding areas.

Practice 33. The application of chemicals (ground and aerial) is managed to minimise the risk of spray drift to neighbouring properties and environmentally sensitive areas.

Spray drift is a potential source of friction between farmers and their neighbours. Spray drift can also cause much damage to wildlife. Liability for damage, illness or injury caused by spray drift is becoming a serious issue.

Spray drift is affected by a combination of factors, including:

- wind velocity at spray nozzle height,
- stability of local atmospheric conditions,
- nozzle and pressure choice,
- boom height,
- equipment speed, settings and maintenance.

Examples of practices to minimise spray drift are:

- Check the weather forecast before starting spraying. Do not spray if the wind direction and speed would cause the spray to drift onto sensitive areas. Spray early in the morning if possible.
- Spray only when the wind is light (between 2 to 11 km/h).
- Avoid spraying on hot days (greater than 30°C) and very dry days (less than 40% relative humidity) as these conditions can increase the evaporation and drift of sprays.
- Select the right combination of spray unit, nozzle type and size and pressure.

- When spraying near an environmentally sensitive area (flora or fauna) allow a buffer distance between the area sprayed and the sensitive area.
- Inform neighbours when spraying up wind from them.
- When using a boom sprayer, keep the boom height as low as possible.
- Erect or plant barriers to catch possible spray drift, and establish buffer zones between production areas and neighbours and sensitive natural areas. Buffer zones can be established by planting trees and shrubs downwind of a production area. Vegetation that is tall, rough and thin is better at catching droplets than vegetation that is short, smooth and thick. Use multiple vegetation layers as a screen rather than a single layer. When growing vegetables, tall vegetable plants such as corn can be planted to produce buffer barriers to catch spray. Buffer zones and barriers can be shown on the farm property map.

Practice 34. *Appropriate volumes of chemicals are mixed to minimise the amount of surplus chemical remaining after application.*

Practice 35. *Surplus chemical mixes and tank washings are disposed of in a manner that minimises the risk of environmental harm on and off the site.*

Avoid surplus chemical mixes remaining after application by carefully calculating the amount of spray needed for the area. Left over spray and washings from a spray tank or chemical container must not be allowed to enter a waterway or drainage from the property. Label instructions for disposal should be followed and laws regarding chemical use should be checked.

Methods for disposal of chemicals include:

- Store washings or surplus spray in an appropriately labelled container and use for next compatible spray mix.
- Dilute washings or surplus spray and spray on to target crop in a manner that will not exceed label rates or wash off chemical previously applied.

- Spray washings or surplus mix onto an area away from waterways, drainage and storage areas.
- Empty washings or surplus spray into a lime-filled pit (obtain advice as to quantities of lime and appropriate sites before using this method). Post-harvest dips may also be treated with lime to deactivate the chemical.

Spray equipment should be filled and washed in an area established for this purpose. Spillages and washings should not be able to escape from the area. Ensure the area is well away from watercourses and dams.

Practice 36. Equipment used to apply chemicals is maintained in working condition and checked for effective operation at least annually by a technically competent person.

Faulty equipment may lead to excessive application rates of chemicals. During each use, the equipment should be checked for leaks and faulty nozzles. At least annually, the equipment should be calibrated to check that the volume of spray delivered is correct. The calibration must be done by a technically competent person. This can be the farm owner, a farm worker, an advisor, or an equipment representative as long as they have been appropriately trained.

A record of the calibration should be kept. The information to record includes the name of person who did the calibration and the date and results of the calibration. The information can be recorded in a log book or on a record form.

Practice 37. Chemicals are stored in a well lit, sound and secure structure, with only authorised people allowed access. The structure is located and constructed to minimise the risk of contaminating the environment and equipped with emergency facilities in the event of a chemical spill.

Incorrect and careless storage and handling of chemicals can lead to the contamination of soil and water on and off the site. To minimise the risk of environmental contamination, chemicals must be stored in a well lit, sound and secure structure with access restricted to authorised people.

The structure must be located in an appropriate place, constructed to protect the chemicals from weather exposure, and equipped with emergency facilities to contain spillages. The structure may be stand alone or located inside another building. For example if small quantities of chemicals are stored, a locked cupboard with shelves would be a suitable structure provided it is segregated from packing, storage and handling areas.

Measures to minimise the risk of environmental contamination include:

- Locate structure away from water sources and where the risk of flooding is high
- Use a cool, waterproof structure that keeps chemicals out of direct sunlight and severe weather exposure.
- Use an impervious floor (for example concrete), with bunding around the floor to contain any spills or leaks and also prevent water entering.
- Install lighting so that chemical labels can be read clearly.
- Keep structure locked to ensure children and unauthorised people are kept out.
- Keep a spill kit (shovel and dry sand or soil) in a clearly visible and accessible area.

Do not store chemicals with chlorine or fertilisers containing ammonium nitrate, potassium nitrate or sodium nitrate as spillage may cause explosions.

Figure 8. Chemicals must be stored in a well lit, sound and secure structure, with only authorised people allowed access.

Practice 38. *Chemicals are stored in the original container with a legible label and according to label directions or instructions from a competent authority. If a chemical is transferred to another container, the new container is clearly marked with the brand name, rate of use and withholding period.*

A chemical must be stored in the original container with a legible label to avoid using the wrong chemical or application rate. The only occasion when a chemical should be transferred to another container is when the original container is damaged. The new container must be marked with the chemical brand name and information from the original label must be available to prevent incorrect use.

Practice 39. *Empty chemical containers are not re-used and are kept secure until disposal.*

Practice 40. *Empty chemical containers are disposed of according to relevant country regulations and in a manner that minimises the risk of causing environmental harm on and off the site. Official collection and disposal systems are used where available.*

Un-rinsed containers can hold as much as 3% of chemical concentrate. Un-rinsed containers should be treated as hazardous waste, as they present a hazard to people who handle them and have potential to contaminate the environment.

All used chemical containers should be triple-rinsed. This is done by filling the container with clean water to approximately a quarter of capacity, replacing the cap, shaking and then adding the waste water to the spray tank. This is repeated three times. Pressure rinsing is also an option but special equipment is available.

Once steel containers are rinsed they should be punctured to prevent reuse. Empty chemical containers must be stored in a designated, secure area (preferably locked), and disposed of either through an approved disposal scheme, or according to a procedure that meets regulations in your country. Access to this area must be restricted for both people and

animals.

Figure 9. Empty chemical containers must not be reused and are kept secure until disposal.

Practice 41. *Obsolete chemicals, that are unusable or no longer approved, are clearly identified and kept secure until disposal.*

Practice 42. *Obsolete chemicals are disposed of through official collection systems or in legal off-site areas.*

Obsolete chemicals must be disposed of through official collection systems or in legal off-site areas. The age of a chemical can be determined from the expiry date or manufacture date on the container. A rule-of-thumb is that active ingredients begin to deteriorate 2 years after manufacture. Regulatory approvals for chemicals can also change.

An annual check of chemicals in storage will ensure that these chemicals have current approval, are still within their expiry date and the containers are intact with readable labels. If a chemical is found to be obsolete, it must be clearly identified and kept secure until disposal. This can be achieved by marking the container with the words “obsolete” and placing it in a designated area for obsolete chemicals, which may be inside the storage structure.

Practice 43. *The application of chemicals is recorded for each crop, detailing the chemical used, reason for application, application date, treatment location, application rate and method, weather conditions, and operator name.*

Practice 44. *Where applicable, a record of chemicals held in storage is kept, detailing chemical name, date and quantity obtained and date when completely used or disposed of.*

A record of chemicals obtained, applied and stored must be kept to show that chemicals have been applied and stored correctly and for traceability in the event of environmental contamination being detected. The records enable possible causes of the contamination to be investigated.

The information required can be recorded separately or together in a log book or on a record form. A copy of the delivery receipt can also be kept as a record of chemicals obtained. Examples of records for obtaining, storing and applying chemicals are contained in Section 5. Examples of documents and records.

Other chemicals

Practice 45. *Fuels, oils, and other non-agrochemicals are handled, stored and disposed of in a manner that minimises the risk of contaminating the environment.*

Fuels, oils and other non agricultural chemicals can pollute waterways and soils if handled, stored and disposed of incorrectly. Theft, vandalism and accidental damage by moving vehicles can cause spills and should be guarded against. Take reasonable steps to secure vulnerable tanks against interference; this may be as simple as locking pumps or taps.

Fuel storage facilities should be away from watercourses and with sufficient surrounding space to permit easy access, thus reducing the chance of accidental damage. All fuel storage facilities should be surrounded by an anti spill retarding wall. Check for leaks frequently and repair them promptly. Even slow leaks can have a major impact if allowed to continue. Materials to soak up any spillages should be available at the storage area.

Mobile fuel tanks should be designed to protect them from accidental damage. Use mobile tanks with care, especially when using near watercourses.

The risk of fire should be minimised.

3.7 Harvesting and handling produce

Practice 46. *The application, storage, and disposal of chemicals used after harvest, such as pesticides and waxes, follow the same practices as described in the Chemicals section.*

Chemicals used after harvest to treat produce include pesticides such as fungicides, insecticides and fumigants and surface coatings such as waxes. Guidelines on implementing practices associated with applying, storing and disposing of these chemicals are described in Section 3.6 Chemicals.

If rat and mouse baits are used in packing sheds, ensure they are enclosed in bait stations to prevent native birds and animals eating the bait. Dispose of used baits and carcases according to the product label. Take care when burying carcases so there is no risk of polluting surface or ground water and dogs or native animals eating them.

3.8 Waste and energy efficiency

Practice 47. *A waste management plan is documented and followed, including identifying types of waste products generated by property activities and using practices to minimise waste generation, reuse or recycle waste and store and dispose of waste.*

The objective of waste management is to avoid, reduce, reuse or recycle waste wherever feasible or dispose of a waste in a way that is meets community expectations and legislation. A waste management plan identifies the significant types of waste, the methods used to manage the waste and the person responsible. The waste management plan can be documented in a log book or as a work instruction. An example of a waste management plan is contained in Section 5. Example documents and records.

The first step to managing waste is to determine the types of waste generated on the property. Examples of waste products are:

- Inert materials – metal, rubble, glass
- Persistent materials – timber (boxes, bins, pallets), packaging (cartons, polystyrene boxes, plastic film and bags), plastic (seedling trays, fertiliser and seed bags, plastic mulch, irrigation pipes and tape), tyres
- Biodegradable materials – paper and cardboard (office paper waste), substrates (peat, coconut pulp), spent hydroponic solutions, reject plants and vegetative waste, reject produce
- Toxic waste – waste chemicals, oil, batteries, treated timber.

The types of waste should be prioritised based on the amount of waste generated and the potential impact of the waste on the environment. The methods used to manage waste include:

- avoid or minimise waste,
- reuse or recycle waste, or
- dispose of waste.

Disposal of waste should be the last resort and can include burning or burial in landfill (onsite or community disposal facility). There may be regulations related to burning of certain types of waste. The potential environmental impacts of disposal neen to be considered such as creation of dark smoke and pollution of groundwater. If disposing of waste materials on site, do not bury or dump materials close to waterways or where run-off or leaching from the materials can contaminate waterways or ground water.

Practice 48. *Consumption of electricity and fuel is reviewed and efficient operating practices are identified and used.*

Practice 49. *Machinery and equipment are serviced to maintain operational efficiency or are replaced.*

Most energy (including electricity) comes from the burning of fossil fuels such as oil, coal and gas. Burning of fossil fuels release carbon dioxide, nitrous oxide and methane into the atmosphere, which results in the greenhouse effect known as “global warming”. Energy use can be monitored by checking electricity and fuel costs.

Major uses of energy are:

- electricity for lighting, cool rooms, equipment, and irrigation
- fuel for vehicles and equipment.

Regular maintenance of vehicles and equipment ensures efficient operation and reduces energy use and costs.

Figure 10. If disposing of waste materials on site, do not bury or dump materials close to waterways or where run-off or leaching from the materials can contaminate waterways or ground water.

3.9 Biodiversity

Biodiversity is the variety of all life forms: the different plants and animals and the ecosystems of which they are a part. Native biodiversity refers to the biodiversity found in a particular locality. Native biodiversity provides benefits that are essential to sustaining and fulfilling human life and maintaining productive agriculture.

Benefits from native biodiversity include:

- fungi, worms and bacteria transforming sunlight, carbon and nitrogen into fertile soil,
- pollination from insects,
- regulation of climate,
- providing shade and shelter, and waste absorption and breakdown.

To manage biodiversity on a property, the farmer or employer needs to know what native vegetation exists and if it is of special importance, consider the impacts of the property operations on the environment, and develop practical ways to manage native vegetation, protect rare animals and control problem plants and animals.

The protection of rare species of animal, plants and insects is becoming more and more important, many countries have developed lists of endangered species that they wish to protect, farming operations must comply with country regulations in the protection of rare and vanishing biodiversity. The following good agricultural practices have been formulated for the protection of rare plants, insects and animal species affected by the farming operation.

Practice 50. *Property activities comply with country regulations covering the protection of endangered plant and animal species.*

Governments have developed lists of plants and animals that are considered important because of their rarity or they may support other significant features (for example as a drought refuge for native animals). Biodiversity legislation varies between the ASEAN member countries. It is important to check whether there is any biodiversity legislation that applies to the property. For example, there may be regulations that prevent clearing of native vegetation.

Practice 51. *To conserve native plant and animal species, access and activity is managed in significant remnant native vegetation areas, wildlife corridors, and vegetation areas on and near the banks of waterways.*

Native vegetation is an indicator of the native biodiversity that is present on a property. Environment protection agencies and other competent authorities can provide advice on native vegetation and animal species present in the locality. Wildlife corridors provide access for native animals within and through the property. Vegetation areas on and near the banks of waterways help to minimise soil erosion and pollution of waterways.

To conserve native plant and animal species, access and activity in significant remnant native vegetation areas must be managed and wildlife corridors and vegetation areas on and near the banks of waterways maintained.

These areas of environmental significance should be shown on the property layout map. An example of a property layout map is contained in Section 5. Examples of documents and records.

Practice 52. Measures are used to control feral animals and environmental pests.

Measures must be used to prevent feral animals and environmental pests such as exotic plants from taking over areas of remnant native vegetation. Examples are rats and common monkeys that may take over environmental sensitive areas and eliminate rare animals from that site, and then become pests to the farm by damaging crops.

3.10 Air

Practice 53. The generation of offensive odour, smoke, dust, and noise is managed to minimise the impact on neighbouring properties.

Air pollution issues, particularly odours, dust, smoke and noise, are usually of most significance to neighbouring properties.

Odours can be caused by animal manures, waste disposal sites for produce, composting sites and activities, and waste management equipment. Most people do not like the smell of raw manure. Offensive odours can be reduced by replacing raw animal manure with other less odorous products such as composted or dry manure.

If fresh manure is used, it must be stored and used to minimise odour. Protection of stored manure (and compost) from rain, and containment of run-off effluent needs to be managed to avoid contamination of adjacent soils, work areas and waterways. It is not always possible to keep a large distance between the area where manure is spread and the neighbours. Contacting the neighbours before spreading manure will help in maintaining good relationships.

Whenever possible, schedule times to spread manure when it will have the least impact on neighbours. In general, manure spreading should be done on weekdays during office hours. At these times, neighbours are more likely to be away from home. Avoid spreading manure on weekends, holidays or when social events are taking place.

Carefully consider the weather before spreading manure. Manure should not be spread when the wind direction is going to carry the smell to a neighbour. Even under appropriate weather conditions, the more manure used, the more likelihood that the smell will be excessive. Extra manure will not provide additional benefits to the crop and will only make the smell worse. Odours are reduced and drying is quicker, when less manure is used.

Another good practice is to dig the manure into the soil as quickly as possible. The best method is to incorporate it as it is put on, or to inject it. As with the storage area, natural and man-made barriers between production areas and neighbours can greatly reduce the likelihood of complaints. Apart from the visual effect, barriers can also help to filter and thin out odours.

Figure 11. Offensive odours can be caused by animal manures, waste disposal sites for produce, composting sites and activities, and waste management equipment.

Packing sheds often have produce waste disposal areas, which can produce odours. The same principles apply as for storage of animal manures:

- disposal areas should be as far away as possible, and if possible, downwind of neighbours, and

- visual screening of the disposal area reduces the perception of odour problems.
- waste disposal sites should be regularly covered with soil to minimise odours and the risk of disease transmission and pest build-up.

Excessive dust can cause annoyance and in some cases health problems to neighbours and staff. Dust created around packing sheds can also settle on packed produce, affecting visual quality. The combination of soil type, production system and weather conditions contributes to the risk of dust pollution. Control measures may include planting shelterbelts and windbreaks, modifying cultural practices or reconsidering the appropriateness of particular cropping activities on exposed sites.

Choose cultivation practices carefully. Working soil to fine tilth in dry windy weather should be avoided. Uncultivated crop stubble also provides protection against wind erosion. Minimise the amount of time soil is left without vegetation or a cover crop.

Wetting down or sealing frequently used traffic ways will significantly reduce dust levels. These areas include transport delivery and pickup areas, harvested produce delivery points and unsealed roads to the packing shed.

If burning in the open is the only practical method of disposal of materials and it is legal in the locality, precautions should be taken to prevent dark smoke and causing a nuisance to neighbours. Before burning check local bushfire restrictions and regulations.

Do not burn plastics, rubber, tyres or other materials known to produce dark smoke or plastics or chemicals as they release toxic fumes and residues. Check wind direction before burning and only burn when wind direction is away from neighbours. As a courtesy, inform neighbours before burning materials. Keep fires small and only burn dry materials.

Excessive noise can be a nuisance to neighbours. Measures to reduce noise include locating equipment away from boundaries, restricting operation of loud equipment during the night, sound proofing loud equipment and using buffer zones.

3.11 Training

Practice 54. *Employers and workers have appropriate knowledge or are trained in their area of responsibility relevant to good agricultural practices and a record of training is kept.*

People whose roles may impact on the environment must have adequate knowledge and skills to perform their duties. Their training needs should be considered and appropriate training planned and carried out. The training may take the form of on-the-job training or formal training. Refresher training and signs in the work area help to ensure workers are aware of environmental hazards and measures to reduce the risk of hazards occurring.

A record of training must be kept to show that employers and workers have been trained. This information can be recorded in a log book or on a record form. An example of a job responsibility and training record form is contained in Section 5. Examples of documents and records.

3.12 Documents and records

Practice 55. *Records of good agricultural practices are kept for a minimum period of at least two years or for a longer period if required by legislation or customers.*

Records enable traceability of property operations to investigate possible causes of environmental harm and also provide evidence for auditors and customers that good agricultural practices have been implemented. They must be kept for a minimum of 2 years of longer if required by government legislation or customers.

Practice 56. *Out of date documents are discarded and only current versions of documents relevant to good agricultural practice are used.*

To avoid the use of obsolete documents, any out of date documents must be discarded and only current versions used. Placing the date of preparation on the bottom of the document will identify the latest version.

3.13 Review of practices

A review of practices is necessary to confirm that practices are being carried out as required and records are accurate and contain the required information. This self-assessment identifies the practices that are not being done correctly and actions needed to investigate and rectify the problem.

Practice 57. *All practices are reviewed at least once each year to ensure that they are done correctly and actions are taken to correct any deficiencies identified or if changes occur to environmental regulations.*

Practice 58. *A record is kept to show that all practices have been reviewed and any corrective actions taken are documented.*

All practices must be reviewed at least once each year. The practices do not have to be reviewed at the same time. It is best to review the practices at the time when they are being undertaken. For example at harvest time, review the practices that are associated with harvesting and preparation of the product for sale. A review of pesticide use during production would be undertaken before produce is harvested.

Despite best intentions, problems arise from time to time. The review may identify a practice that is not being done correctly. The problem must be investigated and actions taken to correct the problem and prevent it happening again.

A record must be kept of the practices reviewed and corrective actions taken. A self-assessment checklist is a useful tool. It provides a simple, systematic outline for reviewing practices and when completed it provides a record of the review and corrective actions taken. An example of a self-assessment checklist and corrective action is contained in Section 4. Self-assessment checklist.

Practice 59. Actions are taken to resolve complaints related to environmental management, and a record is kept of the complaint and actions taken.

Complaints from local communities, neighbours and others concerning environmental hazards must be investigated and actions taken to resolve the complaint. Examples of complaints are dumping of waste near a waterway, spray drift from pesticide application and offensive odours from manure heaps.

A record of the complaint and actions taken must be kept. This information can be recorded in a log book or on a record form.

4. Self-assessment checklist – good agricultural practices

This self-assessment checklist enables the level of compliance with the good agricultural practices contained in the environmental management module of ASEAN GAP to be checked. The relevance of the practices will depend on the location of the farm or packing business, type of produce, and the systems used for production, harvesting, handling, packing, storage and transport. Each practice is assessed and a tick is placed in the relevant column. If attention is needed, the actions required are recorded in the column titled, "Actions required/ taken". When the actions have been taken, the assessor checks that the actions are satisfactory and writes a comment in the "Actions required/ taken" column with the date and a signature.

Chemicals	Yes	Needs attention	Not relevant	Actions required/ taken
1. Sites used for production comply with country regulations that restrict production at high altitudes or on steep slopes				
2. Chemicals are stored in a well lit, sound and secure structure, with only authorised people allowed access. The structure is located and constructed to minimise the risk of contaminating workers and equipped with emergency facilities in the event of a chemical spill.				

3. Chemicals are stored in the original container with a legible label and according to label directions or instructions from a competent authority. If a chemical is transferred to another container, the new container is clearly marked with the brand name, rate of use and withholding period.				
4. Where there is a significant risk of chemical contamination of workers, Material Safety Data Sheets or safety instructions from chemical labels are readily available.				
Site history and management				
5. Highly degraded areas are managed to minimise further degradation				
6. Management of site activities conforms to country environmental legislation covering air, water, noise, soil, biodiversity and other environmental issues				

Planting material				
7. To minimise chemical usage and nutrient runoff, planting material is selected for disease resistance and compatibility with site properties such as soil type and nutrient levels				
Soil and substrates				
8. The intended production practices are suitable to the soil type and do not increase the risk of environmental degradation				
9. Where available, soil maps are used to plan rotation and production programs				
10. Cultivation practices that improve or maintain soil structure and minimise soil compaction and erosion are used				
11. The use of chemical fumigants to sterilise soils and substrates is justified and a record is kept of the location, date, product, application rate and method, and operator name				

Fertilisers and soil additives				
12. Nutrient application is based on recommendations from a competent authority or on soil, leaf or sap testing to minimise nutrient runoff and leaching.				
13. Areas or facilities for storage, mixing and loading of fertilisers and soil additives and for composting of organic matter are located, constructed and maintained to minimise the risk of environmental harm on and off the site.				
14. Equipment used to apply fertilisers and soil additives is maintained in working condition and checked for effective operation at least annually by a technically competent person				
15. The application of fertilisers and soil additives is recorded, detailing the name of the product or material, date, treatment location, application rate and method, and operator name.				
16. For hydroponic production systems, the mixing, application and disposal of the nutrient solution is monitored and recorded.				

Water				
17. Irrigation use is based on crop water requirements, water availability, soil moisture levels, and consideration of environmental impact on and off the site.				
18. An efficient irrigation system is used to minimise wastage of water and the risk of environmental harm on and off the site.				
19. The irrigation system is checked for operational efficiency during each use, according to manufacturer's instructions or other appropriate methods, and maintained to ensure efficient delivery.				
20. A record is kept of irrigation use, detailing crop, date, location, volume of water applied or duration of irrigation, and name of person who managed the irrigation activity.				
21. Water collection, storage, and use is managed to comply with country regulatory requirements.				

22. Water used from sources that may cause environmental harm to land and soil, waterways and sensitive areas is managed or treated to minimize the risk of environmental harm.				
23. Water from toilets and drainage systems are disposed of in a manner that minimises the risk of environmental harm on and off the site.				
24. Water discharged from the property, including waste water from harvesting, cleaning and handling operations, is managed or treated to minimize off site environmental harm.				
Agrochemicals				
25. Employers and workers have been trained to a level appropriate to their area of responsibility for chemical application.				
26. If the choice of chemical products is made by advisers, proof of their technical competence is available.				
27. Crop protection measures are appropriate for the control of pests and based on recommendations from a competent authority or monitoring of crop pests.				

28. Integrated pest management systems are used where possible to minimise the use of chemicals.				
29. Chemicals are only obtained from licensed suppliers.				
30. Chemicals used are approved for the targeted crop by a competent authority in the country of application, and up to date documentation is available to demonstrate the current approval status.				
31. Chemicals are applied according to label directions or a permit issued by a competent authority.				
32. A rotation strategy for chemical application and other crop protection measures are used to avoid pest resistance.				
33. The application of chemicals (ground and aerial) is managed to minimise the risk of spray drift to neighbouring properties and environmentally sensitive areas.				
34. Appropriate volumes of chemicals are mixed to minimise the amount of surplus chemical remaining after application.				

35. Surplus chemical mixes and tank washings are disposed of in a manner that minimises the risk of environmental harm on and off the site.				
36. Equipment used to apply chemicals is maintained in working condition and checked for effective operation at least annually by a technically competent person.				
37. Chemicals are stored in a well lit, sound and secure structure, with only authorised people allowed access. The structure is located and constructed to minimise the risk of contaminating the environment and equipped with emergency facilities in the event of a chemical spill.				
38. Chemicals are stored in the original container with a legible label and according to label directions or instructions from a competent authority. If a chemical is transferred to another container, the new container is clearly marked with the brand name, rate of use and withholding period.				
39. Empty chemical containers are not re-used and are kept secure until disposal.				

40. Empty chemical containers are disposed of according to relevant country regulations and in a manner that minimises the risk of causing environmental harm on and off the site. Official collection and disposal systems are used where available.				
41. Obsolete chemicals, that are unusable or no longer approved, are clearly identified and kept secure until disposal.				
42. Obsolete chemicals are disposed of through official collection systems or in legal off-site areas.				
43. The application of chemicals is recorded for each crop, detailing the chemical used, reason for application, application date, treatment location, application rate and method, weather conditions, operator name.				
44. Where applicable, a record of chemicals held in storage is kept, detailing chemical name, date and quantity obtained and date when completely used or disposed of.				

Other chemicals	Yes	Needs attention	Not relevant	Actions required/ taken
45. Fuels, oils, and other non-agrochemicals are handled, stored and disposed of in a manner that minimises the risk of contaminating the environment.				
Harvesting and handling produce				
46. The application, storage, and disposal of chemicals used after harvest, such as pesticides and waxes, follow the same practices as described in the Chemicals section				
Waste and energy efficiency				
47. A waste management plan is documented and followed, including identifying types of waste products generated by property activities and using practices to minimize waste generation, reuse or recycle waste and store and dispose of waste.				
48. Consumption of electricity and fuel is reviewed and efficient operating practices are identified and used.				

49. Machinery and equipment are serviced to maintain operational efficiency or are replaced.				
Biodiversity				
50. Property activities comply with country regulations covering the protection of endangered plant and animal species.				
51. To conserve native plant and animal species, access and activity is managed in significant remnant native vegetation areas, wildlife corridors, and vegetation areas on and near the banks of waterways.				
52. Measures are used to control feral animals and environmental pests.				
Air				
53. The generation of offensive odour, smoke, dust, and noise is managed to minimise the impact on neighbouring properties.				

Training	Yes	Needs attention	Not relevant	Actions required/ taken
54. Employers and workers have appropriate knowledge or are trained in their area of responsibility relevant to good agricultural practice and a record of training is kept.				
Documents and records				
55. Records of good agricultural practices are kept for a minimum period of at least two years or for a longer period if required by government legislation or customers.				
56. Out of date documents are discarded and only current versions are used.				
Review of practices				
57. All practices are reviewed at least once each year to ensure that they are done correctly and actions are taken to correct any deficiencies identified or if changes occur to environmental regulations.				

58. A record is kept to show that all practices have been reviewed and corrective actions taken are documented.				
59. Actions are taken to resolve complaints related to environmental management, and a record is kept of the complaint and actions taken.				

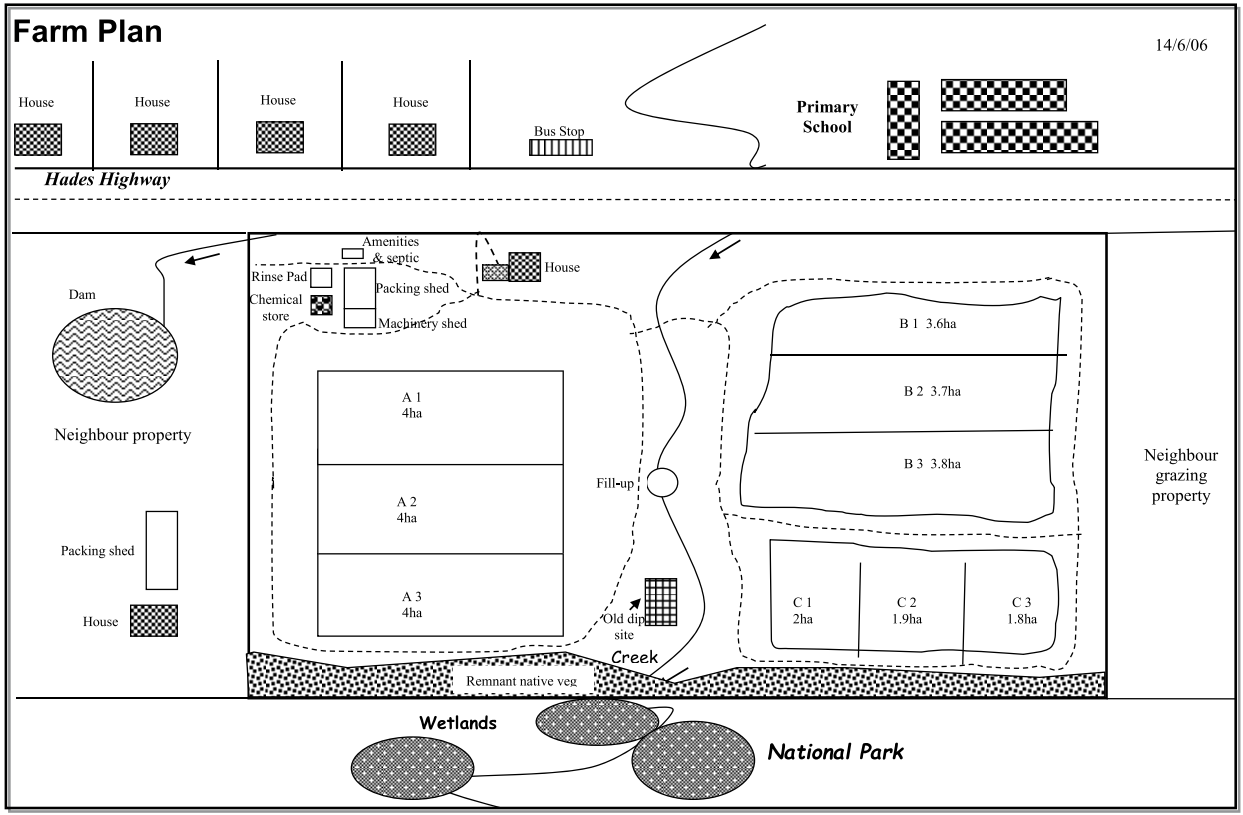
Name of assessor: **Signature:** **Date:**

5. Examples of documents and record

The section contains examples of documents and record forms that are required to implement various practices in the environmental management module. The documents and record forms are examples only and other methods and formats can be used. ASEAN GAP specifies the information that has to be documented and the records to keep, but does not specify how to document information and keep records.

The example documents and record forms contained in this section are:

- Farm plan
- Pest and disease monitoring record
- Chemical inventory
- Spray record
- Postharvest chemical record
- Chemical authorisation form
- Fertiliser and soil additives record
- Irrigation record
- Job responsibility and training record
- Waste management plan
- Corrective action report


Farm Plan
14/6/06
House
House
House
House
Bus Stop
Primary School
Hades Highway
Amenities & septic
House
Rinse Pad
Packing shed
Chemical store
Machinery shed
Dam
Neighbour property
A 1 4ha
A 2 4ha
A 3 4ha
B 1 3.6ha
B 2 3.7ha
B 3 3.8ha
Fill-up
Neighbour grazing property
Packing shed
House
Old dip site
C 1 2ha
C 2 1.9ha
C 3 1.8ha
Creek
Remnant native veg
Wetlands
National Park

Pest and Disease Monitoring Record

Business/Grower Name:
Year/Season:

Date	Area/ Crop	Pest / disease score	Monitoring result and action required	Operator

Pest / disease score	Clear 0	Low 1	Medium 2	High 3

Chemical Inventory

Business/Grower Name:

Date purchased	Name of product	Quantity	Place of purchase	Batch no. (where available)	Manufacture / expiry date	Method and date of disposal

Stocktake	Date:	Name:	Date:	Name:

Spray Record

Business/Grower Name: Crop/ Variety:

Year:

Date/ Time	Block/ Row	Crop stage/ target	Product	Dilution rate	Application rate	Equipment / method used	Date safe to harvest or WHP	Comments/ weather conditions	Operator

Postharvest Chemical Record

Business/Grower Name:

Chemical	Tank Size	Tank Mixing Rate		Application Method
		Fresh	Top-up	

Date	Time	Chemical	Fresh (F) or Top-up (T)	Comments	Signature

Chemical Authorisation

This chemical storage shed is to be kept locked at all times.

…….. is responsible for the use and storage of all chemicals used on this property, and the training and supervision of all staff who are required to use chemicals.

The following staff have authorisation to use chemicals:

Authorised Person	Manager's Signature	Date

Fertiliser and Soil Additives Record

Business/Grower Name: Year:

Date	Crop/ variety	Block Row	Product	Supplier of product	Application rate	Comments	Operator

Irrigation Record

Business/Grower Name: Year:

Date	Crop	Variety	Block/ row	Volume of water applied	Rainfall	Comments

Job Responsibility and Training Record

Business/Grower Name:

Name	Chemical application	Fertilising	Irrigation	Harvesting	Grading and packing	Cleaning	Personal hygiene	Repairs and maintain	Self assessment checklist

C = attended farm chemical user course
✓ = performs job and training completed
✓✓ = performs job, training completed and has responsibility for area

Waste Management Plan

Business/Grower Name:

Area / Waste type	Management method	Responsibility
Obsolete and unusable chemicals and chemical containers	Obsolete and unusable chemicals are stored separately in the chemical store and marked "not for use". Periodically dispose them through registered collection agency. Rinsed chemical drums stored in holding area awaiting disposal to approved off-farm site. Other drums (e.g fertiliser) are cleaned for minor reuse around farm (e.g. rubbish bin)	Manager
Leftover chemical solutions – spray tank and postharvest dip tank	Leftover spray and postharvest dip tank solutions are disposed of according to label directions. Where label directions provide, spray and dip tank solutions are drained into absorption trench (operator signs/instructions are provided). Where label directions require specialist solution disposal off-site, a contractor is contacted for pump out and disposal services.	Manager Operator

Area / Waste type	Management method	Responsibility
Machinery and vehicles – oils, tyres, spare parts	Waste oil is collected and stored in waste oil holding containers in the machinery shed. Some oil is reused on farm equipment. When storage becomes significant, a waste oil collection contractor is contacted. Machinery/vehicle spare parts and tyres are collected and stored in designated area until disposal.	Manager Maintenance staff
Paper and cardboard	Cardboard and paper are collected and compacted for recycling or disposal.	All Staff
Plastic – irrigation lines, soil covers	Used irrigation lines and plastic mulches are rolled up and stored at on-farm holding sites awaiting appropriate disposal.	Manager
Glass and wire	Used/ broken glass storage containers are identified and staff instructed for their collection while awaiting disposal.	All Staff
Organic – crop residues, packing shed waste products	Crop residues mulched/worked back into soil. Packing shed waste produce collected and deposited in composting area.	Manager Operator
Sewage – septic run-off, waste paper	Septic waste pump out by contractor as required. Septic water dispersed through sub-surface absorption trenches.	Manager

Corrective Action Report

Business/Grower Name:

Date	Problem and cause	Action taken to fix problem	Signature/ date when problem fixed

Appendix 1. Glossary of terms

Abbreviations

AADCP	ASEAN-Australia Development Cooperation Program
ASEAN	Association of Southeast Asian Nations
AusAID	Australian Agency for International Development
GAP	Good Agricultural Practice
MRL	Maximum Residue Limit
QA	Quality Assurance
QASAFV	Quality Assurance Systems for ASEAN Fruit and Vegetables

Terms

Acidity	The strength of an acidic substance, measured as pH – acid substances have a pH of 1-7.
Alkalinity	The strength of an alkaline substance, measured as pH – alkaline substances have a pH of 7-14.
Biopesticide	A pesticide that is manufactured from biological sources.
Biodiversity	The variety of life on the planet, measurable as the variety within species, between species, and the variety of ecosystems.
Bunding	Wall or similar structure designed to trap or contain liquid.
Competent authority	An organisation or company that is a recognised authority to develop or monitor standards, rules of operation, codes of practice, regulations, and policies. Examples include government departments, international committees such as CODEX, industry organisations, QA/GAP system owners, and auditing companies.

Composting	A managed process where organic materials are subjected to moisture, heat and microorganisms for a specified period to produce a product known as compost.
Contamination	Environmental – the introduction or transfer of a hazard into the environment – soil, water, air.
Customer	A business or person who buys or receives produce. For example, a packer, marketing group, distributor, wholesaler, exporter, processor, retailer, or consumer.
Environmental hazard	Negatives impacts that occur to the environment on and off the property.
Fertigation	The application of nutrients through an irrigation system.
Field capacity	The soil water content after rainfall or irrigation at the point where drainage stops.
Fumigation	The applicant of a chemical to control pests in the soil or substrate, such as insects, diseases and weeds.
Eutrophication	The enrichment of water by nitrogen or phosphorus, causing algae and higher forms of plant life to grow too fast, which disturbs the balance of organisms present in water and the quality of the water.
Good agricultural practice	Practices used to prevent or reduce the risk of hazards occurring during production, harvesting, postharvest handling of produce.
Integrated pest management	A system for managing pests that integrates multiple strategies to minimise the use of chemical pesticides, such as encouraging beneficial insects and microorganisms to flourish, good crop hygiene and plant health, regular monitoring of crops for pests, using biological control agents and soft pesticides, and selective use of chemical pesticides.

Maximum Residue Limit (MRL)	The maximum amount of a chemical in fruit and vegetables for sale for human consumption, which is permitted by a competent authority.
Nutrient	Element or compound essential for animal and plant growth. Common nutrients in fertilisers are nitrogen, phosphorus, potassium.
Nutrient leaching	The process by which soluble nutrients in the soil are washed into a lower layer of soil or are dissolved and carried away in water.
Obsolete chemical	A chemical that is no longer suitable for use. For example approval for use of the chemical may be withdrawn, the chemical is older than the use by date, the container may be damaged and the chemical soiled.
Organic material/ product	A material or commercial product originating from plants and animals and not from synthetic sources.
Persistent chemicals	Organochlorine pesticides, heavy metals and other chemicals that remain for long periods in soil, water and the general environment (for example, herbicides in ground water).
Pest	An unwanted animal or plant.
Pesticide	Products used to control pests – for example, insecticides, fungicides, herbicides, fumigants. Pesticides can be manufactured from chemical or biological sources.
Produce	Fruit and vegetables (including herbs)
Property	The whole area of a farm or business. It includes all houses, buildings, production areas, roads, fauna and flora, and watercourses within the surveyed boundaries of the property.
Corrective action	Action taken to remove or minimise or prevent re-occurrence of a hazard.

Risk	The chance of something happening that will impact upon a hazard. It is measured in terms of likelihood and consequences.
Salinity	A measure of how much salt is in water or soil.
Sedimentation	The accumulation of earthy matter (soil and mineral particles) washed into a waterway or water body that settles on the bottom.
Side dressing	The application of a fertiliser or soil additive beside a growing plant either on top of or beneath the ground.
Site	A defined area on the property – for example, a production site.
Sodicity	A sodic soil has an exchangeable sodium level of more than 6%.
Soil additives	Products or materials that are added to the soil to improve fertility, structure or control weeds. Examples are animal manure, sawdust, compost, seaweed, fish-based products.
Soil erosion	The wearing away of land surface by wind or rain.
Substrate	Growing medium used in place of soil – for example peat, coconut pulp.
Target	The item or site to which an activity is directed. For example, applying a pesticide spray to a target crop to control a target pest or applying fertiliser to a target paddock for crop nutrition.
Traceability	The ability to follow the movement of produce through the specified stages of production and distribution.
Water quality	The chemical, physical and biological characteristics of water.

Wildlife corridor	Linking of wildlife habitat, generally native vegetation, which joins two or more larger areas of similar wildlife habitat.
Workers	All people working on a farm or in a business, including family members and contractors.

Appendix 2. References and additional information

Global organisations

- World Trade Organisation of the United Nations - WTO — www.wto.org
- World Health Organisation of the United Nations - WHO — www.who.int
- Food and Agriculture Organization of the United Nations — www.fao.org
- Codex Alimentarius Commission (Codex) — www.codexalimentarius.net

Publications

- Guidelines for Environmental Assurance in Australian Horticulture, Horticulture Australia Ltd. – www.horticulture.com.au

On-farm assurance programs

Program	Website
GLOBALG.A.P.	www.global.org
ChileGAP	www.chilegap.com
Freshcare On-Farm Food Safety Program (Australia)	www.freshcare.com.au
SQF 1000 and 2000	www.sqfi.com
Thailand Q System, Malaysian SALM System, Singapore GAP-VF System, Indonesian INDON GAP System – QASAFV Project Website	www.aphnet.org

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