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SUSTAINABLE PRODUCTION AND COMMERCIALIZATION STRATEGIES IN THE AGRI-FOOD SECTOR IN SOUTH AFRICA

DELIVERABLE D1.4

Best sustainable production practices

PROJECT INFORMATION

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GLOSARY

EU	European Union
EC	European Commission
UNOPS	United Nations Office for Project Services
UNEP	United Nations Environmental Programme
UNDP	United Nations Development Programme
GAP	Good Agricultural Practices

1. INTRODUCTION

The **D.1.4. Best Sustainable production practices** is a confidential document delivered in the context of *Result 1*–, *Activity 1.3 – Development procedures and capacity building in clean production, by providing training in sustainable irrigation and resource management among agri food smallholders*.

The SUPRA project (Sustainable production and commercialization strategies in the agri-food sector in South Africa; ZAF/UNEP/00091206/2015/027) is an action implemented by *FUNDACION SUSTALDE* (SUSTALDE, Spain, Coordinator), *Agricultural Research Council – ARC* (ARC, South Africa, partner), *Cape Peninsula University of Technology - CPUT* (CPUT, South Africa, partner) and *Council for Scientific and Industrial Research -CSIR* (CSIR, South Africa, partner).

The action is an EU funded programme, implemented by the *United Nations Environment Programme ("UNEP")* in collaboration with the *United Nations Development Programme (UNDP)* and *UNOPS*, under the *SWITCH Africa Green - Component B*, which has been developed to support African countries in their transition to an inclusive green economy, and in promoting a shift to sustainable consumption and production patterns and practices.

The SUPRA project, which has an overall duration of 30 months, aims to develop more sustainable patterns in the agricultural sector in South Africa by engaging in transition towards a green economy, promoting resource and energy efficiency. The project is conducted in South Africa and focuses on three main levels: 1) Breaking the link between green economic growth and environmental degradation in the agri-food sector by assisting small farmers to adopt best practices in sustainable production, including the efficient utilisation of water in irrigation; 2) Promoting agri-food operators to adopt more sustainable practices by means of voluntary agreements and Green Certification Schemes engaging in transition towards an inclusive green economy; and, 3) promoting changes in policies, regulations and standards in order to foster the generation and implementation of Sustainable practices and Green Certification Schemes along the agri-food sector in South Africa.

It should be noted that, although the original contractual title is "*Sustainable production and commercialization strategies in the agri-food sector in South Africa"*, the SUPRA has been selected as acronym for the action aiming at widen disseminate the action.

2. OBJETIVES

The main objective of the deliverable “D.1.4. Best sustainable production procedures”, is to strengthen the sustainability of the agri-food sector in Limpopo, Eastern Cape and KwaZulu Natal. In this sense, the use of Good Agricultural Practices (GAP) will be encouraged as a solution that contributes to the technical, social and environmental sustainability of agricultural activity.

The training program will consist on a theory and practical part, that will be conducted by the local partners of the project, aiming to capacitate at least 30 smallholder farmers in the use of Good Agricultural Practices, so that, at the end of the program the smallholders farmers have sufficient capacity to be able to manage independently and efficiently their crops, and are ready to start with the implementation of the Green Certification Scheme

This manual, therefore, is designed to be used as the main tool for the development of the theoretical part of the training program that will be implemented under the activity addressed to the 30 smallholder farmers.

3. GENERAL ASPECTS

Consumers are increasingly concerned about getting healthy food, produced respecting the environment and the welfare of the workers at the same time. In this context, the Good Agricultural Practices (GAP) are defined as a set of principles, standards and technical recommendations for the production, processing and transport of food, aimed at taking care of human health, protect the environment and improve life conditions.

The establishment of the Good Agricultural Practices is voluntary for production and mandatory for those how want to obtain the Green Certification.

The adoption of GAP is based on the following principles:

- Integrated and sustainable soil management (Fertility, structure, protection against erosion)
- Integrated and sustainable water management (quality, responsible use)
- Integrated and sustainable management of crops (appropriate seed, rotation, diversification)
- Personal management (training, monitoring)
- Management of the facilities (location, hygiene)

3.1. **Benefits of the "adoption" of good agricultural practices**

The main benefits involving the GAP are:

- Appropriate promotion and adoption of Good Agricultural Practices from farm will helop improve the safety and quality of food and agricultural products. In addition producers and consumers will benefit from global markets and improve their livelihood and the national economy as a whole.
- Reduction of the risk of non-compliance with regulations, standards and national and international guidelines
- Promotion of sustainable agriculture and reinforcement of social development goals
- Improved management of the farm in productive and economic terms, increasing the competitive ness of the company by reducing costs.
- They represent a resource for inclusion in the markets. Commercial chain is reduced, enabling the direct entry of the farmers to supermarkets, exporters, etc.

4. SOIL AND CROP MANAGEMENT

4.1. Introduction

The primary factors affecting organic matter content, build-up, and decomposition rate in soils are: oxygen content, nitrogen content, moisture content, temperature, and the addition and removal of organic materials. All these factors work together all the time. Anyone can limit the others. These are the factors that affect the health and reproductive rate of organic matter decomposer organisms. Farmers need to be aware of these factors when making decisions about their soils.

Increasing oxygen speeds decomposition of organic matter. Tillage is the primary way extra oxygen enters the soil. Texture also plays a role, with sandy soils having more aeration than heavy clay soils. *Nitrogen content* is influenced by fertilizer additions. Excess nitrogen without the addition of carbon speeds the decomposition of organic matter. *Moisture content* affects decomposition rates. Soil microbial populations are most active over cycles of wetting and drying. Their populations increase following wetting as the soil dries out. After the soil becomes dry, their activity diminishes. Just like humans, soil organisms are profoundly affected by *temperature*. Their activity is highest within a band of optimum temperature, above and below which their activity is diminished.

Adding organic matter provides more food for microbes. To achieve an increase of soil organic matter, additions must be higher that removals.

Appropriate mineral nutrition needs to be present for soil organisms and plants to prosper. Adequate levels of calcium, magnesium, potassium, phosphorus, sodium, and trace elements should be present, but not in excess. The action balance theory of soil management helps guide decision-making toward achieving optimum levels of these nutrients in the soil. Several books have been written on balancing soil mineral levels, and several consulting firms provide soil analysis and fertility recommendation services based on this theory.

Commercial fertilizers have their place in a sustainable agriculture. Some appear harm-less to soil livestock and provide nutrients at times of high nutrient demand from crops.

Topsoil is the farmer´s capital. Sustaining agriculture means sustaining the soil resource. Maintaining ground cover in the form of cover crops, mulch, or crop residue for as much of the annual season as possible achieves the goal of sustaining the soil resource. Any time the soil is tilled and left bare it is susceptible to erosion. Even small amounts of soil erosion are harmful over time. It is not easy to “see” the effects of erosion over a human lifetime, and therefore erosion may go unnoticed. Tillage for production of annual crops has created most of the erosion associated with agriculture. Perennial grain crops not requiring tillage provide a promising alternative for drastically improving the sustainability of future grain production.

4.2. Features of good soil

- Feels soft and crumbles easily
- Drains well and warms up quickly in the spring
- Does not crust after seeding
- Soaks up heavy rains with little runoff
- Stores moisture for drought periods
- Has few clods and no hardpan
- Resists erosion and nutrient loss

- Supports high populations of soil organisms
- Has a rich, earthy smell
- Does not require increasing inputs for high yields
- Produces healthy, high-quality crops

It is important to know the basic aspects of the soil to adapt the production and optimize performance. It is necessary to record the basic characteristic of the land:

- Identification of the plot and location
- Altitude, dimension, orientation
- Soil fertility
- Availability of water
- Previous Crop
- Application of pesticides, and other chemicals
- Pests, diseases and weeds
- Possible previous contamination of both soil and water
- Cleanliness of the soil. The site must be free of garbage, paper, plastics and empty containers

Soils that have previously been used as garbage dumps or other facilities that may have caused pollution to the soil should **never be used.**

4.3. Land actions before seeding

Soil preparation before seeding pursues the following objectives:

- Create a structure favourable for the emergence of seeding fast and uniformly, allowing young plants to have quick access to vital resources of nutrients, water and soil aeration
- Incorporate fertilizers, lime (CaO), compost, manure and chemicals for plant nutrition and pest control and, depending on location, incorporate residues from previous crop.
- Control weeds, pests and diseases.
- Shape the earth so that it can supply and drain irrigation water efficiently, or water Stagnate as little as possible. This may involve levelling, preparation of furrow and other preparations.

The soil sustains and feeds crops, so farmers should regularly analyse the quality through a physical-chemical analysis so a fertilization plan can be scheduled.

Rows should be designed at the appropriate distance for the type of crop to be used, as well as the length of each row.

In addition, farmers should prepare the irrigation system, adapting the type of crop to be implemented. Before starting plating, farmers should irrigate the area to facilitate the transplantation and mark the level where the plants have to be planted.

Some good agricultural practices to prevent the erosion are: avoid tilling on slopes, rational crop rotation, balanced fertilization and tillage.. It is advisable to keep the soil bare, for which groundcover can be used. The practice of conservation tillage, both direct seeding and minimum tillage, are also recommended techniques to control erosion.

Crop rotation plays an important part in the health of the crop, which may be susceptible to pest and diseases. For example Beans should not follow crops that are hosts to pests and diseases that attack beans (Table 1); in particular, other legume crops such as runner beans should be

avoided. In between the bean crop, a minimum of one and preferably two “recommended crops” should be grown to actively manage soil health and optimize bean yields. Yields of beans will decline if no rotation is practiced. Poor rotation will also build up levels of pests and diseases in the soil, which may be difficult to “remove” by the use of chemical treatments. Crop rotation is the most cost- effective means of maintaining soil health and crop yields (Table 1).

To be avoided as preceding crops	Not useful as preceding crop	Recommended as rpeceding crop
Beans, peas, potato, African eggplant, melon, cucumber, watermelon, lettuce and okra	Ground nuts, pepper, lettuce, carrot, onion and garlic	Cereals (maize, sorghum, millet, fodder, grass) cabbage, kale, sukumawiki,cassava, sweet potat

Table 1: Example of crop rotation in beans

4.4. Site preparation

The ground should be prepared so that it is fluffy and levelled. Some standards to minimize possible negative effects of the tillage are:

- Avoid tillage when the soil is moist in order to avoid the compaction of the soil. In marginal conditions, the use of tractors with dual wheels or wide footprint wheels reduces this problem.
- The tillage that leaves more waste in surface reduces the risk of erosion.
- The control of the depth of the implements of the tractor is critical to reduce diesel consumption and thus increase the efficiency of the work.
- Perform the work transversally to the slope, whenever possible, in order to reduce soil erosion.

Any land preparation methods should take into consideration adoptive methods that ensure soil conservation, water resources management and environmental conservation. Depending on availability of resources and crop requirement, and landscape, soil preparation may be mechanized or non-mechanized

Tillage-Field Preparation

- Excessive disturbance of the existing soil layers should be avoided during tillage to prevent the bringing to the surface of the poorer ñayers more likely to cause asphyxia and colonized by different microorganisms as well as soil erosion. Soil preparation should enable the root system to spread to a depth of 40 to 60 cm for shallow root crops to ensure good water and mineral supply to the plant (loose, fine soil). Ant ploughing should be performed once a year and be completed before cropping by levelling and finer loosening, for example, by two runs of an offset plough set at a pepth of 15 to 25 cm.
- Organic, lime or lime-magnesium enrichment agents are applied before ploughing so that they are turned in evenly.
- Good soil levelling prevents the accumulation of water that could asphysiate the plants or cause the spread of diseases. The field should be perfectly level and not too stony. Choose well-oriented flatland, preferably next to a watercourse to make watering easier. Avoid depressions that can be flooded and that can cause asphyxiation during the rainy season.
- Ridging (performed by machine at 1.2 m intervals) or shaping (by hand) is performed in case of furrow irrigation. The ridges should be regular, 30-35 cm high and 25-30 cm wide at the top, which will be levelled off.

- The field must be fenced to prevent livestock from entering. It is not advised that livestock should be allowed to graze the crop residues (they can bring weed seeds or spread nematodes).
- The false sowing can be used to reduce the number of weed seeds in the soil before planting. This consists of full preparation of the soil as for sowing and then watering to cause weed seeds to germinate. These are then eliminated by hoeing or chemicad weed killer.

Hoeing

- At a certain time of plant growth, hoeing may be required for aerating the soil and weeds management; hoeing must be very shallow to avoid damaging roots near the surface.

Mulching

- Mulching is the protective layer of material that is spread on top of the soil between crop plants. Mulches can be decaying weeds, grass, rotten manure or compost. Mulches have many benefits, they.
    - Protect the soil from erosion;
    - Reduce compaction from the impact of heavy rain
    - Conserve moisture, reducing the needs of the irrigation
    - Prevent weeds growth,
    - Maintain soil temperature,
    - Keep fruits and vegetables clean
    - Prevent disease spores splashing up on the crop
    - Break the cycle of some pests that pupate in the base soil, for example leaf miners.

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On the other hand, in cases where the period between harvesting one crop and seeding the next one is too long (which can also occur with crop rotation), it is important to include cover crops, as they improve system stability, not only in terms of soil properties, but also for their ability to promote increased biodiversity in the agricultural ecosystem. While commercial crops have a market value, cover crops have value for their effect on soil fertility or as pasture for cattle. Especially in regions where the production of biomass are very small, as dry areas and eroded soils, cover crops are beneficial because:

- They protect the soil in fallow periods.
- They prevent loss of nutrients, mobilizing and recycling them,
- They improve soil structure and break the compacted layers.
- They can be used to control weeds and pests.

4.5. Seed and Crop management

The use of certified seed and rootstock is essential for obtaining the quality and uniformity of the product that the market demands. The main consideration should focus on selecting the crops that are most suitable for production and of course the demands of the market.

It is important to organize full traceability on seeds and planting materials. The following information at least needs to be recorded.

- Supplier name

- Presence or absence of GMO
- Planting/sowing date
- Previous crop

Seed sowing and seedling management are primary activities critical for better quality and more produce. More skills are needed at this stage to ensure crop health and high yield.

Sowing on prepared substrate

Soil block, or in pots (individual or cell packs) put one seed per block or container. Either soil for block or pots, a clean mix of compost and sand will be used; this must be permeable and such that the block will remain in good condition. This technique has many advantages:

- It avoids sowing in infested or exhausted soil
- The seedlings are healthy and vigorous, less susceptible to subsequent stress and ready for planting out in a short time.
- Practically 100% re-growth is assured if the conditions of planting out are good (the root hairs remain intact).
- Any application of products (pesticide or other)is performed either directly in the sustate when the blocks are prepared or subsequently in local applications of very small amounts

The substrates used must have: good porosity; rich organic content; low salinity; good moisture retention capacity; sterility with regard to pathogens and no weed seeds; balanced mineral content; they must not contain heavy metals (lead, mercury, cadmium, etc.) or substances that are toxic for the seedlings (chlorine, arsenic, etc.).

Sowing in the soil

The seedlings produced using this method are planted with bare roots, and re-growth is less successful than sowing in prepared substrate, especially when the weather conditions are unfavourable for establishment

a. *Preparation of seedbeds*:

Horizontal beds 1 m wide are prepared. They can be raised by 15 cm during rainy periods to improve drainage. They will be a maximum of 10 m long to make access and moving around easier.

Prior disinfection may be necessary in case of infested or exhausted soil or during a period of unfavourable weather. The soil must be prepared, loosened and.pre-watered before sowing is performed. All watering will be done with watering cans with roses with small holds. It is essential to sow in soil that is moist but not too wet and to maintain the moisture content throughout the duration of the nursery. Watering doses and frequency must be adapted according to this criterion. Sow seeds in rows at 20-cm intervals at right angles to the axis of the bed. Mark out and make straight furrows. Carefully refill the furrows with fine, loose soil and tamp lightly.

b. *Sowing depth*

The seeds are sown at a depth of 0.5–1 cm in heavy soil and 1–1.5 cm in light soil. Sowing must be regular to obtain homogeneous, regular emergence, and as many seedlings as

possible should be planted at the same time. Germination (epigeal) is 6 to 14 days after sowing (with soil temperatures of between 25 and 30 °C.). Anything that carries a risk of asphyxia (heavy soil, excess water, compacted soil, sowing too deep, etc.) will compromise emergence. The latter will be irregular and the seedlings will be subject to collar and root diseases.

c. Sowing dates

The scheduling of sowing dates must take many other important data into account, such as shipping capacity or the duration f the crop cycle (i.e. 22 to 25 weeks for cherry tomato), conditions during harvesting and crop protection.

4.6. Density and distribution of the plants

The plant density is defined as the number of plants per unit area (plants/ha) and will determine the quantity of sowing. . Note that the density and seeding pattern has a great influence on crop yields. In addition, there is a direct relationship between seeding density and the incidence of pests, diseases and weeds affecting crops.

It is necessary to seed/ plant at a suitable distance to avoid:

- The decolouration (if seeding)
- Excessive competition of cultivated plants
- The spread of pests and diseases
- Excessive weed growth

Factors to be considered in determining the number of plants and their distribution are:

- Characteristic of plants: Morphology, fruiting system location, degree of foliage growth and growth habits of the variety, among others.
- The crop production: period of cultivation and production system
- Environment and infrastructure: location of cultivation, conditions of temperature, ventilation, light and relative humidity in the area.
- The use of recommended varieties for the area, according to their adaptation, productivity, management, grain quality, and tolerance to diseases and pests.
- The use of seeds, flower buds, and seedlings acquired in nurseries or certified farms, knowing the origin of the material and making sure it is free of disease.

The temperature affects the germination and plant development, a factor that should be considered to establish the seeding season. Some practices that increase the temperature or decrease the temperature (use of shading), which contribute to overcoming the most sensitive states of seeding in relation to diseases and pest, can be used.

Seeding should be documented, recording the name and type of seed, variety, dose used, quantity/density, planting date and emergence date. Likewise, farmers should document seed treatments, recording the name of the products, doses used, number of treated seed, date of treatment and the reasons why it was made.

The transplant of seedlings should be done when the seedlings are well developed.

5. CROP, PEST AND DISEASES

Crop enemies may be active in the early stages of production, right from seeding. It is essential to obtain healthy seed that is of high quality and free from infection (virus-free, invulnerable to bacteria and with no pest insect larvae). Seedbeds should be established in good sanitary conditions protected from nematodes, virus, disease-bearing insects, etc.

5.1. Good Agricultural practices in Managing Crop Pest and diseases.

Implementing different methods to keep the crops healthy without solely relying on spray of pesticides, is called Integrated Pest Management (IPM). IPM is attractive because it has the following benefits:

- Effective control
- Lower costs
- Safer to farmers and families
- Protects environment

IPM includes cultural, physical, biological and chemical methods to manage the pests

IPM uses many different methods together to control pests and diseases.

1. Cultural Methods: involve farming practices that prevent problems such as:
   - Crop rotation
   - Sowing date
   - Plot selection and layout
   - Association crops
   - Destruction of crop residue
   - Tilling
   - Reasoned fertilization
   - Resistance varieties.
2. Biological control: involves the use or promoting natural enemies (predators and parasitoids)
3. Physical methods: where pests are killed or prevented from reaching the crops by physical means (i.e. planting maize on the edge of cabbage field, maize acts as physical barrier to cabbage pests)
4. Chemical methods: where chemicals are used to kill the pests. The chemical may be manufactures pesticides or natural extract from plants such as neem and pyrethin.

5.2. Cultural methods

Crop rotation: whatever the type of production, crop rotation offers various advantages in plant protection:

1. **Best use of topsoil:** continual or frequently repeated cultivation of the same species on the same land leads to imbalanced use of the various strata of the soil. Several seasons

of monoculture tend to deplete the layer of soil from which the plant draws its mineral nutrients.

2. P**reventing the development of disease and pests:** Diseases and pests specific to the cultivated species or family may survive in the soil (e.g. fungal sclerotia, cyst nematodes, etc.) or in crop litter (insect pupae in stalks etc,) through to the following year. Hence, repeated cultivation of the same or related crops may allow such organisms to proliferate and epidemics to develop. Crop rotation can help reduce certain phytosanitary risks. Furthermore, because the same diseases and pests may affect a range of different crops, it is advantageous to organize lengthy, varied rotations. The introduction of trap plants or (prolonged) fallow periods can also alleviate some phytosanitary problems.
3. Preventing the growth of specific types of unwanted flora: Repeated use of the same selective herbicides (or those having the same mode of selectivity) generally leads to selection of a specific weed that in just a few years can become difficult to control. In addition, certain crops not covering the ground promote the growth of weeds whereas others that cover the ground rapidly tend to choke weeds.
4. Crop rotation offers two advantages: the clearing effect (either naturally or by mechanical intervention) of certain crops, and alternation of weed control strategies. The growth of weeds can thus be controlled throughout the entire rotation

5.3. Sowing date

"Crop Staggering" is ofter necessary, so that a given stage in the development of the host plant (seeding, for example) no longer coincides with the stage of disease contamination or pest infestation, thereby limiting the damage the latter causes to crops. To determine the best sowing date, the crop growth and development cycle must be compared with the pest populations building cycle.

Plot selection and layout

To make sure that crops are grown under optimal conditions, it is important to choose the appropriate site for the variety to be sown or planted—the right exposure soil type and structure, and slope. For example: Healthy soils provide necessary plant nutrients, which are important for strong, healthy growths that help plants to resist pests and diseases.

Associating crops

Associating certain crops with others seems to have a positive impact on pest dynamics (promoting insect development or diverting them from the primary crop), trap crop or on the density of useful entomofauna; example of associating crops:

- Flowering plants, such as marigold, phacelia alyssum and coriander, to provide shelter and food for beneficial insects such as wasps.
- Marigold also attract trips to move out of cultivated crop
- Maize lines on the edge of brassica, such as kale or cabbage, acts as a trap crop by confusing pests moving in search of cultivated crops; maize flowers also provide food for beneficial insects.

Destruction of crop residue

Destruction of crop residue, a practice that dates way back, can be effective if the inter-campaign period can be strictly observed. Destroy crop residues by ploughing, burying, composting or feeding them to livestock. During plant growth, pull out and destroy any plants

that are badly affected by pests (e.g. whiteflies) in the late afternoon or evening to prevent pests from moving to another crop.

Reasoned fertilization

There are interactions between fertilization and crop protection. Whether applied on the ground or in the form of a nutritive solution, the type of fertilizer must be balanced. Excessive use of nitrogen must be avoided: Overly vegetative, vigorous growth facilitates the development of various diseases, predatory insects and weeds. Rational use of fertilizers is important at a time when farmers are facing economic constraints and try to limit production costs, putting the priority on immediate profits.

Use of Resistance varieties

The ideal solution for farmers would be to have a plant stock that is resistant or at least tolerant to disease and the various pests, even though it would not last forever, because pathogens and pests can overcome that resistance or tolerance. Avoid planting uncertified seeds; they can be a source of diseases and pests.

5.4. Biological control

Biological control is a method for controlling a pest by using or promoting its natural enemies or a disease by fostering its antagonists. Biological control is directed primarily against pests (insects, mites and nematodes). Any predatory, parasitotic (entomophagous fungi) or infectious (viruses) organisms that limit the frequency and severity of irruptions are considered natural enemies of crop pests.

5.5. Physical control

- This involves the use of covering crops with nets; because this practices is expensive, it is only recommended for high value crops
- Hand removal of pests is recommended for small plots
- Planting windbreaks—growing in line of tall plants–such as maize with cabbage, maize acts as catch crop, preventing pests moving to such a crop.

The use of chemical control (pesticides) as the last solution

In integrated pest management, pesticides cannot be used unless:

- They are absolutely necessary, and no other control method has proven effective enough or realistic economically relative to the crop's market value.
- They are non-hazardous to the environment and, especially, sufficiently selective towards antagonists or natural enemies.

6. WATER

6.1. Introduction

Agriculture carries a high responsibility for water resources in quantitative and qualitative terms. Water is an essential element for plant life, determining its state of development and it is the main means of nutrients transport that soil absorbs. It also allows proper refrigeration to adapt to weather conditions.

Water consumption of each crop depends of the type of crop, the climate and soil type. However, the water should be considered ass a scarce resource and of great value, so that the objective of its management must be conservation and good use.

Water can also be a carrier of microorganisms and chemical waste. It is therefore a priority to ensure that water is free of microorganisms that affect human health and that impact product safety.

The main resources of pollution are often wastewater discharges from towns and human and animal faecal material, as well as dead animals placed in the water source for irrigation.

Careful management of water resources and efficient use of water for rainfed crop and pasture production, for irrigation where applicable and or livestock are criteria for good agricultural practices. Efficient irrigation technologies and management will minimize water and will avoid excessive leaching and salinization.

6.2. GENERAL MEASURES FOR PROPER MANAGEMENT OF WATER

Managing water resources efficiently entails a number of key operations.

- ✓ Farmers must have water resources that are on their property documented (springs, rivers, lakes, streams, and groundwater recharge points).
- ✓ .
- ✓ Maximize water infiltration and minimize unproductive efflux of surface water from watersheds
- ✓ Manage ground and soil water by proper use, or avoidance of drainage where required. It is recommended to use covers in the soil to prevent the drag of water sediment.
- ✓ Improve soil structure and increase soil organic matter content; apply production inputs, including water or recycled products of organic, inorganic and synthetic nature by practices that avoid contamination of water resources.
- ✓ Adopt techniques to monitor crop and soil water status, accurately schedule irrigation and prevent solid salinization by adopting water saving measures. An annual physical and microbiological analysis to see if the water is contaminated should be performed, keeping a record in which the sampling, sample site, results and compliance with the standard is indicated
- ✓ Manage water tables to prevent excessive extraction or accumulation, and provide adequate, safe and clean watering points for livestock.
- ✓ Tanks and water channels must be protected to prevent the entrance of animals to water sources.
- ✓ Agrochemical applications and preparations must not be made near water sources, or throw organic matter to the water, since decomposition decreases oxygen content.

To guarantee reliable and economically viable crop yields, application of irrigation water to supplement natural rainfall is frequently needed. However, water is a costly input, often in short supply and not always of the desired quality. Hence, particularly with resource poor small farmers, it is essential that sustainable and cost effective methods of applying and managing irrigation water are adopted, and that the quality of the water applied and its impact on soil and crop water balances is carefully monitored.

Key issues to consider when applying and managing water resources:

- Water quantity: Application of only the quantity actually required for optimal crop growth. Many irrigation systems apply more water that the plant or the soil can absorb, leading to waste of a scarce resource, drainage problems and unnecessary expense.

- Water quality: Ensuring that the chemical content of the water applied does not lead to soil salinity or affect the quality of the irrigated crop
- Application method: choice of a method of applying water to the crop that is low cost and easily managed by small scale growers
- Drainage method: avoiding risks of water-logging and, wherever feasible, recycling the use of excess irrigation water.
- Water charges: establishing a method of charging water users, this is both equitable and provides farmers with an incentive to use water sparingly.
- Irrigation management: Instituting a system of water and irrigation management that involves farmers and ensures efficient water use and irrigation system maintenance.

6.3. MEASURES RELATED TO IRRIGATION

An irrigation planning should be done to ensure rational use of water and avoid excessive or insufficient crop depending on the phonological stage of the plant. It is important to always use the recommended irrigation method for cultivation. It is also recommended to measure the flow of water for irrigation and use strictly the necessary water. Additionally, physic-chemical properties of water and soil type must be considered.

- ✓ Irrigation techniques that minimize water loss and erosion should be used.
- ✓ Wastewater can't be used to irrigate crops.
- ✓ Canals through which the water goes must be kept clean.
- ✓ Usually it is recommended to irrigate at night or early in the morning to avoid water loss.
- ✓ In the case of drip irrigation it is recommended to make short irrigations frequently to increase water efficiency as well as prevent water loss, salinization problems, etc.
- ✓ In case there are modern irrigation systems, periodic checks should be taken on equipment to ensure proper operation.

The common methods used in irrigation are:

- Surface (furrow or flood)
- Overhead (sprinklers)
- Trickle (drip or buried)
- Micro sprinklers.

The type of irrigation system chosen is important to product safety because this determines the amount of contact between the irrigation water and the produce. Where water quality is unknown or cannot be controlled, growers are advised to consider irrigation practices that minimize contact between water and the edible portion of the crop

What to consider when planning irrigation

Water requirement: On sandy soils, irrigation should be more frequent that on heavier soils.

Water quality: Avoid saline water, which will cause an immediate drop yield. Avoid irrigating directly with chlorinated water

Watering regularity: from the moment of emergence, the plant must never be subjected to water stress. The emergence and flowering/pod formation stages are particularly sensitive.

Frequency of irrigation: to encourage the establishment of the root system, do not water too often until the crop has begun to put down roots (to encourage deeper rooting). To avoid root collar diseases, irrigation should be prudent and not excessive in sandy soil.

Timing of irrigation: With spray or row irrigation, water in the morning to reduce the risk of prolonged.

6.3. MEASURES RELATED TO WATER USED BY STAFF

- ✓ The site must have potable water for drinking and washing hands and body.
- ✓ It should be noted that the stagnant water is a source of mosquitoes and other animals that affect health
- ✓ If there is no potable water, it must be treated by boiling, clarification or chlorination.

6.4. MEASURES RELATED TO WASH

- ✓ Water used in washing the harvested product must be potable or potabilized.
- ✓ The water used for washing tools or work instruments, must be potable or potabilized. For reuse, it must be filtered.
- ✓ The water used in spraying should be of potable quality if it used at least 30 days before harvest.

7. FERTILIZATION

7.1. Introduction

Good Agricultural Practices related to soil fertility improvement include maintaining and improving organic matter, appropriate crop rotation, manure application, rational mechanical and conservation tillage, maintaining soil cover, minimizing soil erosion losses by wind and water and application of organic and inorganic fertilizers in amount and timing, and by methods appropriate to agronomic, environment and human health requirements,

The fertilizers can be defined as those organic or inorganic inputs containing at least one of the three primary elements required for plant growth, such as Nitrogen (N), Phosphorus (P) and Potassium (K).

They can be used before sowing (basic dressing) or after sowing (top dressing). They can be applied manually or mechanically (through fertilizer or irrigation also known as fertigation).

7.2. Practices to maintain soil fertility

Maintaining soil organic matter through mulching and allowing plant stalks to rot in the field.

- Higher organic matter in the soil creates porous soil and improves aerations
- Organic matter improves soil moisture
- Soil organic matter acts as buffer against adverse environmental effects such as higher temperature and drought

Disturb the soil as little as possible during land preparation:

- Minimum tillage, zero and conservation tillage are possible solutions in land preparation to maintain soil fertility.

Crop rotation:

- Planting crops with different requirements in rotation, such as leguminous and cereals, also intercropping deep-rooted crops with shallow-rooted ones, e.g. sorghum, and sun hemps.

Aerate the soil:

- Aeration—by double digging, adequate ground cover and mulching—provides bith soil micro-organism and plant roots with much needed oxygen to breathe.

Provide Drainage:

- Too much water can cause serious damage to the soil and plants; by applying mulching, adding humus to the soil and ridging can help prevent water logging.

Protect the land from soil erosion and degradation

Practices that can help to protect against soil erosion and minimize the loss of topsoils are strongly encouraged such as:

- Terracing
- Conservation tillage
- Planting bunch grasses
- Planting tree hedges and shelter belts
- Planting perennial crops such as fruit trees with cover crops.

7.3. FERTILIZER APPLICATION

Fertilizers are natural or synthetic substances that are added to the soil or plants to provide them with nutrients necessary for plant development. The use of fertilizers is a common practice to increase soil fertility and consequently the quantity and quality of fruits and vegetables.

Fertilizer application in arable land should be oriented to their rational use, in order to reduce the economic and environmental impact. Management should be done carefully to avoid contamination of soil and water.

It is necessary to have a fertilizing program by a trained staff whose aim is to get the most productive benefit, reducing product losses and avoiding environmental pollution, as well as the presence of harmful substances for consumers.
It is important to organize full traceability of fertilizer applications. The following information, at the least, needs to be recorded for each application.

- Name of the producer/person responsible for application
- Farm number and size (ha)
- Data of application
- Type of fertilizer
- Origin of fertilizer
- Quantity applied
- Method of application

Dosing, weighting and preparation of the mixtures must be carried out by a trained technician, because the amounts of fertilizers to be applied are critical.

Fertilization must be balanced to prevent the development of infectious and physiological diseases, and prevent generation and accumulation of harmful substances for consumers. Avoid applying fertilizers with high solubility where there is a risk of water pollution, either superficial or deep.

7.4. GENERAL CRITERIA FOR FERTILIZER APPLICATION

- Only registered and licenced products that comply with the law of the country for which the product is intended should be used.
- Any application of chemical or organic fertilizers should be recommended and supported by a technician with knowledge in agronomic practices.
- Fertilizer inputs must be adjusted to the needs of crops.
- It must be ensured the homogeneous distribution of nutrients by choosing those with a homogeneous composition and using techniques for applying nutrients that ensure uniform distribution of fertilizers to prevent nutrient accumulation zones.
- Organic matter levels should be kept appropriate to the soil texture.
- The supplied organic matter should be well decomposed.
- The provision of mineral fertilizer will be made taking into account the input of soil nutrients and organic matter inputs made.
- Doses should be adjusted, not only to the crop but also to the expected performance. Soil fertility should be taken into account, along with the richness in organic matter and the preceding crop.
- The calculation of the dose of fertilizer will be made for each plot, using the analysis and registration book for the fertilization with the necessary data to determine the balance of N in the plot.
- The bare ground will be avoided if possible in rainy season.

7.5. GENERAL RECOMMENDATIONS

For rational fertilization several factors must be taken into account:

- Avoid applying N in times of low activity and lot of rain to prevent leaching loses.
- Plots with high organic matter, release large amounts of N. Burying practices of plant residues and green roofs help to maintain organic matter, which will result in a reduced need of N supply.
- The composition of For manure and slurry should be taken into account, if they are managed. . The organic N and urea are of slow assimilation, so may not be available until the next crop.
- Be careful of not producing runoff. To avoid these, as well as evaporation losses, proceed to an immediate buried after application.

7.6. USE OF FERTILIZERS

In the use of fertilizers, both infiltration and runoff depend on soil structure, which is function of:

- The nature of the vegetation cover
- The plot and the work carried out. It is recommended that the work carried out should be made to foster water retention, not to occur flooding.
- The nature and type of fertilizer
- The type of soil and climate

Regarding the use of fertilizers, dragging risks are higher for liquid fertilizers. In the case of base soil with moderate slope, it is recommended burial, even in depth, especially if there are breaks in slope.

7.7. STORAGE

- The storage area of the fertilizers should be covered, be clean and dry.
- Inorganic fertilizers must be stored separately from other products, especially plant protection products. Such separation must consist at least of an air barrier and additionally, the product must be separated by a physical barrier. It is recommended to place them on pallets or skids to prevent moisture.

- Fertilizer should be stored in their original container or in a properly identified one if they are in bulk.
- The fertilizer storage area must be properly marked.
- The rodent control program should include the fertilizer storage area.
- Storage of organic matter must be on impermeable surfaces, including leachate collection. Storage of the manure should be avoided alongside crop areas or water sources, unless there is an effective physical barrier. Both storage area and the treatment area should have bund walls to prevent runoff to the crop area or the water source.
- In the storage area an updated registration of fertilizers in stock must be kept.
- Storage places for organic fertilizers should be located as far as possible from the areas of production and product handling or packaging.
- The storage conditions must prevent runoff to water surface and leaching into groundwater resources in addition to preventing the spread by wind.
- Avoid traffic of machines and people on areas where compost is stored.

7.8. REGISTRATION OF FERTILIZERS.

- All fertilizer applications must be recorded, indicating the cultivated species, growth stage, product, fertilizer type, brand and assets of the fertilizer ingredient, volume / ha, dose, form and date of application, technician who recommended the application and applicator.
- If applicable, the regulations of the equipment used in the fertilization process and their annual maintenance should be recorded.
- the process to which the compost was undergone should be registered, or a certificate emitted by the supplier that tests its quality. This certificate must include the type of treatment, start-date, end-date and the place where it was made.

7.8 PARTICULARITIES OF ORGANIC FERTILIZERS.

The increase of soil organic matter increases the retention capacity of water and nutrients and reduces erosion, so the use of organic fertilizers is an activity that contributes to improve soil fertility. However, organic fertilizers can be a source of microbiological contamination, so it is necessary to reduce the risks of contamination.

For the effective management of organic fertilizers the following should be noted:

- It should be used only manure or sludge subjected to stabilization treatment to reduce the risk of microbiological contamination in surface applications.
- Manure applications must be made at least two weeks prior to the date of sowing or plating to avoid toxicity and safety problems at the plant or in the fruits.
- From application to harvest at least 230 days must pass.
- Manure stabilization processes are composting, anaerobic reactor, vermicomposting, solarisation, drying, and pasteurization and lime stabilization.
- If the manure is generated on the farm, consider the following:
    - The preparation of fertilizer must be done in a place where water sources cannot be polluted.
    - Fertilizer preparation techniques must be used properly.
- The location for storage and treatment of animal manure should be away from the produce production areas.

- Barriers or some type of physical containment should be used as part of manure storage areas to prevent contamination of produce or production areas by pathogens spread by rain wash, subterraneous water flow or wind spread from the stored manure,
- Contamination of groundwater supplies can be minimized if animal manure is stored on a cement floor or in special holes lined with clay.
- Manure piles should be covered with plastic or other materials and/or stored under a seed because rainfall on manure piles can result in runoff containing pathogenic bacteria that can contaminated fields, equipment, etc
- Treated manure should be kept covered and away from waste and garbage to prevent contamination by birds or rodents.
- The use of human manure as fertilizer is prohibited.

8. HARVEST AND POST- HARVEST

8.1 INTRODUCTION

The optimal time of collection or harvesting the crops is determined by the crop cycle and market preferences, as well as the time from which the product is collected until it reaches the consumer, and the production objective, whether for seeds, agro industry or fresh consumption.

The practices made in the collection and handling of harvested products affect directly the quality and status of the product sent to the market. The objectives of the farmer must be make a good quality and conditions harvesting, keep the harvested product in good condition until consumption or sale and place the harvest on the market as soon as possible after collection.

Fresh produce must be harvested at the correct stage of maturity if it is to maintain its quality attributes throughout its post-harvest life. Prematurely harvested produce is highly susceptible to shrivelling and mechanical damage and it is of inferior flavour and colour when ripe. Over mature produce may be fibrous, soft and of poor eating quality in terms of sweetness, flavour and colour. It is, therefore, essential that those involved in harvesting receive training to identify the correct maturity indices for the produce concerned. Furthermore, carful and correct harvest techniques are essential in ensuring integrity of harvested produce and preventing rejections at the pack house. Wounding during harvest can provide entry points for pathogens, therefore causing decay. Those involved in harvesting must be trained in efficient and careful handling of fresh produce.

To achieve these objectives, it is important to plan the production from the early stages in relation to:

- The crop selection and forecasting the time needed to respond to market needs.
- The contacts with buyers to sell the product at a good price when it is ready for harvesting.
- Early planning of harvesting operations, coordination of labour, equipment and transportation.
- Supervision at all stages of harvesting and post harvesting.

8.2 TRAINING WORKERS

Workers should know the general aspects of product handling. The general training should cover the following aspects:

- Demonstration of the causes and effects of the damage to the product, with emphasis on the need to always take care of handling in order to prevent physical injury.
- Explanation of the needs to avoid contamination of the harvested product, avoiding placing the product directly on the ground, especially if it is wet or to be used in the collection or storage of boxes polluted by the soil, vegetable waste or decomposition products, for example.

In addition, the workers assigned to specialized tasks, such as selection and product collection and sorting, grading and packaging (if applicable) after harvest, should receive specialized training, covering the demonstration and explanation of the criteria for assessing when products are ready for collection, and discard those which do not meet the requirements imposed by the

market; harvesting techniques, selection and classification of products, the correct application of post-harvest treatments and packaging method destined for market, among others.

8.3 PLANNING

In general, the decision of when to start harvesting depends on weather conditions and market situation, in addition to labour availability.

Marketing dates will be more or less flexible depending on the type of product. Some products, such as roots and tubers can be harvested to be sold over an extended period, or stored on the farm until favourable prices. Others must be sold immediately, as they are easily spoilt.

Once taken the decision to harvest, it should be considered if this is the best time to do it, as the aim is to send the product to market in the best conditions.

The basic rules that must be respected are:

- Harvest good quality crop.
- Maintain hygiene and quality standards during harvesting and throughout the post-harvest chain.
- Harvest during the coolest hours of the day: early in the morning or late evening under light conditions.
- Do not harvest when the product is wet. The wet product will be too warm if not vented, and will be more exposed to deterioration.
- Protect the harvested produce in the field by keeping it in a shaded environment

8.4 HARVESTING

Manual harvesting:

Manual harvesting is one pf the most popular methods of harvesting produce. Workers must, however, be properly trained if quality is to be assured. The selection of a harvesting procedure will depend on the produce characteristics.

Vegetables:

Either the whole or a part of vegetative growth can be harvested by hands only or sharp knives. Knives must be kept sharp and clean at all times to prevent from spreading virus diseases from plant to plant. Harvesting methods vary with plant parts harvested:

- Leaves only (spinach, rape, etc.) and lateral buds (Brussels sprouts): the stem is snapped off by hand;
- Above ground part of the plant (cabbage, lettuce): the main stem is cut through with a heavy knife, and trimming is done in the field (the cut stem must not be placed on the soil).
- Bulbs (green onions, leeks, mature bulb onions): immature green onions can usually be pulled from the soil by hand; leeks, garlic and mature bulb onions are loosened by using a digging fork as for root crops (such as carrots) and lifted by hands.

Flower structures

Immature flower heads (cauliflower, broccoli) can be cut with a sharp knife and trimmed in the field; broccoli can be snapped off by hand and subsequently trimmed

Fruits

Many ripe fruits and some immature seed-bearing structures, such as legume pods, have a natural break-point of the fruit stalk, which can easily be broken at harvest. Fruit and other seed-bearing structures harvested in the immature or unripe green state are more difficult to pick without causing damage to either the produce or the plant. These are best harvested by cutting them from the plant, using clippers, secateurs or sharp knives. The clippers may be mounted on long poles for tree fruit, with a bag attached to the pole to catch the fruit. Plucking methods vary according to the kind of produce being harvested:

- Ripe fruit with a natural break point, which leaves the stalk attached to the fruit, are best removed by a “Lift, twist and pull· series of movements, e.g. apple, passion fruit, tomato.
- Mature green or ripe fruit with woody stalks that break at the junction of the fruit and the stalk are best clipped from the tree, leaving up to a centimetre of fruit stalk attached. Of the stems are broken off at the fruit itself, disease may enter the stem scar and give rise to stem end rot, e.g. mango, citrus, avocado.
- Immature fruit with fleshy stems can be cut with a sharp knife, e.g. zucchini, okra, papaya, capsicum; these can also be harvested by breaking the stem by hand, but this method may damage the plan or fruit and the rough break will be more susceptible to decay that would a clean cut.

Recommended good harvesting Procedures

- Use white clean cloth and gloves
- Use correct clean containers
- Prevent overfilling
- Prevent damaging the fruit, dropping the fruit in to the containers at a distance and rough handling.
- Use selective harvesting and correct maturity index
- Use correct equipment and harvesting techniques
- Harvesting time and weather conditions.

8.5 HARVESTING CONTAINERS

Rigid containers, such as wooden and plastic crates, and plastic buckets can be used for the field collection of harvested produce. Containers must be smooth, with no sharp edges or projections as these could damage the produce. They must be clean and must not be overfilled. Harvesting bags equipped with either shoulder slings around the neck, or waist slings, can be used for the collection of firm-skinned fruit such as citrus and avocados. They are easy to carry and leave both hands free to harvest. Harvesting bags must be designed to open at the base, so as to allow produce to be emptied easily into a field container without tipping the bag.

8.6 Good Agricultural Practices during harvesting

Containers used for field collection

- Must be smooth, with no sharp edged or projections to damage the produce.

- Must be clean
- Must not be overfilled

Harvested Produce

- Must not come into contact with the soil or contaminated surfaces, e.g. surfaces that are visibly contaminated with dirt, oil and chemicals.
- Must not be dropped.
- Must be gently transferred to collection bins and protected from sun or rain until such time that it can be transported to the pack house.

Cuts and bruises must be avoided during harvesting operation

Personnel, participating in harvesting and grading

- Farm workers who are in direct contact with fresh fruit and vegetables must have good habits of body hygiene and wear clean clothes and cover their hair.
- Any farm worker with cuts or wounds, if authorized to continue working, must protect them with waterproof bandages
- They must wash their hands with soap, before starting harvesting of fruit and vegetables and each time they return to the handing areas after a pause, immediately after having used the toilets and after having handled any contaminated products. It is recommended to brush under nails and between nails, rinse and dry the hands with the dry towel. The use of shared towels is not advisable.
- Each farm worker must go through hygiene checklist; those who fail hygiene check should be leased to go back home.

8.7 SELECTION AND CLASSIFICATION

The selection and classification process aims to make groups of fruits and vegetables per sizes to meet the quality standards of the target market. The classification may also be done by weight, length, diameter or colour.

The main measures to be taken include:

- The fruits or vegetables that have some degree of decomposition or mechanical damage should be rejected.
- The rejected fruits / vegetables should be adequately eliminated, as they can serve to inoculate pest in the future.
- All the selection and classification operations must be carried out in facilities or areas that have controlled hygienic and safety conditions.
- Both staff and materials and elements must fulfil with appropriate hygiene conditions in the handling of a food product.

8.8 PACKAGING

The packaging allows locating the product into suitable containers, depending on the market to which the product will be directed.

- Packaging materials must be new, or in case of being reused, must be clean and in good condition.
- Packaging materials should be stored and handled under conditions that allow their use for a good agri-food product.
- The process should take place in a protected site to avoid product contamination.

- The packaging must be carried out by capacitated personnel, especially regarding safety and hygiene aspects.
- The staff must have the necessary facilities for hygiene and make use of them properly. In addition, the necessary precautions to avoid the contaminations of the products must be considered.

8.9 STORING

Horticultural and fruits agri food producers must be aware of the minimum requirements to store its products adequately. The main factors that influence directly on the conservation of the products are:

Temperature: when separated from the mother plan, fruits, vegetables and flowers are still breathing. Low temperatures reduce the rate of breathing and ethylene sensitivity, reducing also water loss, so the life of the product increases. However, it is also important to avoid cold damage, since this can cause that the products to not mature properly, increased susceptibility to decay and development of disagreeable flavours.

Humidity: Water loss or dehydration, not only means the decrease of fresh weight but it also affects the appearance, texture and in some cases the taste. Turgidity loss is directly associated with the feeling of freshness.

Light: the exposure to light can result in colour changes in the food, taste or vitamin losses.

In general, all food products must be stored under strict conditions not to be affected and must preserve the qualities that make them suitable for consumption. Furthermore, the commercialization process should be done as soon as possible to prevent the deterioration of the products during storage.

The selected place for storage of the harvested product must have the following characteristics:

- Be isolated and protected from the weather.
- Allow access only to authorized staff.
- Have the necessary protection against vectors and pests.
- Have the necessary protection to prevent the entry of animals.
- Staff must comply with applicable hygiene standards.

8.10 TRANSPORT

- ✓ The transportation where the harvest is transported must be clean and in good conditions.
- ✓ To make the transportation in a safely way (for product and driver) the vehicle conditions should be adequate.
- ✓ Transport vehicles must travel at a safe speed to avoid damage to the product.
- ✓ It is recommended to transport the product protected to avoid contamination and damage.
- ✓ Transport of food products should not be done with the transport of other products, such as fertilizers, etc.
- ✓ The driver must have driver's license depending on the type of vehicle that will be driven, and must be able to carry out this task.

9. WASTE MANAGEMENT

9.1 TYPES OF WASTE

One of the characteristics of the agricultural sector lies in the large amount of materials and substances that are transformed into waste. Some are dangerous, such as packaging and plant protection products; others are very bulky, such as vegetable matter, plastic greenhouse... Among the by-products or waste that are difficult to degrade in the environment the following ones stand out:

- Plastic waste. They cause ecological instability, deterioration of the field, plugging, visual impact, etc.
- Vegetable waste; they can pollute irrigation water and may increase the risk of diseases transmission.
- Pesticide Packaging Waste.
- Others (paper and cardboard, wire, wood ....)

9.2 MEASURES FOR WASTE MANAGEMENT

Regarding liquid waste, measures should be taken to prevent them from becoming polluting agents for food and water, whether by infiltration into the soil or surface water drag (canals, rivers, ponds and lakes).
The following aspects should be taken into account:

- The generation of liquid waste should be minimized, preparing the mixture of agrochemicals in the required amount.
- The not used mixture and the water used for washing the equipment and tools must be applied where the crop is not treated, in a demarcated area for this purpose and must be registered.
- Water sources (rivers, wells, canals) must be protected avoiding the discharge of polluted water into them.

Regarding solid waste:

- It should be an especial rack (locked) for the expired products or unmarked products which should be identified with a sign stating "expired products".
- Containers of agrochemicals must not be reused.
- Containers that have contained agrochemicals will be considered hazardous waste and therefore they should not be disposed as household waste.
- To prevent the reuse of washed containers, the containers must be drilled in the bottom without damaging the label and the must be stored safety.
- The expired pesticides and fertilizers must not be kept.
- The agrochemicals should be transported in their original containers with their labels, preventing them from impacts and breakage.
- The charge and discharge of vehicles must be done in a safely manner, avoiding the deterioration of packages and labels.
- Waste plastic materials such as bags, cords, hoses and sheets must be collected and disposed manually.
- All facilities should have clearly identified locations for disposal of waste according to its type (organic, inorganic).
- The recycling of used plastics in agriculture activities should be promoted, which they may be used in the preparation of poles, fences, planters, among others.

- Plastics that cannot be reused and recycled, should be arranged in the nearest authorized municipal landfill.

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ANNEX I: FIELD NOTEBOOK

HISTORY OF THE PLOT

	PLOT NUMBER							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Location								
Area (ha)								
Altitude								
Orientation								
Slope								
Water availability								
Use of the previous soil								
Land use in adjacent land								
Previous crop								
Type of pests and diseases								
Possible previous contamination								
State of the current field								

IDENTIFICATION OF THE PRODUCER AND THE PLOT

Name of the cooperative:
Identification of the technical responsible:

Nº Plot	Area (ha)	Type of crop	Variety	planting framework	Start date	Harvesting date	D/I (1)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

(1) Indicate dry land (D) or irrigated (I), specify whether Flood (F), Drip (D) or Sprinkler (S)

PREVENTION SOIL EROSION AND DEGRADATION

Name of the plot	
Geographical location of the plot	
Plot boundaries	
Plot size	
Crop	**Previous:** Crop Specie: Variety: **Present:** Crop Specie: Variety: **To develop:** Crop Specie: Variety:
Soil type	
Water supply for irrigation	**Source:** **Quality:** **Reliability:**
Vegetation	
Previous land use	
Rainfall	**Mean Annual (mm):** **Mean Monthly (mm):**
Temperature:	**Monthly maximum:** **Monthly minimum**

TRACEABILITY ON SEED AND PLANTING

A. LAND PREPARATION				
Date	Operation	Previous crop	Method	Outcome

B. NURSERY ACTIVITIES (WHERE SEEDLINGS ARE PRODUCED FOR TRANSPLANTING)			
Date	Operation	Materials used (type, quantity)	Outcome

C. TRANSPLANTING (WHERE PRATICED)				
Date	Area planted	No of seedlings	Spacing	Outcome

D. SOWING (WHERE DIRECT SEEDING IS PRATICED)					
Date	Area	Seed (gm) Presence of absence of GMO	Method	Spacing	Outcome

PEST AND DISEASE CONTROL

Date	Duration	Type of pest/disease	Impact pre-treatment	Treatment date/type	Environmental factors during the infestation	Damages and estimated costs of damage and control

EQUIPMENT

Identification of the equipment	Annual Maintenance date	Responsible	Verification conducted	Observations
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Registry cleaning machinery and tools

Date	Equipment /machinery	Used Procedures	Observations
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

MAINTENANCE OF MACHINERY AND TOOLS

Date	Equipment /machinery	Name of the person who calibrate the equipment or qualification	Observations
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

IRRIGATION PLAN

Crop type	ha	Type of soil	Watering regularity	Frequency of irrigation	Timing of irrigation	Observations
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

IRRIGATION

Date	Crop type	Irrigated area (ha)	Method	Duration and estimated hour of irrigated	Quantity	Climate information	Observations/Impact

CROP PRACTICES

Date	Crop type (1)	Irrigated area (ha)	Type of practices (2)	Equipment/machinery used (3)	Observations (4)

(1): You must attach the biannual crop planning in the case of horticultural and herbaceous annual planning to perform, including the density of planting and crop rotation
(2): all cultural practices carried out in the crops include: soil work (harrow, cultivator, milling, etc.), pruning, thinning, planting, harvesting, application of fertilizers and pesticides, irrigation (indicate volume provided), etc.
(3) Indicate the type of machinery used for the realization of production practices
(4) Labour / MAQ: Machinery

INVENTORY OF FERTILIZERS

Date	Commercial name of the product	N-P-K relation	Quantity stored	Responsible	Stored position	Observations

TRACEABILITY OF FERTILIZER APPLICATION

Name of producer/or person responsible for application	Farm number and size (ha)	Date of application	Type of fertilizer	Origin of fertilizer	Quantity applied	Method of application

REGISTRY OF AGROCHEMICALS

Name of the product	Quantity purchased	Date of purchased	Stored position	Observations

THE USE OF AGROCHEMICALS

Date	
Applied Product	
Identification of the area (name and number of the plot, map, etc.)	
Size of the application area (ha)	
Person in charge of mixing and authorizing the application	
Farmers who made the application in the field	
Identification of application equipment	

HARVESTING AND MARKETING

Date	Product	Quantity (kg) /Units	Yield (kg/ha)	Customer	Nº of invoice (if applicable)

TRAINNING PROGRAMM

Date	Training	Nº attendance	Name	Observations

FIELD SANITATION AND PRE-HARVEST ASSESSMENT

A pre-harvest assessment is made on the production area prior to harvest. Risk and possible sources of crop contamination are noted, assessed and, if applicable, corrective measures performed and documented.

Farm Name:			
Person conducting pre-harvest assessment			
Date of Inspection:		**Projected Harvested date:**	

Procedures:

1. Prior to harvest inspect the toilet and hand-washing facilities, harvesting toolls and equipment, employee health and condition of the harvest area, making sure there are no potential food safety risks.
2. Where an issue is observed, correct the problem and document the corrective action before harvest begins.

	Date Inspected	Corrective Action Taken
Field Sanitation Facilities		
Are toilet and hand washing facilities properly located?		
Are toilet and hand washing facilities properly stocked?		
Harvesting tools and equipment		
Is harvest equipment available and in good condition?		
Have harvesting tools been cleaned and disinfected?		
Are field bins in good conditions?		
Are field bins clean?		
Is transportation equipment clean and available?		
Employee health		
Is potable water available for workers?		
Are first aid kits available in case of emergency		
Field hygiene		
There is no evidence of significant, high concentrations of domestic or wild animal contamination		
Are fuels and chemicals that might contaminate the crop areas isolated?		
There are no notable sources of biological, physical or chemical contamination (dump sites/manure/burning debris) that may be a food safety risk.		
Are contaminated areas isolated as “no –harvest” zones?		
There is no evidence of unauthorized entry in the crop area.		
If there is evidence of unauthorized entry in the crop area has it been investigated?		

CONTAMINATED PRODUCT PROCEDURES

Purpose: to ensure crops contaminated by glass/ brittle plastics breakage, chemicals or pesticide are not harvested for human consumption. Glass on harvesting equipment is protected so fruit is not contaminated in the event of a breakage.

Procedures:

1. Notify the appropriate supervisor
2. Fruit that is contaminated will be disposed of and harvested area avoided.
3. Where glass/brittle plastic breakage occurs, inspect harvest area, looking for signs of contamination. Remove and discard all broken pieces of glass. Clean up harvest area where contamination occurred.
4. Work will stop until equipment can be repaired, and all fruit containers that may have been contaminated are cleaned, washed and inspected.
5. Equipment that has been contaminated will be thoroughly cleaned and inspected prior to being used again.
6. Document the date of the occurrence, description of the event and corrective action taken

Date	Description of event	Corrective action taken	Supervisor Initials