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Strategies to combat unfair practices for horticultural cooperative products sold directly to consumers and through sales networks

Specialized Consultancy Guide

Management and Governance of Fruit and Vegetable Cooperatives, member relations and regulatory framework

Engelie Beenen, HollandDoor
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INTRODUCTION

Large numbers of farmers operate relatively small, independent family farms, while processors and retailers tend to be highly concentrated. This imbalance creates an asymmetry in bargaining power, making it difficult for farmers to effectively defend their interests when negotiating with other actors in the supply chain.
At the same time, farmers and horticultural producers increasingly face challenges related to price volatility, making collaboration an essential factor for future progress.

Adopting a network perspective can lead to fundamental changes in how farmers in a sector function. Cooperation can take many forms, both informal and formal, and may serve advocacy purposes (such as farmers' unions) or commercial objectives (such as joint marketing, processing, or purchasing).

Two main types of cooperation can be distinguished: **horizontal cooperation** between farmers through bargaining or producer organizations, and **vertical cooperation** across the supply chain through interbranch organizations. This document focuses primarily on the organization of horizontal cooperation through cooperatives, often referred to as producer organizations.

Cooperatives and producer organizations can fulfil a wide range of roles, generating benefits both for their members and for overall welfare. They provide various services to members, which are discussed further in this document.

However, the effectiveness of a cooperative depends strongly on how it is organized, including the skills and capacities of its board and management. Strong governance is essential for building trust among members and for ensuring financial viability and long-term sustainability.

We end this guide with an overview of the regulatory framework. This multi-level regulatory framework can also lead to differences in how cooperatives function across countries.

This document is intended as a source of inspiration for Romanian cooperatives, while recognizing that the approach may need to be adapted and tailored to local conditions and specific needs.

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1 Introduction to Agricultural Cooperatives

1.1 Why to set up a cooperative instead of trading with a private firm?

In many countries and many sectors farmers do contract with private companies that supply inputs and services. However, the private companies may not be reliable in their services or may take advantage of the weak bargaining position of farmers. There are also situations where such private companies may not exist. In situations of market failure, cooperatives provide the solution, because they supply the services/inputs that are otherwise not available, or, by their very existence, force private suppliers to ask fair prices. Thus, cooperatives can provide the missing inputs, can provide inputs at lower prices and higher quality, and can sell the farm products without exploiting the farmers. Cooperatives enable the farmers to specialize in on-farm production activities, while still benefiting from economies of scale and scope in input supply and output marketing, without bearing the risk of being exploited by more resourceful trading partner.

1.2 Cooperative: Principles and values

In establishing and operating a cooperative, farmers and their advisors often use the Cooperative Principles to guide them. Also, governments use the Cooperative Principles in designing legislation on cooperatives. The Cooperative Principles can be considered as the practical expression of the values behind collaboration in cooperatives. There are seven Cooperative Principles that were reformulated by the ICA General Assembly in 1995.

Importance:

The 7 cooperative principles are important because they ensure that cooperatives operate fairly, democratically, and sustainably, while focusing on the needs of their members rather than maximizing profit. These principles guide how cooperatives are formed, managed, and developed, helping them stay true to their purpose of improving members' economic and social well-being.



Principle 1: Voluntary and open membership

Cooperatives are voluntary organizations, open to all persons able to use their services and willing to accept the responsibilities of membership, without gender, social, racial, political or religious discrimination.

Principle 2: Democratic member control
Cooperatives are democratic organizations controlled by their members, who actively participate in setting their policies and making decisions. Men and women serving as elected representatives are accountable to the membership. In primary cooperatives members have equal voting rights (one member,
one vote) and cooperatives at other levels are also organized in a democratic manner.

Principle 3: Member economic participation
Members contribute equitably to, and democratically control, the capital of their cooperative. At least part of that capital is usually the common property of the cooperative. Members usually receive limited compensation, if any, on capital subscribed as a condition of membership. Members allocate surpluses for any or all of the following purposes: developing their cooperative, possibly by setting up reserves, part of which at least would be indivisible; benefiting members
in proportion to their transactions with the cooperative; and supporting other activities approved by the membership.

Principle 4: Autonomy and independence
Cooperatives are autonomous, self-help organizations controlled by their members. If they enter into agreements with other organizations, including governments, or raise capital from external sources, they do so on terms that ensure democratic control by their members and maintain their cooperative autonomy.

Principle 5: Education, training and information
Cooperatives provide education and training for their members, elected representatives, managers, and employees so they can contribute effectively to the development of their cooperatives. They inform the general public –
particularly young people and opinion leaders – about the nature and benefits of cooperation.

Principle 6: Cooperation among cooperatives
Cooperatives serve their members most effectively and strengthen the cooperative movement by working together through local, national, regional and international structures.

Principle 7: Concern for the community
Cooperatives work for the sustainable development of their communities through policies approved by their members.

1.3 Principles versus practice

In practice, not all countries and all sectors follow these guidelines literally. An example of the diversity in practice relates to democratic decision-making. While the one-member-one- vote principle is still dominant among most cooperatives, in some countries a more proportional voting system has been introduced. Also among (national) cooperative unions voting is often proportional, related to either the volume of trade or the number of ownership shares. Another example of 'principles in practice' relates to the principle of member economic participation, which also becomes increasingly differentiated. Members can have various financial relationships with their cooperative, and in some countries even non-members may participate in the equity capital of the cooperative (or its subsidiaries).

Putting the Cooperative Principles into practice is sometimes a challenging task. For instance, in some countries and some sectors, farmers become members of an agricultural cooperative because only through the cooperative do they have access to inputs like fertilizers. Also, government or donor funded programmes for rural development may require farmers to join a cooperative to receive benefits.

Unfortunately, those entities where members are forced to join, or so- called cooperatives that only exist for accessing temporarily available subsidies, may encounter difficulties in their sustainability and even in their day-to-day operations. Members in such so-called cooperatives do not have a sense of ownership, are not committed, and may easily free ride on the entity. As soon as the outside opportunity terminates, the entity may fall apart. These entities are not genuine cooperatives.

Another challenge in practice is that, despite a policy of non-discrimination, in some countries not everyone is free to join a cooperative as they may not meet the membership requirements. An example is when membership is only open to those having land, while the law prevents women from owning land. This deadlock can be broken by landless women who can establish a women's cooperative to create specific income opportunities for them. It can be a rural savings and credit cooperative to support production and marketing of their traditional handicrafts, or marketing of fruits and vegetables that they grow.

Also, protecting the independence of a cooperative could be difficult. In the past, especially in developing countries and in communist states, cooperatives have suffered from heavy state control and interference resulting in little benefit for the members. For instance, cooperatives were used to control the production and export of coffee, tea and cocoa. The prices set by these cooperatives were often political prices, giving farmers few incentives to increase output or quality. Today, most governments have shifted away from direct interference in cooperative affairs and towards facilitating cooperative development.

1.4 Cooperation among cooperatives

As the sixth Cooperative Principle indicates, cooperatives often work together. Local cooperatives, usually called primary cooperatives, join forces in setting up a cooperative union. For instance, a number of primary cooperatives from different villages collect the products from their members, but the actual marketing of these products is done by the cooperative union. Because the union sells on behalf of a number of primary cooperatives, it can benefit from economies of scale in product handling, such as sorting and grading, storage and packaging, while it also has a better bargaining position than the individual primary cooperative. Cooperative unions often collaborate in a cooperative federation.

For more information, we refer to the document: Partnerships.

1.5 Examples Cooperatives Netherlands

The Netherlands is one of the world's largest exporters of fresh produce, and cooperatives play a major role in organizing growers and supplying supermarkets across Europe. In the Dutch fruit and vegetable sector, cooperative principles help farmers:

- access international markets
- receive fair prices
- share risks
- improve sustainability
- strengthen rural communities

FruitMasters

FruitMasters is a cooperative of Dutch fruit growers (e.g., apples and pears). Farmers can choose freely to join if they want to sell their produce together as long, they meet the cooperative statutes (bylaws).
In FruitMasters, bylaws explain:

- who can join the cooperative
- how growers vote
- how profits are shared
- rules for delivering fruit
- responsibilities of the board

When farmers are willing to agree with the FruitMasters roles and regulations they are able to join as member. Examples of such rules are that they meet the required product specifications, meet the required certifications (such as GlobalGap, IFS, BRC) and sell 95% of their products via FruitMasters.

FruitMasters is controlled by growers, not external investors.
Members decide business strategies independently from supermarkets and so protects farmers' interests. Each member has one vote. Important decisions are made in the General Members' Meeting

FruitMasters services for members:

1. marketing and selling fruit
2. sorting and packaging
3. logistics and transport
4. branding and product development (Kanzi, Migo, Prestige)
5. quality control and certification
6. innovation and technology
7. market information and advice
8. sustainability support

They have a sourcing team (in the office & relations managers in the field) who is in daily contact with the farmers. This to understand the volumes, quality and products, that can be sold. This team works closely with a special sales team who is in daily contact with all kinds of retailers and clients in Europe and abroad, to sell farmers produce, understand their requirements, develop marketing campaigns. Both teams work closely together.

It allows small farmers to access markets that would be difficult to reach individually. By joining voluntarily, members share benefits such as marketing and distribution support.

United Growers (see also slides below)



Growers can **choose freely** to join United Growers if they want to cooperate in selling their vegetables. Tomato or pepper farmers join the cooperative to access larger buyers such as supermarket chains in Europe.
Each member has voting rights in important decisions such as pricing strategies, sustainability goals, and investments in technology. For example, Members vote on whether to invest in new packaging solutions. This ensures fairness and prevents control by a few large producers.
Member Economic Participation: Members contribute capital and share profits from selling vegetables collectively. United Growers works with other organizations for logistics and distribution. Cooperatives share transport networks to deliver vegetables efficiently across Europe. This helps to reduces costs and increases market power.
United Growers promotes sustainable agriculture and supports local communities. Growers reduce pesticide use and energy consumption to protect the environment.
Ensures long-term food security and environmental protection.

Using the **cooperative principles**, United Growers helps farmers:

- sell vegetables more efficiently
- earn fair income
- innovate with new technology
- improve sustainability
- strengthen cooperation in the food supply chain



1



2



3



4


strategy and challenges
Fossil free
Chemical free
Water neutral
Reduce labour
Sustainable proof
Future prooffamily businesses

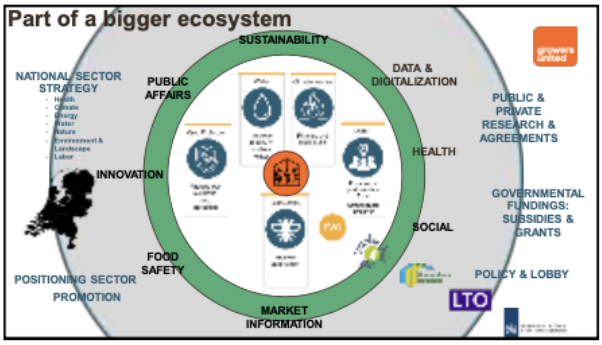
5


Research and development center
The center for cultivation specialists
Practical cases and test set-up
Data growing Monitoring and control

6


market focus - from breeder to shopper

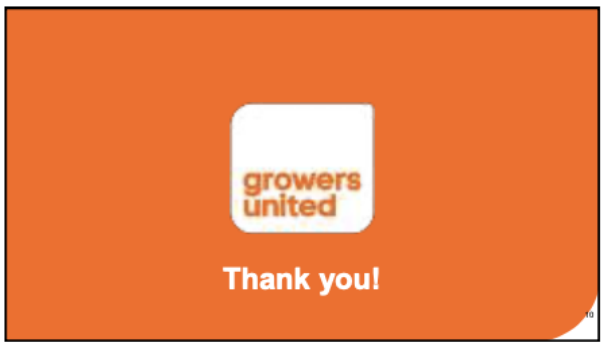
7


Part of a bigger ecosystem
SUSTAINABILITY
DATA & DIGITALIZATION
PUBLIC & PRIVATE RESEARCH & AGREEMENTS
GOVERNMENTAL FUNDINGS: SUBSIDIES & GRANTS
POLICY & LOBBY
LTO
MARKET INFORMATION
FOOD SAFETY
POSITIONING SECTOR PROMOTION
INNOVATION
SOCIAL
HEALTH
PUBLIC AFFAIRS
NATIONAL SECTOR STRATEGY

8



9


growers united
Thank you!

10

1.6 Top Dutch fruit & vegetable cooperatives

Royal FruitMasters

- One of the largest fruit cooperatives in the Netherlands
- Specializes in apples, pears, cherries and berries
- Over 400 fruit growers supply the cooperative

Overview of FruitMasters sales channels

Channel	Example buyers	Role in supply chain
Supermarkets	Albert Heijn, Lidl	largest market volume
Wholesalers	traders, distributors	supply smaller retailers
Export markets	EU retailers	international sales
Food service	restaurants, hotels	premium fruit demand
Processing industry	juice & jam companies	value-added products
Branding	Kanzi®, Migo®	product differentiation

Royal ZON



- Cooperative marketing fruit and vegetables through **auction** systems
- Supports growers with logistics and sales services
- Offering a trade-park infrastructure for traders

The Greenery



- International supplier of fruit and vegetables
- Owned by cooperative growers

Growers United

- Cooperative of greenhouse vegetable growers
- Supplies tomatoes, peppers and cucumbers
- Listed as major Dutch producer cooperative
- Locations in the Netherlands, Maroc, Tunesia to supply year round

2 Cooperative Governance Structure

Once a cooperative has been established, members need to direct and control the activities of the cooperative enterprise. The questions of who within an enterprise has the right to decide, who is responsible for a specific decision, and who is accountable to whom, are all issues of corporate governance.

2.1 Corporate governance structure within a cooperative

While cooperatives are also corporate bodies, they deal with characteristics that make their governance more challenging than the governance of non-cooperative enterprises.

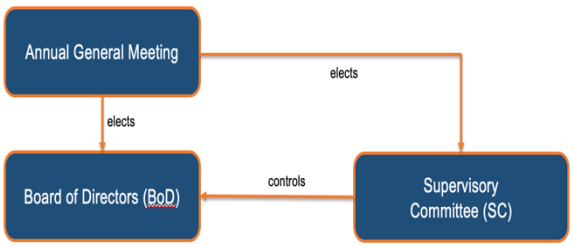
First, cooperatives use the principle of **democratic decision-making**, whereas in a non-cooperative company, top managers have primary **authority** to make decisions.

Second, cooperatives use delegation within their decision-making structure. Although members hold the final decision-making authority, they usually delegate this authority to the Board of Directors (BoD). The BoD may then delegate certain responsibilities to professional managers. The BoD remains accountable to the members (for example, through the Annual General Meeting), while managers' report to the BoD.

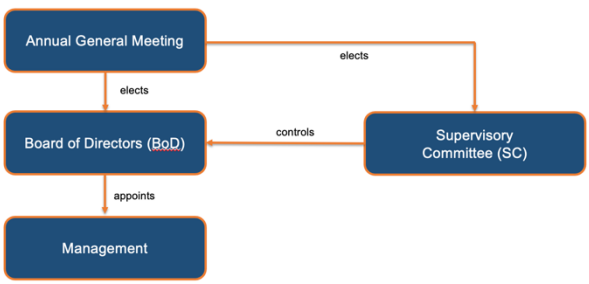
One must consider the following challenging characteristics of cooperatives:

- Although cooperatives are primarily economic organizations working for the benefit of their members, they are also commercial enterprises, dealing with the market, and social organizations, concerned about the community.
- Members of the cooperative have a dual relationship with the cooperative: they are both owner of the cooperative and customer of the products and services offered by the cooperative.
- The Board of Directors is elected by members, while management is hired; in small cooperatives, members may also perform operational tasks.
- Multipurpose cooperatives offer various services, which makes governance more complex due to diverse member interests.

Basic Model cooperative governance



Extended model cooperative governance



2.2 Roles and responsibilities: BoD, Chair, Supervisory, Management

Members, united in the General Assembly, are the key stakeholders of a cooperative. They are both the main users of its services and the joint owners of the enterprise.

Board of Directors:
The main governing body is the Board of Directors (BoD). The board of directors sits between the members on the one hand and the daily management on the other and that makes them responsible for fulfilling the needs of the members and at the same time monitoring the quality of life and the collaborative character of the organization.

Board members are **elected for a limited term, typically three or four years**, and may sometimes be re-elected. While continuity helps build expertise and stable policies, periodic renewal is important. The BoD should reflect changes in membership and respond to evolving economic and political environments. To maintain continuity, board terms are often staggered so that only part of the board is replaced at a time.

Larger cooperatives may include external experts, such as specialists in finance or marketing, to strengthen oversight of management.

It is recommended to strive for a certain balance between the different age groups on the board of directors. For example, to take into account the diversity between older and younger members, some coops foresee that, for example, when the chair is of some age, the vice-chairman is chosen from among the younger members. Conversely, a younger chairperson can be flanked by an older vice-chairperson. These are not necessarily legal obligations, but they could be rules that can be established within the organization. **Women, youth, and disadvantaged groups** should be encouraged to participate in leadership and decision-making. In many countries, women play a major role in agricultural production, making their involvement in cooperative governance both fair and beneficial.

Skills
Among the many factors that contribute to the success of the coops, the human factor is especially important, not only the loyalty of the members but also the leadership of the group.

In many cases, members of the board are chosen from older members with extensive agricultural experience, but not necessarily with the necessary knowledge of the external market forces that influence the coop. They may not all immediately have a deeper knowledge of management, marketing, accounting, financial statements, communication, organization, etc…. . Leading a cooperative requires both entrepreneurial abilities and strong lobbying skills in political and social contexts, which involves costs.

When skills are lacking, one should therefore not hesitate to organize further training courses in these areas. Acquiring new skills and competencies is thus certainly necessary.

Chairperson Finding the right chairperson of a BoD is important. Such person can "make" or "break" the organization. Despite it is vital for the establishment of coops, it is something that cannot or does not have to be regulated by the government.

The Chairperson chairs the meetings of the Board of Directors and the General Meeting. A chairperson must, of course, be the right person that, on the one hand, gains the confidence of their fellow members, but on the other hand, through a very strong personal commitment, wants to put time and energy into the joint 'project'. He may need to be able to hand over some of his tasks on his farm to his or her partner and/or other business leaders. In many cases, this can already be a major obstacle.

The chairperson must inspire and accompany the group. A little charisma should certainly not be missing. Preferably, he or she is someone who has his or her own opinion and can propagate this, but he or she is also willing to compromise and can bring a group of directors and/or members to a compromise.

BoD workload in cooperatives **Small cooperatives** Typical context: local farmer cooperatives, small service coops, start-ups, member groups with limited staff. **Time commitment** Chairperson: about 1–2 days per week Regular board members: about 0.5 day per week on average Often part-time and combined with members' own farm or business activities **Number of board members** Usually 3–5 members Elected from the membership **Meeting frequency** Board meetings: every 1–2 months (6–10 per year) Extra meetings: when major decisions or problems arise General Assembly: 1–2 times per year **Typical tasks** Setting direction and priorities Supervising manager or coordinator (if present) Financial oversight Maintaining member relations Building partnerships	**Medium-sized cooperatives** Typical context: regional marketing cooperatives, processing cooperatives, input supply cooperatives, financial cooperatives. **Time commitment** Chairperson: about 2–3 days per week Board members: about 1 day per week Often includes preparation, committee work, and stakeholder meetings **Number of board members** Usually 5–9 members Sometimes includes members with specific expertise (finance, marketing, legal) **Meeting frequency** Board meetings: typically monthly (10–12 per year) Committee meetings (finance, audit, strategy): 3–6 per year General Assembly: once per year **Typical tasks** Strategy development Monitoring financial performance Supervising professional management Risk management Networking and representation Major investment decisions

Supervisory Committee

The Supervisory Committee does not manage the cooperative. Its role is oversight, control, and advice — ensuring the cooperative is well governed and remains accountable to its members

Tasks:

- Reviews financial and management reports
- Discusses performance and challenges with the BoD or manager
- Provides recommendations
- Reports findings to the Annual General Meeting
- Ensures follow-up on agreed improvements

Typically, the Supervisory Committee consists of:

- Elected cooperative members (often 3–7 people depending on the size of the cooperative)
- Members who are independent from day-to-day management
- Individuals with relevant expertise (for example in finance, law, agriculture, marketing, governance.

Meeting frequency depends on the size and complexity of the cooperative:
- Small cooperatives: 2–4 meetings per year
- Medium to large cooperatives: 4–6 meetings per year

Management

While the Board of Directors (BoD) sets strategy and supervises, management implements decisions and runs the business the management is responsible for the day-to-day business. Many tasks are performed at the management level: financial, administrative, commercial, human resources matters and logistics. Depending on the size of the organization and the degree of development, these tasks can be performed either by one person or by a larger team in a larger organization, possibly assisted by an administration. It is not recommended that the chairperson also assumes the role of director of the management.

The director takes care of the day-to-day management and leadership and thus has operational control. He recruits or fires staff and makes day-to-day decisions in the spirit of the vision and mission set out by the board. Naturally, the director will also report to the board and advise on numerous matters.
Advising and reporting include:
- financial management, balance sheets
- operational matters
- new products, technology or services
- commercial strategy
- regional, national, regulations
- relations with government and politics
- necessary adjustment of the PO's policy

The director is also expected to report to the members through direct contacts, letters, newsletters, meetings, visits and of course at the Annual General Meeting. He can also be responsible for contacts with the government, other coops, the chain, and the community in general. He thus acts as a representative of the coop.

This means that he will also occupy a unique place in the organization. Firstly, he is a team player who, together with the chairperson and the board, takes charge of the organization and at the same time is the coach of the staff team. He follows the board but is the leader of the staff. This means that people sometimes expect miracle solutions from him or that he acts as a mediator. He is an advisor to the board and a motivator for staff and members.
The Chair and director form an important tandem

The size and structure of management depend strongly on:
- number of members
- turnover
- business complexity
- services offered (marketing, processing, input supply, finance)
- growth stage

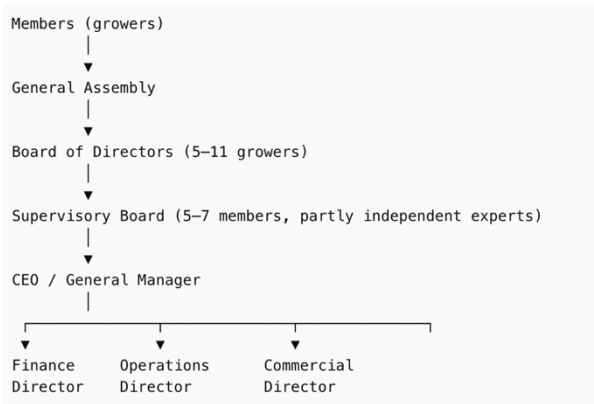
Even small cooperatives benefit from at least one clearly responsible manager or coordinator, ensuring continuity and professionalism.

Youth participation in the governance structure
FrieslandCampina, a Dutch dairy coop, actively involves young farmers in the governance of the cooperative through a dedicated youth network often referred to as FrieslandCampina Young Farmers (Jongeren). This platform enables younger members to participate in discussions about the future of the cooperative and to prepare for future leadership roles. The cooperative considers youth involvement essential for maintaining a strong long-term member base and ensuring that governance reflects generational change in dairy farming. Young members bring new perspectives on innovation, sustainability, digitalisation, and farm succession, which are important strategic topics for the cooperative.

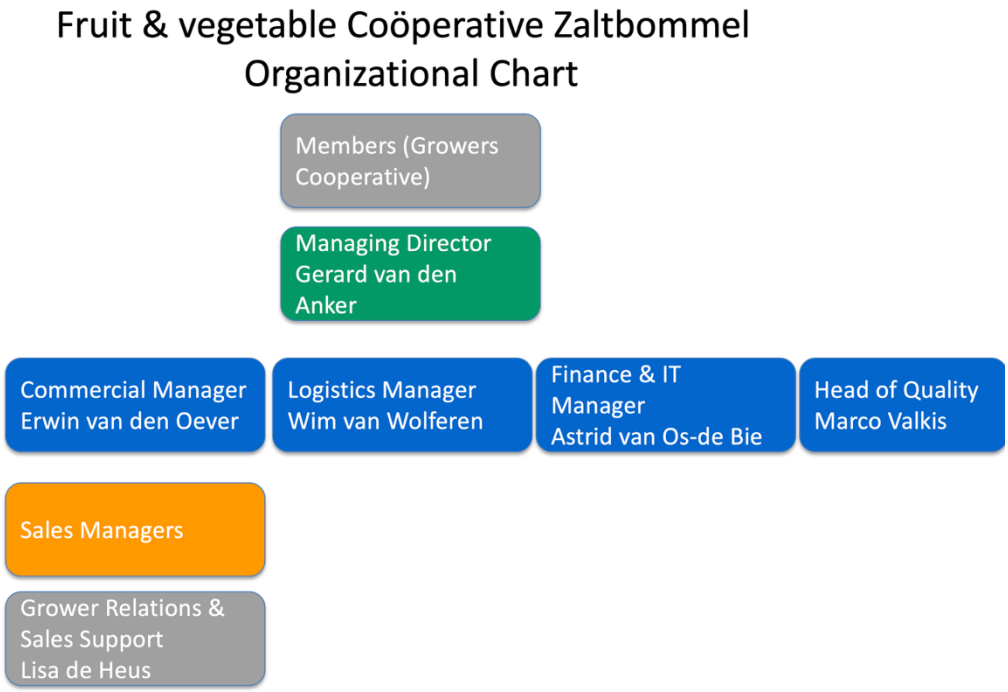
The youth structure functions as a consultative body linked to the broader governance system of the cooperative, which includes the Members' Council, the Board, and the Executive Management. Youth representatives contribute ideas, discuss strategic issues affecting young farmers, and help ensure that the interests of the next generation of dairy farmers are considered in cooperative policies. The youth network also serves as a training ground for future board members, strengthening leadership capacity within the cooperative.



Typical governance structure of Dutch vegetable and fruit coops:



Organogram of fruit- & vegetable auction Zaltbommel



European Union

The EU does not prescribe one fixed governance model for cooperatives, but national laws strongly shape governance practices. Across the EU, a common pattern exists: democratic member control combined with increasing professionalisation of boards and management. The diversity of national legal frameworks explains why governance structures differ between countries, even though they share the same cooperative principles

2.3 Democratic decision-making processes

In a cooperative, decision-making and accountability are shared across three main levels: members, the board of directors, and management. A clear allocation of responsibilities between these bodies is essential to ensure transparency, democratic control, and effective daily operations.

Members: democratic control at the core of the cooperative

The foundation of every cooperative is democratic member control. Members collectively determine the strategic direction of the cooperative through the **Annual General Meeting (AGM)**. In the AGM, members approve the long-term vision, major policies, annual accounts, and key structural decisions such as amendments to statutes or the appointment of auditors or supervisory bodies.

A defining feature of a cooperative is the principle of fairness in voting rights. Many cooperatives apply the rule **"one member – one vote"**, ensuring equal influence regardless of farm size or capital contribution. Where proportional voting is applied (for example based on shares or transaction volumes), limits are usually set to prevent excessive concentration of power. In the EU context, voting rights or shares held by a single member should remain below 50%, protecting the cooperative from domination by a minority and safeguarding collective interests.

Members also play an accountability role by electing the board of directors and monitoring its performance. Through this democratic structure, the cooperative ensures that it genuinely represents producers and remains focused on member needs.

Board of directors: strategic oversight and accountability

The **board of directors**, elected by the AGM, represents the members and is responsible for policy and strategic choices. The board translates the cooperative 's mission into operational strategies, supervises management, and ensures that the cooperative acts in the best interests of its members. Strong governance requires that the board acts collectively and transparently, avoiding conflicts of interest and maintaining trust among members.

Management: professional daily operations

The **manager or management team** is responsible for daily operations of the cooperative, including administration, finance, logistics, marketing, and human resources. Management implements the strategy approved by the board and reports regularly on performance and risks.

Accountability mechanisms within the cooperative are ensured through:

- democratic voting procedures and transparent statutes
- regular financial reporting and approval of annual accounts
- election and supervision of board members
- separation between strategic and operational roles
- internal rules defining member rights, obligations, and possible sanctions

Clear governance structures build trust among members, strengthen bargaining power in the supply chain, and contribute to long-term financial sustainability.

2.4 Key challenges & potential conflict of interests

Cooperatives may find themselves stretched between (at times conflicting) members' interests, business opportunities and social considerations.

A cooperative has a **dual nature**: it is both a member-based association and a market-oriented enterprise. This structure creates internal tensions, particularly when business sustainability requires decisions that may not align with short-term member preferences.

- Dual objective tension (members vs. enterprise viability) Cooperatives must balance member interests with the need to operate efficiently

and competitively in the market. Economic sustainability must remain the priority to ensure long-term continuity.

- Short-term member gains vs. long-term investment needs
  Members may prefer higher immediate prices or payouts, while the enterprise requires reinvestment in quality systems, technology, or market development to remain competitive.
- Governance complexity and leadership capability
  Leaders must combine business, financial, and strategic skills to respond to changing market demands such as stricter quality standards and supply chain requirements.
- External stakeholder influence
  Government or NGO support may push cooperatives toward broader social objectives, which can divert focus from core commercial performance and efficiency.
- Decision-making efficiency vs. democratic control
  Collective decision processes may slow strategic responses to market changes, reducing competitiveness compared to investor-owned firms.
- Alignment of incentives between members and enterprise
  Differences in production scale, risk tolerance, or time horizon among members can create internal conflicts affecting pricing, investment priorities, and strategic direction.

Overall: the main governance challenge is maintaining strong business performance while aligning member expectations with long-term market competitiveness.

Practical tips to manage cooperative challenges (enterprise & market oriented)

- **Clarify the cooperative ’s primary economic objective**
  Define the cooperative first as a competitive enterprise that serves members through strong market performance. Clearly separate business decisions from broader social expectations.
- **Adopt professional governance structures**
  Create a clear division between Board (strategy & oversight) and management (operations). Recruit leaders with strong skills in finance, marketing, supply chains, and risk management.
- **Align member incentives with long-term enterprise value**
  Use pricing formulas, patronage refunds, or investment schemes that reward members for quality, loyalty, and long-term commitment rather than short-term gains.
- **Implement transparent communication on investment needs**
  Clearly explain why reinvestment in technology, quality control, branding, or market access is necessary for competitiveness and future member returns.
- **Develop clear decision rules and performance metrics**
  Introduce KPIs related to profitability, cost efficiency, market share, and product quality. Evidence-based decisions reduce conflicts and increase legitimacy.
- **Segment member expectations where needed**
  Recognize differences between small and large producers or between growth-oriented and risk-averse members. Tailored service models or differentiated pricing can reduce tensions.
- **Manage external stakeholder influence carefully**
  Accept public or donor support only when it aligns with business strategy. Avoid commitments that weaken competitiveness or increase operational costs without clear returns.
- **Invest in leadership and managerial capacity**
  Continuous training in strategic planning, contract negotiation, and value chain development strengthens the cooperative ’s ability to respond to market changes.
- **Strengthen contractual arrangements with members**
  Delivery commitments, quality standards, and pricing mechanisms reduce opportunistic behaviour and support planning certainty.

Overall tip: treat the cooperative as a market-oriented firm with member ownership, ensuring that governance and incentives support competitiveness, profitability, and long-term enterprise growth.

3 Membership (Growers)

Farmers and horticulturists can become direct members of a coop. Members of a cooperative can be natural or legal persons. Free entry for new members (shareholders) is essential, in the absence of a dominant shareholder and a speculative goal.

Everything is done on the initiative of and under the control of the cooperative and everyone has a certain say in the direction of the organization. This does not mean that for each decision, each member has to be consulted. They elect their representatives on the board of directors to do so.

This requires a group structure as explained in chapter 2 but also requires respect for agreements. A member supports the development that goes beyond mere self-interest (bears co-responsibility). It is therefore important to have the same motivation and view on things together with the other partners. This increases the involvement of the shareholders in their organization.

Non-producer membership
EU Member States may allow individuals or organizations that are not producers, or that do not produce products in the sector for which the Cooperative is active, to become members, but only under certain conditions set out in national law.

These members are often referred to as "non-active members" or non-producers.
Non-producers can only be part of a Cooperative if the producers remain in control of the organization. They are not counted when checking whether the Cooperative meets the minimum requirements for recognition, such as the required number of producer members. In addition, non-producers are not allowed to directly benefit from measures financed by the European Union.

Member States may also restrict or remove the voting rights of non-producers, especially for decisions related to the use of public funding.

Rules concerning producers who are not members of a cooperative (coop) can be laid down in several places, depending on the legal issue involved. In practice, the framework usually combines EU law, national legislation, and the cooperative 's own statutes

3.1 Member commitment

Member commitment refers to the willingness of members to continue trading with and investing in the cooperative, even when short-term alternatives may appear more attractive. It reflects a long-term orientation toward the cooperative 's economic success and stability. Strong commitment is critical because cooperatives depend on predictable supply volumes, capital contributions, and participation in governance. Without commitment, long-term investments become risky and transaction costs increase.

Members who are committed:

- Accept cooperative statutes with rules and regulations
- Accept cooperative strategies and objectives
- Prefer to sell or buy through the cooperative consistently
- Are willing to invest time, capital, and effort
- Remain loyal even when short-term prices fluctuate

How member commitment can be created – practical tips

1. **Deliver clear economic value**
   - Offer competitive prices and reliable market access
   - **Ensure timely payments** to support farmers' cash flow
   - Provide high-quality services (inputs, marketing, logistics)
   - Offer bundled services (e.g. credit + inputs + marketing) to increase dependency and value

2. **Strengthen long-term incentives**
   - Encourage reinvestment of profits to improve competitiveness
   - Align pricing and benefits with quality and loyalty
   - Design contracts or delivery agreements that support stable supply volumes
   - Reduce opportunities for side-selling or opportunistic behaviour.

3. **Ensure professional and trustworthy management**
   - Build trust through consistent, transparent decision-making
   - Communicate clearly why investments and strategies are needed
   - Demonstrate strong financial discipline and market orientation

4. **Improve communication and transparency**
   - Explain pricing formulas, costs, and investment decisions
   - Share performance results regularly
   - Clarify how benefits are distributed among members
   - Reduce perceptions of unequal treatment between member groups

5. **Encourage participation linked to business performance**
   - Promote member involvement in key decisions affecting strategy
   - Strengthen understanding of market challenges and investment needs
   - Use participation to build acceptance of long-term decision

3.2 Examples from the Netherlands

Market access - developments:
United Growers closely monitors market trends and client requirements. The cooperative advises members on market developments and new varieties that match demand. Members remain free to make their own production decisions, but their choices are informed and guided by market-oriented insights and recommendations.

Payment terms:
For members of cooperatives such as **Royal FloraHolland**, **FruitMasters**, and Plantation **guaranteed payment** is a key element of member commitment and financial stability. Within max 2 weeks farmers are paid for the products they delivered.
Farmers and growers depend on **predictable cash flow** to finance production costs, labour, and investments. When buyers delay payment or go bankrupt, individual producers often lack the financial capacity to absorb losses. A cooperative reduces this risk by acting as a trusted intermediary, ensuring members are paid even when market conditions are uncertain.

Cooperatives use financial, contractual, and risk management tools to reduce payment risk from clients:
1. Credit risk assessment of buyers
2. Payment guarantee funds or collective reserves
3. Pre-financing and invoice factoring systems

4. Contractual safeguards
5. Diversification of buyers
6. Professional financial management

Communication:
in addition to their formal Annual General Meeting for decision-making, many cooperatives in the Netherlands, organize regular meetings with member groups — often every two weeks or monthly. These meetings are used to discuss market developments, share financial data, prices, quality requirements, strategic priorities, and communication plans. This frequent interaction helps to align production decisions with market needs, strengthens transparency, and supports coordinated implementation of cooperativestrategies.
Sometimes participants in these member groups act as representatives for several farmers within their region, conveying local perspectives and sharing information between the cooperative and the wider membership.

4 Regulatory framework

We end this manual with an overview of the regulatory framework.

This multi-level regulatory framework can also lead to differences in how cooperatives function across countries. While EU legislation provides a common foundation, Member States retain flexibility in implementing national rules on cooperativestructures, taxation, governance, and recognition of Producer Organizations. As a result, cooperatives may operate under different legal conditions, levels of administrative burden, and degrees of market freedom. These differences can influence business decisions, organizational flexibility, access to public support, and ultimately the competitiveness of cooperatives in different Member States.

Cooperatives operate within a multi-level legal framework, in which rules are defined at European Union (EU) level, national level, and within the internal statutes of the cooperative itself. Each level plays a distinct role in shaping how cooperatives are organized, governed, and able to carry out their economic activities.

4.1 Framework at EU level - National level - Cooperative level

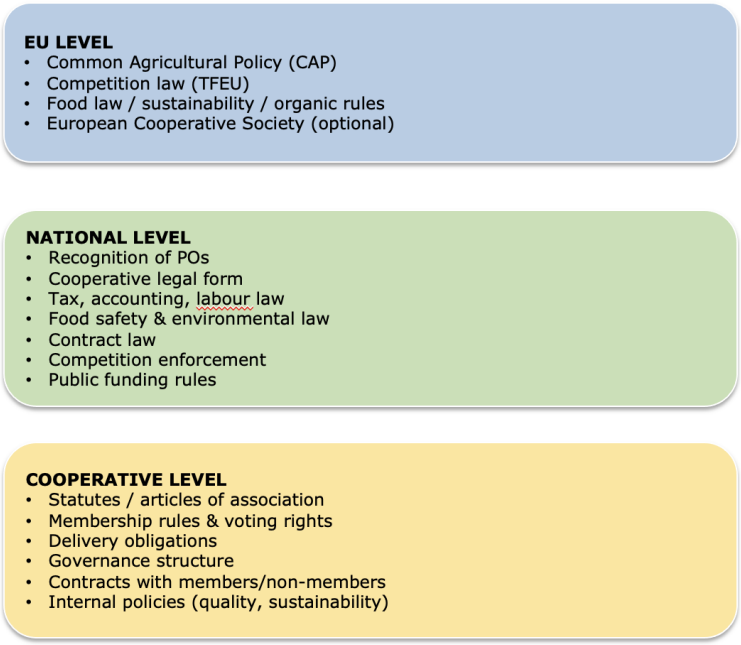
At EU level, the legal framework is mainly established through the Common Agricultural Policy (CAP) and related legislation governing Producer Organizations, competition rules, and market functioning. These rules set the overall objectives for cooperation between producers, such as improving market efficiency, strengthening the bargaining position of farmers, and promoting sustainable production. EU legislation provides the general conditions under which cooperatives and POs may operate and benefit from public support.

At national level, Member States translate EU rules into concrete legal requirements. National legislation determines, for example, how cooperatives are recognized, how cooperatives are legally structured, and which tax, labour, accounting, and food safety rules apply. **Differences between Member States may therefore influence how cooperatives** organize their governance, financing, and commercial activities.

At cooperative level, the statutes (articles of association) and internal regulations define the specific functioning of the cooperative. These rules regulate the relationship between the cooperative and its members, including voting rights, delivery obligations, financial participation, and internal decision-making procedures. The statutes allow cooperatives to adapt the general legal framework to their specific business model and sector needs, provided they remain compliant with EU and national law.

Understanding the interaction between these three regulatory levels is essential for analyzing how cooperatives function in practice. It also helps to identify where flexibility exists, where legal constraints apply, and **how differences in national legislation may affect the business environment of cooperatives in different Member States.**

The following diagram gives a brief overview of aspects regulated at EU, National and international level.



4.2 Statutes

The statutes (articles of association) form the legal foundation of a cooperative. They define the cooperative 's objective, governance structure, and the rights and obligations of its members. The main objective of the statutes is to ensure that the cooperative operates in line with its purpose of serving the economic interests of its members, while complying with applicable EU and national legislation.

For potential members, the statutes provide clarity on key aspects such as membership conditions, voting rights, financial participation, delivery obligations, and decision-making procedures. They therefore play an important role in creating transparency, trust, and legal certainty regarding how the cooperative functions.

The statutes are typically developed at the moment of establishment of the cooperative by the founding members, often with the support of legal advisors or notaries. They are formally adopted by the members and can usually be amended through decisions of the general annual meeting, allowing the cooperative to adapt its rules to changing economic or organizational needs.

Typical basic structure

1. **Name, legal form, and registered office**
2. **Purpose and objectives**
3. **Membership**
   - admission conditions
   - rights and obligations
   - termination of membership
4. **Capital structure**
   - member shares
   - financial contributions
5. **Governance**
   - General Assembly
   - Board of Directors / Management Board
   - Supervisory Board (if applicable)
6. **Decision-making procedures**
   - voting rights (often one member = one vote)
7. **Profit allocation**
   - reserves
   - dividends/patronage refunds
8. **Liability of members**
9. **Amendement procedures**
10. **Dissolution procedures**

The statutes of a cooperativeshall also provide for:

- penalties for infringement of obligations under the statutes, particularly for non-payment of financial contributions, or of the rules laid down by the cooperative.
- rules on the admission of new members, and in particular the minimum period of membership which may not be less than one year
- the accounting and budgetary rules necessary for the operation of the organization
- procedures for determining, adopting and amending the rules of the cooperative
- the imposition on the members of financial contributions as needed to finance the cooperative rules enabling the producer members democratically to scrutinise the cooperative and its decisions
- rules detailing the arrangements for non-producer members to be entitled to voting rights
- minimum membership periods
- rules on the resignation dates for cooperative members. The resignation of membership must be notified to the organization in writing. The resignation will not take effect until the following 1 January
- the accounting and budgetary rules necessary for the operation of the organization
- agreement on action to be taken in the event of circumstances beyond the control of the cooperative force majeure)
- possible provisions to be made to recover investments or the value of investments in the event of a member leaving the cooperative group

4.3 Netherlands versus Romania: differences in regulations

A comparison between the Netherlands and Romania illustrates how national legal traditions, policy priorities, and market conditions can result in different regulatory approaches. While both countries implement EU rules, the degree of legal prescription, fiscal support, and government involvement in the organization of agricultural markets may vary. Understanding these differences helps to identify how the national legal environment can affect the functioning, flexibility, and competitiveness of cooperatives

Comparison table

Topic	Netherlands	Romania
Main legal framework	Dutch Civil Code Book 2 (legal persons) (ICA)	Law 566/2004 on agricultural cooperatives (jopafl.com)
Type of regulation	general company law rules also apply	specific law for agricultural cooperatives
Degree of state intervention	relatively limited	relatively strong
Cooperative definition	cooperative is a form of association serving members' economic needs (Kreston Lentink)	cooperative defined as autonomous association promoting members' interests (jopafl.com)
Minimum members	generally at least 2 members (Kreston Lentink)	minimum often 5 members for agricultural cooperative (ResearchGate)
Governance requirements	largely defined in statutes	partly defined by law
Role of cooperative principles	not strongly embedded in legislation (ICA)	explicitly based on cooperative principles (econstor.eu)
Fiscal incentives	limited specific incentives	tax exemptions and incentives introduced to stimulate cooperation (ResearchGate)
Policy objective	neutral legal framework	policy tool to stimulate farmer cooperation
Flexibility for statutes	high flexibility	more legal requirements

Netherlands: → flexible legal framework - state interference: **LOW**

- cooperatives regulated mainly under general company law
- legislation gives significant freedom to design statutes
- state does not strongly prescribe internal governance
- cooperative often used as flexible business structure
- law mainly ensures legal personality and liability structure (ICA)

Romania: state interference: **MEDIUM–HIGH**

- agricultural cooperatives regulated through specific cooperative legislation
- law includes definition of cooperative principles
- government introduced tax incentives to stimulate farmer cooperation
- legislation aims to increase market organization of small farms (ResearchGate)

4.4 Key differences affecting cooperative business environment

1. Tax treatment and fiscal incentives

Netherlands

- Cooperatives are generally taxed under the standard corporate income tax system.
- There are no major sector-specific tax exemptions for agricultural cooperatives.
- Fiscal policy is largely neutral: the cooperative is treated as a normal business entity.
- Profit distribution to members is structured through patronage refunds or member transactions.

Business impact

- predictable tax framework
- limited administrative complexity
- cooperatives compete under similar conditions as other companies

Impact on business: stable and neutral

Romania

- Romanian legislation provides specific tax incentives for agricultural cooperatives in order to stimulate cooperation between small farmers.
- Examples include:
  - exemptions or reductions for profit tax under certain conditions
  - possible exemptions from property tax for cooperative assets
  - tax benefits for member transactions
- Fiscal policy aims to encourage farmers to join cooperatives due to historically low participation rates.

Business impact

- positive financial incentives
- but also additional administrative requirements to qualify for exemptions
- risk that incentives change over time

Impact on business: financial support but higher dependency on policy

2. Degree of state involvement in agricultural market organization

Netherlands

- Agricultural markets are highly market-driven.
- The government generally does not intervene in price formation for agricultural products.
- Cooperatives negotiate prices directly with buyers (retailers, processors).
- Public policy focuses on:
    - food safety
    - sustainability
    - competition compliance
    - transparency in the food chain

Business impact

- cooperatives have strong autonomy in pricing strategy
- market conditions determine competitiveness
- high degree of entrepreneurial freedom

Impact on business: high commercial flexibility

Romania

- Government policy historically plays a stronger role in **structuring agricultural markets**.
- Agricultural sector characterized by:
    - many small farms
    - fragmented supply chains
    - policy efforts to stimulate collective marketing
- Public programmes encourage formation of cooperatives to improve bargaining power.
- In some sectors, public intervention measures or support schemes influence price stability indirectly.

Business impact

- cooperative strategy may depend more on public programmes
- market structures less consolidated
- more uncertainty in long-term investment environment

Impact on business: higher policy influence on market development

3. Legal structure and governance requirements

Netherlands

- Cooperative law provides high flexibility in governance design.
- Statutes can define:
  - voting rights structure
  - member financial participation
  - delivery obligations
  - internal decision-making procedures
- Limited statutory prescription of cooperative principles.

Business impact

- governance structure can be tailored to business needs
- easier to attract investors or new members
- adaptable to market developments

Impact on business: high organizational flexibility

Romania

- Cooperative law includes more detailed provisions regarding:
  - cooperative principles
  - governance structure
  - member relations
- Legal framework designed to ensure alignment with traditional cooperative model.
- Some structural requirements may reduce flexibility in capital structure or governance arrangements.

Business impact

- more legal certainty regarding cooperative identity
- but potentially less flexibility in structuring investments or governance

Impact on business: more structured but less flexible

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Strategies to combat unfair practices for horticultural cooperative products sold directly to consumers and through sales networks

Specialized Consultancy Guide

Cooperation among cooperatives

Jos Bijman, Wageningen University & Research | HollandDoor
April 2026

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1. Introduction

The sixth cooperative principle of the International Cooperative Alliance (ICA) is *Cooperation among Cooperatives*. The principle states that "Cooperatives serve their members most effectively and strengthen the cooperative movement by working together through local, national, regional and international structures."[1]

This principle is not just some advice; it is also a common practice. Cooperation among cooperatives is a normal practice in all parts of the world and in all sectors of the economy. Cooperatives have a preference for working with other cooperatives (instead of with other business organisations) because of the special organisational characteristics (particularly the democratic decision-making), the principles that all cooperatives follow, and the mission-orientation (compared to profit-orientation of most other businesses). Particularly in agriculture, board members are mostly farmers themselves. A common understanding of the challenges of the agricultural sector makes communication among board members of different cooperatives easier than with other organisations.

This Cooperation among Cooperatives does not prescribe that cooperative should always work with other cooperatives. As businesses, cooperatives choose their collaboration partners for strategic reasons, nor for emotional reasons. Particularly as part of a food value chain, cooperatives collaborate with suppliers and with buyers that are usually not cooperative enterprises.

Cooperation is a strategic choice for any business organisation, including for cooperatives. Thus, cooperatives must clearly explore and decide on what are the goals of the collaborative activities (more specifically, what benefit does it bring the members), on the short and long term cost involved, what investments are needed, and what it means for deployment of current resources (e.g. human and financial resources).

Cooperation is not a goal in itself. It is a tool to reach organisational goals. By cooperating with other business organisations, the cooperative can reach its own goals (e.g. providing the best services to its members) more quickly and/or more efficiently. In addition, cooperation may lead to a stronger position in the competitive market. For instance, by jointly selling products, the collaborating organisations experience lower cost of sales, logistics and market research, while at the same time their bargaining power is higher. In the end, farmer-members benefit through reduced cost of cooperative activities and/or higher sales prices for the agricultural products.

Cooperation is a process. It requires skills and resources. It is dynamic and difficult. It requires trust and commitment. The process of cooperating consists of different stages, and in each stage different skills and resources may be needed. More than other business activities, cooperation depends on individual capabilities (i.e. skills and experiences).

Cooperatives do not only collaborate with other business organisations. Increasingly, cooperatives also work together with non-business stakeholders like Non-Governmental Organisations (NGOs) or Civil Society Organisations (CSOs). Particularly in reaching sustainability goals, cooperatives collaborate with societal organisations, often within the framework of corporate sustainability or corporate social responsibility strategies. For instance, a dairy cooperative may collaborate with a nature conservation organisation to

[1] https://ica.coop/en/cooperatives/cooperative-identity

show that it is serious about improving sustainability (thus strengthening legitimacy), to learn from the biodiversity experts of this organisation, and to develop standards for measuring and evaluating sustainability practices at member farms.

In this report on Cooperation among Cooperatives, we will present and discuss the following topics. Section 2 will elaborate on the various goals that can be reached by collaborating with other cooperatives, other business organisations or societal organisation. Section 3 will discuss the different forms in which cooperation can be organised. We present forms that are based on contractual agreements and those that are based on shared ownership. We also elaborate on the federative structure that is common among cooperatives. Section 4 will briefly discuss mergers and acquisitions. Section 5 discusses the role and position of the cooperative in the food chain, focusing on collaboration of cooperatives and buyers of food products. In section 6 we discuss cooperation between cooperatives and societal organisation. Finally, in section 7, we present guidelines that can help the process of cooperation.

2. Motives for cooperation

Why do businesses want to cooperative with other businesses? Businesses can have multiple reasons for cooperation (Child et al., 2015). The reasons can be described in terms of the goals that the cooperating organisations want to achieve, the challenges that the individual organisation encounter, or the opportunities that they see. While a simple economic explanation could be that collaborating companies want to reduce cost and increase income, there are also more complex strategic motives for collaborating. These strategic motives may not immediately generate economic benefits (by lower cost or higher prices) but are expected to generate benefits in the medium and long-term.

A common list of motives for cooperation is the following:

- To achieve economies of scale
- To strengthen bargaining power
- To share risk (e.g., market risk; innovation risk)
- To block competitors
- To access complementary resources
- To overcome trade barriers (e.g. foreign market entry)

Economies of scale

In economic theory, economies of scale are the cost advantages that enterprises obtain due to their scale of operation and are typically measured by the amount of output produced per unit of cost (production cost). Common sources of economies of scale are in purchasing (bulk buying of raw materials), in managerial cost (one manager overseeing a larger production volume), financial (obtaining lower-interest rates for credit or having access to lower-cost financial), marketing (lower cost of advertising per unit of output), and technological (using technology that allows for larger production volumes).

Producing on a larger scale also allows for a more efficient division of labour. Allocating tasks to specialists will increase production speed and will allow the adoption of more efficient production techniques.

Strengthening of bargaining power

One of the most common motives for collaboration according to economic theory is to strengthen the market power and market position of the business. This motive implies that businesses collaborate with colleagues that produce similar products or deliver similar services. This type of collaboration is called horizontal collaboration. By jointly purchasing inputs or jointly selling products, companies have a better competitive position, leading to lower prices (in purchasing) or higher prices (in selling) or better transaction conditions (e.g. transport, packaging, risk or quality control conditions). Strengthening bargaining power is often motivated by a weak bargaining position, such as when trading partners are more powerful due to size, ownership of unique assets, or control over access to final customers.

Sharing risk

Business activities come with many types of risks, ranging from failing technologies, to disappointing sales, to lack of human resources. By collaborating, companies can make arrangements to share the risks. Such arrangements could be insurances, direct support of other companies in case of technical failure, sharing the burden of low sales, and helping each other with labour sharing arrangements. Sharing risk, even among competitors, is common when developing new foundational technologies; the cost of such technological advances or the infrastructure needed to turn the technology into commercial products cannot be borne by a single company. Companies may share market risk when companies they enter a new (e.g. foreign) market or when they jointly develop a market for new products.

Blocking competitors

Companies may collaborate to make it more difficult for competitors to sell in a specific market (i.e. blocking competitors). When collaboration leads to lower per-unit costs, single competitors may not be able to compete. When only collaborating companies are allowed to use proprietary technology, other companies can compete. By locking-in supplier or distributors with exclusive contracts, companies can make it difficult for competitors to gain access to important resources or to sales channels.

Access to (complementary) resources

Cooperatives, like other businesses, need resources to perform their business activities. The term ‘resources’ relates to financial capital, human resources, proprietary technology, raw materials, knowledge, physical assets, etc. The theoretical explanation usually comes from the resource dependency perspective (Pfeffer & Salancik, 1978): because companies need to have access to resources that are needed to pursue their strategies and carry out their business activities, they collaborate with other companies that have control over those resources. For instance, cooperatives may collaborate with a company that provides quality control technology, or with a company that provides the necessary labour force.

Collaborations often arise between companies that hold complementary resources. By working closely together, both companies benefit from bringing in their own resources. For instance, one company provides the raw materials, while another company owns the facilities to produce final products. A special type of resources is knowledge. Businesses often collaborate in so-called open innovation networks, to exchange knowledge of products, processes and materials, or to jointly develop new technologies or even new products.

Overcome trade barriers

Companies who want to export to foreign countries, particularly if they are unfamiliar with the business culture and customer demand in the other country, may collaborate horizontally to share the market risks. Such collaboration often takes the form of a joint venture, where the exporting company and a foreign country company set up a jointly-owned business to share all market risks. For the exporting company the joint-venture with a local company is also a way to learn how business works in the foreign country. Particularly in countries that have constraining legislation for foreign suppliers, it is common that exporting companies set up joint-ventures or contractual arrangements with local companies.

The cost of cooperation

So far, we have focused on the benefits of cooperation. Joint and individual benefits derive from the various joint activities that collaborating businesses perform. However, cooperation may also come with costs. These costs can be divided in three groups: loss of flexibility; operational costs; and the risk of opportunistic behaviour by the cooperation partner.

Once company A decides to collaborate with company B, it excludes the option of collaborating with company C (unless C is allowed to join the consortium). Where the collaboration of A and B implies a choice for a certain technology, a certain standard, or a certain product line, other options are no longer feasible. Thus, collaboration leads to a certain level of dependency on the partner and to a loss of flexibility. While this is all a deliberate strategic choice, in a dynamic context such choice may result in foregone alternatives.

Cooperation also leads to operational costs. Cooperation requires that companies spend money and time on meetings, information exchange, assessing the skills and knowledge of the partners. Cooperation also involved training and learning processes, where employees of one company need to learn about the technology and resources of the other company.

Finally, cooperation may also bring risk. Particularly the above-mentioned dependency can become very costly when the perceived benign partner turns out to be an opportunistic partner. Over time, an originally enthusiastic partner may turn into an unreliable partner, particularly if market conditions change or when strategies change with new leadership in the company. The measures individual companies take to prevent or mitigate opportunistic partner behaviour can also be considered as costs of cooperation.

3. Forms of Cooperation

Businesses can choose multiple forms for their cooperation with other businesses. A classical list of forms of business collaboration has been provided by Todeva and Knoke (2005). Based on Transaction Cost Theory, these authors have developed a continuum ranging from pure (spot) market transactions between two companies to vertical

integration. Where spot market implies no collaboration, vertical integration implies the end of collaboration between autonomous partners because the two partners integrate into one company.

Table 1 presents the continuum developed by Todeva and Knoke (2005). Between spot market and vertical integration, the authors distinguish 10 forms of more or less intensive cooperation. Table 1 also provide the explanation of the particular form of collaboration.

Table 1. Forms of business collaboration (source: Todeva and Knoke, 2005)

Forms of collaboration	Explanation of collaboration
Vertical Integration	Through acquisition or merger, one firm takes full control of another's assets and coordinates actions by the ownership rights mechanism.
1. Joint venture	Two or more firms create a jointly-owned legal organization that serves a limited purpose for its parents, such as R&D or marketing.
2. Equity investment	A majority or minority equity holding by one firm through a direct stock purchase of shares in another firm.
3. Cooperative	A coalition of small enterprises that combine, coordinate, and manage their collective resources.
4. R&D consortium	Inter-firm agreements for research and development collaboration, typically formed in fast-changing technological fields.
5. Strategic alliance	Contractual business network based on joint multi-party strategic control, with the partners collaborating over key strategic decisions and sharing responsibilities for performance outcomes.
6. Cartel	Large corporations collude to constrain competition by cooperatively controlling production and/or prices within a specific industry.
7. Franchising	A franchiser grants a franchisee the use of a brand-name identity within a geographic area, but retains control over pricing, marketing, and standardized service norms.
8. Licensing	One company grants another the right to use patented technologies or production processes in return for royalties and fees.
9. Subcontractor network	Inter-linked firms where a subcontractor negotiates its suppliers' long-term prices, production runs, and delivery schedules.
10. Industry standards group	Several (major) companies in a particular industry agree on the adoption of technical standards for manufacturing and trade.
Spot Market	Arm's-length transactions between organizations coordinated only through the price mechanism.

From contract to ownership

As said, the order of forms of cooperation in Table 1 present a continuum from spot market to full integration. The forms closer to spot market, particularly cartel, franchising, licensing, subcontractor network, and industry standards group are all contract-based (see Figure 1). This means that partners enter into a contractual agreement. The contract determines the scope of the collaboration. All business decisions that do not fall under the contract can be made by partners individually.

The forms ranging from strategic alliance to joint venture are ownership-based forms of cooperation. This means the collaborating partners have become owner of another entity, which could be a newly formed business (like in the case of a joint venture) or could be an equity investment in the partner. The benefit of ownership is that it allows more information sharing, more benefit sharing, and sometimes (depending on the size of equity investment) it also implies gaining decision-rights. Other advantages of equity investments

are the (long-term) commitment it shows from the investing partner, and the open character (i.e., there is no need to specify all details about the scope of the collaboration in a contract).

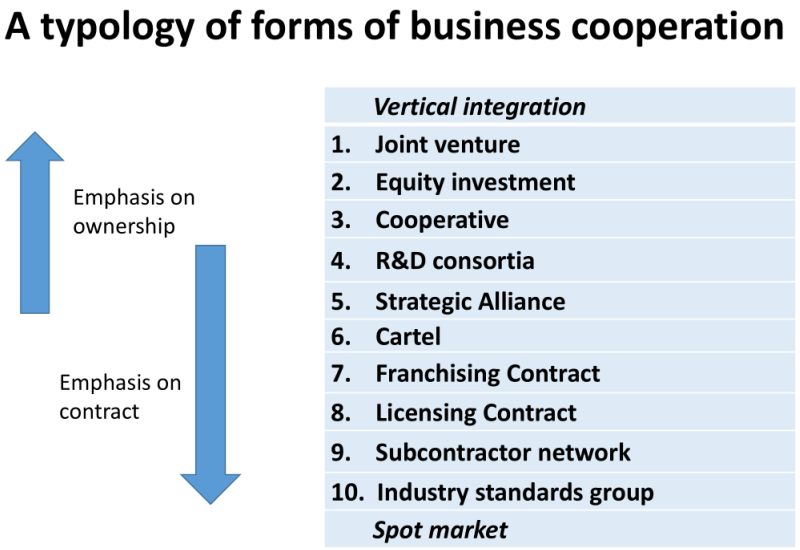

Figure 1. Ownership-based versus contract-based forms of cooperation (source: author)

Most forms of business cooperation do not imply the choice of a specific legal form (such as a Limited Liability Company, a Public Limited Company, or a Partnership). Only in the case of a cooperative, the form of cooperation is also a legal form. In the case of a contractual arrangement there is no legal form at all.

Strategic alliances

The strategic alliance is presented in Table 1 as a form of cooperation in middle in between spot market and vertical integration. A strategic alliance can be more contract or more ownership (Figure 2). According to Kale & Singh (2009), strategic alliances can be contractual arrangement or equity arrangements. The latter can be equity investment of one partner in the other partner or can be a joint venture where both partners invest in a new legal entity.

Strategic alliances are designed to achieve mutual and individual benefits by sharing, combining and creating resources. The essence of a strategic alliance lies in the long-term orientation and the strategic purpose (i.e., they are not just for market transactions but for jointly gaining competitive advantage). Strategic alliances are often set up for innovation, including jointly developing basic technology and setting standards for using the new technology. Strategic alliances, even the contractual ones, require on-going and proactive joint management by the partners to deal with opportunities but also with tensions and challenges.

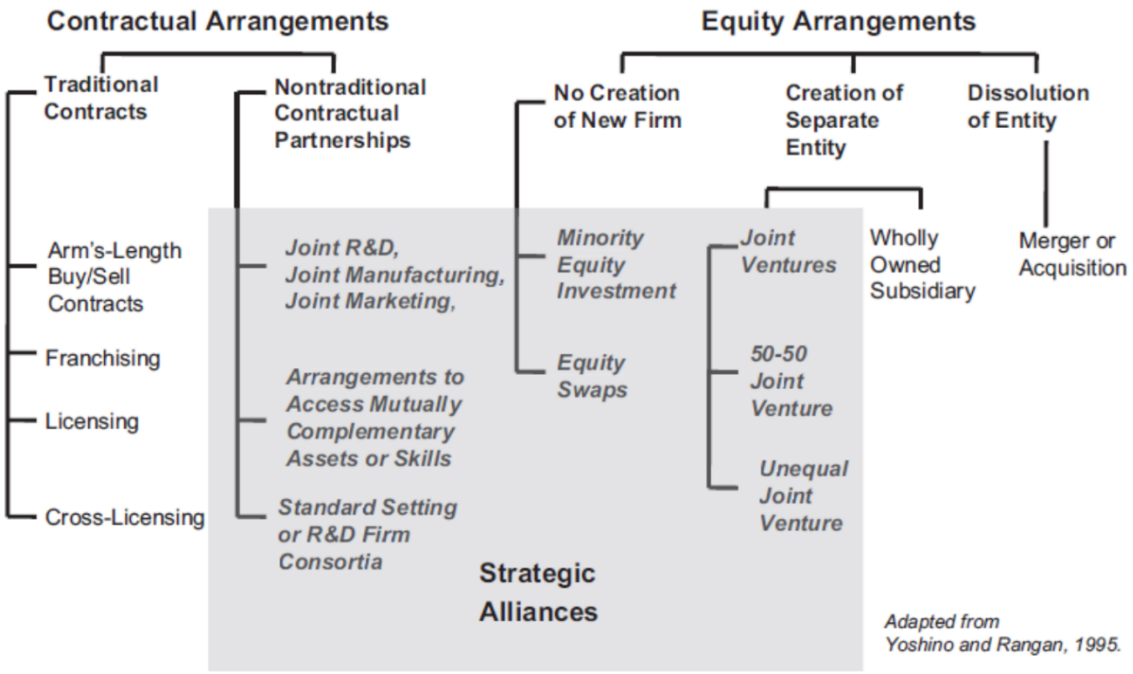

Figure 2. Strategic Alliances (source: Kale and Singh, 2009)

Federative cooperative

For cooperative businesses, another form of cooperation exists, particularly in the agrifood sector. It is quite common for primary cooperatives to work together with other primary cooperatives in a regional cooperative (often called a cooperative union). Primary cooperatives are the cooperatives where farmers are members. They are often organised within a relatively small geographical area, such as a village. The regional cooperative, organised on larger geographical area, is structured as a cooperative of cooperatives (Figure 3). The benefit of this federative model is that the primary cooperative can remain small and maintain close relationships with the farmer-members, while economic activities that need a larger scale – for efficiency reasons – can be organized in the regional cooperative. The regional cooperative can benefit from economies of scale in product handling (such as processing or packaging) and from having greater bargaining power. In some countries, regional cooperatives are collaborating in a cooperative federation, often at the national level.

The federative structure of cooperation among cooperatives makes use of the subsidiary principle: activities that can be done best at the local level (because of efficiency or social-political reasons) are organized within the primary cooperative, while activities that need a larger scale of operations to be competitive, are organized within the regional cooperative or in the cooperative federation.

Federative structures also have disadvantages. Because cooperatives at all layers of the structure make autonomous decisions, there is need for extensive coordination, not only horizontally among primary cooperatives or among unions, but also vertically among the different layers of the federative structure. Coordination requires information exchange, which is not always easy in a complex organisational structure. If many organisations, at different layers, need to decide on strategic choices, it is not only difficult because of the

different interests involved, but also because partners may base their decision on information that others do not have. In addition, the federative structure has the disadvantage of slow decision-making. The challenges of fast and unfiltered information exchange become particularly problematic when an organisation at a higher layer is responsible for marketing while markets (rapidly) change and the information on (changing) customer demands need to be translated from the federation to the union to the primary cooperative to the farmer-members. Every step entails a risk of information distortion, deliberately or by coincidence.

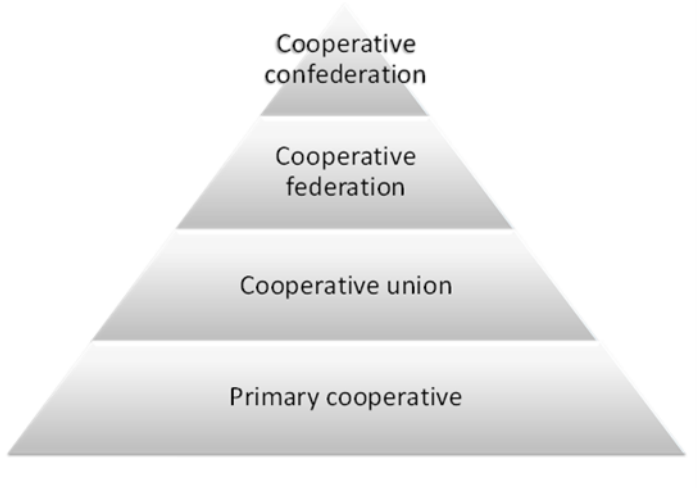

Figure 3. The Federative Cooperative Structure

4. Mergers and acquisitions by cooperatives

As we have seen in Table 1, the extreme position on the continuum of business cooperation forms is the vertical integration. This is the situation where two partners integrate into one business entity. Integration is vertical integration if the partners were sellers and buyers, thus economic actors in two stages of the value chain; it is horizontal integration

when the partners were in the same stage of the value chain. Integration is often discussed under the heading of mergers and acquisition.

Mergers among cooperatives is a common development. Most cooperatives start as small, local business organisations. Soon members and management realize that the cooperative is too small to compete in the market. If a federative structure is not possible of desirable, the alternative is the merger of two small cooperatives into one larger cooperative. That larger cooperative can take advantage of economies of scale and bargaining power, just like to closely collaborating cooperatives could do. The main advantage of a merger compared to a collaboration are the efficiency gains that can be reached. Merging two companies into one allows for efficiency enhancing reorganisation, such as integrating different departments, firing redundant managers and employees, and selling redundant assets, but it also allows a re-orienting of the strategic goals, selecting a new board, and focusing on new investments.

It is not common for cooperatives to acquire another cooperative. As Van der Krogt et al. (2007) have shown, cooperative have a preference for mergers over acquisitions. Mergers do not involve a transfer of capital from the owners of one business to the owners of another business.

Disadvantages of a merger, compared to an alliance, is that is usually involves substantial cost of reorganisation (not only financial cost but also the risk of losing key human resources), and that the expected efficiency gains do not materialize. In addition, mergers require the hiring of expensive financial, fiscal and legal advisors.

5. Cooperatives in the Food Chain

Cooperatives can take different positions in the food chain. Because they are farmer-owned businesses, most cooperatives are active in the upstream part of the food chain. In the food chain as shown in Figure 4, cooperatives can be found mainly at the first three stages: in producing and distributing farm inputs; in supporting members in the primary agricultural production (e.g. through extension services), and in marketing the farm product. The latter task may be limited to sales, but it may also include processing of the farm product. Depending on the type of farm product, cooperatives are more or less involved in processing. In perishable products like milk, cooperatives traditionally have a large market share, while in processing storable products like grains the role of cooperatives is limited. Transaction costs and the risk of exploitation explain these differences. The reason is that perishable products cannot be stored for a long time, which is reducing the bargaining power of a farmer, potentially leading to buyers taking advantage for their negotiating power.

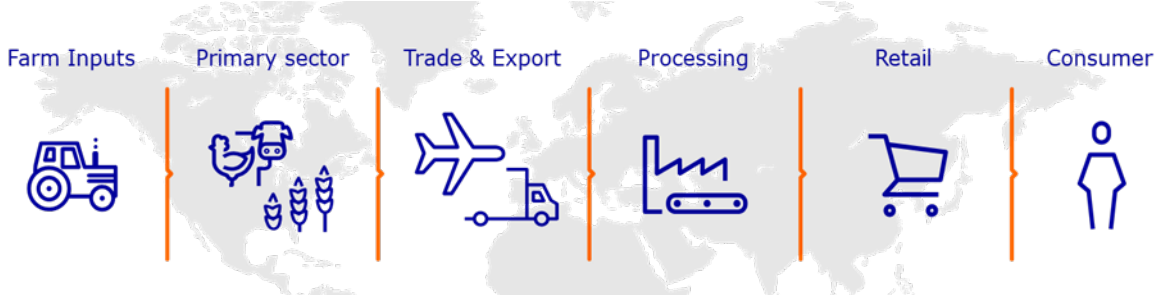

Figure 4. The food chain. Source: Rabobank (2019)

The activities of cooperatives in marketing farm product may be placed on a continuum. Some cooperatives limit themselves to collection of the products of the members and jointly bargaining with customers, other cooperatives also provide storing, sorting and packaging services, while other cooperatives process the farm commodities in a broad range of intermediate or final consumer products. Some cooperatives even engage in retail by selling directly to consumers.

Collaboration in the food chain, for instance between a cooperative and supermarket, implies that the cooperative is not just a supplier to the supermarket but that cooperative and supermarket discuss how their business transactions may evolve in the near future, what type of products will be demanded, what type of quality standards will be applied. Collaboration may be targeted to improving logistics, improving product quality, and jointly developing new products. Increasingly, collaboration between cooperatives and their buyers (including supermarkets) involves agreements on sustainability goals and standards. For instance, the now common standard for producing and delivering fresh produce – GlobalG.A.P. – has been developed in close collaboration between several supermarket companies and several suppliers of fresh produce (many of them being cooperatives).

A special type of collaboration of the cooperative in the food chain involves the relationship between cooperative and its members. In the past, the cooperative was considered a service provider for the members. The member interests always had priority. However, when member farms grown in size and diversity, and products are shipped in strictly coordinated supply chains, the cooperative and its members have become more and more strategic partners, making agreements on what to produce and how to produce even before the growers make production decisions.

Marketing & Innovation Strategies for Cooperatives

Depending on their position in the food chain, cooperatives may develop different marketing and innovation strategies. Cooperatives that focus on bargaining only are likely to have a simple marketing strategy: find the customer that is willing to pay the highest price. Of course, price is not the only sales condition that matter; the bargaining cooperative will also negotiate favourable delivery conditions and clear agreements on quality control.

Processing cooperatives, particularly those that sell branded products, follow a different marketing strategy. They advertise their products among consumers, and they need to find the most appropriate sales channel. For most food products, the supermarket is the most important sales channel, which leads to strategic interaction between cooperative and supermarket company. Cooperatives that sell differentiated products continuously work on their competitive position by advertising, developing new products and positioning their products in the market segment that delivers them the highest returns on both short and long term.

The innovation strategy will be different for other cooperatives, depending on their type of products and their marketing strategy. Table 2 distinguishes between process and product innovation. Bargaining cooperatives usually do not follow explicit innovation strategies, although when the demand for their products may shift, for instance towards

more sustainable products, farmers may have to adjust as well. For processing cooperatives that produce intermediate food products, the innovation strategy will be mostly focused on improving the efficiency of production and logistic processes. For cooperatives that produce consumer products, the innovation strategy is extremely important, as it will deliver the competitive advantage of the cooperative. By marketing innovative products, the cooperative will maintain or even improve its competitive position, both in relation to other producers and in relation to its supermarket customers.

Table 2. Process versus Product Innovation

	Process Innovation	**Product Innovation**
Definition	New elements introduced in an organisation's production, management and service process	New products or services introduced to meet or generate customer demands
Orientation	Internal focus Driven by the need to improve efficiency	Customer focus Driven by the need to add value
Activities	Apply new technology or new forms of organizing to improve the efficiency and effectiveness of business processes	Design, develop, produce and market new products
Effect on member-cooperative relationship	Minor, as the focus is on internal processes of the cooperative business	Minor for products that are produced in the cooperative business Major, in case new products originate from innovations at the member-farms

6. Cooperation with societal organisations

Cooperatives also collaborate with societal organisations representing the interests of consumers or employees, or the interest of nature and climate. Particularly the growing awareness of sustainability and climate challenges has induced cooperatives to team up with societal organisations. This previously unfamiliar type of collaboration can bring the following advantages for cooperatives. First, it may provide them an extra legitimacy among consumers and other stakeholders (including policy makers). Second, cooperatives can learn from societal organisations, particularly from nature conservations organisations, about what are good farming practices for preserving biodiversity and strengthening nature conservation. Third, cooperatives and societal organisation can develop experiments and innovation projects for which they can obtain state subsidies. Fourth, cooperatives and societal organisations can lobby for favourable policies and legislation. While in the past agricultural cooperative and nature conservation

organisations were considered as opponents, in recent years they have realized that they have much to gain when collaborating in projects or even strategic alliances.

7. The process of cooperation: the SICO framework

The SICO Framework is a tool to be used for assessing, discussing and strengthening collaboration among businesses that pursue Sustainability-Oriented Innovation (Bijman and Lucassen, 2023). The SICO Framework has been developed for application in food systems but can also be used as a generic tool to support collaboration.

Grand societal challenges, such as climate change, loss of biodiversity, and an unsecure food supply urge cooperatives in food systems to make producing, distributing and consuming food more sustainable. Innovation has long been considered crucial for economic growth and competitiveness of business. However, in the face the major sustainability challenges, innovation is increasingly important for creating broad societal value, including environmental, social and prosperity benefits. The process of innovation towards improved sustainability is called Sustainability-Oriented Innovation (SOI).

Innovation that leads to enhanced sustainability outcomes, for companies and society at large, requires collaboration among different value chain actors. However, sustainability is characterized by many uncertainties and risks. Technologies are still under development, policies are becoming stricter, and market preferences are shifting. To deal with these uncertainties, cooperatives working towards SOI need to better collaborate with their business partners.

Collaboration partners need to agree on the direction of their joint sustainability efforts and investments, need to commit to specific sustainability outcomes, and need to align individual decisions with jointly agreed targets and procedures. All this makes collaboration for SOI a challenging endeavour. To facilitate collaboration for achieving SOI, the SICO Framework has been developed (Table 3).

Table 3. The SICO Framework (source: Bijman and Lucassen, 2024)

SICO Framework			
Theme	**Sub-themes**		**Indicators**
Partner identification	A. Previous experience	A.1	Partnership experience
		A.2	Reputation of reliability of partner(s)
		A.3	Reputation of capabilities of partner(s)
		A.4	Personal ties with partner(s)
	B. Complementarity and synergy	B.1	Value chain collaboration
		B.2	Complementarity of resources and capabilities
		B.3	Goal harmonization
		B.4	Common sustainability vision
		B.5	Use of common sustainability indicators and quality standards
		B.6	Partner compatibility
Collaboration Operation	C. Communication	C.1	Face-to-face interactions
		C.2	Frequency information exchange
		C.3	Geographical proximity
		C.4	Atmosphere
	D. Coordination	D.1	Participation in decision-making
		D.2	Equity arrangements
		D.3	Use of contractual agreements
		D.4	Level of (inter)dependency
		D.5	Conflict resolution
	E. Commitment	E.1	Transparency in motives of partner(s)
		E.2	Organization support
Environment	F. Conducive environment	F.1	External organizational support
		F.2	Reputation of own organization

The Framework consists of themes and indicators that have an impact on the effectiveness of business collaboration. These themes and indicators have been found through literature review and interviews with multiple business organizations working on SOI.

The SICO Framework for strengthening collaboration during the process of Sustainability-Oriented Innovation is a generic tool for reflection. The framework is an action-oriented tool, not a normative 'how-to-do' tool. It does not prescribe how partners should behave to be good collaboration partners. The SICO Framework is also not a step-by-step checklist or a fill-in-the-blank form. It is not a blueprint on how to collaborate for SOI, simply because it is impossible to create such a blueprint. Instead, it is a tool for assessing and discussing how the process of collaboration is evolving and how partners experience the advantages and disadvantages as well as the strengths and weaknesses of this process. The Framework can be used to find solutions when challenges arise between collaborating organizations, both profit-driven and non-profit organizations. In addition, the SICO Framework is a handy tool for advisers and consultants who want to support and facilitate collaboration among businesses as well as between business and civil society organizations.

Anyone who wants to evaluate, improve or start collaboration between two or more business partners may find the SICO Framework helpful. Even in situations where the power distribution among partners is unequal, the SICO Framework can be used to detect vulnerabilities and discuss ways to deal with those weaknesses. In addition, the SICO

Framework can be used to keep partners committed to the original agreement or to enter negotiation on revising the agreement.

The SICO Framework can be helpful in all stages of collaboration. Before starting a collaboration, the SICO Framework provides guidance on identifying potential partners (C1), on the design of the collaboration (C2), and on assessing the socio-economic environment that may influence the collaboration (C3). During the collaboration, the SICO Framework helps reflecting on how the process of collaboration is evolving, what challenges are encountered, and how these challenges can be addressed. To keep the collaboration process smooth and effective, it is advised to regularly evaluate the partnership. A collaboration is a process, rather than an event. Finally, after the collaboration has terminated, one can use the SICO Framework to reflect on the success factors and challenges, to learn for future partnerships. While in time partner identification comes before operation of collaboration, there is no order of importance in the different indicators.

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Strategies to combat unfair practices for horticultural cooperative products sold directly to consumers and through sales networks

Specialized Consultancy Guide

Marketing and branding practices in agricultural cooperatives

Jos Leeters HollandDoor
April 2026

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1 Introduction

This report focuses on the marketing and branding of Dutch cooperatives with activities in the fruit and vegetable sector. It differentiates between two distinct directions: external (sales oriented) marketing and branding, focusing on realizing and maintaining a competitive commercial position in the chosen target market(s) and internal (member oriented) marketing and branding, focusing on creating a sustainable member community. After exploring the specific characteristics of those two types of marketing and branding, the report analyzes how marketing and branding strategies relate to the three-value-disciplines model of Treacy & Wiersema[1], which distinguishes between three possible strategic choices: Product Leadership, Customer Intimacy and Operational Excellence. Finally, the report shows 5 examples of Dutch cooperatives and analyzes how they operationalize and express external and internal marketing and branding. Understanding these dynamics is essential for evaluating how horticultural cooperatives contribute to the competitiveness and resilience of the members they represent in an increasingly globalized and market-driven environment.

2 Marketing and branding in Dutch horticultural cooperatives

The Dutch horticulture sector holds a prominent position in global agricultural trade. Despite the relatively small geographic size of the Netherlands, the country is among the world's leading exporters of horticultural products, including vegetables and fruits. This strong position has many reasons. Apart from a favorable geographical location, a high level of technology and innovation (based on the so-called triple helix concept [2]), the most important factor is a high degree of cooperation between growers. Within this collaborative structure, horticultural marketing cooperatives have played a crucial role since the nineteenth century. Their importance extends beyond organizing supply; they are central actors in shaping marketing strategies and developing branding initiatives that strengthen the competitive position of Dutch horticulture both domestically and internationally.

Marketing cooperatives were originally established as a response to fragmented production and weak bargaining positions of individual growers. By organizing collectively, growers were able to improve price formation, standardize quality, and gain access to broader markets. In the fruit and vegetables sector, cooperatives quickly became the main method for farmers to sell their produce in the national and international markets. Auctions were set up to bring transparency to price formation, while collective logistics and distribution enabled growers to reach buyers more efficiently. These early cooperative structures laid the foundation for the professional organizations that characterize the Dutch horticulture sector today.

Over the past 150 years, the cooperative landscape in Dutch horticulture has undergone significant transformation. Many small, regional cooperatives merged into larger and more professional organizations with international activities. These mergers were driven by increasing scale requirements, globalization of markets, and the need for professional marketing and sales expertise. A well-known example of such consolidation is The Greenery, which was founded in 1996 as a merger of nine fruit and vegetable auctions. This development reflects a broader trend in which cooperatives evolved from local trading platforms into market-oriented organizations capable of negotiating with large retail chains and international buyers. The growing concentration on the demand side of the market, particularly in retail,

[1] https://mbaknol.com/strategic-management/three-value-disciplines/

[2] Triple helix: continuous cooperation and exchange between the government, academia and the business community, driving innovation and development

further accelerated this process, making scale and professionalization essential for maintaining competitiveness.

Alongside the consolidation of general marketing cooperatives, the Dutch horticulture sector has also seen the development of specialized producer organizations. These organizations focus on specific product groups, particularly in the fruit vegetable segment. Tomatoes, cucumbers, sweet peppers, and eggplants are examples of crops where specialized cooperatives have emerged. Organizations such as Harvest House, Growers United, Prominent and more illustrate this trend toward specialization. These cooperatives combine product-specific expertise with targeted marketing strategies, allowing them to position their products more effectively in the market. In the fruit sector, Royal Fruitmasters serves as another example of a cooperative that has developed a strong identity and professional marketing approach tailored to its product category. The emergence of specialized cooperatives demonstrates how differentiation and focused branding have become increasingly important in modern horticultural markets.

Marketing and branding have therefore become central functions within horticultural cooperatives. Traditionally, horticultural products were sold as relatively undifferentiated commodities, with competition largely based on price and quality. However, changing consumer preferences, sustainability concerns, and increased competition from other producing countries have pushed cooperatives to develop more sophisticated marketing strategies. Branding allows cooperatives to communicate added value, such as sustainability, taste, reliability, and (Dutch) origin. By developing recognizable brands, cooperatives can strengthen relationships with retailers, create consumer loyalty, and reduce dependence on price competition. This shift from commodity marketing to value-based marketing requires professional expertise, strategic planning, and consistent communication.

A common theme across Dutch horticulture cooperatives is the need for professional marketing and branding in two distinct but interconnected directions. The first direction is external, market-oriented marketing and branding. This focuses on supporting the sales of the products of cooperative members. External marketing activities include positioning products in specific market segments, developing packaging concepts, promoting sustainability labels, and building relationships with retail chains and international buyers. Through these efforts, cooperatives aim to create demand, improve price levels, and strengthen the market position of their members. External branding also contributes to the reputation of Dutch horticulture as innovative, reliable, and high-quality.

The second direction is internal marketing and branding, which focuses on the cooperative itself and its relationship with members. Internal branding aims to attract new members and retain existing ones. Because cooperatives depend on the commitment of growers, maintaining a strong internal identity is essential. Members must perceive clear added value in terms of marketing support, pricing, services, and strategic direction. Internal marketing activities may include communication about cooperative achievements, member meetings, transparency in decision-making, and showcasing successful marketing initiatives. A strong internal brand fosters trust, loyalty, and alignment between growers and cooperative management.

Balancing these two directions, external and internal marketing, poses a strategic challenge for cooperative boards and management. On the one hand, cooperatives must invest in professional market positioning to compete effectively in increasingly concentrated and international markets. On the other hand, they must ensure that members remain engaged and satisfied, as the cooperative’s scale and market power depend on sufficient volume and commitment. If too much emphasis is placed on external branding without delivering value

to members, internal support may weaken. Conversely, focusing primarily on internal matters may limit the cooperative's competitiveness in the market. Achieving the right balance between these objectives is therefore crucial for long-term success.

The importance of scale further reinforces this need for balanced marketing and branding strategies. Larger cooperatives are better able to invest in professional marketing teams, market research, and brand development. They can also negotiate more effectively with large retail organizations and international buyers. At the same time, growth through mergers or member expansion requires careful internal communication to maintain cohesion. The Dutch horticulture sector demonstrates that successful cooperatives combine strong external branding with a clear internal value proposition for members. This dual focus strengthens their market power and enhances their ability to respond to changing market conditions.

In addition, sustainability and innovation have become increasingly important themes in cooperative marketing and branding. Dutch horticulture is known for its advanced production systems, energy efficiency, and efforts to reduce environmental impact. Cooperatives often incorporate these elements into their branding strategies, emphasizing responsible production and transparency. By doing so, they respond to growing consumer demand for sustainable products while also supporting members in adopting new technologies and practices. This integration of sustainability into branding further highlights the strategic role of cooperatives in aligning production with market expectations.

3 Characteristics of marketing and branding

Marketing and branding in a business-to-consumer setting (B2C) is based on 95% emotion and 5% ratio, whereas marketing and branding in B2B (business-to-business) works the other way around: 5% emotion and 95% ratio. In both situations however, having a brand is a positive asset, as it creates recognition, it shows that you are 'different than the rest' and facilitates a preference in the buying and/or choosing process. It even creates space for the decision-maker to realize that the lowest price is not the most important.

Does it also mean that with a brand you can increase your price? Yes, but indirectly. With a brand, a seller can increase its value. And with a higher value ……..… a higher prices is more acceptable.

Is having a brand the best marketing tool you can have? Yes and no. The performance of any organization, against the promises or acceptations it has made, are leading. If these promises are fulfilled, a brand name has an added value.

Having a brand name is not very common for farmers and/or their cooperatives. There's only a few good examples in global fruit and vegetable value chains of growers with full ownership in their chain. Zespri (kiwi's) is one of these.



Even for traders (importers, exporters, service providers for retail chains) it's not very common and simple to create and maintain a brand. But some are successful. The Dutch trader Nature's Pride is one of these examples with its premium brand 'Eat Me'.





Retailers are usually the ones who create their brand, and thereby ownership in the chain (examples: Albert Heijn and ALDI in European consumer markets and Wal-Mart in the US), as they know that the smartest in the chain, with the ability to claim ownership, is in a good position to making the most profit and having a stable market position.







But ownership requires much efforts, time, and budgets. And it comes with a responsibility, that doesn't end after sales. It's a continuous task to be and maintain more relevant, offer more knowledge and communicate directly to the consumer.

4 Strategic directions (three-value-disciplines)

Farmers and their cooperatives can choose how to build and communicate their name and/or brand, based on one of the three pillars of the three-value-disciplines model of Treacy & Wiersema[3]: Product Leadership, Customer Intimacy and/or Operational Excellence.

4.1 Product Leadership

If you can provide a superior, unique product that offers clear benefits and high-quality performance compared to competitors, Product Leadership may be your primary choice. It implies in your marketing and branding:

- emphasizing quality, innovation, and special characteristics (organic, specialty varieties, sustainability)
- developing premium branding (e.g., storytelling about origin, terroir, farmer expertise)
- investing in product development (new varieties, value-added processing) and premium packaging
- using certifications as brand signals (organic, fair trade, regional labels, geographical indication)
- highlighting uniqueness and innovation in your PR and communication

4.2 Customer Intimacy

The basic concept of Customer Intimacy is building close relationships with individual buyers to increase sales and retention. It's all about tailoring solutions to each customer's needs to create exceptional value over time. It's about understanding and serving specific customer segments and it has the following implications for your marketing and branding:

- building long-term partnerships with buyers (e.g., supermarkets, wholesalers)

[3] https://mbaknol.com/strategic-management/three-value-disciplines/

- tailoring product offerings to customer needs (custom packaging, volumes)
- emphasizing trust, traceability, and farmer stories
- engaging in direct marketing (farm-to-consumer channels, CSA models): co-branding
- highlighting personal approach, transparency, and the relationship in your PR and communication

4.3 Operational Excellence

If you are able to go for continuous improvements in your operation, to focus on growth and execution of your strategy better than your competitors by building efficient and smooth processes, Operational Excellence may be the foundation for your marketing and branding strategy. The main implications for your B2B marketing and branding are:

- framing the cooperative as reliable and efficient
- emphasizing consistent quality, availability, and competitive pricing, based on volume contracts
- promoting scale advantages and streamlined logistics, based on supply chain principles
- highlighting professionalism and operational reliability in your communication

4.4 From strategy to marketing strategy and branding message

Although focus on a single strategy usually works best, a cooperative may choose for a combination of value disciplines. The consequence of the choice for a certain key discipline of the cooperative on the content of its marketing strategy and branding message, is in the below matrix.

Value discipline	Cooperative focus	Marketing strategy	Branding message
Product Leadership	Innovation, specialty crops	Differentiation marketing	Premium, unique, sustainable
Customer Intimacy	Relationships, customization	Relationship marketing	Trust, transparency, local
Operational Excellence	Efficiency, scale	Cost leadership & reliability	Consistent, dependable

Dutch cooperatives often lead in one pillar, but maintain acceptable performance in the others. Examples:

- The vegetable cooperative United Growers has a clear focus on Customer Intimacy, whereas the member-cooperatives under United Growers (Green Diamonds, Prominent, Purple Pride, SweetPoint and PapriCo) primarily focus on Product Leadership (section 5.2).
- The fruit cooperative Fruitmasters is strong in Product Leadership with its premium variety branding, but also scores high on Operational Excellence, based on scale, and on Customer Intimacy, based on dedicated and tailored relationships management with retail chains all over Europe (section 5.5).

5 Dutch best practices

5.1 Royal ZON

5.1.1 Facts and figures

Royal Cooperative Producer Organisation of South-East Netherlands Royal ZON is one of Europe's largest grower cooperatives since 1915. It has approximately 130 growers on 350 ha of greenhouse horticulture and 2,850 ha open field. The top 10 assortment is: tomato, bell pepper, cucumber, (white) asparagus, leek, berries, iceberg, radish, courgette, gherkin. The working arm of ZON has around 100 employees.

Zon is located on a A1 location (an EU logistics hotspot), in the 2nd largest production area of the Netherlands, with perfect trimodal connections (water, road, rail) to more than 40 million consumers nearby, including the large consumer market in the German North-Rhine-Westphalia (NRW) state.

ZON's MISSION: producer organisation that aims for the lowest possible costs for the grower and the highest level possible of services.

ZON's VISION: contribute towards a healthier life with future-proof fruit and vegetables in short, fresh international supply chains.

ZON's AMBITION: growers greatly enjoy working together with ZON; customers greatly enjoy buying at ZON and employees greatly enjoy working at ZON.

5.1.2 External sales, marketing and branding

Although offering a wide range of fruit and vegetables, ZON's primary strategic focus isn't based on Product Leadership as such. Customer Intimacy and Operational Excellence are the cornerstones of its market approach, with (expansion of) key account management to retail as ZON's key commercial goal. ZON has developed tailored sales instruments for its targeted buyers in different market channels:

- a digital platform, with the auction clock used as the main instrument for day trading for exporters, wholesale and food service
- a digital environment for direct sales & deliveries of the goods to the largest (retail and processing) clients
- a dedicated sales approach for the processing industry

Apart from these sales services, ZON also offers to its clients:

- transport and logistics
- quality control
- sorting and packing
- quality assurance

5.1.3 Internal marketing and branding

ZON's origin is in the Southeast part of the Netherlands, close to the German border. In terms of language and business mentality, the German neighbours are kind of similar to the Dutch, which has meant from the beginning that ZON considers both Dutch and German farmers as its primary target group. It's not surprising that growers (members and potential members) in the entire southeast part of the Netherlands and a wide cross-border circle in Germany, have a high priority in the strategic-commercial principles and goals of ZON. All for internal purposes: trying to bind and maintain a strong community of farmers. The strategy mentions three dimensions:

- improving and intensifying cooperation with members by focusing on relationship management and facilitation of member growth ambitions
- being the number 1 choice for non-affiliated growers (non-members)
- cooperation with other producer organisations

Services go far beyond facilitation of the transaction process as such, including:
- knowledge sharing in general
- transport and logistics
- agronomical advisory (growth management)
- business development, including advisory on certifications, sustainability and beyond

Through regular farm visits, ZON product managers help members improve crop planning, quality standards, and market positioning. The cooperative organizes workshops, training sessions, and innovation projects where farmers can exchange best practices and learn about new cultivation techniques, sustainability requirements, and technological developments. This continuous professional support helps members remain competitive and confident in their partnership with ZON.

In addition, ZON promotes transparency and involvement in decision-making. Members are kept informed about market trends, pricing developments, and strategic initiatives through newsletters, digital platforms, and regional meetings. By actively inviting feedback and encouraging participation in committees and working groups, the cooperative ensures that farmers feel heard and valued. This sense of ownership strengthens the bond between members and the organization.

To attract new members, ZON highlights the benefits of collective marketing, stable sales channels, and access to a strong network of buyers. Potential members are often invited to informational sessions and farm visits, where they can experience firsthand the support structure and cooperative culture. ZON also showcases success stories of current members and demonstrates how collaboration leads to improved market access and long-term business stability. These efforts make joining the cooperative appealing for growers seeking both economic security and professional support.

5.2 United Growers

5.2.1 Facts and figures

Growers United has a special organisation and governance. Since a few decades, the Netherlands has seen the establishment of product-specific producer organisations in the greenhouse sector. Highly specialised farmers in one particular (greenhouse) crop started to collaborate, largely out of a sort of dissatisfaction with the large, multi-product cooperatives that could not always offer the best services specifically for their product group, such as The Greenery (see section 5.4) and ZON (see section 5.1).

Good examples are:
- Green Diamonds (cucumbers)
- Prominent (tomatoes)
- Purple Pride: (eggplants)
- SweetPoint and PapriCo (sweet pepper)
- Harvest House (tomatoes, cucumbers, sweet peppers)
- Fossa Eugenia (wide assortment)

United Growers was founded in 2020 to add more commercial power to 4 of these product-specific producer organisations, being the sales arm with a dedicated focus on packaging and sales of the products of these 4 groups: cucumbers, tomatoes, eggplants and sweet peppers.

5.2.2 External sales, marketing and branding

Whereas Product Leadership is the driving force for the affiliated producer organisations, Customer Intimacy is the leading goal of United Growers, with the European retail sector as its primary channel.
United Growers sells vegetables of the 25 members (family businesses) of the producer organisations, producing at > 90 locations, not only in the Netherlands, but also in Belgium, Spain and Marocco. In fact, the 4 producer organisations, being cooperatives by themselves, function as brands for Growers United in its sales and marketing. The production base is:

- 82 ha cucumbers by product group Green Diamonds: producing 73 million cucumbers per year
- 493 ha tomatoes by product group Prominent: producing 283 million kg tomatoes per year
- 82 ha eggplants by product group Purple Pride: producing 44 million kg eggplants per year
- 176 ha sweet pepper by product groups SweetPoint and PapriCo: producing 50 million kg sweet peppers per year

The value chain for United Growers includes breeding and the cooperative even runs a research and test centre, serving all growers. Sustainability is a key theme in all activities of the cooperative. It includes a transition to fossil free energy, wate reduction, chemical free and water neutral production.

5.2.3 Internal marketing and branding

Growers United focuses strongly on cooperation and shared ownership. The members are in fact double members: member of the product cooperative and member of the sales cooperative United Growers. In United Growers they are not only suppliers but also co-owners who hold shares in the cooperative and invest jointly in facilities, such as packaging lines tailored to customer specifications. This creates long-term commitment and financial involvement.

The cooperative also binds members through:

- knowledge sharing and collaboration; growers exchange expertise and support each other in crop specialization or switching crops
- network advantages; members benefit from a strong commercial network and shared purchasing of inputs and energy;
- business continuity solutions – growers can merge operations with other members, which helps companies without successors and strengthens long-term cooperation.

These elements encourage loyalty because members gain economic advantages, knowledge, and long-term security within the cooperative.

Mouth-to-mouth is an important way of finding and binding new members. But not everybody can join. United Growers has a selective admission process: "new members are welcome, provided they are a good match for the Growers United strategy, So, United Growers does have expectations for potential new members. They look for growers who:

- have a cooperative mindset and are willing to collaborate with others
- are open and supportive within the network
- are fully committed to strict quality standards
- fit the strategic direction of the cooperative

5.3 ABB

5.3.1 Facts and figures

ABB Growers was established as a cooperative in 1998 and is a blueberry specialist with a full-service package (fresh and frozen) through sourcing in both hemispheres and year-round availability and sales. It started in the southeast region of the Netherlands, where the head office is still located, but over the years the globe became the working area of ABB. Product Leadership is the key starting point for ABB, but Customer Intimacy and Operational Excellence are also on a high level.

The cooperative represents 190 growers with 1,160 ha blueberries, producing 10 million kg per year. The strong product focus allows ABB to build deep expertise and position themselves as a dedicated partner for retail and foodservice customers. ABB's MISSION is to give blueberries a permanent place in people's daily lives by connecting growers, customers and consumers across borders and seasons.

5.3.2 External sales, marketing and branding

ABB supplies European:
- retail (supermarkets and specialty stores)
- wholesale (distributors and foodservice suppliers)
- foodservice (ingredients for processing and gastronomy)

The commercial strategy is shaped around premium quality (based on selected strong varieties), year-round supply and long-term retailer partnerships. ABB emphasizes consistent quality and strict sorting based on size, firmness, flavour, and origin. ABB uses advanced sorting technology and quality checks for every batch.

A key element of ABB's commercial strategy is ensuring continuous availability. ABB works with a global network of growers in multiple countries to supply blueberries throughout the year. This helps ABB meet retailer demand and remain a reliable partner, reducing seasonal gaps and thereby strengthening negotiating power with retailers. It also allows ABB to work in short and transparent supply chains, and thus ABB can position itself as connector of the entire chain from grower to customer, creating efficiency and transparency.

5.3.3 Internal marketing and branding

ABB attracts and binds blueberry farmers mainly through technical support, market access, long-term cooperation, and price/quality incentives. At the same time, they work with clear expectations regarding quality, planning, and collaboration before new growers can join their network.

ABB guides existing members and affiliated farmers throughout the entire cultivation process, from variety selection and crop strategy to harvest planning and quality monitoring, which helps farmers improve yields and align production with market demand. Their internal guidelines mention:
- grower support and on-site advice: specialists visit farms, analyse conditions, and set quality and production goals together with growers
- planning and logistics coordination: growers receive clear schedules for harvest, volumes, and delivery expectations
- quality feedback and data reports: each batch is evaluated, and growers receive improvement points for future seasons

- training and knowledge sharing: meetings and online sessions allow growers to exchange experience within the network
- long-term relationships: ABB Growers explicitly aims to build "long-term partnerships" with growers for better returns and consistent supply

ABB actively invites growers worldwide to collaborate, which takes place by the ABB-representatives in the field and through regular market visits and trade fair participation. However, ABB does not publish how they deal with members and non-members and which rules and regulations are in place for members and for non-member suppliers. But their collaboration model implies clear practical entry expectations:

- compliance with strict quality standards: all blueberries are selected based on freshness, flavour, firmness, and origin
- ability to meet agreed volumes and planning: supply is coordinated through detailed agreements and regular communication
- willingness to follow cultivation guidance: growers are expected to cooperate on variety selection, harvest planning, and quality monitoring
- certification and traceability: production must align with recognized standards and traceable supply chain requirements.

5.4 The Greenery

5.4.1 Facts and figures

The Greenery was established in 1996 after a merger of 9 fruit and vegetables cooperatives in the Netherlands. All 9 cooperatives had a long history in various regions of the country, some more than a century. But they all had hard times. Giving the changing market dynamics. The merger was driven by major shifts in the market:

- rapid scale expansion and growing international competition
- a transition from supply-driven auctions to a demand-driven retail market
- the need for tighter integration between production, logistics, and retail

The merger created a new, centralized cooperative with a strong business entity to handle marketing and sales for member growers. Over time, The Greenery transformed the old auction system into a modern supply chain model, combining logistics, marketing, quality management, and innovation. The initiative helped Dutch growers maintain market access and competitiveness amid the rise of European retail chains. Whereas The Greenery had 10,000 members at the start, today, between 350 and 400 growers are members, making it still one of Europe's leading fresh produce cooperatives

5.4.2 External sales, marketing and branding

The core strategic strength of The Greenery lies in the combination of Customer Intimacy and Operational Excellence, with a retail-focused sales strategy. The commercial strategy includes:

- chain integration and chain control by direct collaboration between growers, logistics partners, and retailers to reduce intermediaries
- customer-driven supply by sourcing, packaging, and delivering according to the exact demands of retail, wholesale, and catering customers across Europe
- year-round assortment by integrating both Dutch-grown and imported produce
- sustainability and fair pricing
- data-driven innovation by using research and consumer data to develop category plans, innovative packaging, and marketing concepts that support retail partners

- logistics excellence, with advanced supply chain solutions like storage, inspection, packing, and refrigerated transport

On an operational level, the sales team provides:
- tailored quality sourcing and commercial support to distribution centres of retailers, based on category management and sales support;
- data and market research, category plans, sales support programs, innovative concepts and sustainable packaging solutions, all tools that help retailers optimize assortments and improve sales performance.
- trade marketing and in-store promotion concepts, such as shelf plans and product mix advice, in-store displays and promotional materials, and exclusive brands and tailored product ranges
- consumer-oriented services through the online platform Verse Oogst, informing (Dutch) consumers about product origin, recipes, and grower stories. This strengthens brand perception and stimulates demand, indirectly supporting channel sales.

Besides retail, The Greenery supplies wholesalers and exporters with flexible volumes and fast deliveries. The commercial staff uses modern tools, such as ERP systems and EDI communication for orders, confirmations, scanning, and invoicing.

5.4.3 Internal marketing and branding

The most relevant argument for The Greenery to bind its members, same as for all other marketing cooperatives, is performing well in the market through collective bargaining power by a professional sales and marketing team. Guaranteed access to large retail, wholesale, and foodservice customers, thereby reducing individual sales risk, is the key motivator to stay and/or come on board.

The Greenery uses several communication, governance, and engagement tools to share knowledge and manage relationships with its member-farmers. These instruments ensure both information flow, member involvement as well as finding new members through mouth-to-mouth communication:
- dedicated staff and personal contact through a team of account managers and grower relationship managers, focusing on interaction on various fields such as crop planning, market demand, pricing developments, and operational issues; technical specialists and category managers also support growers with market and production knowledge
- governance and formal member structures, especially the general members' assembly, the member council, advisory committees, committees per product group and regional member meetings; these structures strengthen member participation and long-term relationships
- seminars and workshops on topics such as sustainability, retailer requirements, and innovation, as well as trainings and webinars (also for remote growers), field days and demonstrations
- a member magazine with updates on market trends, success stories, and cooperative news and a digital newsletters (email) with frequent short updates and operational information
- a member website / portal with market information, planning tools, documents, and updates and online dashboards with sales data, pricing information, and forecasts
- relationship-building initiatives, such as grower visits by the management.

5.5 Fruitmasters

5.5.1 Facts and figures

Fruitmasters was founded in 1904 and is the largest cooperative in the Netherlands in the fruit sector, serving around 400 members. Fruitmasters strongly focuses on marketing and branding, based on an active sourcing policy and concept development. Fruitmasters has a wide fruit assortment, covering apples and pears, berries, stone fruit, grapes and exotic fruit.

Apples and pears mainly come from the Netherlands; Fruitmasters developed various varieties, such as KANZI®, Tessa®, Morgana®, Bloss®, Joly Red® and the pear variety Migo®.

Berries are grown in the Netherlands, but Fruitmasters imports from all over the world in order to deliver year-round supply; a selection of strawberries, blueberries, blackberries, raspberries and red berries from Dutch soil are being marketed under the concepts Bob's (Best of Berries) and Prestige®.

Stone fruit mainly comes from the Netherlands, with cherries and plums being popular and having the highest quality and reputation.

Grapes and exotic fruit (like lemon, grapefruit, kiwi, mandarin, orange and pomegranate) are all imported.

Industrial fruit, especially apples, pears and strawberries with damaged skin or flesh are delivered to the processing industry, bakeries, hotels and catering companies.

5.5.2 External sales, marketing and branding

Product Leadership, mainly built on premium varieties, is the cornerstone of the commercial strategy of Fruitmasters. But both Operational Excellence Customer Intimacy get much attention as well. In practice, the Fruitmasters management and staff (around 200) are serving the domestic and (nearby EU) supermarket channels as well as wholesalers and players in the processing and foodservice industry, driven by the following approaches:

- market-oriented and demand-driven sales, designed to respond flexibly to changing demand and retail consolidation; Fruitmasters works according to its "Healthy Growth 2030" roadmap
- integrated chain coordination and control (from breeding , cultivation, sorting, packaging, branding to in-store presentation)
- focus on quality assurance, reliability, and traceability
- product and variety differentiation; this is considered as a Unique Selling Proposition of Fruitmasters; the cooperative invests in distinctive varieties and market-driven assortments, such as new apple or berry concepts, thereby creating added value and differentiation
- efficiency and logistics-driven sales support, supported by professional automation, centralization, and advanced logistics facilities, ensuring freshness and speed from grower to retailer.

5.5.3 Internal marketing and branding

Similar to Royal ZON (section 5.1) and The Greenery (section 5.4), Fruitmasters has a history of more than a century and has built various mechanisms to bind its members. Fruitmasters

uses the following approaches and tools to manage relationships with its member-farmers and to keep them on board:

- the governance structure as such, based on co-ownership by the members: the growers can vote in the assembly on strategy, investments (e.g., sorting facilities, storage) and the board composition; it gives them a sense of control and influence, reducing the incentive to leave
- mandatory or semi-mandatory supply commitment by the members to supplying a large share (often all) of their fruit through the cooperative, thereby creating structured supply obligations, making it possible to pool the fruit in large volumes and market collectively; revenues are averaged and redistributed to growers, which is considered as the fairest way of selling; growers receive advance payments in the season and final seasonal settlements (top-ups/bonuses) after ending of the sales season
- various services and technical support, with a large team of field / relations managers, providing:
  - production planning coordination among growers
  - agronomic advice (crop management, disease control)
  - quality control, built on strict quality specifications
  - uniform packaging and grading standards
  - supports with certification, food safety, and quality supervision
  - storage, sorting, packaging infrastructure
  - logistics and cold-chain management
  - innovation in varieties and cultivation methods

Last but not least, beyond economics, there is also a cooperative culture, which is kept alive in regional grower networks. This creates social cohesion, trust and motivates members to staying inside the system.

6 Change never stops

The role and functioning of cooperatives must be considered as ever-changing mechanisms. We have seen and we will see in the future the rise and fall of agricultural cooperatives. Simply because of changing geopolitical and economic situations and because of changing needs and expectations of consumers, traders and retailers. Same as for many other sectors and organisations, keep in mind that development, innovation and change never really stop. Here's some food for thoughts:

Change is the only constant (everything is always changing, so every innovation is temporary)

If you're not moving forward, you're falling behind (progress is continuous; standing still effectively means losing ground)

Necessity is the mother of invention (new needs constantly create new innovations, meaning invention is an ongoing cycle)

One generation's innovation is the next generation's starting point (every breakthrough quickly becomes outdated and replaced)

What's new today is old tomorrow (short lifespan of "newness" in a fast-changing world)

Project number: 2024-1-RO01-KA220-VET-000255736

Strategies to combat unfair practices for horticultural cooperative products sold directly to consumers and through sales networks

Specialized Consultancy Guide

Tips Entrepreneurship, Partnerships, Post-Harvest, Value Chain Management

Engelie Beenen, HollandDoor
April 2026

Erasmus+

Projectnumber: 2024-1-RO01-KA220-VET-000255736

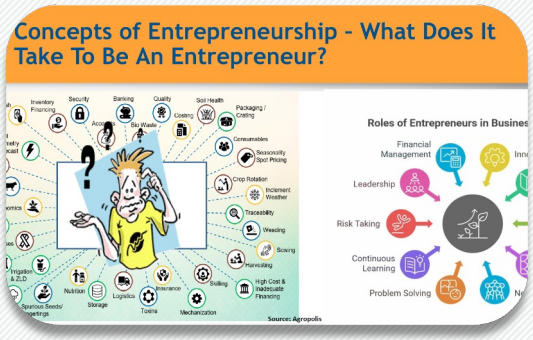
Golden Tips

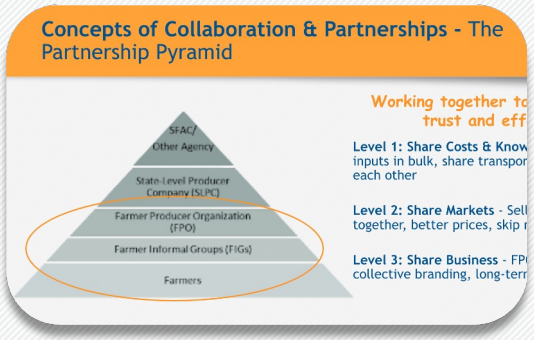
HollandDoor
Connecting the Agroworld

Integrated tip guide for horticultural cooperative members

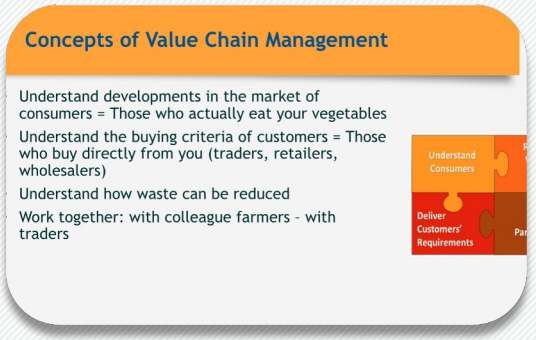
Combination of Entrepreneurship, Partnerships, Post-Harvest & Value Chain Management

Contents









Chapter 1
Entrepreneurship

Chapter 2
Partnerships

Chapter 3
Post-Harvest

Chapter 4
Value Chain Management

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Chapter 1: Entrepreneurship

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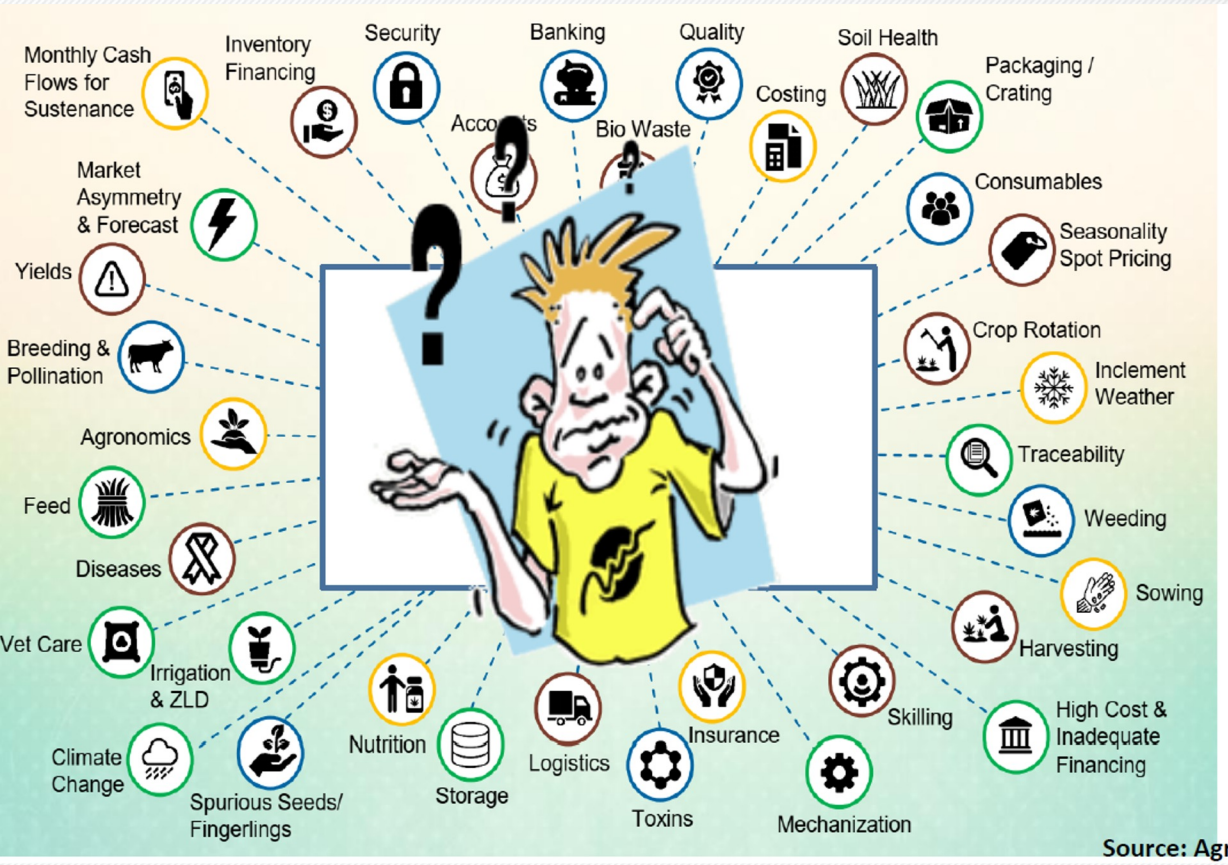
Concepts of Entrepreneurship - What Does It Take To Be An Entrepreneur?



Source: Agropolis



Concepts of Entrepreneurship - Discover Your Business Opportunities

Complexity

Product improvements – better product

Value addition – new product

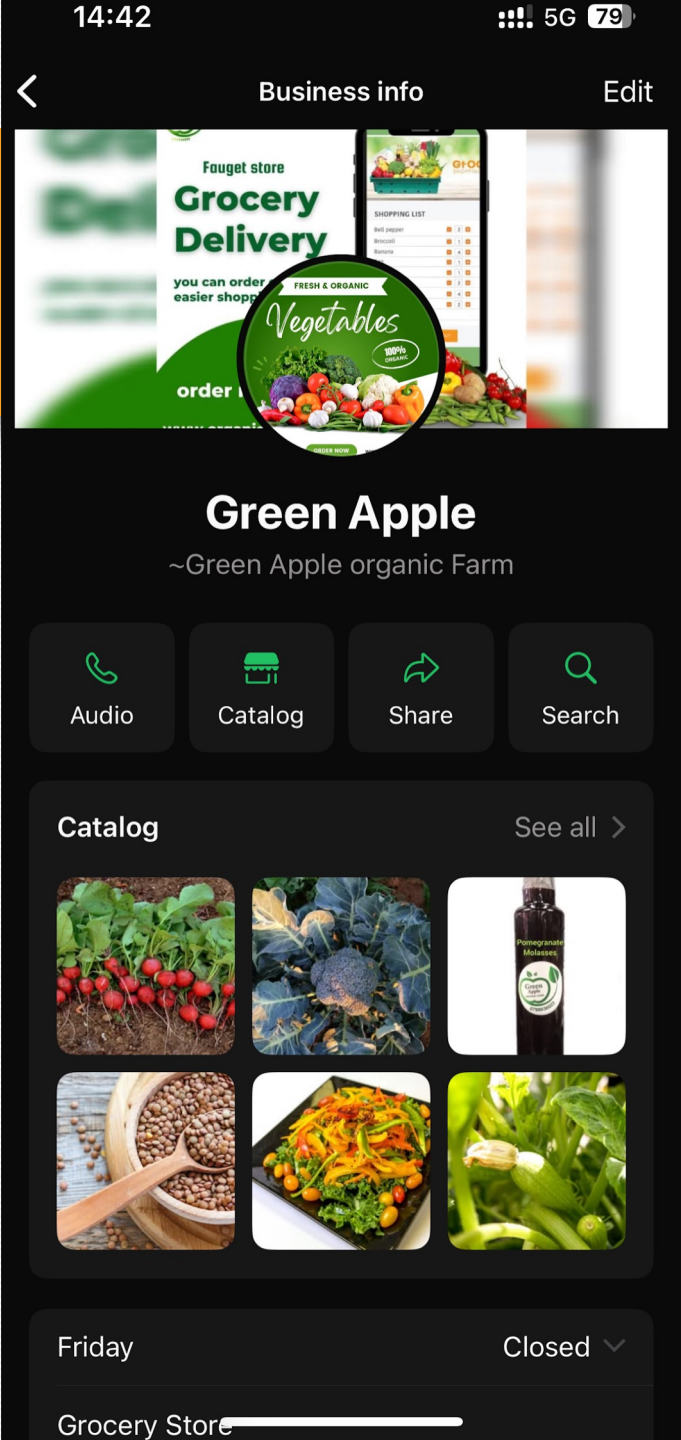
(Online) marketing – WhatsApp sales

Farm experiences – agri-tourism

Agricultural services – consulting

"Every successful business solves a problem - what problem will you solve?"





Golden Tip #1: Start With What You Know

❌ **AVOID:** Jumping into business you know nothing about

✅ **DO THIS:** Build on your existing skills and networks

What do I have now?

Your land - Use what you already have more efficiently

Your crops - Improve vegetables you're already growing successfully

Your skills - Build on farming knowledge you've developed

Your network – Use it as extended team – peer consulting



Your biggest opportunity might be right in front of you

Test protected cultivation - Start with simple poly tunnel

Upgrade your varieties - Try disease-resistant or high-yield seeds

Improve your quality - Better harvesting timing, presentation

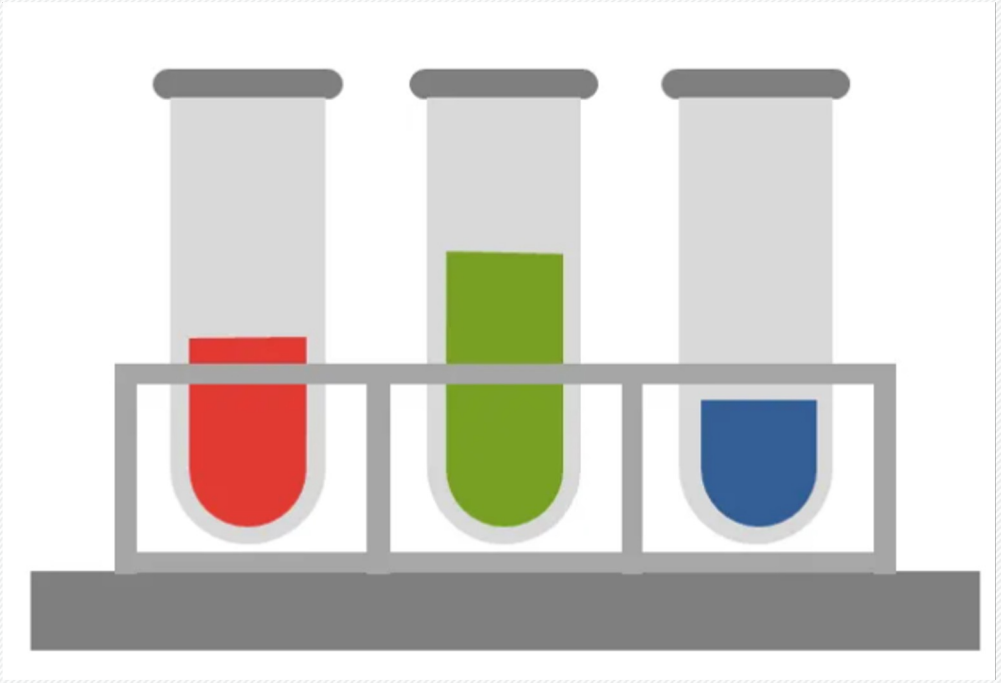
Fulfill one market need or opportunity together

Golden Tip #2: Try, Fail, Improve, Repeat

❌ **AVOID:** Making big expenditures immediately

✅ **DO THIS:** Run mini-experiments to prove your concept

Failure is only the end if you decide to stop.



The Entrepreneur's Testing Method

Packaging improvement:
Test new ideas for small plot first
Try branded crates with 20 boxes only
Experiment in single low-tech greenhouse

Learn fast, adjust quickly:
Set 3-month test periods
Try two approaches side by side
Document what works

Golden Tip #3: Know Your Business Figures

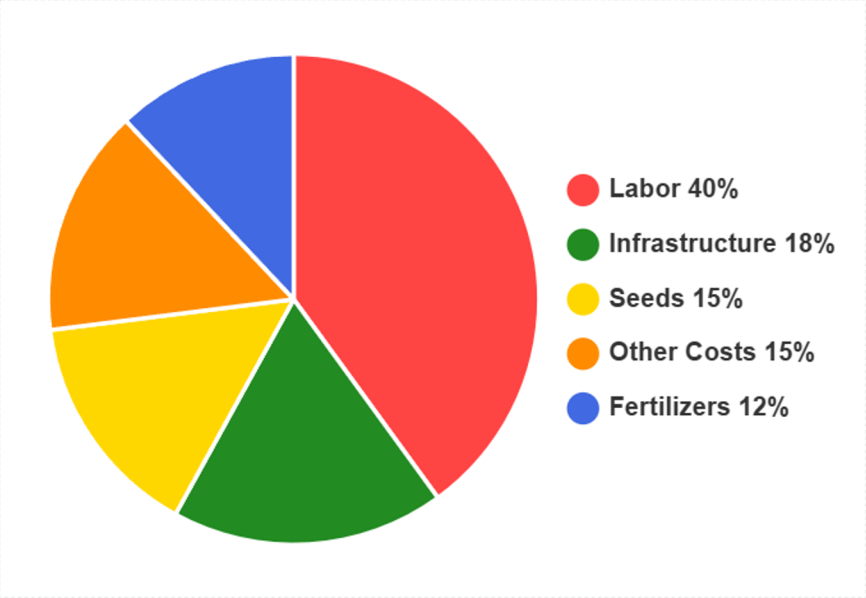
₹

❌ **AVOID:** Guessing if you're making money

✅ **DO THIS:** Calculate your costs and profits

Get organized!

- ❑ Calculate cost per kg of production
- ❑ Know your profit margin percentage
- ❑ Understand where your money goes



Expense estimates

You can't manage what you don't measure

Use simple tools

Take pictures and upload receipts for all farm expenses

Use smartphone Apps for expense tracking, harvesting, or crop protection record keeping

Golden Tip #4: Expand Your Knowledge & Network

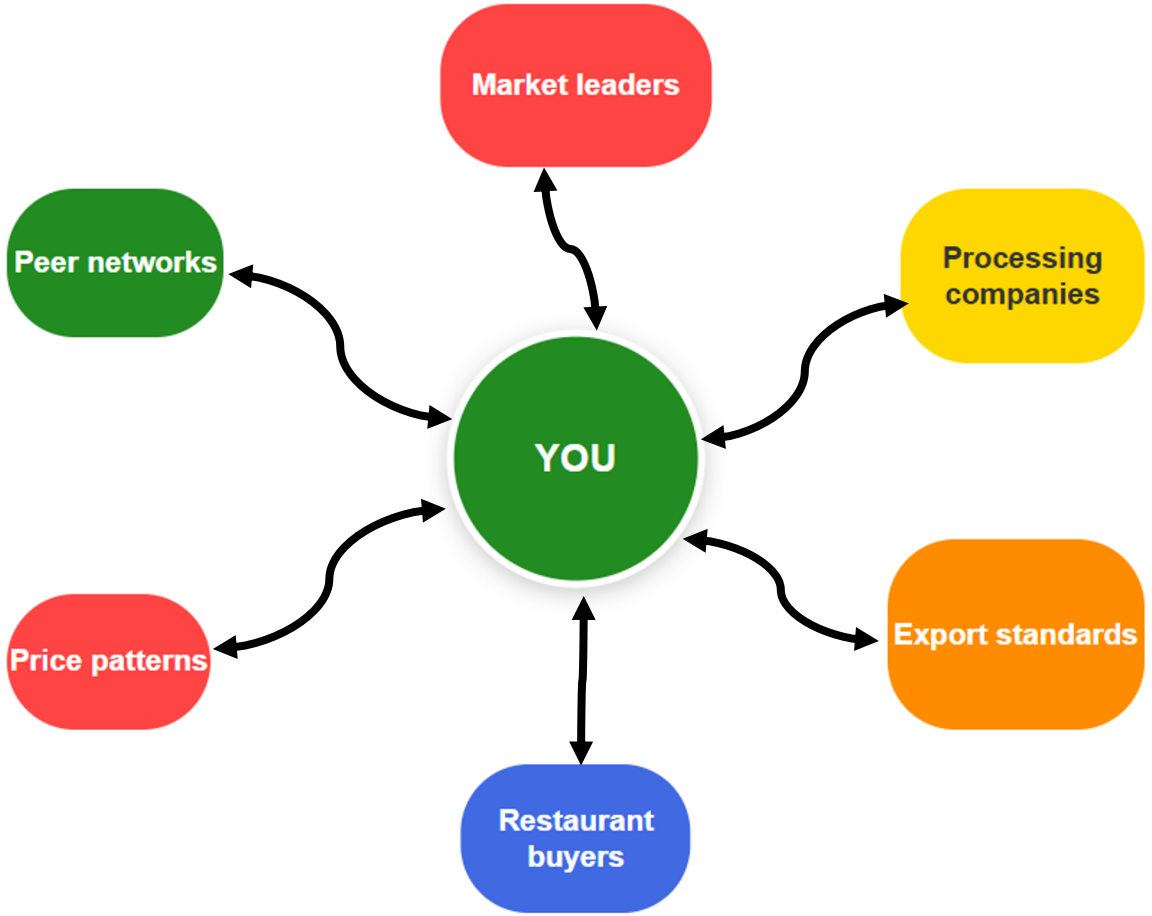
❌ **AVOID:**
Figuring everything out alone

✅ **DO THIS:**
Learn from your peers and your customers

Your network is your net worth

Study successful businesses:

- Research how top agri-businesses price, package, and market their products
- How do they work together with their partners
- Connect with entrepreneurs who've solved similar problems and expand your professional network in-person and online



Golden Tip #5: Access Finance and Funding

Scaling up? You might need financing

❌ **AVOID:** Expecting free money without own investment

✅ **DO THIS:** Show commitment in time and money

Funding landscape:

- NABARD subsidies and government schemes
- PM-KISAN
- Pradhan Mantri Fasal Bima Yojana
- Kisan Credit Card
- Micro-finance institutions
- FPO loans
- Community funding
- Equipment financing
- Input supplier credit



Put your money where your mouth is

Invest your own savings first - shows commitment to lenders

Prove concept works before asking others for money

Remember: investors fund people who share the risk

Golden Tip #6: Plan & Perseverance

❌ **AVOID:** Expecting succes with one ‘trail’, or within three months



- ❑ Test – Limit the number of details – but make them perfect
- ❑ Skills and attitude are more contributing to succes then money

✅ **DO THIS:** Plan, act, learn, adopt, improve and try again

Dream & Do
Love what you are doing

- ❑ Try one thing you never did before
- ❑ Learn from it, what did you (dis)like and try another aspect
- ❑ New cultivation technique, speaking with traders, reading about market developments, maybe agri tourism?

Behind every success are 10 failures

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Chapter 2: Partnerships

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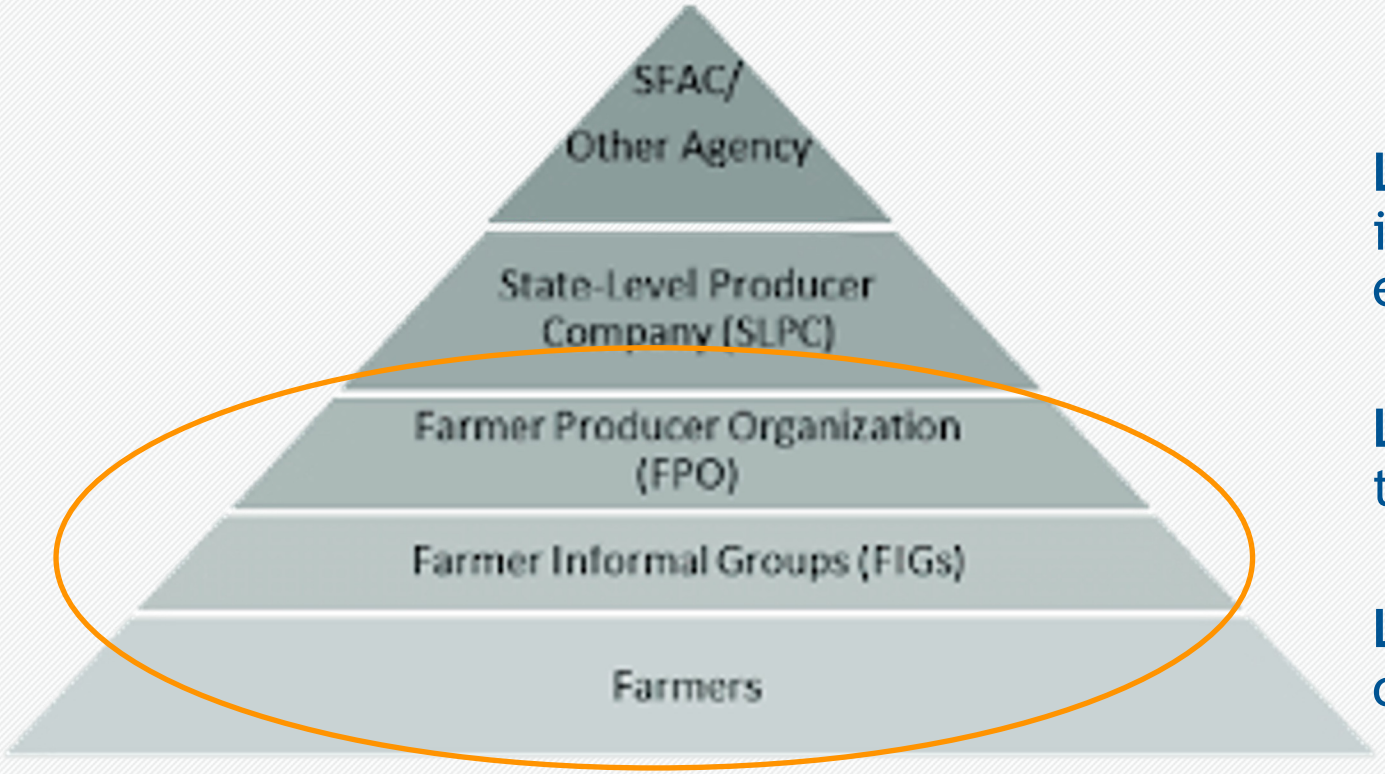
Concepts of Collaboration & Partnerships - The Partnership Pyramid



Working together takes time, trust and effort

Level 1: Share Costs & Knowledge - Buy inputs in bulk, share transport, learn from each other

Level 2: Share Markets - Sell produce together, better prices, skip middlemen

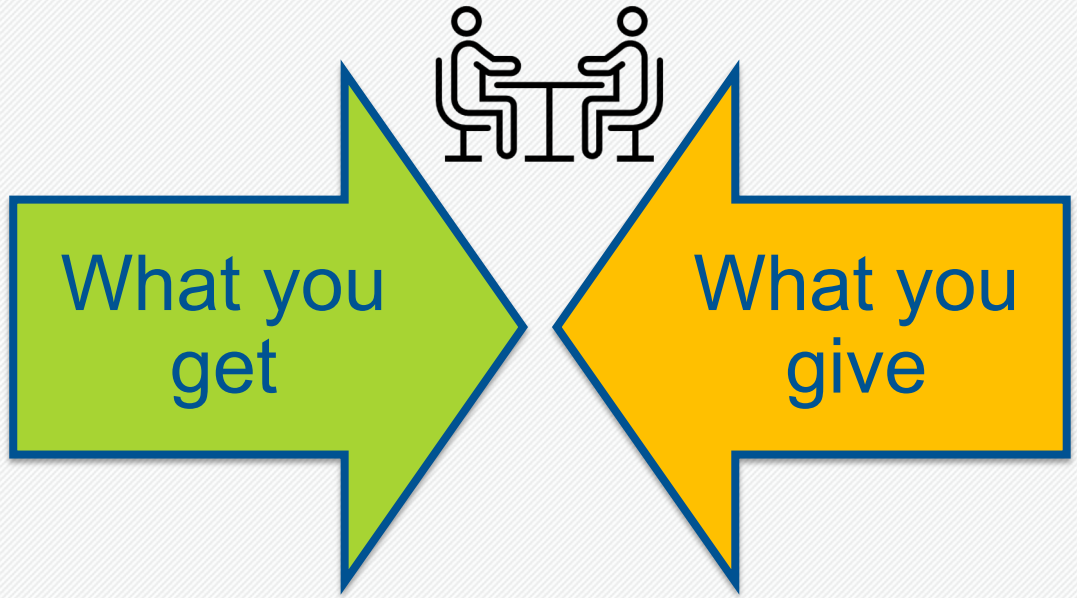
Level 3: Share Business - FPO formation, collective branding, long-term contracts

Golden Tip #1: Understand What Partnership Means

❌ **AVOID:** Thinking partnership is just "working together sometimes"

✅ **DO THIS:** Discuss what you can gain and what you can give

"Am I ready for regular meetings and flexible planting schedules?"



Lower costs & better prices - Bulk buying, skip middlemen

Shared knowledge & risk - Learn from others, support during bad times

Weekly 1-hour meetings
Plan together, make group decisions

Transparency & reliability - Share real costs, show up consistently

Golden Tip #2: Choose the Right Partners



❌ **AVOID:** Partnering with anyone who's willing

✅ **DO THIS:** Look for farmers who share your goals

Watch their current farming - Do they keep promises to family/neighbors?

Start with low-risk activity - Market information sharing, not money

Your partner checklist

- ☐ **Farm similar crops**
  Same harvest timing, same buyers
- ☐ **Live close enough**
  Maximum 5km distance for practical coordination
- ☐ **Have similar farm size**
  Avoid big farmers dominating small ones
- ☐ **Show up consistently**
  Already reliable in other village activities

Golden Tip #3: Work on Your Market Channel

❌ **AVOID:** Everyone selling individually to whoever pays today

✅ **DO THIS:** Choose one market channel and work it together



Visit buyers together and learn what they actually need!

Local market - Split transport, take turns selling, share stall space

Collection center - Meet quantity requirements together

Direct to hotels/restaurants - Reliable weekly supply as a group

Golden Tip #4: Be Reliable as a Group

❌ **AVOID:** Letting buyers down when one farmer fails

✅ **DO THIS:** Have backup plans when members can't deliver



Practice grading produce together before selling!

Quality checking together – Sort and grade produce before it goes to buyer

Backup plan when someone can't deliver - Group covers for each member

Communicate with your buyer - in case plans change at the last minute

Golden Tip #5: Formalize or Find New Partners?

❌ **AVOID:** Staying in partnerships that don't work or stay informal

✅ **DO THIS:** Use the partnership traffic light system

🟢 **GREEN LIGHT □ Time to formalize**

After 6+ months of success, buyers asking for guaranteed volumes – Do you need to formalize your group?

Handling larger amounts of money – Do you need formal accounts and transparency?

🔴 **RED LIGHT □ Find New Partners**

Frequent arguments about money – Is the trust broken?

Members regularly missing commitments – Are you partners reliable?



🟡 **YELLOW LIGHT □ Re-evaluate**

Some success but not growing – Are your goals ambitious enough?

Partners starting to lose interest – Time to re-motivate or change approach?

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Chapter 3: Post-Harvest

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Concepts of Post-Harvest Management

Losses from farm to market are expensive

Improve your post-harvest practices to reduce waste!

🌱 **Harvest:** 100% of your vegetables

📦 **Sorting, grading, packaging:** 10-15% of produce lost or damaged

🚚 **Transport:** 10-15% of produce lost or damaged

🛒 **Market**: 5-10% of produce lost before it reaches the consumer



Only 60-75% of initial harvest reaches the consumer!

Golden Tip #1: Plan Before You Start

❌ **AVOID:** Waiting until season start to organize yourself

✅ **DO THIS:** Make a growing plan before buying your seeds







Right varieties – Choose seeds known for disease tolerances and shelf life

Know the market peaks – Grow varieties that start earlier or finish later to get a higher price

Prepare infrastructure – Get crates, knives, shade cloth, transport ready beforehand

Planning = saving money!

Golden Tip #2: Instruct Your Team

❌ **AVOID:** Let workers harvest how they always do

✅ **DO THIS:** Train and check workers on proper harvest methods



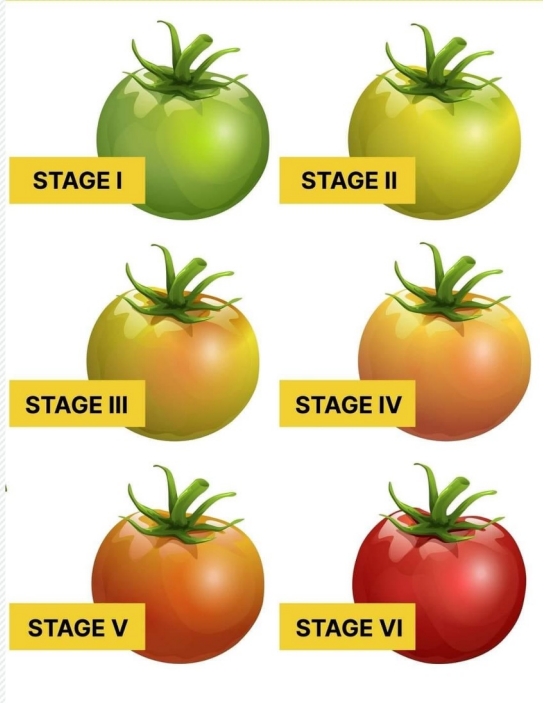
Picking techniques – Demonstrate proper picking technique and give them the tools

Keep it cool – Move harvested vegetables to shaded area and cover with wet cloth

Golden Tip #3: Sort & Grade for Better Prices

❌ **AVOID:** Mixing good and damaged produce together

✅ **DO THIS:** Sort and clean for better prices



Make your product stand out!

Clean vegetables – remove dirt before bringing to market

Harvest timing – Train workers on maturity signs and sorting by ripeness and size to improve overall quality

Golden Tip #4: Transport With Care

❌ **AVOID:** Rough handling and hot transport





✅ **DO THIS:** Transport your produce with care





Try out 1 thing!

Smart loading – Load high-value crops last, unload first, and create air circulation spaces

Use crates instead of sacks - less damage during transport

Keep vegetables cool - wet cloth on top, avoid direct sunlight

Golden Tip #5: 4-Week Challenge for More Profit

❌ **AVOID:** Trying to change everything at once

✅ **DO THIS:** Focus on one improvement and track results for 30 days



Week 1: Measure current losses and damaged produce

Week 2: Train your team on proper harvesting methods

Week 3: Track results with your team

Week 4: Evaluate your findings and plan your next improvement

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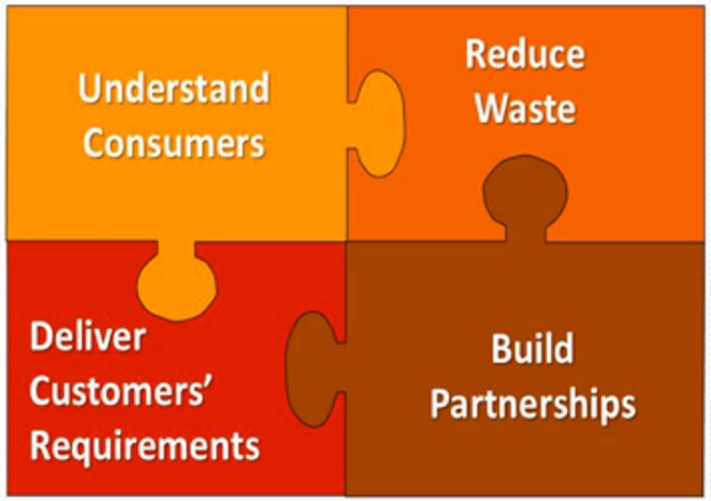
Chapter 4: Value Chain Management

Concepts of Value Chain Management

- Understand developments in the market of consumers = Those who actually eat your vegetables
- Understand the buying criteria of customers = Those who buy directly from you (traders, retailers, wholesalers)
- Understand how waste can be reduced
- Work together: with colleague farmers – with traders



Golden Tip #1: Work Together, Earn more Together

❌ **AVOID:** Competing with neighbours, with the same product for the same low price



Figure 2.2: Supply chain strategy of growing individual slices of the pie

✅ **DO THIS:** Form group of '5' farmers or farmers and buyer and try working together to better serve the market

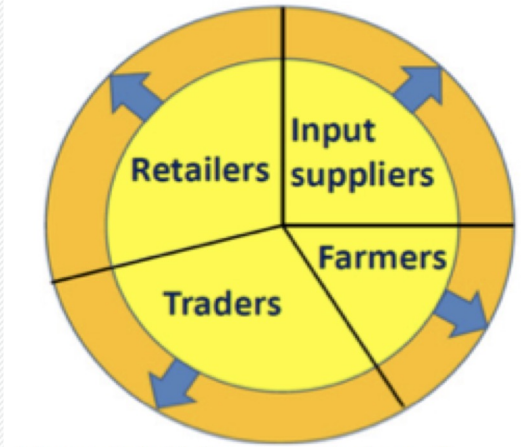


Figure 2.3: Value chain strategy of cooperatively growing the pie

Start this week!

Buy seeds or crop protection together from one dealer, negotiate for 15-20% discount

Share a truck for transport to split fuel cost

Commit working together to meet (one) market need, like a new variety, or package and evaluate how it went

Golden Tip #2: Know What Buyers Want

❌ **AVOID SUPPLY DRIVEN:** You sell what you produce

✅ **TRY VALUE DRIVEN:** You are market oriented and produce what you can sell



Talk to market vendors - ask what customers ask for most

Check with local hotels/restaurants - what do they buy regularly, and could you deliver that?

Write it down - which vegetables, what size and quality, which months

Golden Tip #3: Pick ‘values’ you can work on

❌ **AVOID FOCUS ON ONLY PRODUCTION:**
Selling just core products, like tomato, cucumber

✅ **TRY TO ADD VALUE:**
Discuss with traders which value is relevant to get a better price

You can do so much more!

Ask your trader which values are important to get a better price

Jointly select one you can work one. Not only at product level, also organisational level

Pilot and Evaluate

PRODUCT LEVEL



ORGANISATIONAL LEVEL
RELIABILITY – INFORMATION – SERVICE – RELATIONSHIP BUILDING - INNOVATIONS

Golden Tip #4: Reduce Waste, Save Money

❌ **AVOID:** Putting good and spoiled vegetables together at the market



✅ **DO THIS:** Harvest and transport vegetables with care to prevent damages. and to earn better price



Try out 1 thing!

Harvest at right time - not too early (small size) or too late (overripe)

Use crates instead of sacks - less damage during transport

Keep vegetables cool – protect on top, avoid direct sunlight

Golden Tip #5: Make Your Produce Stand Out

❌ **AVOID:** Your vegetables look same as everyone else's



✅ **DO THIS:** Small improvements that buyers notice



Make your product stand out!

Clean vegetables and remove dirt before bringing to market

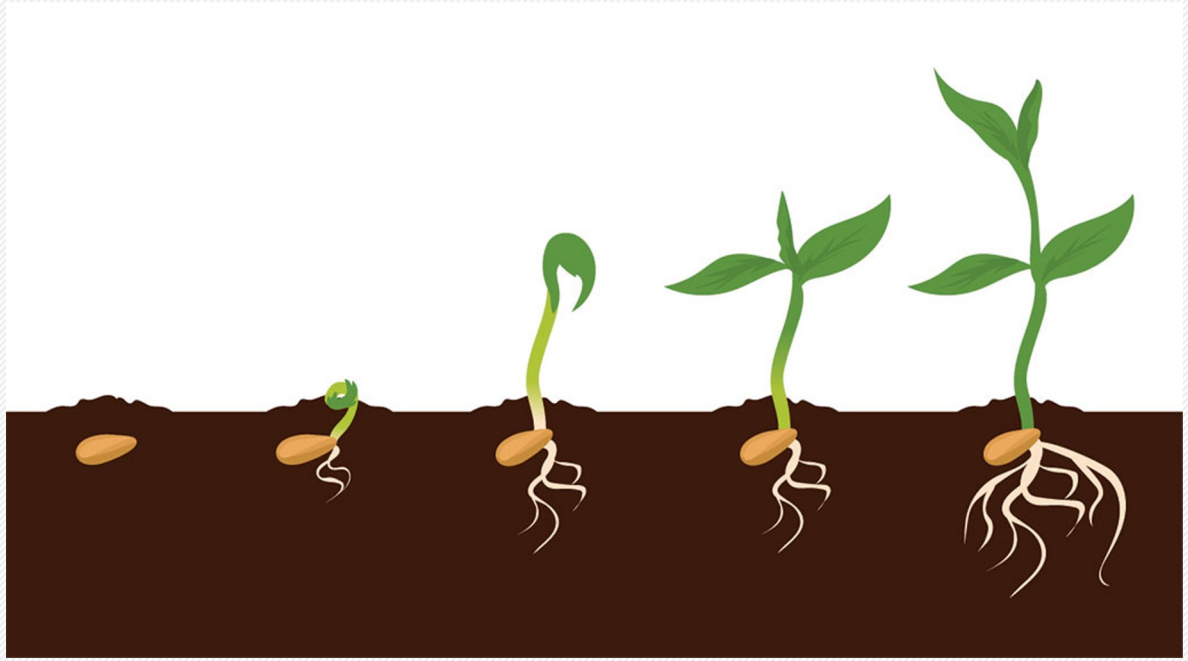
Sort by size – large, medium, small

Come at consistent time - same day, same time every week to build trust with your buyer

Golden Tip #6: Start With One Thing

❌ **AVOID:** Think about changes but never start

✅ **DO THIS:** Pick one improvement and do it for 30 days



✅ **TRY THIS:** Register your income and expenses and keep records of input usage and crop protection plans

Continued small steps make big changes!

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Erasmus+

Project number: 2024-1-RO01-KA220-VET-000255736

Strategies to combat unfair practices for horticultural cooperative products sold directly to consumers and through sales networks

Specialized Consultancy Guide

Post Harvest Manual

Engelie Beenen, HollandDoor
With co-authors: Vincent van den Wijngaard, Bashar Daoud
April 2026

PREFACE

Each year, estimates suggest that one-third of all food produced is lost or wasted, making postharvest loss a critical global food security and sustainability issue of today.

We face the immense challenge of feeding over nine billion people by the year 2050. To meet these demands, yields will have to double using the same amount of natural resources while fertile arable land, water, energy are constraining factors. In recent years, major institutions including the US government, the United Nations, the CGIAR Research Consortium, and several others as a significant opportunity to impact food security and improve livelihoods have recognized postharvest loss. Despite this increased attention, a lack of knowledge, technical capacity, and resources remain obstacles for stakeholders worldwide to act on these issues.

This manual provides practitioners, and students with a comprehensive introduction to postharvest loss processes and tends to increase the knowledge and capacity to prevent food losses. The manual is definitively not exhaustive. The main aspects of post-harvest management in the supply chain are described in a practical format. Since different products require their own specific post-harvest management strategies to maintain quality and prevent losses, this manual will be supplemented with specific product fact sheets.

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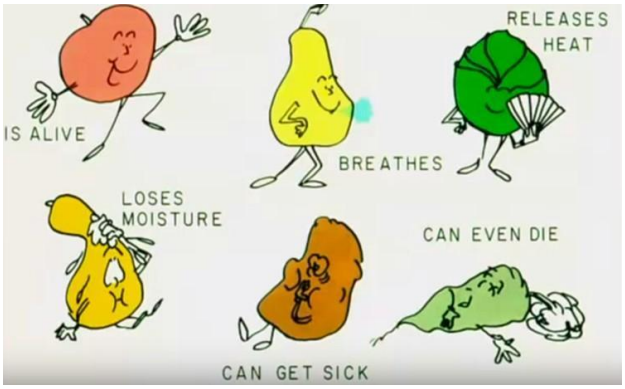
1 TRAINING CONTENT

This training book consists of relevant information about Post Harvest management. Fresh products are still alive after harvesting and very vulnerable to decrease in quality, weight, and nutrition. It's known that losses are not only a loss in financial revenues of farmers but also a waste of water, energy, labor, and nutrients. In a world in which we have to feed more and more people with affordable food, it's for social, ecology and economical reasons utmost important to pay attention to post harvest management.



1.1 TRAINING OBJECTIVES

By the end of this training manual, you will:

- Understand the scale and significance of postharvest loss issues globally and how they impact food security, rural development, and environmental sustainability.
- Become familiar with the postharvest supply chain for vegetables from harvest to market and understand major issues of loss at key stages including harvesting, storage, and drying.
- Gain fundamental knowledge of theories, approaches, and techniques currently being used to prevent postharvest losses.
- Gain an appreciation of how the international community has responded to postharvest loss, and identify the current initiatives, actors, and stakeholders involved in postharvest loss prevention worldwide.

2 INTRODUCTION POST-HARVEST MANAGEMENT

Directly after a product is removed (harvest) from its parents plant, or removed from the ground a product begins to deteriorate. Post-harvest handling is the stage of production that immediately follows the harvest: it includes cleaning, sorting, packing, cooling and transport.

Postharvest management and post-harvest treatment, largely determines the final quality of the produce, independent if it is sold for fresh consumption or as an ingredient for processed food.

There are two main functions of Post-Harvest Management:

- To maintain the good quality of the harvested produce for the market.
- To reduce the level of losses in weight and quality after harvest

Overall: good post-harvest management has a positive impact on economical- social and ecological aspects.

The golden rule of Postharvest Management is:
"QUALITY CANNOT BE IMPROVED AFTER HARVEST BUT MAINTAINED"…

This manual focuses on maintaining the quality and the prevention of food loss between production and retail.

2.1 IMPORTANCE OF POST-HARVEST MANAGEMENT

Global food losses in the supply chain causes enormous ecological, social and economic losses and has serious attention of different organizations:

- The United Nations with their Sustainable Development Goals (SDG) recognizes that about one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons of food per year worth nearly USD one trillion. These losses account for about one-fourth of water used in agriculture, total cropland area, and total fertilizer use, and produce about 3.3 billion tons of CO2 emissions yearly.
- A global agenda under the United Nations Sustainable Development Goal (SDG) targets 50% reduction of per capita global food waste at the retail and consumer levels and food losses along production and supply chains by 2030.
- In developing countries, about 65% of lost food occurs at the production, processing and postharvest stages.
- Reducing food loss and waste can save money for farmers, businesses, and households; can feed more people; and can alleviate pressure on climate, water, and land resources.

- Specifically, postharvest loss reduction can:
  - Increase market share and competitiveness of farmers
  - Stimulate growth of agribusiness industries, such as input suppliers (e.g. packaging, processing ingredient) and logistics providers (e.g. transport, storage).
  - Generate more employment and income opportunities and stimulate the rural economy.
  - Promote gender equality, as more women are involved in postharvest and marketing operations.
  - Improve human nutrition and health
  - Vegetables are high income and nutritious food crops. Reducing postharvest losses reduces poverty and food insecurity.
  - Cross-cutting strategies to reduce food losses include:
    - Developing loss measurement protocol
    - Setting loss reduction targets

2.2 MAIN REASONS OF POST-HARVEST LOSSES

There are numerous factors affecting post-harvest losses, from the soil in which the crop is grown, the fertilizers they get, to the handling of produce when it reaches the shop. First of all it's good to understand that products after harvest are still alive.

Factors influencing losses are:

Pre-harvest production practices may seriously affect post-harvest returns. Examples of these factors are: irregular supply of water for photosynthesis and transpiration, too much rain, lack of plant nutrition can affect the quality of fresh produce. Extreme temperatures causing abnormal ripening lead to decay in quality and harm the post-harvest condition of produce. Good crop husbandry is important for reducing losses.

A lack of knowledge, techniques, and facilities for fresh produce handling or (cold) storages causes serious postharvest losses of vegetables and fruits in several countries.

Also a poor market systems and so mismatch between production and market needs can result in waste of products, when products cannot be sold. Sometimes farmers tolerate this, while in other periods their produce can be sold for feasible prices.

A lack in processing opportunities can contribute to waste of fresh products, when these products are not sold, but also cannot be processed.

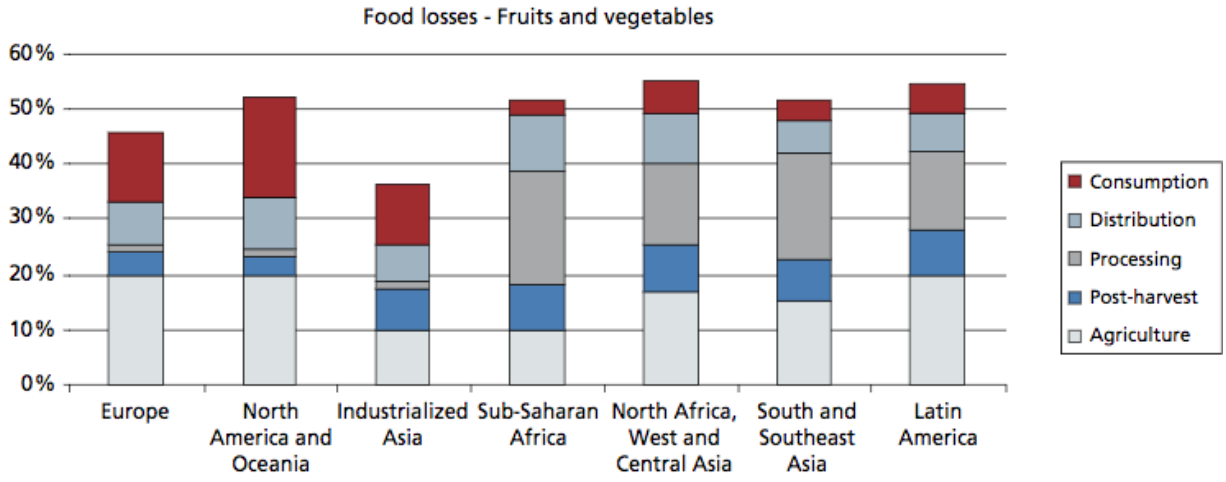
Bad climate conditions for products in open fields (or products in uncontrolled circumstances) and bad pest management can result in poor quality and sensitivity for

pests and diseases and rotten products.



Postharvest losses vary with crop, location, production season, value chain, and value chain actor. Postharvest loss is usually absorbed by farmers as reduced farm gate price and consumers as increased purchase price.

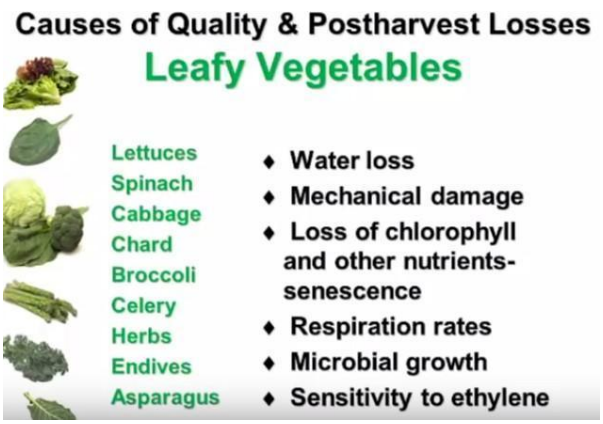
Post harvest losses, also called food loss, occur worldwide, are losses between production and retail. Studies showed significant differences in losses between regions and between levels in the supply chain. In developing (developed) countries we see collaborative initiatives and increasing investments to reduce losses. Investing in reduction Post Harvest losses could be relatively modest compared to the prospects of increasing production under limiting natural resources.

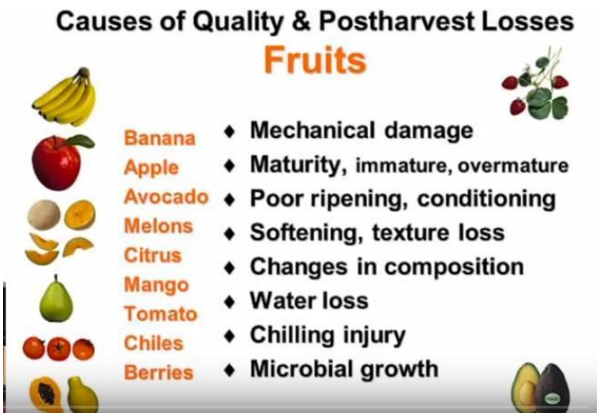


Part of the initial production was lost or wasted at different stages of the FSC (Food supply chain) in different regions.

This manual focuses on prevention of food loss.
Food waste (waste on consumer level) is not a part of this manual.

2.3 Study post harvest losses





In practice a value chain approach can be used to monitor – identify post-harvest losses and to find improvements to reduce these losses. This approach consists of three components:

- Value chain analysis – assessment of all losses along the value chain and identify priorities for intervention.

- Technology interventions with available technologies to local conditions.

- Building capacities: interventions to better control the quality and volume of produce and to create a more competitive marketing. Traditional chains are in general long, with less organization and coordination, less technology, lack of control of food safety, quality, and less relation with end consumers. Modern chains are much more demand driven and focused, better organized.

Postharvest activities are conducted starting at the farm (harvesting and field handling), pack house, or processing plant, and during transport and marketing.

In the next chapters we zoom in and out to specific parts of the supply chain.

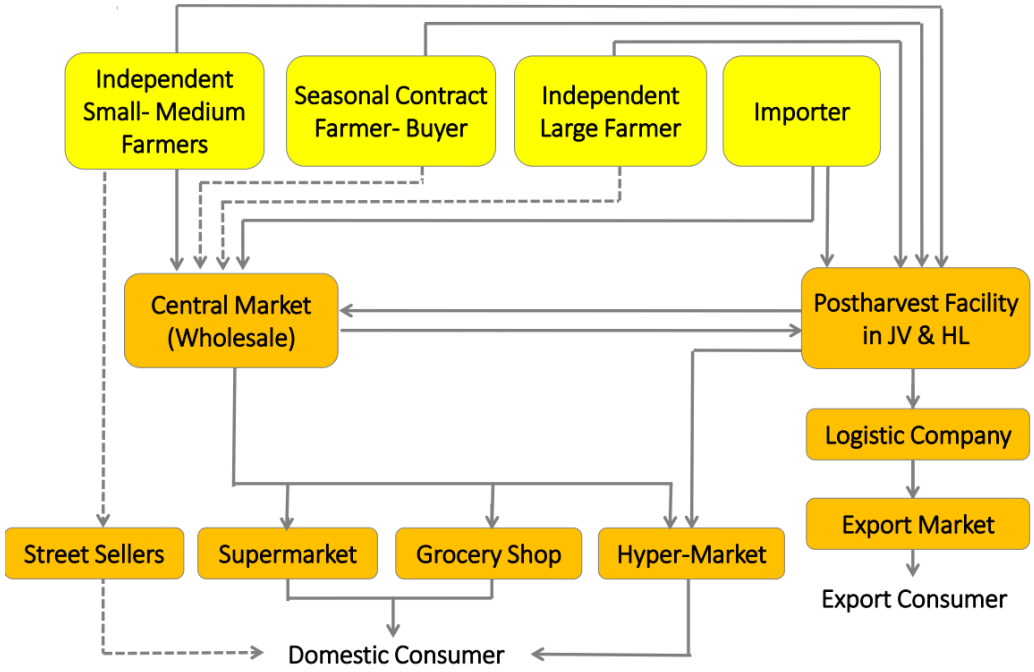


Source: *Wageningen University*

2.4 Post Harvest and Value Chain in Romania

Value chain

In Romania, the value chain for fresh produce is decentralized and includes a mix of traditional wholesale markets, modern retail chains, and export channels. While a significant number of small-scale farmers are active, production is increasingly integrated into supply chains led by supermarkets and larger commercial farms. It is not centralised to one market as shown in the image below



Postharvest practices vary widely. Small-scale farmers often sell through local markets with limited postharvest handling. In contrast, medium and large producers—especially those supplying retailers or export markets—use more advanced systems, including sorting, grading, and cold storage. EU standards and certifications have contributed to improvements in postharvest infrastructure, particularly among commercially oriented farms.

The postharvest is developed on several levels. B. Daoud (EcoConsult) indicated 5 categories of governance structure that also indicates the development of postharvest awareness and way of operating. There are:
- the independent small scale farmers (90%)
- farmers with seasonal contract with buyers (5%)
- independent medium farmer operating in a niche market (3%)
- large farmer with export facilities (1%)
- Independent large scale certified farmers (1%)

The small scale farmers are in the majority. The produce is merely for the traditional central market, where post- harvest attention is kept to a minimum. Small –medium farmers with contact or contract with exporters deliver their products to the larger scaled farmers/buyers who handle their product in postharvest facilities, where sorting and grading is done, with or without the use of cooling facilities. Only certified farmers seem to have upgraded these facilities from pre-cooling of arrived produce, sorting and grading in a hygienic environment and with cold stores of market ready products.

For Romania, the most reliable structure (based on Eurostat/OECD data) is: ~90% of farms are very

small (<5 ha). These small farms: use only ~23% of agricultural land and are mostly subsistence or semi-subsistence. Less than <1% of farms are very large (>50 ha)but they control ~50–54% of the landThe remaining farms (~9%) are medium-sized (5–50 ha)(OECD)

Organisational aspects of postharvest

Well-organized postharvest facilities—such as semi-automated sorting and grading lines combined with cold storage—are primarily found among large commercial farms and producer groups in Romania. These actors are often vertically integrated, functioning not only as producers but also as traders and suppliers to retail chains or export markets. However, such investments are not yet widespread and remain concentrated among a limited number of market-oriented producers.

In contrast to countries such as the Netherlands and Spain, where cooperative structures play a central role in organizing the value chain, collaboration among farmers in Romania is still relatively limited. Although producer organizations exist, their role in strengthening market position, coordinating supply, and facilitating investment in postharvest infrastructure remains underdeveloped.

At the policy level, Romania operates within the framework of the European Union, which provides standards and support mechanisms for improving agricultural value chains. Nevertheless, challenges remain in effectively aligning stakeholders and strengthening coordination across the chain. As a result, farmers often act individually, which can weaken their bargaining position and limit their ability to access higher-value markets.

B. Daoud identified 17 general gaps to a country or constraints that actually need intervention to gain better positions on the market:

1. Inefficient national standards for food quality & safety
2. There is no national export marketing strategy.
3. Lack of structural collaboration between actors in the value chain
4. The middle man rules the supply chain; there is no transparency and lack of efficiency
5. If export occurs it is only to the traditional ME markets of neighboring countries
6. No compliance with high- end markets
7. Lack of knowledge on market demands
8. There is not an farmers organization that lift up the position of the farmers
9. Many unskilled workers handling the produce and harming produce quality
10. Poor logistics at borders and airports
11. Freight schedules are not reliable
12. Complex border procedures with low priorities for fresh produce
13. Lack of knowledge on quality
14. Limited postharvest technology in Romania
15. No Global Gap certified body
16. Absence of accredited laboratories for MRL testing.
17. The image of Romania produce have o international value

The overall view is that there is no guiding (governmental) body that structures the agricultural industry. The absence of cooperation limits the willingness of long term investments that are necessary to develop the facilities, to improve the supply chain and enhance the value chain. Therefore all the produce is pushed to the wholesale market, where opportunism after overproduction and low prices seems to guide the export of produce.

Although the organizational structure in Romania is not the issue of this manual, it is clear that investing in postharvest technology and postharvest management only goes along with long term stability, strong future foresights and willingness to cooperate in the value chain.

The technological and management issues that are handled in this manual will come to place when the circumstances are right.

Key constraints in the value chain

Several structural constraints continue to affect the performance of the Romanian fresh produce sector (eurostat):

1. Fragmentation of farm structures, limiting economies of scale
2. Limited cooperation and weak development of producer organizations
3. Unequal access to postharvest infrastructure, especially among smallholders
4. Dependence on intermediaries in parts of the supply chain, reducing price transparency
5. Gaps in market information and alignment with retail and export requirements
6. Variability in product quality due to inconsistent handling practices
7. Logistical inefficiencies in certain regions, particularly for small-scale producers
8. Limited adoption of advanced postharvest technologies across the sector
9. Skills gaps in postharvest handling and quality management.
10. Challenges in building strong branding and market positioning for Romanian products

3 FACTORS INFLUENCING POST HARVEST QUALITY AND LOSSES

The following sections describe post-harvest management at all stages in the food supply chain from the moment of harvesting, to handling, storage, processing, and marketing. There are many that affect quality of fresh produce or that affect losses. Many of them are mentioned below:

1. MARKET DEMAND
2. CULTIVATION STRATEGIES
3. HARVESTING
    a. Maturity stage
    b. Climate conditions
    c. Methods & tools of harvesting
    d. Time of harvesting
4. PRECOOLING
5. PACKAGE HOUSE OPERATIONS
    a. Pre storage treatments
        i. Washing
        ii. Sorting and grading
    b. Packaging and package material
6. STORAGE
    a. Temperature
    b. Relative humidity

3.1 MARKET DEMAND

Attention to post harvest management starts before the cultivation starts. Where traditionally producers sell what they produce, nowadays more and more modern farmers produce what they have sold.

Relationships

To take advantage of opportunities, market developments and to prevent losses, a farmer needs to be in close communication with their clients and really understand their needs. Building a good reliable relation with their clients is crucial and should be part of the operational process of a farmer.

Without contract farming and pronounced seasons short-term prices can fluctuate exceptionally based on the supply of farmers and demand of consumers. It's not rare that prices in peak seasons are that low that it's not worthwhile to harvest products, or products are thrown away. An enormous loss of resources like seed, water, fertilizers, other inputs, and labor is the undesired consequence.



However, supplies are low at the start and end of the harvest season, so prices are high. Farmers who are located in areas where early or late-season crop production is possible (for example, hill or mountain areas) or who can use production methods, such as plastic tunnels or greenhouses, that bring forward the harvesting date, are best placed to take advantage of high early or late- season prices and are the first one in contact with the market.

Since market demands, food habits, and production locations (and so competition) are changing continuously worldwide it's crucial to be aware of these developments.

Examples of important information is:

- Production areas of specific products / varieties / competitors
- Price fluctuations of several years
- Food trends / developments / consumer habits
- Technology developments in production
- Distribution developments

Example of sources of information of market demands and developments

- Direct contact with clients, visit their stores, keep close contact by phone, mail
- Market studies (in general commissioned by a group of entrepreneurs, a cooperative, a branch or governmental organization)
- Colleagues / cooperative / contract farmer
- Visit (international) trade fairs
- Breeding companies. They are not only aware of trends, they also have information about production areas of specific products / varieties, and appropriate cultivars for a specific climate (at least they should have this information).
- Relevant magazines / internet sources

3.2 CULTIVATION STRATEGIES

As mentioned before, the golden rule is that 'quality cannot be improved after harvesting but maintained'.



So the best way to prevent losses, starts with selection of the right products / varieties for a specific climate and good cultivation technology and strategies.

For the selection of economical en climate appropriate varieties visit research fields of breeders or ask breeders for production data of varieties in a given climate. The figure at the right shows the different colors of 11 different varieties after a similar number of days.

Furthermore appropriate technology, greenhouses, cultivation strategies, pest management strategies are crucial for producing the best quality.
F.e. Growing strawberries on racks reduces the use of water, reduces also problems with rotten strawberries, harvesting is more convenient than growing on the ground surface and chemical treatments to control weed are not needed, it's possible to mow the weed.



These topics are part of modules like greenhouse technology, climate conditions, integrated pest management, irrigation, and fertigation strategies.

3.3 HARVESTING

At which stage of maturity, a fruit should be harvested is crucial to its subsequent storage, marketable life, and quality. Maturity always has a considerable influence on the quality of fresh produce as well as the storage potential and occurrence of many storage disorders.

There are mainly three stages in the life span of fruits and vegetables: maturation, ripening, and senescence. For climacteric fruits (fruits that continue with ripening after harvesting) maturation is indicative of the fruit being ready for harvest. At this point, the edible part of the fruit or vegetable is fully developed in size, although it may not be ready for immediate consumption. During this (after harvest) ripening process the fruit emits ethylene along with increased rate of respiration.

Ripening treatments is an important operation in many climacteric fruits before retailing. A small dose of ethylene is used to induce the ripening process under controlled conditions of temperature and humidity. This gives an opportunity for uniform ripening and availability based on market demand. Harvesting ripe fruit is very delicate and challenging to withstand long transportation. Few examples of climacteric fruits are mango, banana, sapota, apple, custard apple, etc.

Senescence is the last stage, characterized by natural degradation of the fruit or vegetable, as in loss of texture, flavor, etc.

Non-climacteric fruit do not ripen further after harvesting, produce in general a limited amount of ethylene, do not respond to ethylene treatments and have less respiration. For non-climacteric fruits, development of eating quality before harvesting is indicative of the fruit being ready for harvest. Therefore, non- climacteric fruits should be harvested after attaining proper development of eating quality (ripening) while still attached to the mother plant.

Examples climacteric fruits	Examples non-climacteric fruits
Apples	Black berries
Avocado	Bleu berries
Banana	Cucumber
Fig	Egg plant
Kiwi	Grapes
Mango	Lemon
Nectarine	Olives
Peach	Oranges
Pear	Pineapple
Tomato	Strawberry
Water melon	Zucchini

To prevent losses from harvesting phase the next aspects must take into consideration:

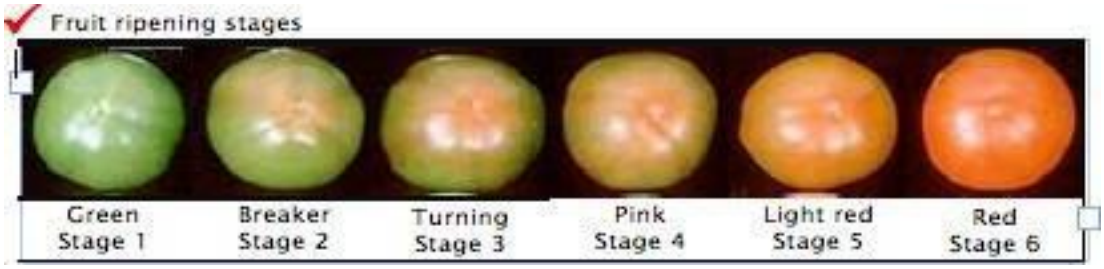
3.3.1 Maturity stage

Harvesting depends upon the purpose for which the products are used: The availability of a maturity index for products per local or export markets can help to pick the right products for a specific market. The maturity at harvesting affects its marketability, shelf life, storage time, nutritional content, freshness, flavor.

The parameters to judge the maturity of fruits and vegetables for harvesting are:

- **Color:**

Color charts are used for determining the maturity of tomato, mango, peach, plum etc. For example, tomatoes for the local market can be harvested when red ripe, for medium distance markets at the pink stage and for distant markets at the breaker stage. It's recommended to use color charts in a company to instruct the employees which products need to be harvested.



- **Firmness:**



The degree of softness (firmness) can be measured/estimated with an instrument known as Penetrometer. For determining the firmness of fruit, it is inserted inside the fruit with desirable force or with a digital meter. The firmness of fruit decreases with ripening.
Penetrometers are often used to determine the best harvesting period of fruit.

- **Size and Shape:**

Size and shape is a useful index for determining the harvest maturity of most of the fruits and vegetables. For example, the fullness of cheeks and roundness of shoulders are important maturity index for determining maturity of mangoes etc. Sizing rings with holes for specific sized produce can easily be made from a thin piece of wood or strong plastic.

❖ **Sugar content (TSS Total soluble solids)**

In climacteric fruits, carbohydrates accumulate during maturation in the form of starch. As the fruit ripens, starch is broken down into sugars. In non-climacteric fruits, sugar tends to accumulate during maturation. A quick method to measure the amount of sugar present in fruits is with a brix hydrometer or a refractometer. A drop of fruit juice is placed in the prism of the refractometer and a reading taken; this is equivalent to the total amount of soluble solids or sugar content in the fruit juice. This method is widely used in grapes in many parts of the world to specify maturity but also in strawberries or tomatoes to identify differences in taste and variety.

❖ **Brix–Acid Ratio (sweet–sour balance)**
TSS/Add Ratio:

Knowing the sugar content alone is not enough to measure maturity and quality of citrus fruits and grapes. In these fruit, the ratio of sugar to acid content is a much better predictor for harvesting of high quality produce. In many fruits, the acidity changes during maturation and ripening, and in the case of citrus and other fruits, acidity reduces progressively as the fruit matures on the plant.



❖ **Days from Full Bloom to Harvest:**

The time period between full bloom and fruit maturity is quite constant in some crops like pear, mango, apple, and pomegranate. Therefore this parameter can be used for judging the harvesting period of these fruits. In some vegetable crops, the time period from sowing/transplanting to maturity also serves as an indicator of harvesting and is practiced in some crops like watermelon, okra, bell pepper etc.

❖ **Leaf/Flowers/Inflorescence Condition Changes**

In many cases, leaf quality often determines when fruits and vegetables should be harvested. In root crops, the condition of the leaves can indicate the condition of the crop below the ground. For example, if potatoes are to be harvested for storage, then the optimum harvest time (optimum maturity) is soon after the leaves and stems start drying and most leaves have dried. If harvested earlier, (before yellowing of leaves) the skins will be less resistant to harvesting and handling damages and more prone to storage diseases. The same is true for onion and garlic. In the case of bananas, dryness of inflorescence at the tip of fingers and disappearance of angularity of fingers are often taken as a maturity index (observe dried flowers at the tip of each banana).

Example color parameters of tomatoes:

a) Green stage: The mature green fruits are generally harvested to send them to the distant market.
b) Pink Stage: At this stage colour turns to pink or red at the blossom end. They are picked for the local market.
c) Ripe stage: At this stage surface of the most of the fruits is red and the soften of fruits begins.
d) Fully Ripe: At this stage fruits have approached maximum colour development and are soft. Starch is charged into sugars. They are generally consumed or used for canning and processing.

Depending upon the purpose for which they are used and market distance, tomatoes are harvested manually by plucking the fruits at different maturity stages.

Harvesters need always to be trained in the right maturity stage and way of harvesting.

3.3.2 Climate conditions during harvesting

Poor weather at harvesting time affects the operations and functionality of harvesting machines or human labor and usually increases the moisture content of the harvested products. In general, the higher the temperature the shorter the storage life of horticultural products and the greater the amount of loss within a given time, as most factors that destroy the produce or lower its quality occur at a faster rate as the temperature increases.

In the night, when it is cooler, the evaporation of a product is lower, so products are more filled with water. Effect is that in general products are more vulnerable but have also more weight.

- Harvesting at cooler times of the day minimizes product heat load and increases work efficiency of pickers. Care should be observed because the plants and leaves are brittle (high water content) and prone to damage. It is also important to protect from damage the developing plant or fruit for subsequent harvest.

- In some cases, harvesting when the sun is up is practiced since the produce is less brittle and more resistant to damage during subsequent handling. In this case, the harvested produce should be moved to a shaded area to reduce heat load and water loss. The produce should also be allowed to dissipate heat before packing. High product temperature accelerates quality deterioration due to increased water loss and respiration.

- Harvesting in the later part of the day is advantageous in certain cases. The produce is less turgid, hence less prone to physical damage. Sugar content in leafy vegetables is also high as a result of photosynthesis during the day, which could slow down leaf yellowing after harvest.

- Harvesting during or just after rain is not recommended as wet condition (rain water on the leaves or fruit) favors microbial growth and enhance tissue breakdown. If harvesting cannot be avoided during rainy days, it's preferred that products are washed and dried properly before packaging.

Try to avoid contact with the soil and keep products out of the sun.

3.3.3 Harvest handling & tools

Each product has his own way of picking or cutting the fruit. Vegetable crops can roughly be divided into fruit crops and other crops. Fruit crops, such as cucumbers and tomatoes are harvested multiple times. Other crops like leaf crops, radish and fennel are harvested once. Fruit should never be harvested by pulling but twisting. When you harvest several times for maximum yield and desired quality, it is needed to prevent damage to the plants for subsequent harvest.

Losses due to harvesting are caused by employment of improper harvesting methods such as: Rough handling; untimely harvesting; lack of appropriate and/or poorly-designed harvesting tools, equipment, and harvesting containers.

There are basically three methods most commonly used for harvesting any fruits or vegetables.

(a) Harvesting individual fruits/vegetables with hand by pulling or twisting the fruit pedicel
(b) Harvesting individual fruits or fruit bunch/vegetables or vegetable bunch with the help of fruit clippers/secateurs/scissors
(c) With harvester specially designed for harvesting

Harvesting Individual Fruits/Vegetables with Hand by Pulling or Twisting the Fruit Pedicel This is simple and most commonly used method of harvesting. Harvester can easily pick the optimum mature fruits. One important disadvantage of this method is pulling little peel of the fruit, which ends in quick spoilage of the fruit, or that plants are damaged. Many products are twisted from the stem, to prevent plant damages.

Harvesting Individual Fruits, Fruit Bunch/Vegetables, or Vegetable Bunch with the Help of Fruit Clippers/Secateurs/Shears or Scissors



This method is an advanced form of hand pulling and twisting method. Here, fruit stalks are cut close to the point of attachment of fruit, leaving a very small portion of pedicel attached with fruits. This is highly accepted and widely used in many products.
Postharvest quality is found better in this method compared to any others. One important precaution should be in cutting fruit stalks close to the fruit; otherwise, the part of the pedicel attached with fruit may puncture other healthy fruits during subsequent handling and marketing. Fruits born in bunches like grapes, vine tomatoes are harvested with scissors or secateurs.

Product	Method
Loose tomatoes	picking
Vine tomatoes	Cut with shears
Cucumber	Cut with knife / scissors
Pepper	Cut with knife / scissors
Eggplant	Cut with knife / scissors
Lettuce	Cut with knife

Mechanical Harvesting This method is used on commercial scale and specially designed machines are only used. Fruits and vegetables get more damaged with harvesting and quality deteriorates rapidly. Therefore, it is advisable to use harvesters where harvested produce is intended to be used for processing.

Field handling

Use harvesting containers with smooth surfaces (e.g. plastic or metal buckets or trays). They facilitate collection with minimal or no damage to the product. A cotton bag or small bucket tied to the picker's waist can also be used. Total weight per container should preferably be less than 20 kg for one person to easily carry.



Field handling and packing is possible for vegetables that do not require extensive sorting, sizing, trimming, cleaning, or waxed or fungi treatments after harvest. Fruit harvested at different stages of ripeness can be sorted during the harvesting and field handling operations by either placing them in separate containers.

Sometimes at the end of a row-shaded packing tables are placed to sort – grade and package the products. (Never on the soil!).
Not that common, but sometimes (when no sorting and grading)

facilities are available) mobile packing facilities are used in the field for f.e. cantaloupe, honeydew melon, eggplant, cucumber, summer squashes, and peppers.

Field pack operations entail much less handling of products than in packinghouses. This reduces product damage by too much handling. Handling costs are also reduced in field pack operations.

Cleaning is less difficult due to lack of water. Another difficulty with any type of field sorting and or packing, is the need for increased supervision or trained workers to maintain consistent quality in the packed product. Field packing is not used for commodities that require classification for both color and size, such as tomato.
Products that really need grading, sorting, sizing, and special packaging for special clients, or products that require classification for both color and size, such as tomato go directly to a central cooling and sorting facility.

3.3.4 Hygiene & Disinfection

The impact of plant disease in the horticulture business can be enormous. Good cleaning and disinfection of hands-shoes-equipment is required to prevent spreading of bacteria, fungi's viruses. Use alcohol, ethanol, Na-hypochlorite, horti- clean, easy clean or other products.






- **Prior to harvest**

Never use harvest containers for storage of waste, chemicals, or other dangerous materials. Examine the condition of harvest tools, containers, crates, and pallets at the start of the season and occasionally during the season. Discard them if they cannot be properly cleaned or repaired.
Where packing containers are stored outside, examine them for debris, and clean and sanitize them before use.

- **During harvest**

When packing in the field, avoid contaminating containers or bins by exposure to soil or animal droppings. Keep packing boxes and bins off the soil by placing them on a dummy pallet or tarp. Do not allow employees harvesting fresh fruit or vegetables to stand in bins. Shoes can transfer contaminants to the container and to the harvested product. If packing indoors, remove as much dirt and mud as practical from produce outside of packing areas before bringing the product into a "clean" area.

- **In general**

Keep equipment or machinery that comes in contact with fresh produce as clean as is practical. This includes all sorting, grading and packing equipment. Dirty equipment that comes into contact with produce can transfer contaminants to the produce. Clean equipment such as knives, boots, gloves and aprons; sanitize them when appropriate, inspect them regularly, and replace them when needed.

❖ **Visitors**

Visitors in greenhouses need to clean their shoes, disinfect their hands, wear protected clothes from boots – overall – hairnet. It is important to make an operational routine in controlling, cleaning, disinfecting all tools, hands, shoes, equipment.





3.4 PRE-COOLING

Highly perishable vegetables require proper handling and good cold chain management, so that they stay fresh and wholesome.

Pre-cooling is rapid removal of field heat from the produce (to an optimum of 2-6C) to reduce the rate of respiration, microbial activity, refrigeration load and further ripening. As a rough guide, a one-hour delay in cooling reduces a product's shelf life by one day. Although this is not true for all crops, it applies to very highly perishable crops during hot weather. Lowering the temperature also reduces the rate of ethylene production and moisture loss, as well as the spread of microorganisms and deterioration from injuries. So, every form of cooling is beneficial even if not optimum (e.g. avoiding exposure to the sun or evaporative cooling storage).

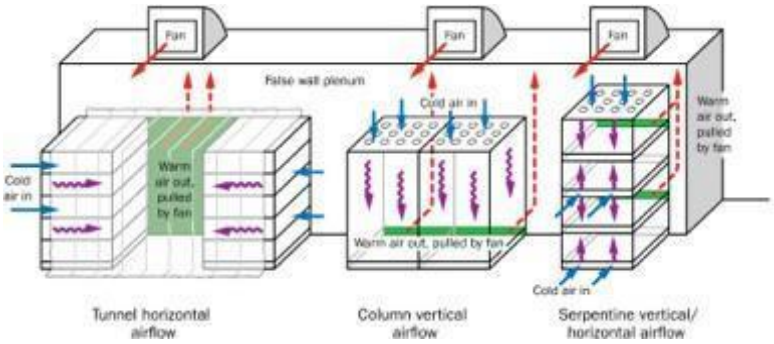
Methods of pre-cooling:

a) Room cooling.
b) Vacuum cooling
c) Forced-air cooling.
d) Hydro-cooling.
e) Ice cooling.

Room cooling: Horticultural produce is placed in a room and allowed to cool by cold air. The room is isolated and the refrigeration unit cools air. It is a slow method, cold air does not circulate readily through the produce and is only appropriate for very small amounts of produce or produce that does not deteriorate rapidly. Its cost is relatively low.

Forced air-cooling is used mainly for bulk produce and palletized produce. It is the most versatile and widely used of all cooling methods. Chilled air is forced to flow around each piece of produce. This close contact of chilled air with the produce results in rapid, even cooling throughout the mass of produce. This method is faster than room cooling because

a flow of chilled air is in direct contact with the product.



Ministry of Agriculture, Food and rural affairs Ontario

Cold, refrigerated air (blue arrows) is pulled through containers by high-capacity fans in a false wall plenum within a cold storage. These fans create a partial vacuum and pull air through strategically located openings (green shading) in the plenum. Produce cools primarily by the convective action of high-speed cold air, when it picks up field heat from warm produce (purple arrows) as it passes around the produce. The warmed air (red arrows) is then blown back into the cold storage to the evaporator coils of the refrigeration system to be re-cooled.

The tunnel horizontal airflow system is the most common FAC system. Refrigerated air travels horizontally through containers, so align side openings, if possible.
Baskets of produce, such as tree fruit, are often packed inside a corrugated cardboard shipping container, which restricts refrigerated airflow. Tapered plastic containers or baskets of fruit on open racks can result in the opposite problem, allowing too much refrigerated air to short-circuit between containers with little cooling occurring.
Ideal containers stack tightly on all sides and fill the entire pallet footprint. This minimizes the short-circuiting of air. Corrugated cardboard containers with vent openings that line up or reusable plastic containers (RPCs) on pallets work well. Many growers use plastic bins for handling produce in bulk. One-way forklift entry bins are best, since two-way forklift entry bins allow refrigerated air to short-circuit.

Hydro cooling: Produce is cooled by cold water either by immersion in a tank of circulating cold water or showering the cold water over the produce. Heat transfer is faster than forced air cooling because water is in direct contact with the product and has a higher heat removal capacity than air. It is a more expensive method than room cooling. The boxed product is placed on a conveyor that pushes the boxes through a cooling tunnel. Large quantities of chilled water are sprayed directly onto the tops of the boxes. Water flows down through the product and is collected in a tank or sump underneath the tunnel. The refrigerated spray often is chlorinated.
Sodium hypo chloride may be added to destroy the rot spores on the skins of fruit and vegetables, which improves storage life and market quality.

Ice cooling: crushed or fine granular ice is used to cool the product. ¬The ice is either packed around produce in cartons or sacks, or it is made into a slurry with water and injected into waxed cartons packed with produce. The ice then fills the voids around the produce. It's faster than hydro cooling because contact with the product is good, and ice has a higher heat removal capacity than water.

Pre-cooling tips:

- Do not load pre-cooling rooms beyond maximum capacity
- When stacking produce, use adequate air-circulation
- Avoid over cooling, chilled products and de-hydration. Transfer products immediately after pre-cooling to another storage
- Separate ethylene sensitive products from ethylene producing products
- Use vented boxes for air cooling and waxed boxes for hydro cooling
- Use potable water for pre-coolers for food safety reasons

3.5 PACKAGE HOUSE OPERATIONS

3.5.1 Pre-storage treatments like washing, sorting, grading

The next activities are one of the most important postharvest operations after harvesting:

- Cleaning of the produce
- Sorting: removal of diseased and defective produce, stones, foreign matters from the lot
- Grading / quality selection into homogenous groups according criteria of the client and may be based on color, size, and extent of defects
- Fungicide treatment for products stored for a long period like citrus fruit
- Packaging and labeling of the produce

Cleaning of the produce

Cleaning basically prevents undesirable content from entering other products, the storage line, the packages. Cleaning can be done dry (dusting method) or wet (water).
A dry method is used to remove soil at f.e. carrots, potatoes, radishes (to reduce transport costs, to remove pathogenic micro-organism that affect quality and to present products more properly).
Wet cleaning is generally done in a package house with automated washing systems with clean water, sometimes detergent, for 3-5 minutes with water of about 27 degrees. Washing is mostly used in fruit and vegetables.

Sorting and grading

With sorting and grading you make from a heterogeneous group of products a homogenous group of products. Effort and time spent depends highly on which market segment and the

market criteria of this segment you are delivering.

Activities are done in the farmer's field or in the pack houses. Both manual and mechanical graders are used for grading. Mechanical graders easily grade all round- shaped fruits and vegetables.

Sorting	Grading
1. Undesirable type of fruits i.e. diseased, damaged, deformed are removed	1. Fruits and vegetables are categorized according to difference in their weight, size, colour, maturity etc.
2. Done primarily to reduce spread of infection to other fruits	2. Done to fetch better price in the market.





Basic attention points / hygiene





- Products not consumable / waste must not be allowed to accumulate in fresh fruit and vegetable handling and storage areas or the adjoining environment. Storage areas for waste should be kept clean
- Sorting equipment and re-usable containers used for fresh fruits and vegetables or that come in contact with fresh produce that are not washed prior to packing should be cleaned and disinfected as necessary. (prevent contamination).
- Prevent any metal / glass / hairs / plastic / band aids etc. during sorting of the products. Colored Band-Aids (bleu) and hairnets are highly recommended during sorting and grading.
- Use gloves for hygiene aspects
- Wash rinse, sanitize sorting machinery and packing line surfaces at the end of each day
- Store package material in a clean area, away from dirt and animals, insects (also mice and/or rats.

3.5.2 Packaging handling and material

3.5.2.1 Introduction

All fresh fruits and vegetables are living products and as mentioned before their life processes continue after harvest; the two most important being respiration and transpiration. The former being a complicated sequence of chemical reactions involving conversion of starches to sugars and the change of those sugars into energy.

The normal *respiration* results in the fruit and vegetables consuming oxygen and giving off carbon dioxide, water and heat. The higher the ambient temperature surrounding the product the greater will be the temperature of the product itself and consequently the larger its rate of respiration.

The second process, *transpiration*, is the loss of water by evaporation which will occur once the fruit or vegetable is removed from its plant or root which has been the source of water during its formative period.
Harvested fruits and vegetables of different plants have different rates of respiration; some respire at a faster rate (and thus are more perishable vegetables), while some respire at a relatively slow rate (less perishable vegetables). Not only that, the respiration rate also varies throughout the seasons and by region even for the same fruit and vegetable. With good climate conditions in a packaging hall, during storage, and transport but also with selecting special package material decline in quality and losses can be reduced.

3.5.2.2 Main functions of packaging

Both packing and packaging materials play many important roles in quality maintenance of fresh produce.

The main functions of a package are:

- To maintain the quality and extend shelf life of vegetables and fruits.
- To protect from damaging
- Transport products and easy handling
- Store products, to resist
- For marketing purposes, information, convenience, it's directly related to sales strategy
- Packed efficiently for different clients / purposes (for consumer small packages, for wholesale larger packages)
- Identification of the producer, product, harvest time, net weight, country of origin, quality

Regarding its function, fruit and vegetable package can be observed in two ways:



- **Primary package**; the layer of the package which is in direct contact with the product; usually offered to the customer
- **Secondary package**; holds the primary package during transport and storage, and therefore facilitates its handling.

3.5.2.3 Packing handling

Packing starts with placing the produce in the box.





- While placing, care must be taken to place in line, pedicel end of all fruits should be in one direction, and separation layers or trays must be used where it is necessary. See picture.



In the fist box the pedicel can damage the other fruits. Not in the second box.

- The product must fit well in the box or container and not so much space in between the products to prevent scroll and roll damages and transport of 'air'.
- The box should **not be under-filled or overfilled**. Overfilling is where farmers fill more in a box beyond the capacity of the box. They do this primarily for two reasons:
  (a) *Demand by the commission agent* (*Traders*)—It was observed that those lots containing more weight in a box priced more.
  (b) *To save the cost of packing and transportation*—Farmers want to save

something immediately and he/she calculates the cost of empty boxes, packing charges, handling and transport charges by saving the number of boxes, and to do so they prefer overfilling.
The practice results in damage and touching (pressure marks) in almost all fruits.





Attention points in handling:

- Sort non-consumable products out, leave them in the fields or better, destroy these products
- Hygiene: Wash, eventually disinfect containers when needed. (wood is vulnerable for bacteria / microorganism, more difficult to clean).
- Reduce sand / soil / leaves from the products to increase value and prevent transport of non-marketable ads.
- Prevent sand, microorganism in the containers.
- Take care at the strength of the boxes when CFB boxes are used, In case of stack transport, they must be able to carry enormous weight.

3.5.2.4 Types packaging

There are various types of fruit and vegetable packages. These include:

1 **Containers; mainly for transport**



- For crops that are not so susceptible to physical damage, such as **melons, pumpkins, yams, potatoes, cassava**. Crops are stacked into a container which is fitted for transport and delivered to the clients without using any other package.
- Containers are often used for harvesting in the field and transport to a packing hall.





2 **Cardboard, wooden, or plastic boxes or crates;** a widely accepted way of

packing various fruit and vegetables.
The boxes come in various shapes and sizes and are adaptable to different products.

CFB boxes (corrugated fiber box / cardboard) are most common and widely used all over the world. Utmost important is to order the right strength of the material for your product, the ability to stack and the ventilation of each box. More and more attention is paid to bio- degradable boxes.




The boxes can be printed for marketing purposes.





Plastic crates are easy to clean, very strong, easy to stack, but are more expensive. This requires a deposit system / organization and a system to clean the crates regularly.




3 Films / plastic bags

4 **Modified atmosphere package;** MAP is the sealing of produce in plastic bags to establish an atmosphere of low oxygen and high carbon dioxide and humid conditions that slow metabolic processes and water loss. It depends on the type of product in which the mixture is used. The carefully managed gas mixture within the package maintains an optimal crop respiration rate and extends crop storage life and quality**.**



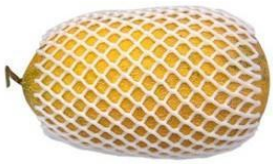
ified atmosphere package of vegetables

Commercial plastic bags are used: 25 micron-thick (with market label as 001 film) low-density polyethylene (LDPE), high-density PE (HDPE) or polypropylene (PP) films. Thicker films (002-004) are not advisable due to increased water condensation inside the bag that favors rotting. Place produce inside the bag, seal, and keep for 3-10 days (usual duration of transport or storage/ temporary holding period), then in the open.

Benefits of MAP are high; see table below

Vegetable	Weight loss, %	Shelf life, days	Net return, USD/kg (partial budget)
Tomato	1-8 (6-20)	15-19 (9)	0.13-0.36
Chili	0-1 (9-12)	6-9 (3-6)	0.40-0.65
Eggplant	0-4 (6-22)	4-14 (2-5)	0.20-0.80
Leaf mustard	1-5 (11-28)	3-4 (1)	0.10-0.35
Cauliflower	25 (31)	9 (7)	0.10
Bitter gourd	1 (6)	4 (2)	0.30
Cabbage	1-5 (19-22)	12-24 (8-14)	0.21-0.48
Chinese kale	1 (37)	3 (1)	0.32
Cucumber	0 (10)	4 (2)	0.25
Kangkong	2 (22)	3 (1)	0.09
Long bean	0 (12)	3 (1)	0.15
Mustard, aromatic	4 (14)	3 (1)	0.58

Cushioning materials are used to reduce bruising and touching marks drastically. When products are transported from pack house to destination markets, when loading, unloading, and transportation jerks causes bruising it's recommended to use cushioning material to preserve post- harvest quality of fresh produce. There may be many types of cushioning materials from newspaper sheets, newspaper cuttings, bubble sheets, specially designed foam nets, special moulded trays, gunny bags, leaves, and other locally available material.





3.5.2.5 Packaging as sales strategy - to satisfy several market segments

High quality packages can be used to increase product sales, to be attractive to the market, to create brands or to satisfy specific consumer segments.















3.5.2.6 Criteria in choosing the right packaging:

1. Crop requirements; each crop has its own package requirements, for instance, berries are much more susceptible to damage than apples, and therefore, they require carefully managed packing.
2. Crop transport and storage management; there is a difference between packing the crops that will be directly delivered to the market, and crops that will be stored for a certain period.
3. Type of storage; crop package should be in accordance with the type of storage (CA storage, cooling storage, simple storage facilities, pre-cooling), as well as with the duration of the storage (short-term or long-term storage).
4. Message to customers; the package is a way of communicating with the customers. Therefore, before packing their fruits and vegetables, farmers should consider how they want to present their products to customers.
5. Value for money; First what are the farmer's own financial possibilities. Besides that, for certain high-value crops (e.g. blueberries), farmers can afford higher costs of packaging. On the other hand, for crops such as potatoes, farmers prefer using more affordable packaging solutions.
6. Recyclability / biodegradability: A growing number of municipalities / retailers / clients have waste disposal restrictions.
7. Transport of empty packaging must be easy

3.6 STORAGE

Almost all fruits are seasonal in nature. Every year, harvesting season falls during a fixed period, say 2–3 months. Demand for many fruits and vegetables are round the year. The demand of any fruit or vegetable beyond the harvesting season is called off-season demand. This demand can be fulfilled only if fruits are stored in the harvesting season and sold during off-season.

Cooling is the foundation of quality protection as it slows metabolic processes and microbial growth. Every degree of reduction from ambient temperature increases storage life. So, every form of cooling is beneficial even if not optimum (e.g. avoiding exposure to the sun or evaporative cooling storage).
Desired temperature and relative humidity (RH) for vegetable storage are usually achieved by a mechanical refrigeration system which is expensive.
See Annex 1 for proper storage temperatures

The management of temperature, ventilation, and relative humidity are the three most important factors that affect postharvest quality and storage life of horticultural produce.

Temperature, relative humidity, and ventilation affects main factors of after harvest losses like:

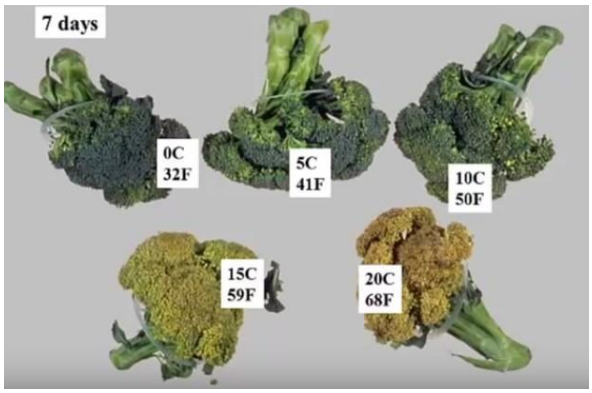
- Product respiration
- Water loss
- Damage
- Ethylene
- Microbiological growth
- Physiological disorders
- Continued growth

Temperature will affect all those causes of deterioration or quality loss. Another important factor that we need to take into account is **the time**. If temperature cannot be handled according to the needs of a specific product then you must be able to manage time. In other words the shorter the time between harvest and consumption the better.

Example of importance of temperature: After harvesting strawberries they are held for 7 days at different storage temperatures. Development of gray mold / botrytis is highly affected by temperature. In the second picture the same for broccoli.



From left to right, upper to bottom
0, 5, 10, 15°C (32, 51, 50, 59 F)



Products can be divided in two types:

1. Non-chilling sensitive (keep products close to 0°C or 32F, but not freezing)
2. Chilling sensitive (general temperature differs between 10–12°C (50F-55F) The first group is the easiest one. As long they are stored just above freezing temperature they stay in good quality.

The second group –chilling sensitive- is more challenging. They are more vulnerable for influences of temperature. Symptoms of chilling injury are:
Surface pitting, water soaking, browning, necrosis, rots, poor flavor and ripening.

The difficulty is that chilling injuries mainly are not seen during storage in a cooled store, but manifest between 2-3 days after they left the cooled store and are transferred into normal room or warmer temperatures. This happens in the later stage of the distribution channel which causes returns from the wholesaler /trader / retailer.

Examples of chilling injury





Fig. 5: Rust like discolored spots on green bean pods indicative of chilling injury.

Cucumber
Upper: 8 days at 12,5C and 3 days 20C Bottom:
8 days at 5C and 3 days 20C





Water loss and Humidity:
Another aspect in post-harvest management is water loss. While during the cultivation water is absorbed by the roots and released by the leaves; after harvesting water is only released and not absorbed anymore. Negative consequences of water loss are:

- A loss of (sales) weight of products
- Visual – shrilling effects – product looks less fresh
- It effects the texture and taste of a product

When water loss is less than 3% between harvesting and end market there is, generally speaking, no effect on the marketability of the product. Above the 5% it affects the products quality and marketability.

Causes: There is movement of water vapour between stored food and its surrounding atmosphere until balanced water activity in the food and the atmosphere. A moist food will give up moisture to the air while a dry food will absorb moisture from the air. Fresh horticultural products with high moisture content and need to be stored under conditions of high relative humidity to prevent loss and wilting (except for onions and garlic). Dried or dehydrated products need to

be stored under conditions of low relative humidity in order to avoid adsorbing moisture to the point where mold growth occurs
Water loss is related to the product plus VPD (Vapour pressure deficit). VPD is directly related to temperature. Green leafy vegetables like salads f.e. will lose water more rapidly than a pepper or pepper with more wax skin. And the warmer the product is, the more it will lose moisture.

Attention points to control water loss:

- Lower the temperature
- Prevent warm air movements around the products by covering the products with paper to absorb moisture or plastic with holes (prevent condense on the product!), when on the right temperature plastic films can be used.

Time

The longer the food is stored the greater is the deterioration in quality and the greater is the chance of damage and loss. Hence, storage time is a critical factor in loss of foods especially for those that have a short natural shelf life.

General guidelines in vegetable storage:



- Only good quality produce should be stored; sort and clean them.
- Use containers that can be easily moved in and moved out of the storage chamber
- Keep cartons closed and stacked without causing damage.
- Products that are stored for a longer period, or who are sensitive for transpiration, cover them with a clean carton sheet or store them in plastic bags
- In prolonged storage, the produce should be checked periodically to cull out diseased or deteriorated produce and prevent disease spread.
- Keep cartons closed

4 TRANSPORT

The produce needs to be transported several times along the supply chain. The transportation usually follows the route:

From plant →Storage on farm →Sorting and packaging →Wholesale →Distribution center →Supermarket

The more transportation there is the higher the chance of degrading, loosening or damaging products. It is also common to see that sorting, packaging and wholesale are being done in one location.

Transportation is not only transported by trucks, it can also be transported by trolleys, bikes, tractor or conveyor belts. On the farm transport to the storage room can be done on harvest trolleys.

On the farm:

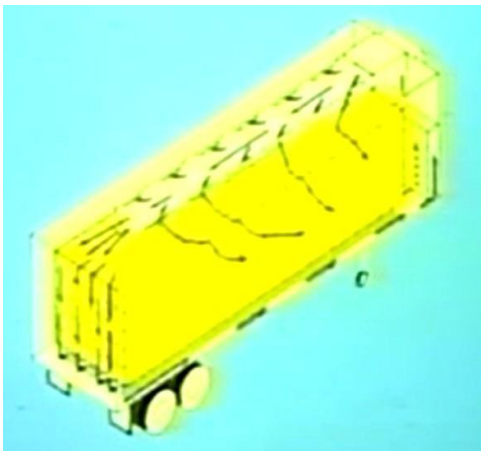


Harvest trolleys cucumber and tomato

Previously pre-cooling at the farm was treated before. This pre-cooling is done to meet the desired temperature of the transport. The entire supply chain cooling needs to be applied. Failing to meet this requirement at one part of the chain makes the produce starting to degrade. This can seriously influence the shelf life of the products. Applying cooled transport and cold storage we call the Cold supply chain.
However some farms lack cooling storages. Usually these farms harvest in the "cold " morning and then transport can pick up the produce. For other farms who have the cold storage, transport could pick it up later on the day.

Truck transport

Transportation by truck is a very common way to do so. Depending on the products, mostly the trucks are cooled. For the truck to stay cool it is very important to have free airflow. Which means the way to load the truck is very important.



Air flowing around the ceiling, walls and bottom of the truck





Left: loaded too high, right: loaded too wide

The above pictures show wrong ways to load a truck. The left picture shows correct distances to the sides but on top it's loaded too high. The right picture shows a very widely loaded truck. The problem of blocking the airflow is preventing an even distribution of airflow. This only applies if the walls are smooth, some trucks have riffed walls, which allow air circulation, even when the load has been put against it. Once this distribution is not homogeneous, temperatures will also differ. In the right picture for instance the boxes on the side of the truck will have a higher temperature. This means that there is a disruption of the cold chain, which results in rotten fruits or vegetables in the worst case scenario.

In some locations in the world cold outside conditions could cause the opposite, products to freeze once improper loading is applied.

Left picture of the boxes on top also close a so-called chute. This chute cannot be closed or even touched, this chute otherwise cannot provide proper airflow. If this chute is broken this always needs to be fixed before loading. Temperature of the truck also needs to meet the desired settings before loading commences.

Space should also be kept between the load and doors as well as the load and floor. Load bars can be used against shifting of the truckload. Pallets can be used to keep distance between floor and load and even between the door and load. Although for the latter load bars are more common to use.



Produces loaded on pallets and separated by pallets.

The picture clearly shows how pallets can be prepared for transport. Different fruits or vegetables need to be separated by pallets. Below the closed boxes, above the open boxes. Below the pallets a carton cover is put to prevent particles from the pallet from entering the products below.

Quality check cold supply chain

Several checks are implemented in the cold supply chain. The chain is only effective if all along the chain the temperatures are being met. Before the truck is being loaded from the farmer the driver checks which temperatures the produce has.
Did the farmer pre-cool? Did he pre-cool long enough? It can take hours before the products finally meet the temperatures applied.

Once the truck is opened it will also be clear whether or not the truck has the desired temperature. A data logger is a digital device logging all measured temperatures. The data provides information of measured temperatures over time.

This means irregularities can be spotted. Too cold or too warm are both not desired. As mentioned before: quality cannot be improved, only maintained.

Via track and tracing the whole supply chain can be made visible for every single product at any time. So when a product indicates a previous exposure of too cold or too hot temperatures in the past, this track and trace system tells us exactly which farmer produced the products, which trucks drove it. Dataloggers of these trucks might provide the answer.

5 REFERENCES

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- Eurostat (Romania CAP strategic plan)

ANNEX 1: OPTIMAL STORAGE CONDITIONS FRUIT AND VEGETABLES

Product	Optimal Storage Temperature		Chill Point		Freezing Point	Optimal Humidity	Top Ice Accepted [1]	Water Sprinkle Accepted [2]	Ethylene Production	Sensitive to Ethylene [3]	Approximate Storage Life	Comments
	(°F)	(°C)	(°F)	(°C)	(°F)	%						
Apples	30-40	-1 -4			29.3	90-95	No	No	High	Yes	1-12 months	Chill sensitive stored at 35-40 F (2-4 C)
Apricots	31-32	-1 -0			30.1	90-95	No	No	High	Yes	1-3 weeks	
Artichokes	32-35	0-2				90-95	Yes	Yes	No	No		
Artichokes, Jerusalem	31-32	0-2			28.0	90-95	No	No	No	No	4-5 months	
Asparagus	32-35				30.9	95-100	No	Yes	No	Yes	2-3 weeks	
Avocados, ripe	38-45	3-7	36	2		85-95	No	No	High	Yes		
Avocados, unripe	45-50	7-10	45	7		85-95	No	No	Low	Yes, Very		Keep away from ethylene producing fruits
Bananas, green	62-70	17-21	56	13		85-95	No	No	Low	Yes		
Bananas, ripe	56-60	13-16	54	12		85-95	No	No	Medium	No		
Basil	52-59	11-15	50	10		90-95	No	Yes	No	Yes		
Beans, dry	40-50					40-50					6-10 months	
Beans, green or snap	40-45				30.7	95					7-10 days	
Beans, sprouts	32	0				95-100					7-9 days	
Beans. Lima	37-41	0			31.0	95					5-7 days	
Beets	32-35	0-2				90-95	Yes	Yes	No	Yes		
Beets, bunched	32	0			31.3	98-100					10-14 days	
Beets, topped	32	0			30.3	98-100					4-6 months	
Blackberries	32-33	0-1			30.5	90-95	No	No	Very Low	No	2-3 days	
Blueberries	32-35	0-2				90-95	No	No	Very Low	No		
Bok Choy	32-35	0-2				90-95	No	Yes	No	Yes		
Broccoli	32	0			30.9	95-100	Yes	Yes	No	Yes	10-14 days	
Brussels Sprouts	32	0			30.5	90-95	Yes	Yes	No	Yes	3-5 weeks	
Bunched Greens	32	0				90-95	Yes	Yes	No	Yes		Beets, Chard, Green Onions, Mustard, Parsley, Radish, Spinach, Turnip
Cabbage, Chinese	32	0				95-100	No	No	No	Yes	2-3 months	
Cabbage, early	32	0			30.4	98-100	Yes	Yes	No	Yes	3-6 weeks	
Cabbage, late	32	0			30.4	98-100					5-6 months	
Cantaloupe	36-38	2-3	34	1		90-95	No	No	Medium	Yes		
Carrots, bunched	32	0				95-100	Yes	Yes	No	Yes	2 weeks	Ethylene may cause a bitter flavor
Carrots, immature	32	0			29.5	98-100					4-6 weeks	
Carrots, mature	32	0			29.5	98-100					7-9 months	
Cauliflower	32	0			30.6	95-98					3-4 weeks	
Cauliflower	32-35	0-2				90-95	No	No	No	Yes		
Celery	32	0			31.1	98-100	Yes	Yes	No	Yes	2-3 months	
Celeriac	32	0			30.3	97-99					6-8 months	
Chard	32	0				95-100					10-14 days	
Cherries	32-35	0-2				90-95	No	No	Very Low	No		
Cherries, sour	32	0			29.0	90-95					3-7 days	
Cherries, sweet	30-31				28.8	90-95					2-3 weeks	
Chicory	32-35	0-2				90-95	Yes	Yes	No	No		
Chicory, witloof	32	0				95-100					2-4 weeks	
Chinese Pea Pods	32-35	0-2				90-95	No	No	No	No		
Coconuts	55-60	13-16				80-85	No	No	No	No		Extended storage 32-35 F (0-2 C)
Collards	32	0			30.6	95-100					10-14 days	
Corn, sweet	32	0			30.9	95-98	Yes	Yes	No	No	5-8 days	
Cranberries	38-42	3-6	36	2		90-95	Yes	No	No	No		
Cucumbers	50-55		40	4	31.1	95	No	No	Very Low	Yes	10-14 days	
Currants	31-32				30.2	90-95					1-4 weeks	
Eggplant	46-54		45	7	30.6	90-95	No	No	No	Yes	1 week	
Elderberries	31-32					90-95					1-2 weeks	
Endive	32	0			31.9	95-100	Yes	Yes	No	No	2-3 weeks	
Escarole	32-35	0-2				90-95	Yes	Yes	No	No		
Escarole	32	0			31.9	95-100					2-3 weeks	
Figs	32-35	0-2				90-95	No	No	Low	No		

Product	Optimal Storage Temperature		Chill Point		Freezing Point	Optimal Humidity	Top Ice Accepted	Water Sprinkle Accepted	Ethylene Production	Sensitive to Ethylene [3]	Approximate Storage Life	Comments
	(°F)	(°C)	(°F)	(°C)	(°F)	%	[1]	[2]				
Garlic	32	0			30.5	65-70	No	No	No	No	6-7 months	May be stored at 55-70 F (13-21 C) for shorter periods
Ginger Root	60-65	16-18	55	13		65-70	No	No	No	No		
Gooseberries	31-32				30.0	90-95					3-4 weeks	
Grapefruit	55-60	13-16	50	10		90-95	No	No	Very Low	No		
Grapes	31-32				29.7	85	No	No	Very Low	Yes	2-8 weeks	
Green Beans	40-45	4-7	38	3		90-95	No	No	No	Yes		
Green Peas	32-35	0-2				90-95	No	No	No	Yes		
Greens, leafy	32	0				95-100					10-14 days	
Guavas	45-50	7-10	40	4		90-95	No	No	Medium	Yes		
Herbs	32-35	0-2				90-95	No	Yes	No	Yes		
Horseradish	30-32				28.7	98-100					10-12 months	
Jicama	55-65					65-70					1-2 months	
Kale	32				31.1	95-100					2-3 weeks	
Kiwi, ripe	32-35	0-2				90-95	No	No	High	Yes		
Kiwi, unripe	32-35	0-2				90-95	Ne	No	Low	Yes, Very		
Kohlrabi	32	0			30.2	98-100	Yes	Yes	No	No	2-3 months	
Leeks	32	0			30.7	95-100	Yes	Yes	No	Yes	2-3 months	
Lemons	52-55	11-13	50	10		90-95	No	No	Very Low	No		
Lettuce	32	0			31.7	98-100	No	Yes	No	Yes	2-3 weeks	
Limes	48-55	9-13	45	7		90-95	No	No	Very Low	No		
Lychees	40-45	4-7	36	2		90-95	No	No	Very Low	No		
Mangos	50-55	10-13	50	10		85-95	No	No	Medium	Yes		
Melons, Casaba/Persian	50-55	10-13	45	7		85-95	No	No	Very Low	Yes		Riper melons may be stored at 45- 50 F (7-10 C)
Melons, Crenshaw	50-55	10-13	45	7		85-95	No	No	Low	Yes		Riper melons may be stored at 45- 50 F (7-10 C)
Melons, Honey Dew	50-55	10-13	41	5		85-95	No	No	Medium	Yes		Riper melons may be stored at 45- 50 F (7-10 C)
Mushrooms	32	0			30.4	95	No	Yes	No	Yes	3-4 days	
Napa	32-35	0-2				90-95	No	No	No	Yes		
Nectarines	31-32				30.4	90-95	No	No	High	No	2-4 weeks	
Okra	45-50		45	7	28.7	90-95	No	No	Very Low	Yes	7-10 days	
Onions	32-35	0-2				65-75	No	No	No	No		May be stored at 55-70 F (13-21 C) for shorter period
Oranges	40-45	4-7	38	3		90-95	No	No	Very Low	No		
Papayas	50-55	10-13	45	7		85-95	No	No	Medium	Yes		
Parsley	32	0			30.0	95-100					2-3 months	
Parsnips	32	0			30.4	98-100	Yes	Yes	No	Yes	4-6 months	
Peaches	31-32				30.3	90-95	No	No	High	Yes	2-4 weeks	
Pears	29-31				29.2	90-95	No	No	High	Yes	2-7 months	
Peas, green	32	0			30.9	95-98					1-2 weeks	
Peas, southern	40-41					95					6-8 days	
Peppers, hot chili	32-50					60-70	No	No	No	Yes	6 months	
Peppers, sweet	45-55	7-10	42	6	30.7	90-95	No	No	No	No	2-3 weeks	
Persimmons	32-35	0-2				90-95	No	No	No	Yes, Very		
Pineapples	50-55	10-13	45	7		85-95	No	No	Very Low	No		Odor may influence avacados
Plums	31-32				30.5	90-95	No	No	High	Yes	2-5 weeks	
Pomegranates	41-50	5-10	41	5		90-95	No	No	No	No		
Potatoes	45-50	7-10	38	3		90-95	No	No	No	Yes		
Precut Fruit	32-36	0-2				90-95	No	No	Low	No		
Precut Vegetables	32-36	0-2				90-95	No	No	No	Yes		

Product	Optimal Storage Temperature		Chill Point		Freezing Point	Optimal Humidity	Top Ice Accepted	Water Sprinkle Accepted	Ethylene Production	Sensitive to Ethylene [3]	Approximate Storage Life	Comments
	(°F)	(°C)	(°F)	(°C)	(°F)	%	[1]	[2]				
Prunes	31-32				30.5	90-95	No	No	High	Yes	2-5 weeks	
Pumpkins	50-55		50	10	30.5	65-70	No	No	No	Yes	2-3 months	
Quinces	31-32				28.4	90					2-3 months	
Quinces	32-35	0-2				90-95	No	No	High	Yes		
Radishes, spring	32	0			30.7	95-100	Yes	Yes	No	Yes	3-4 weeks	
Radishes, winter	32					95-100					2-4 months	
Raspberries	31-32				30.0	90-95	No	No	Very Low	No	2-3 days	
Rhubarb	32	0			30.3	95-100	No	Yes	No	No	2-4 weeks	
Rutabagas	32	0			30.0	98-100	Yes	Yes	No	Yes	4-6 months	
Salad Mixes	32-35	0-2				90-95	No	Yes	No	Yes		
Salsify	32				30.0	95-98					2-4 months	
Spinach	32				31.5	95-100					10-14 days	
Sprouts	32-35	0-2				90-95	No	No	No	Yes		
Squashes, summer	41-50		40	4	31.1	95	No	No	No	Yes	1-2 weeks	
Squashes, winter	50				30.5	50-70	No	No	No	Yes	1-6 months	
Strawberries	32	0			30.6	90-95	No	No	Very Low	No	3-7 days	
Sweet Potatoes	55-60		54	12	29.7	85-90	No	No	No	Yes	4-7 months	
Tangerines	32-35	0-2				90-95	No	No	Very Low	No		
Tangerines	40-45	4-7	38	3		90-95	No	No	Very Low	No		
Tomatoes, mature green	55-70				31.0	90-95	No	No	Low	Yes	1-3 weeks	Riping can be delayed by storing at 55-60 F (13-16 C)
Tomatoes, ripe	55-70				31.1	90-95	No	No	Medium	No	4-7 days	
Turnip greens	32				31.7	95-100					10-14 days	
Turnips	32	0			30.1	95	Yes	Yes	No	Yes	4-5 months	
Watercress	32				31.4	95-100					2-3 weeks	
Watermelon	55-70	13-21	50	10		85-95	No	No	No	Yes, Very		Keep away from ethylene producing fruits

1) Top icing the products may be very effective keeping the temperature low and the product surface close to *100%* humidity.

2) Spraying with water may be effective by keeping the temperature low (evaporative cooling) and the surface 100% humid.

3) Products sensitive to ethylene should not be stored together with products producing ethylene. Exposure to ethylene may soften the flesh, adding bitter taste to the product or/and accelerate ripe

FACTSHEET POSTHARVEST

Optimal Storage Conditions for Fruit and Vegetables

Product	Optimal Storage Temperature		Chill Point		Freezing Point	Optimal Humidity	Top Ice Accepted [1]	Water Sprinkle Accepted [2]	Ethylene Production	Sensitive to Ethylene [3]	Approximate Storage Life	Comments
	(°F)	(°C)	(°F)	(°C)	(°F)	%						
Apples	30-40	-1 -4			29.3	90-95	No	No	High	Yes	1-12 months	Chill sensitive stored at 35-40 F (2-4 C)
Apricots	31-32	-1 -0			30.1	90-95	No	No	High	Yes	1-3 weeks	
Artichokes	32-35	0-2				90-95	Yes	Yes	No	No		
Artichokes, Jerusalem	31-32	0-2			28.0	90-95	No	No	No	No	4-5 months	
Asparagus	32-35				30.9	95-100	No	Yes	No	Yes	2-3 weeks	
Avocados, ripe	38-45	3-7	36	2		85-95	No	No	High	Yes		
Avocados, unripe	45-50	7-10	45	7		85-95	No	No	Low	Yes, Very		Keep away from ethylene producing fruits
Bananas, green	62-70	17-21	56	13		85-95	No	No	Low	Yes		
Bananas, ripe	56-60	13-16	54	12		85-95	No	No	Medium	No		
Basil	52-59	11-15	50	10		90-95	No	Yes	No	Yes		
Beans, dry	40-50					40-50					6-10 months	
Beans, green or snap	40-45				30.7	95					7-10 days	
Beans, sprouts	32	0				95-100					7-9 days	
Beans. Lima	37-41	0			31.0	95					5-7 days	
Beets	32-35	0-2				90-95	Yes	Yes	No	Yes		
Beets, bunched	32	0			31.3	98-100					10-14 days	
Beets, topped	32	0			30.3	98-100					4-6 months	
Blackberries	32-33	0-1			30.5	90-95	No	No	Very Low	No	2-3 days	
Blueberries	32-35	0-2				90-95	No	No	Very Low	No		
Bok Choy	32-35	0-2				90-95	No	Yes	No	Yes		
Broccoli	32	0			30.9	95-100	Yes	Yes	No	Yes	10-14 days	
Brussels Sprouts	32	0			30.5	90-95	Yes	Yes	No	Yes	3-5 weeks	
Bunched Greens	32	0				90-95	Yes	Yes	No	Yes		Beets, Chard, Green Onions, Mustard, Parsley, Radish, Spinach, Turnip
Cabbage, Chinese	32	0				95-100	No	No	No	Yes	2-3 months	
Cabbage, early	32	0			30.4	98-100	Yes	Yes	No	Yes	3-6 weeks	
Cabbage, late	32	0			30.4	98-100					5-6 months	
Cantaloupe	36-38	2-3	34	1		90-95	No	No	Medium	Yes		
Carrots, bunched	32	0				95-100	Yes	Yes	No	Yes	2 weeks	Ethylene may cause a bitter flavor
Carrots, immature	32	0			29.5	98-100					4-6 weeks	
Carrots, mature	32	0			29.5	98-100					7-9 months	
Cauliflower	32	0			30.6	95-98					3-4 weeks	
Cauliflower	32-35	0-2				90-95	No	No	No	Yes		
Celery	32	0			31.1	98-100	Yes	Yes	No	Yes	2-3 months	
Celeriac	32	0			30.3	97-99					6-8 months	
Chard	32	0				95-100					10-14 days	
Cherries	32-35	0-2				90-95	No	No	Very Low	No		
Cherries, sour	32	0			29.0	90-95					3-7 days	
Cherries, sweet	30-31				28.8	90-95					2-3 weeks	
Chicory	32-35	0-2				90-95	Yes	Yes	No	No		
Chicory, witloof	32	0				95-100					2-4 weeks	
Chinese Pea Pods	32-35	0-2				90-95	No	No	No	No		
Coconuts	55-60	13-16				80-85	No	No	No	No		Extended storage 32-35 F (0-2 C)
Collards	32	0			30.6	95-100					10-14 days	
Corn, sweet	32	0			30.9	95-98	Yes	Yes	No	No	5-8 days	
Cranberries	38-42	3-6	36	2		90-95	Yes	No	No	No		
Cucumbers	50-55		40	4	31.1	95	No	No	Very Low	Yes	10-14 days	
Currants	31-32				30.2	90-95					1-4 weeks	
Eggplant	46-54		45	7	30.6	90-95	No	No	No	Yes	1 week	
Elderberries	31-32					90-95					1-2 weeks	
Endive	32	0			31.9	95-100	Yes	Yes	No	No	2-3 weeks	
Escarole	32-35	0-2				90-95	Yes	Yes	No	No		
Escarole	32	0			31.9	95-100					2-3 weeks	
Figs	32-35	0-2				90-95	No	No	Low	No		

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Product	Optimal Storage Temperature		Chill Point		Freezing Point	Optimal Humidity	Top Ice Accepted [1]	Water Sprinkle Accepted [2]	Ethylene Production	Sensitive to Ethylene [3]	Approximate Storage Life	Comments
	(°F)	(°C)	(°F)	(°C)	(°F)	%						
Garlic	32	0			30.5	65-70	No	No	No	No	6-7 months	May be stored at 55-70 F (13-21 C) for shorter periods
Ginger Root	60-65	16-18	55	13		65-70	No	No	No	No		
Gooseberries	31-32				30.0	90-95					3-4 weeks	
Grapefruit	55-60	13-16	50	10		90-95	No	No	Very Low	No		
Grapes	31-32				29.7	85	No	No	Very Low	Yes	2-8 weeks	
Green Beans	40-45	4-7	38	3		90-95	No	No	No	Yes		
Green Peas	32-35	0-2				90-95	No	No	No	Yes		
Greens, leafy	32	0				95-100					10-14 days	
Guavas	45-50	7-10	40	4		90-95	No	No	Medium	Yes		
Herbs	32-35	0-2				90-95	No	Yes	No	Yes		
Horseradish	30-32				28.7	98-100					10-12 months	
Jicama	55-65					65-70					1-2 months	
Kale	32				31.1	95-100					2-3 weeks	
Kiwi, ripe	32-35	0-2				90-95	No	No	High	Yes		
Kiwi, unripe	32-35	0-2				90-95	Ne	No	Low	Yes, Very		
Kohlrabi	32	0			30.2	98-100	Yes	Yes	No	No	2-3 months	
Leeks	32	0			30.7	95-100	Yes	Yes	No	Yes	2-3 months	
Lemons	52-55	11-13	50	10		90-95	No	No	Very Low	No		
Lettuce	32	0			31.7	98-100	No	Yes	No	Yes	2-3 weeks	
Limes	48-55	9-13	45	7		90-95	No	No	Very Low	No		
Lychees	40-45	4-7	36	2		90-95	No	No	Very Low	No		
Mangos	50-55	10-13	50	10		85-95	No	No	Medium	Yes		
Melons, Casaba/Persian	50-55	10-13	45	7		85-95	No	No	Very Low	Yes		Riper melons may be stored at 45-50 F (7-10 C)
Melons, Crenshaw	50-55	10-13	45	7		85-95	No	No	Low	Yes		Riper melons may be stored at 45-50 F (7-10 C)
Melons, Honey Dew	50-55	10-13	41	5		85-95	No	No	Medium	Yes		Riper melons may be stored at 45-50 F (7-10 C)
Mushrooms	32	0			30.4	95	No	Yes	No	Yes	3-4 days	
Napa	32-35	0-2				90-95	No	No	No	Yes		
Nectarines	31-32				30.4	90-95	No	No	High	No	2-4 weeks	
Okra	45-50		45	7	28.7	90-95	No	No	Very Low	Yes	7-10 days	
Onions	32-35	0-2				65-75	No	No	No	No		May be stored at 55-70 F (13-21 C) for shorter period
Oranges	40-45	4-7	38	3		90-95	No	No	Very Low	No		
Papayas	50-55	10-13	45	7		85-95	No	No	Medium	Yes		
Parsley	32	0			30.0	95-100					2-3 months	
Parsnips	32	0			30.4	98-100	Yes	Yes	No	Yes	4-6 months	
Peaches	31-32				30.3	90-95	No	No	High	Yes	2-4 weeks	
Pears	29-31				29.2	90-95	No	No	High	Yes	2-7 months	
Peas, green	32	0			30.9	95-98					1-2 weeks	
Peas, southern	40-41					95					6-8 days	
Peppers, hot chili	32-50					60-70	No	No	No	Yes	6 months	
Peppers, sweet	45-55	7-10	42	6	30.7	90-95	No	No	No	No	2-3 weeks	
Persimmons	32-35	0-2				90-95	No	No	No	Yes, Very		
Pineapples	50-55	10-13	45	7		85-95	No	No	Very Low	No		Odor may influence avacados
Plums	31-32				30.5	90-95	No	No	High	Yes	2-5 weeks	
Pomegranates	41-50	5-10	41	5		90-95	No	No	No	No		
Potatoes	45-50	7-10	38	3		90-95	No	No	No	Yes		
Precut Fruit	32-36	0-2				90-95	No	No	Low	No		
Precut Vegetables	32-36	0-2				90-95	No	No	No	Yes		

Product	Optimal Storage Temperature		Chill Point		Freezing Point	Optimal Humidity	Top Ice Accepted [1]	Water Sprinkle Accepted [2]	Ethylene Production	Sensitive to Ethylene [3]	Approximate Storage Life	Comments
	(°F)	(°C)	(°F)	(°C)	(°F)	%						
Prunes	31-32				30.5	90-95	No	No	High	Yes	2-5 weeks	
Pumpkins	50-55		50	10	30.5	65-70	No	No	No	Yes	2-3 months	
Quinces	31-32				28.4	90					2-3 months	
Quinces	32-35	0-2				90-95	No	No	High	Yes		
Radishes, spring	32	0			30.7	95-100	Yes	Yes	No	Yes	3-4 weeks	
Radishes, winter	32					95-100					2-4 months	
Raspberries	31-32				30.0	90-95	No	No	Very Low	No	2-3 days	
Rhubarb	32	0			30.3	95-100	No	Yes	No	No	2-4 weeks	
Rutabagas	32	0			30.0	98-100	Yes	Yes	No	Yes	4-6 months	
Salad Mixes	32-35	0-2				90-95	No	Yes	No	Yes		
Salsify	32				30.0	95-98					2-4 months	
Spinach	32				31.5	95-100					10-14 days	
Sprouts	32-35	0-2				90-95	No	No	No	Yes		
Squashes, summer	41-50		40	4	31.1	95	No	No	No	Yes	1-2 weeks	
Squashes, winter	50				30.5	50-70	No	No	No	Yes	1-6 months	
Strawberries	32	0			30.6	90-95	No	No	Very Low	No	3-7 days	
Sweet Potatoes	55-60		54	12	29.7	85-90	No	No	No	Yes	4-7 months	
Tangerines	32-35	0-2				90-95	No	No	Very Low	No		
Tangerines	40-45	4-7	38	3		90-95	No	No	Very Low	No		
Tomatoes, mature green	55-70				31.0	90-95	No	No	Low	Yes	1-3 weeks	Riping can be delayed by storing at 55-60 F (13-16 C)
Tomatoes, ripe	55-70				31.1	90-95	No	No	Medium	No	4-7 days	
Turnip greens	32				31.7	95-100					10-14 days	
Turnips	32	0			30.1	95	Yes	Yes	No	Yes	4-5 months	
Watercress	32				31.4	95-100					2-3 weeks	
Watermelon	55-70	13-21	50	10		85-95	No	No	No	Yes, Very		Keep away from ethylene producing fruits

1) Top icing the products may be very effective keeping the temperature low and the product surface close to *100%* humidity.

2) Spraying with water may be effective by keeping the temperature low (evaporative cooling) and the surface 100% humid.

3) Products sensitive to ethylene should not be stored together with products producing ethylene. Exposure to ethylene may soften the flesh, adding bitter taste to the product or/and accelerate ripe