

Session 3.2 Transport and logistics

Key learning points



- A background to transport and logistics
- Types of transport
- Handling and loading practices
- Causes of losses to produce during transport

Main objectives of the session

By the end of the session participants will be better able to:



- Understand the relative importance of transport and logistics in the marketing of fresh fruit and vegetables
- Evaluate the cost effectiveness and appropriateness of different forms of transport
- Reduce produce damage and losses due to ineffective handling and transport practice

3.2.1 A background to transport and logistics

It is hard to imagine how the fresh produce industry would operate without modern forms of transport and organised logistics. If products are not available when and where customers wish to buy them, then fewer sales will take place. It is necessary to ensure that the transport and distribution system will enable products to reach customers on time and in the correct condition as economically as possible.

The choices made about transportation can affect success in the fruit and vegetable businesses significantly. Losses directly attributed to transport conditions can be high. The goal of every person concerned with transport should be that the produce is kept in the best possible condition during transport and that the haulage of the product is quick and efficient.

Where large distances are involved, such as for import and export operations the logistics can be extremely complicated and in an ideal world transport would take produce from the grower directly to the consumer. However in most marketing systems a number of intermediaries are involved and the cost of transport contributes significantly to the price paid by the consumer, and in some cases even exceeds the value of the raw product.

Fresh produce may be loaded and unloaded numerous times before reaching its final destination and this is particularly true for fresh produce exports. To help in improving efficiency of logistical operations at ports many freight terminals have now introduced fast track computerised booking systems that enables better scheduling of freight. E-commerce applications also under development include the remote monitoring of freight through cameras downloading real time pictures to suppliers or buyers from remote locations.

The blanket term “logistics” covers a wide range of activities from the physical transfer of produce from the seller to the buyer via several intermediaries to the requirement to keep track of these movements and tie the supply and delivery to payment.

Specialist companies are often able to organise the entire process of fresh produce transport and logistics and this is often a sensible option for growers or traders not experienced in this kind of activity. However this session will provide further information on the key issues that are related to the transport and the logistics involved in the distribution of fresh fruit and vegetables.

3.2.2 Types of transport

When transporting fruits and vegetables you are left with a choice between, speed, distance, cost, security, safety, damage potential and packaging requirements. Most fresh produce is moved in road vehicles, with lesser amounts by sea, air, train or inland waterways.

Road vehicles: Their use is likely to increase, as their most significant advantage is door-to-door delivery that provides regular services to principal cities. The vehicles in most common use are small pick-ups or bigger articulated trucks, either open or enclosed. Most growers who do not sell to traders will transport produce to market in hired lorries or pick-ups. The unit costs of using smaller vehicles are generally higher than hiring space in a larger lorry. Pick ups however do offer growers the advantages of:

- ❑ Transporting produce immediately after harvest into the market
- ❑ Supplying transport services to neighbouring growers
- ❑ Taking produce for sale at growers markets
- ❑ Making direct sales to retailers and catering clients

Growers hiring vehicles will be given a fixed price for individual use of the transport or the lorry owner will charge by the carton. In both systems there are possibly two major inefficiencies:

Firstly if the lorry is not fully loaded the unit costs are higher. For smaller businesses that cannot afford to make a full load an operator will sometimes offer a groupage service. This is particularly true of exports whereby a freight forwarder consolidates the shipments of several exporters and so saving on freight costs. Cost savings can also be achieved by improving the process of assembling produce and encouraging the sharing of transport. A group of growers may agree to assemble produce on a particular day of the week at specified collection points. Larger volumes of produce can bring cost savings through both economies of scale and by attracting a number of lorry owners to encourage price competition between them.

Secondly when transport is priced by the carton, transporters will sometimes overload lorries in order to maximise their income. By assembling produce at one point so as to guarantee full loads, a fixed price for the lorry can be negotiated better and growers can themselves ensure that the transport is not overloaded. Generally the larger the individual load i.e. the larger the truck used, the cheaper the unit/cost of transport.

The size of transport lorries is controlled through national legislation. Maximum weight limits permitted vary between 40-44 tonnes dependant on the country. The types of trailers most used are:

- ❑ Insulated/ventilated vans, used for short and medium distances in temperate climates and for transporting not highly perishable items such as potatoes or dried fruit
- ❑ Insulated vans equipped with refrigeration or chilling units and used for transporting fresh perishable and frozen products over all distances.

Consideration also needs to be given to deliveries to multiple destinations. Large loads are sometimes too big for individual buyers and better prices can sometimes be obtained by splitting the delivery between different destinations. Produce can be mounted on to 2 or 3 axle truck chassis, 2 or 3 axle trailers or on to container trailers. TIR vehicles (vehicles for international transport are normally made up of an engine and an enclosed trailer of varying lengths up to a maximum of 13.60 metres. Longer wheel based vehicles reduce vibration and consequently crop damage.

Sea transport: In a world of instantaneous communications and next day deliveries it may seem that the logistical operations of sea freight are somewhat outmoded. However huge strides have been made in recent years in controlled atmosphere technology and trackable logistics and this makes sea transport more of a viable option. 75% of exported goods go by sea as ships provide the cheapest form of transport carrying heavy and bulky loads at relatively low cost. However the price you pay for this is slowness and for most perishable fresh fruit and vegetables this is still highly inconvenient. Add to this the time the customer may be from the port and the total consignment time can be considerable.

Fruit and vegetables may be transported in reefer ships (ships providing their own on ship storage options) and container ships that load simply the container onto the ships and with the produce already packed inside. Most fresh fruit and vegetables are transported by reefer ships with temperature controlled facilities within the hold at 4 or 5 levels and each level able to be chilled to various temperatures.

However containerisation is more convenient as it enables ship transport to be combined with road and rail transport and roll on roll off ferries further reduce transit time and the time spent loading and unloading. Containers are delivered not to the sea port but to the container port (ICD). When using a container you use either a full container load or part of a container with those of other exporters.

Over the last few years container ship transport of fresh produce has grown and this has largely been due to the advances in technology allowing a flexibility of temperature range that fresh produce requires. There are two types of container, firstly a dry container and secondly one that is refrigerated with its own motor and cooling system. These offer temperature ranges from -25°C to more than $+15^{\circ}\text{C}$. This is especially beneficial when different temperature fields are required for different types of produce. Within these containers the air is modified with 95% nitrogen and a small amount of oxygen and carbon dioxide to send the fruit to sleep and so halt the maturation process.

But containerisation is also limited by the need for sophisticated facilities to be available at the loading and unloading port because the containers themselves will be stacked and moved around and the development of larger and larger seacraft has required adequate facilities and equipment to be available at ports such as gantry cranes. Container ships are also limited by the amount they can handle at one time. With seasonal fresh produce arriving in high volumes at certain times container lines are often unable to position the vast number of boxes required at the loading ports. Therefore as a general guide the majority of items that are of high value such as grapes, go in containers, while bulky items, such as citrus go in containers.

Conference lines are regular timetabled sailings and have fixed tariffs with rebates of around 10% for regular use. A non-conference ship (tramp) will pick up and sail anywhere. You usually pay less but have to haggle over the rate, but you may not know when the ship will sail. Sea freight charges are based on weight or measurement - whichever is the higher. Goods 3.2 cubic metres in size but weighing 2.8 metric tonnes will pay 3.2 times the freight rate. Most cargoes are larger than they are heavy. Rates vary according to destination and by types of goods. There is usually a minimum rate and freight costs are normally quoted in USD and paid in advance.

Air transport: Although costs are relatively high, air transport is growing in popularity, largely because, it is quick, goods require less packing and have less chance of being lost or damaged. Air transport also enables improved company cash flows as less stock is tied up in transit and payments are made quicker. Air freight offers the enormous benefit of speed, crucial for time sensitive materials and invaluable for fresh produce deliveries of low volume but high value products. Even so air transport of fresh fruit and vegetable produce still accounts for only 1-2% of total international freight.

Air cargo is carried on most passenger flights and you can book space on them in the same way as you would book passenger accommodation. Special arrangements have to be made for unusual cargoes, such as very valuable items, animals or unusual shapes which will require special attention. It is a particularly popular form of transport for highly perishable foods and flowers, seasonal and emergency goods and in particular goods that are low in weight and needing to be transported over long distances.

Air cargo is limited by its size or what the aircraft can accommodate, which may be in some cases relatively small amounts. There are also a few other occasional problems with air transport including; non-standardised packages, careless handling and exposure, consignments sometimes left behind in favour of passengers, flight delays due to bad weather or breakdowns and intermittent refrigeration followed by exposure to high temperatures.

Airport facilities vary considerably and the routing system as well as the carrier should be considered carefully. Charges for air cargo are fixed by the International Air Transport Association (IATA) and most airlines charge similar prices based more on weight than size.

The international trade in air freighting of high value crops is generally well organised but damages through air freight do occur and primarily due to:

- ❑ The use of poor, non-standard packages
- ❑ Careless handling and exposure to the elements
- ❑ Consignments left behind in favour of passengers
- ❑ Flight delays owing to bad weather or breakdowns
- ❑ Intermittent refrigeration followed by exposure to high temperatures
- ❑ Relatively small produce shipments

Rail: The rail network through Europe is excellent and privately owned cargo container trains are sometimes organised on a groupage basis. Rail is also better and quicker than road over long distances. However rail is often a last choice for fresh produce deliveries, primarily due to its image for delays as well as the lack of facilities available for fresh produce storage, loading and unloading. Fruit and vegetables must first be lifted at the farm onto trucks and once you have done that the economics of trans-shipping on to rail becomes doubtful although some companies do integrate rail as part of their supply chain, particularly for ambient and dried goods.

Both rail and road transport charging rates are based on weight to volume and prices vary according to type of goods and destination. One of the many ways in which produce is damaged is through impact and vibration, both occurring in transport vehicles. The severity of these problems is reduced in rail transport.

3.2.3 Handling and loading practices

If produce is to be transported it must be handled. Throughout the entire distribution system, mechanical damage, and in particular impact damage, can be greatly reduced by careful handling. Poor handling of produce during loading and unloading of transport vehicles is a complex problem.

Fresh fruit and vegetable products may be lifted and dropped on average between five to ten times between harvest and consumption. The following table shows the extent of bruising in the third layer of apples after dropping cartons from various heights:

TABLE: The extent of bruising in the third layer of apples after dropping cartons from various heights

Drop height	Bruised fruit %
15 cms	7.5
30 cms	15
45 cms	28
60 cms	40
120 cms	85
Number of drops in cartons from 30 cm	Bruised fruit %
2	6
5	32
10	46

The table indicates that as the drop height increases the resultant bruising and depth of bruising also increases. Even with the industry, some produce lines are considered relatively “tough” and can withstand rough handling but this is invariably true. After a journey of 1600 km and six handling operations the average proportion of bruised apples in tray packs is 10 - 15%. Mechanical damage may not show up immediately but up to two days later.

In practical terms all of this means that the extent to which produce is dropped and tossed will directly affect the extent of mechanical damage. This applies from the grower through to the consumer.

The development of handling systems, using palletised unitised loads is currently the most efficient method of dramatically improving handling. Pallets however need to be related to the form of transport. For example, very close tolerances exist between standard pallet dimensions and the internal width of enclosed or refrigerated road vehicles. This requires careful attention to formation of unit loads and the provision of adequate air circulation. Although the shape and condition of trucks are important

factors in fresh produce transportation, the loading and stowing methods in vehicles are pertinent to damage and loss. Loading aids such as trolleys, roller conveyors, pallet or forklift trucks should be used wherever possible to reduce the handling of individual packages.

But many containers, rail wagons and road vehicles are still loaded by hand. Careful handling by people is difficult to achieve in practice and loading and unloading of vehicles will need to be properly supervised. Many people employed to perform this physical activity are often casual or unskilled labourers with little knowledge of fresh fruit and vegetables, and even less knowledge of good handling procedures. Employee education should be an on-going operation in any handling process. All staff should be aware of the damage they cause and attempts should be made to improve methods of handling. It will not matter if great expense has been devoted to providing excellent equipment and handling facilities if people do not handle the produce gently.

The economic aspect of reducing mechanical damage has to be considered. It is difficult to justify the incorporation of a technique that will maintain quality if the result is that the overall process is no longer profitable. The techniques to solve the problem of mechanical damage must be integrated with the many other aspects of production and distribution. Hence attempts to minimise mechanical damage must be a compromise based on the overall fruit and vegetable marketing system. However it is necessary to appreciate and understand “what is ideal” before “what is practical” can be implemented

Although the shape and condition of transport vehicles are important for fresh produce transportation, packing, loading and stowing methods in vehicles are particularly important. Produce needs to be properly packed and loaded on to a suitable vehicle to minimise damage. This is the maximum load that can be carried economically under satisfactory technical conditions.

The load must be stable and well ventilated. The size and design of packages should give adequate levels of ventilation of contents, with the minimum of wasted space and the packages should be strong enough to protect the contents. Packed produce should be protected from sun and rain at all times, including during loading and unloading. Packages should be loaded on slatted racks, on the beds of vehicles or on pallets in order to allow the circulation of air around stacks during transport.

Stowage must be carefully undertaken to avoid collapse of the stow during transport. Packages should not be stacked higher than the maximum recommended by the maker. Otherwise the bottom may collapse under the weight of those above. If the load is to be distributed to several locations, packages should be loaded in reverse order to that in which they will be unloaded i.e. last on first off. At the same time the product should be loaded evenly around the vehicle. Less impact damage occurs with produce stacked in the middle of the vehicle.

3.2.4 Causes of losses to produce during transport

Fresh fruit and vegetables are very delicate living tissues that are easily damaged. The damage and loss incurred during non-refrigerated transport are caused primarily by mechanical damage and by overheating.

Mechanical damage. Damage of this type occurs for many reasons including:

- ❑ Careless handling of packed produce during loading and unloading
- ❑ Vibration (shaking) of the vehicle, especially on bad roads
- ❑ Fast driving and the poor condition of the vehicle
- ❑ Poor stowage, which allows packages in transit to sway and so the stow may collapse
- ❑ Packages stacked too high and the movement of produce within a package increases in relation to its height in a stack

Overheating: Overheating of produce promotes natural breakdown and decay and increases the rate of water loss from the product. This can occur not only from external sources but also from heat generated by the produce within the package itself. The causes of overheating include;

- ❑ The use of closed vehicles without ventilation
- ❑ Close stow stacking patterns blocking the movement of air between and through the packages, thus hindering the disposal of heat.
- ❑ The lack of adequate ventilation in the packages themselves.
- ❑ Exposure of the packages to sun whilst awaiting transport or while trucks are queuing to unload at their destination.

Transport is a major cause of losses to fresh fruit and vegetables. However a number of other issues may influence the loss including. Picking at the wrong stage of maturity, uneven or over ripening of fruits due to different varieties or sizes, chemical changes leading to water/weight loss, shrivelling, wilting, yellowing, sprouting or greening, improper curing to repair field damages, insufficient wrapper leaves or over trimming. Attacks by micro-organisms can occur at all steps during the post-harvest system.

TABLE: Recommended transport practices

Advice	Reason
Remove products from the cold store during the cool part of the day	In warm conditions produce attracts condensation. Water creates an environment for microbial attack
Transport produce during the coolest part of the day (dawn or night)	Heat causes faster water loss and respiration
Supervise loading and unloading. Boxes should be lifted or carried, never thrown	To prevent boxes being dropped
Loading can be made easy by the use of loading bays or with steps or planks. Trolleys, conveyors, and fork lift trucks reduce handling	Produce can be carried on and off easily
For loading bulk transported cabbages and melons, the throw catch system can be used but should involve at least 5 persons	This is acceptable because of the need for speed in unloading and the low value of the individual fruit

Provide space between crates for adequate ventilation	To prevent accumulation of heat and gases
Containers should be packed to reduce movement and to distribute weight evenly. Only stack to a height that the lowest containers can withstand without crushing. Stow goods in reverse order in their unloading sequence	Shifting loads and poor weight distribution damage produce and cause vehicle handling problems
Use white or white painted canvas to cover produce	The sun's heat will be reflected
Provide ventilation during transport by raising the canvas cover 20 cms with a plank into a low tent space	To provide air flow for the removal of heat and gases
Vans should be double skinned and allow ventilation	To prevent the transmission of heat to the produce
Use horizontal dividers to separate layers of containers in the truck. This system can also be used for bulk transport of such produce as melons, cabbages and citrus	Prevents compression damage to the produce being transported. Can be used for containers that do not stack, as well as bulk shipments
Bulk shipments should be cushioned with a thick layer of straw or leaves on the bottom and sides of the lorry	Water melons are transported this way in the United States to prevent damage
Jolting should be reduced by not driving too fast, particularly on poor roads. Long wheel bases reduce damage, as does air ride suspension, which is preferable to spring leaf suspension	Jolting increases crop bruising and wastage, reducing sales income
Vehicles should be properly maintained	Breakdowns result in time wastage and may result in high levels of produce damage
During loading, unloading and when parked the truck should be in the shade	Gives protection from sun and rain

EXERCISES: Transport and distribution

Find out for your country or region:

- ❑ What types of transport vehicles are available for the transport of fresh fruit and vegetables. Who manages them? Who are the main manufacturers or distributors of these vehicles?
- ❑ What alternative methods are there for distributing fresh fruit and vegetables by air, road, train or ship? Where are the main ports? What kinds of facilities do they have and what are the costs?

Place of variety of fresh fruits and vegetables in boxes together. Allow air circulation between some boxes and no air circulation in others. Store them at different temperatures and see what results.

Drop products of various types from different heights and on to different hard and soft surfaces. Compare the rate of decomposition and damage of different products and record the quality of the product over time.

Contact specialist transport and logistics companies. Find out what electronic systems they use for the transport and distribution of fresh fruit and vegetables.