
UNIT 1 MILK COLLECTION AND TRANSPORTATION

Structure

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1.0 OBJECTIVES

After reading this unit, we shall be able to:

- ^{2/21} outline the factor involved in planning and developing milk collection structure;
- ^{2/21} indicate steps to be followed in organizing a milk collection system;
- ^{2/21} specify various types of milk collection system;
- ^{2/21} enumerate type of containers at different structural points of collection;
- ^{2/21} state needs and modes of transporting milk.

1.1 INTRODUCTION

Milk production, in most of the countries particularly, developing countries, is confined to rural/hinterland areas; while demand for milk and dairy products is mostly urban in nature due to obvious reasons. Availability of inputs required for production of milk is cheaply and conveniently available in rural areas, whereas densely populated potential consumers are in urban areas. In addition, rural population, in general, face lot of marketing problems due to scanty and scattered nature of milk production, habitants and unavailability of proper infrastructure. Hence, milk has to be collected, transported and marketed from villages to towns/cities for better return.

The milk collection system, chosen must reflect the local conditions in terms of technical competency, cost, infrastructure and climate. Milk collection from producers through collection points is done mostly in rural areas with a large number of small suppliers and thus, eliminates a need for their own chilling and storage facilities. Collection points must comply with the same hygienic requirements as the dairies in addition to infra-structural facilities of quick transportation. In no case, milk after milking should take more than 4 hours, particularly in temperate countries, to reach to a point where it is chilled promptly to less than 4 °C.

1.2 PLANNING MILK COLLECTION

Well-adapted handling techniques for milk and dairy products are being practiced in most of the countries since long. Thus, under similar environmental conditions, a successfully adapted model of milk collection of some other countries, found economically sound and technically reliable, can be taken up cautiously; of course, if required, with certain modifications in light of local existing conditions and

developing features. The ultimate aim of every collection system is to provide regularly “safe” milk for the processing units and/or the customers to meet their demand at economical cost. Important considerations are given here.

i. Climatic Conditions

Climatic conditions like temperature and humidity with sharp seasonal variations play an important role in planning a suitable milk collection system. The climatic conditions of a centre or area remain persistent which cannot be changed by human being at large. Milk collection structural requirements of a tropical country will be altogether different from that of cold one. High climatic temperature and humidity conditions are very much conducive for the growth of micro-organisms. Sharp seasonal variations also lead to unpredictable situation for an established collection system to compete. Special components are needed in such conditions to prevent milk spoilage. Usually, a chilling component needs to be installed at collection point, if not done at production point, to bring down the temperature of milk to below 4°C within 4 hours of after milking. Therefore, a milk collection system must always be well adapted keeping in view the climatic conditions of the locality and region.

ii. Development Features

Planning of a collection system must be done in view of the actual stage of development which is subject to a change with the development of that locality and area. Development features include:

- ^{2/21} Communication network,
- ^{2/21} Availability of technical know-how for maintenance and replacement of equipment,
- ^{2/21} Education and skill level,
- ^{2/21} Purchasing power of a big segment of the population,
- ^{2/21} Working and earning opportunities for the rural population,
- ^{2/21} Basic amenities and infrastructure particularly transport.

iii. Inherent Characteristics of Milk

Because of specific nature of milk, a collection system needs to:

- ^{2/21} provide a suitable container (utensils, can, tank or tanker) to effect carriage, storage and process,
- ^{2/21} give fair measure (volume or weight) for payment,
- ^{2/21} test (platform, laboratory tests) for microbiological and chemical quality, including adulteration, to avoid spoilage,
- ^{2/21} inhibit microbial development by speedy transit, refrigeration and processing.

iv. Size of Dairy Plant

Milk collections largely involve the provision of milk for handling only a few hundred kilograms, ranging from 1000 Kgs to 5,000 Kgs per day depending upon the availability of energy, water, equipment, technical and managerial know-how. If collection has to provide milk for rural processing units, several systems can be appropriate. The system should consider time gap between milking and chilling along with cost of these operations. Depending upon the potentiality of milk production, suitable capacity and size of reception and chilling facilities should be planned.

v. Density of Supply in the Milk-shed

If milk is supplied to large dairy plants over a long distance from the production site, a milk collection centres are established to collect sufficient milk to justify a call for lorry or tanker. Intermediate collection points are more likely to be required

when milk has to be collected from a low-density production area at a long distance. Large collection center will supply more directly to the factory.

vi. Scattered and Scanty Milk Production

In rural India, milk production is largely a subsidiary activity to agriculture. Small farmers and landless labourers usually maintain one to three milch animals. As a result, small quantity of milk is produced. This situation makes the task of milk collection complex. A multi stage milk collection system is considered to be advantageous.

vii. Distance to Dairy Plant/Market

The rate, at which milk deteriorates in warm climate, excludes transport of milk over long distances. Where long transport of raw milk is unavoidable; speedy transit, refrigeration and processing is necessary to inhibit microbial spoilage. These may include a collection point, a first stage collection centre and an intermediate depot/ point to chill and bulk milk for onward dispatch by long distance tanker to a processing plant. Milk collection via such a multi stage collection system is naturally much more costly.

viii. Type of Products to be Manufactured

The marketing must take into account the perishable nature of the product. Immediate conversion, into more stable and marketable products, is the time-honoured solution. After processing, dairy products have always a much better keeping quality.

The quality of milk reaching dairy is a deciding factor for manufacturing a product. The collection structure is decided on the basic of types of products to be prepared in the dairy.

Check Your Progress 1

1. Why do you need planning of a milk collection system?

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2. Name the considerations taken into account in planning milk collection?

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1.3 ORGANIZING MILK COLLECTION

After planning milk collection, steps are taken to organize collection system. The first step is to undertake extensive surveys in the milk shed area. Availability of milk at various collection points is ascertained based on the number of animal, future potential of milk availability and the presence of competitors. This is followed by route planning and finalization of location for collection and chilling center. Since organization involves interests of producer, processor and consumer, the collection system must be well organized and operated under tight and well controlled manner.

i. Objectives

Milk collection system is organized with an objective to collect sufficient quantity of milk for processing plant and to ensure:

- ^{2/21} accurate measurement of producers' deliveries,
- ^{2/21} receipt of unadulterated, clean, hygienic and good quality milk.
- ^{2/21} regular payment to producers and giving incentive for quality production.
- ^{2/21} economic collection and efficient transportation to dairy plant.

ii. Steps

To organize a good milk collection system, the following steps are considered:

Milk survey and location of milk collection/milk-shed area: Milk survey of is done to establish its potential of milk in the area. Two types of milk survey are required. First is a broad milk shed survey with the aim of defining the likely overall potential of the milk-shed area, the possible general location of collection centers and likely routing for collection vehicles.

In second type, a more detailed comprehensive survey is carried out to ensure the worthwhile location of a collection point. On the basis of number of milkmilch animals, the number of potential producers is established; current milk production and products made are estimated and likely potential in association of other agricultural activities is assessed. A meeting of potential producers may be called and possibility to form a producers' cooperative or association of milk suppliers should be discussed.

Establishment of a collection point: Having done the survey on milk potential and possible location of milk collection points in a milk shed area, actions are to be taken to establish the milk collection centers, acquire sites, erect necessary buildings and install the equipment. The collection point will be established at a convenient location, usually central to the potential suppliers and close proximity to the access appropriate road system for onward transportation of milk to the dairy. Availability of adequate and reliable power supply and potable water would be additional requirements if considered for establishing a refrigerated bulk tank and developing some cooling facilities at the centre. Security arrangement to prevent loss of items, an office to work and keep records on supplies, a laboratory for sample testing and housing facilities for inputs like chemicals and medicines, feeds and equipment can also be provided.

Deciding a milk collection route: In most cases, sending milk directly from collection centre to main dairy or chilling centre is neither convenient nor economical. Hence, a proper route planning is done taking into account milk availability, permissible route length, road access and village connectivity, and distance of collection points from the site of chilling/dairy plant. The economic route design has a great impact on the progress of milk shed, milk quality and procurement cost. Increase in the cost of milk, on account of quality deterioration or less capacity utilization of vehicle, has direct impact on the total cost. Hence, the following information are needed in deciding a milk collection route:

- ^{2/21} Details of milk shed area with respect to number of collection points and pattern of expected quality of milk to be collected throughout the year at individual points.
- ^{2/21} Geographical map of the milk shed area indicating road, river and railways.
- ^{2/21} Distance map of collection centre and milk producing villages.
- ^{2/21} Availability of type of transport vehicles.
- ^{2/21} Expected minimum and maximum time required to carry milk by special route vehicle to the chilling/dairy sites.

Management of organization: Management of organization should be responsible to appoint the staff to collection center.

- i) **Overall management control:** Overall management control will depend upon and is directly related to the management of the main/central dairy. This may be run by Government or an appointed parasitical dairy authority, a private company or by a producer cooperative. The central management will also manage the collection centers, although, perhaps, by delegation. Thus, the overall management authority of the collection system will supervise the collection points, organize the transport for them, give services and management back-up, provide regular payment and organize production requisites and extension services; generally supporting the collection points. A positive approach of the central management to the development of a collection system is vital and for this, central management must include manager procurement as member in a senior position and give attention to his complaints or advice.

Taking the dairy industry worldwide, organizations of producers are the dominant agencies in the overall management control of development of dairying. This may work as cooperatives or association or companies. The full participation of suppliers can be regarded as vital at a collection point.

- ii) **Collection centre management and staffing:** The organization within a collecting centre is a function of its size. A small village society may consist of a management committee of the cooperative with a chairman and secretary. The secretary may be the only full time member staff, assisted by part time workers. At the time of collection, they will receive and record the milk collected and carry out simple testing.

A large centre, might be having a refrigerated bulk tank and may employ several staff under a manager. The number will depend on size of a unit and the range of activities carried out for organizing any collection centre. Three important points are:

- ^{2/21} Responsibilities and the tasks of these employees have to be clearly defined.
- ^{2/21} Proper training is provided in the form of short courses for a few days.
- ^{2/21} A close supervisory control: A group of centres will be placed under a manager at the dairy, making regular visits and applying close supervisory control.

Operating procedures: Management organizations have to set the operating procedures at a centre, including measurement, quality testing, recording, onward transportation and payments.

Operating stage at collection centre starts with reception of milk from the suppliers. At this stage, milk is graded and tested for acceptance or rejection. Accepted milk is measured, recorded, sampled and analysed for quantity and quality on which suppliers are paid. The centre records should be carefully kept in duplicate with the total checked at the dairy and any discrepancy carefully investigated. A record of test results will also be kept. Check tests at the dairy may be carried out periodically and comparisons are made with individual results.

The milk, once accepted, is stored, perhaps only for an hour or so prior to dispatch. Milk should be kept in the shade in water cooling system or in a large centre, where available, refrigerated storage is done. The supplies are then dispatched to the dairy/chilling centre. Transportation schedules should be carefully planned to minimize time and cost.

Cleanliness of the containers used for milking, carrying, storage, and measuring, etc. should be strictly maintained. Chemicals and detergents may be supplied by the organization.

Payment to the producers should be made at mutual agreed intervals regularly by

the centre staff. An acceptable accounting system has to be devised, subject to regular audit. Complaints should be investigated rapidly. Periodic meeting of producers should be arranged. Confidence on the part of all involved is essential.

Supervision and control: Supervision and control of the collection centres include supervisory visit, check measurement, testing and audit.

Five to fifteen collection centres are grouped under a field supervisor, working under procurement manager. The field supervisor will visit each centre unannounced at least two or three times a month to supervise a daily collection, review procedures and check stocks, records, any cash and accounts. Periodic meetings of producers may be conducted and complaint resolved. The field supervisor may also be responsible for building up an area, organizing new collection points.

Supervision and control will also be carried out through the continuous surveillance of the physical records of the producers' supplies, deliveries and test results. Any anomalies that are perceived would immediately be investigated. Control will also be applied through financial records, costing and audit. Costing give a check on business efficiency with comparison being made among centres. Regular audit is vital to ensure there is no misuse of funds.

iii. Producers Participation

The producer participation in organized milk collection is vital and necessary, particularly at the point of first acceptance of milk. Problems such as, short shelf-life, staleness, heated flavour, developed acidity, measuring and testing results, etc. very often surface at the point of collection. Under such a situation, producer association or cooperative is the best type of organization to run a centre and resolve their suspected problems.

iv. Types of Milk Collection Systems

A number of milk collection system have been developed and are being used throughout the world to provide market to the milk producers and obtain sufficiency of milk for processing plant.

Direct from the producer: The individual producer brings milk and delivers to the dairy plant independently. This practice generally suits the large producers located near the processing plant. There is no obligation of any kind on either side.

The processor is in daily contact with the milk producers. Quality control can be performed in the presence of the producer. Adulterations can be dealt with in the presence of suppliers. The relative nearness and personal contact between producers and processors is excellent. Additional job opportunities among rural people can be created.

Dairy has the right to fix the price for milk. Generally low price is offered to producers. Milk producers are normally exploited. Dairy may deny from taking the milk on various grounds. There is no assured market for the milk throughout the year. The dairy because of seasonal variations may not accept all the milk supplied by the producers. Producers do not get incentive for increasing milk production. Neither facilities to increase milk production are provided by dairy nor social and economic needs are taken care of. The profits earned by the dairy are not shared with milk producers.

Through middlemen: The producers, normally in our countries, are having one or two milch animals. The milk is produced for the farmer's family and the surplus is sold locally or converted into a product. Under this situation, a dealer system usually arises in which a middleman collects the surplus milk, carries it to the

processor or to a market in nearby villages or towns and then sells it. Dairy plants has no direct contact with the actual producers directly. The traditional middleman acts as agent between the dairy plant and small milk producers. Sometimes, milk producers are given loan for purchase of milch animals with the agreement that the milk produced will have to be sold to the lender only on his fixed price. Apparently, it seems to be simple and flexible system. It is economical as head load, shoulder sling, bicycle, motorcycle etc. are used as mode of transportation. It saves time of small milk producers/suppliers. Milk is usually of poor quality. More proximity of using preservatives, neutralizer etc. Milk could be supplied to limited distance. Price for the milk received by the producer is very low. Producers do not get any incentive or help for milk production. Milk producer, generally, remains a debtor.

Through agent or contractors: Some dairies enter into an agreement with the authorized agents/contractors for the supply of certain quantity of milk for a specific period. Normally, the price for the milk, its quality and quantity in different seasons are mutually agreed upon. Other details such as mode of payment, timings, transportation of milk, settlement of dispute if any and penalties for failure, etc. are decided at the time of making agreement. Contractors make their own arrangement to collect, chill and transport the milk in cans, tankers, bulk tanks, etc. by their own vehicles. Dairy is no way concerned with milk production and management of milk collection, transportation and incurring expenses on it. Dairy has not to deal with large number of producers but only a few contractors.

Milk producers are, invariably, exploited by the contractors and the dairy as well. Quality of milk, in general, is poor, adulterated and fabricated. Once becoming dependent on the supply of milk by contractors, dairy yields to their dictat. Producers get very low price for milk and profits are taken by the contractors. Often milk producers remain debtor to the agent and they do not have freedom to sell their produce elsewhere. No facilities for increasing milk production nor for the social enlistment are provided. This system of milk procurement encourages red tapism/corruption.

Through cooperatives: At the village level, farmers organize themselves in a cooperative society, which establishes milk collection centres. The society members deliver milk twice a day to the milk collection centres where milk is weighed/measured, tested, and price is paid to farmers according to its quantity and quality. The village society supplies/sells milk to its own district cooperative dairy plant. It transports milk in cans by truck or by insulated road milk tanker, if there is a chilling centre. Besides milk collection, the society also provides technical input services such as artificial insemination, veterinary aids, concentrated cattle feed and fodder seeds, and counselling to society members to enhance milk production.

Unlike the other systems of procurement, the milk producer is the owner of the dairy. He has the right to decide the price of milk and also to get the share of profit made by the dairy. This system gives self-reliance to the producers for solving their problems in a collective manner. This is a foolproof system to eliminate all the demerits of other types of milk collection.

Directly from dairy/chilling plants: Improvement in refrigeration and transportation facilities has made possible to procure milk in bulk quantities from distant places. One dairy situated at thousand kilometers away can get milk from another dairy in good condition. The milk is either chilled or processed and chilled to a temperature just above 4°C and transported through road/rail tankers (insulated or refrigerated) depending upon the distance and volume of milk. Milk at the receiving dairy is usually reprocessed, packaged and delivered to the consumers. Dairies situated in big cities like Kolkata, Delhi, Mumbai, Chennai, etc. are procuring milk utilizing this system from neighbouring or far-off states of this country.

Through Government agencies: Dairying is being considered as an instrument of social upliftment. Hence, in areas, regions, states or countries, where dairy development is still under infancy, Govt. is providing all sorts of inputs to help farmers to adopt dairy farming by providing ready market for their produce i.e. milk. Under this programme, milk is collected at collection centre, established and managed by Govt. staff or agency in the village itself. The milk is measured, tested and paid (daily, weekly, fortnightly or monthly) for the supply. Milk so collected is either transported to a chilling centre and/or a processing dairy or market.

Government support encourages milk production in the area. Ready market at door-steps provides milk production incentive to farmers. Payment on quality and quantity basis at fixed periodic interval increases reliability and assurance among the milk producers. Some times loan is also provided for purchasing animals with subsidies on easy terms to repay.

Check Your Progress 2

1. Write aims of organizing milks collection.
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2. What are the important steps of milk collection organization?
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3. How far is the participation of producers justified in organization of milk collection?
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4. Describe the types of milk collection systems existing in our country?
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1.4 CONTAINERS FOR MILK COLLECTION

Various types of containers made of different materials, sizes, shapes and designs are used in milk handling at pick up-points, collecting centres, collecting and cooling centres and finally for delivering to the processing plant.

i. Materials of Construction/Fabrication

Wood, plastics, porcelain, glass, metals etc. are used for fabricating different type of milk containers of several uses (Table 1.1).

Table 1.1: Type of containers and their uses

S.No.	Container	Uses
1	Wood	Little use for milking, milk fermentation
2	Plastic-Food grade quality	Little use for milk can, sample bottle, measure
3	Porcelain	Very little use during milking at farm
4	Glass	By small scale producers during delivery
5	Metal	On the farm and during milk collection, transport & storage
	Copper plated	Household uses in handling milk
	Steel	Only tin plated steel for short use
	Stainless steel	Only SS with 18-8 chrome and Nickel, surface polished. Very much in use for all type of cans
	Aluminium alloys	Milk cans
	Enamel coated metal	Frequently used for handling milk.

ii. Design of Milk Containers

Milk containers must be designed in such a way that all the parts of a container are accessible for cleaning, sanitization and inspection. The container must give protection to milk from spoilage, light penetration and contamination. Some small-scale farmers use cans which were previously used as packaging material for other foods. Such cans may have joints which are not accessible to washing operations.

iii. Containers on the Farm

Type, size and design of containers depend on the farm operations and size of the herd. Milking is usually done by hand in small organized farms. Machine milking is limited to the large-scale government/institutional farms. For hand milking, wide mouthed buckets made of aluminium or stainless steel are used. In some farms, small-mouthed milking pails are prevalent.

At the end of the milking process, the herd's milk is pooled into one or a few containers. For this, milk cans, bulk tank, refrigerated or insulated vats/tanks with lid to cover, and similar type of containers may be used. The following is the list of equipment and containers used at organized farms:

- ^{2/21} Milking machine
- ^{2/21} Milking pail
- ^{2/21} Weight balance, platform type
- ^{2/21} Storage milk cans
- ^{2/21} Storage vat
- ^{2/21} Bulk storage tank
- ^{2/21} Can cooling system
- ^{2/21} Milk sampling and testing unit
- ^{2/21} Bulk tank cooler

iv. Individual Farmers' Containers

Farmers in rural area have very small holding of milch animals, usually in the range of 1 to 3 in number. They use the containers varying in size and of materials for

milking, storing and carrying to collection point for delivering the milk. Types of containers in use at farmers' house are:

- ^{2/21} Buckets made of galvanized iron, brass, aluminium, stainless steel, etc.
- ^{2/21} Milking pail of galvanized iron.
- ^{2/21} Baked earthen pots.
- ^{2/21} Pitcher of brass, earth or copper.
- ^{2/21} Tumbler, jug etc. of brass, bronze, aluminium, mild steel and stainless steel.
- ^{2/21} Second hand package container of tin, plastic etc.
- ^{2/21} Measures of bronze, aluminium or chrome plated iron.

It is advisable for individual farmers to acquire containers fabricated from approved materials and of standard size. Standard size milk cans ranging from a few litres to the large 40 to 50 litres are available in the market. Farmer organizations should assist the small-scale farmers to acquire milk containers of the right size and design for proper protection in terms of keeping quality, chemical composition, microbial quality, taste and flavour, and also for making handling easier.

Standard containers allow the use of mechanical devices in conveying, tipping, washing, sterilizing, interchanging of lids, loading and unloading. It is easy to control the price of standard equipment throughout the market-both nationally and internationally.

v. Containers at Pick up Points

The individual farmer's containers are handled at pick up points. At the point, sometimes milk from many farmers is pooled into fewer and larger containers. Use of standard containers reduces the time of weighment of milk of the individual farmers/suppliers.

vi. Containers for Collecting and Cooling Centers

Milk from small-scale farmers is collected daily once or twice, and delivered to a processing plant. Evening milk is collected, cooled and held cold overnight for delivery to the processor together with the following day's morning milk. The final delivery of milk to the processor is done mainly in 40-50 litre aluminium alloy cans (may be insulated also) or in bulk tanks.

vii. Containers for Bulk Milk

Bulk milk collection is carried out either in 40-50 litres cans loaded on lorries or pick up or it may be collected using bulk pick up road tankers where the infrastructure allows. Single wall cans are usually used. In few cases, insulated cans are used. After delivery, the processor washes and sanitizes the cans and returns to the collection and/or cooling centre.

Road bulk pick up tankers are used to transport milk from collection or collection-cum-cooling centres. A tank may be equipped with a pump and hose, weighing facilities or a flow meter, sample bottle with an in-built automatic sampling line. Bulk pick up tankers are usually constructed with an insulation layer of cork, polystyrene or mineral wool. The tanker may be refrigerated or simply insulated.

Check Your Progress 3

1. Name different types of containers used for milk collection.

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1.5 TRANSPORTATION OF RAW MILK

The dairy plants organize the collection and transportation of milk in its collection area. Route plans need to be established and continuously optimized for an optimal utilization of the transport facilities and keeping transport cost low. Some sorts of transportation are also required to carry the milk from points of production to the points of collection, pick up, chilling or processing.

i. Purpose

Milk being perishable commodity, it becomes necessary to transport the fresh raw milk to the consumer or the chilling/processing plant within 4 hours of its production. Thus, transportation becomes an integral part of milk collection system. An efficient and suitable facility is selected on the basis of the raw milk collection as well as regional requirements.

ii. Factors determining selection

The following factors may be considered in selection of a suitable, efficient and economic transportation system and transport:

Geographical location: In hilly areas where roads are not developed, small quantity of milk can be carried out on head for short distance and on shoulder sling for comparatively longer distance and larger quantity. In places where river is to be crossed, a boat and road in combination may be used.

Volume of milk: For small quantity and short distance head load, shoulder sling, cycle, etc; for moderate quantities and longer distance motor cycle, cart, tri-wheeler, etc. by road can be transported. If quantity of milk is large, milk in cans on truck & lorries or in road/rail tankers for long distances can be carried.

Variable resources: If the organization is having road/rail tankers and facilities exist for bulking, chilling, loading and unloading, road/rail tankers may be used. In absence of such facilities, only milk in cans or tanks on truck or lorries is transported.

Cost of transportation: Cost of transportation should be kept at minimum level by selecting a suitable transport of optimum size and capacity taking into consideration the quantity of milk to be transported, type of vehicles available, road condition and time involved.

Distance of transport: Depending upon the distance of transport and quantity of milk, a most economic type of transport system is selected.

Condition of road: Condition of road such as dusty, narrow, broken, having sharp turnings, congestion, business, obstacles like railway crossing, etc. are also taken into account in selecting a suitable vehicle for milk transportation.

Own vs. hired: Having own transportation system is too expensive and highly cumbersome. Apart from the initial investment on vehicles, it involves a complete section of maintenance and operational personnel. Even after involving a considerable time, energy and money, the system is neither cost effective nor working satisfactory. On the other hand, hired transport facilities are very effective and relieve the management from several problems and evils. It is economical because of no or low investment and maintenance expenses. The dairy has an agreement with the owner of the vehicle regarding rate, mode and interval of payment, liabilities on account of delays, spoilage of milk, accidents, pilferage during transit, change in the quality due to any fault on his part, etc. Heavy penalties and recoveries are imposed for any lapse on the part of the transporter.

iii. Methods

Generally following methods are being used in dairy industry:

Head load: Generally, producers carry milk on their head to nearby collection/chilling/processing point. This is being practiced in villages to carry small quantity (3 to 25 litres) of milk for short distances (3-8 km) to the collection point, specially in hilly areas where there is no development of road.

Shoulder sling: Use is restricted to hilly areas or other areas where no other means of transport is easily available. When the milk is slightly more (20 to 40 liters) and conveniently can not be carried on head, for little more distance (5 to 10 Km), this method is practiced.

Bullock cart: In villages where no road exists in real sense, bullock cart is used to carry milk, if quantity is more (300–400 Kgs) and distance is to be covered within 1 to 2 hours. It is very slow moving vehicle.

Tonga (Horse cart) : It is faster than bullock cart but it needs road to ply on and carries comparatively less load (200-250 Kgs) for more distances (10-15 Kms).

Pack animal: Ponies, horses, donkeys and bullocks are usually employed to carry 40 to 80 Kgs to a distance of 5 to 10 Km. This method of transport is faster than bullock cart but slower than tonga.

Bicycles: Bicycles are commonly and conveniently used to carry milk to the collection centres, pick-up points and chilling/processing points. It is also used to carry milk in unorganized sector by middlemen/agents/vendors to sell milk in the accessible urban area. It is faster, more convenient and easily accessible to milk producers/consumers home. About 40 litres (l) of milk for a distance of about 10-15 Km can easily be transported.

Motor Cycle: Still heavier duty than bicycle can be taken to cover more than 15 Km and carry more than 100Kg of milk in very short time.

Tricycle or cycle rickshaw: It can carry more load than cycle.

Auto rickshaw: It can carry more load than cycle, rickshaw/motor cycle.

Boat: Boat is used to cross-river. Normally, small boats carry about 200 l of milk for short distances.

Motor trucks: Motor trucks carry milk in cans and bulk tanks to a load of 0.5 to 3.5 tons for more than 100 Km. With the improvement in road facilities and construction of all season roads, motor trucks have been found most effective means of transportation.

Railway wagon: Railway wagons are most dependable and economical for long distance but less popular means of milk transportation. Railway wagon can carry 10 to 12 tons of load for more than 100 Km.

Road tanker: Insulated stainless steel tanks are mounted on road truck chasis for bulk handling (3000 – 12000 l) and for long distance (100 to 1000 Km.) transportation. The tanker may be divided into 2 to 3 equal capacity compartments with separate outlets.

Rail tanker: Insulated and/or refrigerated stainless steel tanks are mounted on rail truck/chasis of the capacity in the range of 10,000 to 50,000 l to transport milk for a long distance 500 to 3000 Km or more.

The extent, structure, distance of the collection area and form of collection, determine the selection of mode of transportation.

iv. Transport vessels

- ^{2/21} Milk cans: 40-50 litre milk cans up to 3000 litres per truck.
- ^{2/21} Farm containers: Made of stainless steel, mobile and insulated (partially with chilling) of 200 to 500 litre capacity.
- ^{2/21} Tanks installed on trucks: Insulated and/or refrigerated of capacity 600 to 3000 litre tanks mounted on truck to receive milk on the route.
- ^{2/21} Milk tankers: Separated into several chambers with or without an integrated reception device and data recording of capacity 3,000 to 50,000 litres milk.
- ^{2/21} Transport pipes: Subterranean pipelines made of stainless steel in developed countries for transporting milk between the dairy and collecting point. Milk is pushed or flowing by gravity at suitable location.

Type of Transport: Roadways, railways, waterways and air ways are the possible types of transport. Sometimes combination of two or more can also be used for transporting milk. In selecting suitability of a type of transport, volume of milk, geographical location of the area, availability of facilities and ultimately the cost of transportation are taken into account. A comparative advantages of can vs. tankers and road vs. rail transport have been given in Table 1.2 and 1.3 respectively.

Table 1.2: Comparative advantages of can and tanker transport

Type of transport vessel	Advantages
Milk can	<ul style="list-style-type: none"> i) Handling small quantities of milk possible ii) Hygienic, if cleaned and sanitized properly
Tanker	<ul style="list-style-type: none"> i) Quicker mode of transport ii) Lower cost for large quantity of milk iii) Better temperature control iv) Less risk of contamination from dust, etc. v) Time and labour saving in loading and unloading vi) Overall saving of detergent, etc.

Table 1.3: Advantages of road and rail transport

Type of transport	Advantages
Roadways	<ul style="list-style-type: none"> i) Most economic to transport milk in containers by using bicycle, tricycle, motor cycle, carts, trucks, lorries and tankers. ii) Loading and unloading possible directly at godowns of seller and buyer. iii) Cheaper than rail over short distances. iv) Most convenient and less time consuming.
Railways	<ul style="list-style-type: none"> i) Cheaper than roadways over long distances ii) Larger quantity of milk can be handled at a time.

1.5 LET US SUM UP

Establishing a milk collection system is based on the considerations of basic characteristics of milk, size of production units, density of milk production, distance and type of market. These lead to a variety of systems, incorporating different

measuring and testing arrangements. The aim is an efficient and fair system of collection. Having clear vision, organization of a milk collection system is done by following certain steps-ensuring milk potential, location of milk-shed and collection centres, establishing the collection centres, ascertaining management controls, setting out operating procedures and deciding on the supervision and control of the centre. Participation of producers as a representative in collection of milk is also ascertained to solve their problems.

Type of milk collection system includes supply of milk to the processing plant directly, through collection and/or chilling centres and through multi-stages of handling. Varieties of containers, made of different materials and of various shape, size, capacity and designs are used at different points of milk handling and processing.

Method and modes of transportation have been summarized in Table 1.4

Table 1.4: Methods and Modes of Transportation of raw milk

S.No.	Type of Transport	Transport Vessel	Method of Transporting	Load Range (in litre)	Distance Range, Km
1.	Roadways	Cans	Head load	3-25	3-8
			Shoulder sling	10-40	3-10
			Pack animal	40-80	5-10
		Cans, vats	Bullock cart	300-400	10-12
			Cans	Tonga	200-300
		Cans, Tanks & Vats Tanks	Bicycle	40-100	10-15
			Cycle rickshaw	150-200	10-15
			Motor cycle	100-150	15-20
			Auto rickshaw	250-500	15-20
					500-4000 3000-12000
2.	Waterways	Cans	Boat	40-200	1-10
3.	Railways	Cans Tanks	Rail wagon	10,000-12,000	100-200
			Rail tankers	10,000-50,000	500-3000

1.6 KEY WORDS

Adulteration	:	Adding to or subtracting from food.
Bulk tanker	:	Insulated, cylindrical tank mounted in a horizontal position on trailer wheels or on the truck to be used for pick up of bulk milk.
Collection centre	:	A place where milk produced in rural area is collected for processing or marketing.
Milk shed	:	A defined area having sufficient milk surplus.
Planning	:	A scheme of action
Refrigeration	:	A Machine used for cooling the milk.
Route	:	A road for passage/travel
Survey	:	To take a view for specific study.
Transportation	:	Act of carrying/conveying from one place to another.

1.7 SOME USEFUL BOOKS

Handbook on milk collection in warm developing countries (1990), published by I.D.F., Belgium

De, Sukumar (1980), Outlines of dairy technology. Oxford University Press, Delhi.

Khan, A.Q. and Padmanabhan, P.N. (1991), The Technology of milk processing. Shri Lakshmi Publications, Chennai- 10.

1.8 ANSWERS TO CHECK YOUR PROGRESS

Your answer should include the following points:

Check Your Progress 1

- 1) i. Rural production and urban consumption, scanty and scattered production, tropical climatic condition, perishability of milk.
- 2) i. Country climatic condition, communication network, cost of production, financial and educational status of producers, infra-structural development, distance between production and consumption, milk potential density, habits of milk consumption, seasonal variation in surplus milk availability, etc.

Check Your Progress 2

- 1) i. Taking care of interest of milk producers, availability of ready market, accurate measurement, price fixation, regular payment, encouraging production etc; milk processor, quality of milk, least cost of transportation and processing etc; milk consumers, price of milk, quality of milk, regular availability etc.
- 2) i. Milk survey, points of location of collection, milk shed, route, establishing collection points, deciding routes, type of organization, operating procedure, supervision, audit and control.
- 3) i. To remove anomalies, argument, loss in weight, doubt in test, quality and quantity of milk etc.
- 4) i. Direct, middleman, agents, cooperatives, organized dairy, Govt. etc.

Check Your Progress 3

- 1) i. Select the containers at different points of collection with respect to milk handling person, quantum of milk, purpose for use, extent of handling, time for which milk is held up, type of process available etc.