UNIT 2 MANAGING PRODUCTIVITY

Structure

2.0 OBJECTIVES

After reading the unit we will be able to.

- managing productivity in dairy industry;
- know various tools and means to enhance productivity ;
- optimization of resource utilization in dairy industry;
- concept of operations and production efficiencies;

- optimization of routes for milk procurement;
- optimum design of milk marketing distribution system;
- important considerations for deciding equipment size and capacities;
- know application and utility of computers in dairy industry; and
- understand management information system (MIS) using computer in dairy industry.

2.1 INTRODUCTION

We are operating in the era of global competition. Event in one country may have impact over the other country of the world. Due to liberalization of trade, the whole world has emerged as one single market. This has been further influenced by the fast development in the field of computer and its application. Communication has become quite affordable, reliable and fast. By sitting in one corner of the world one can have access of the other part of world. In such fast changing situations with open boundaries, the fittest will only survive due to stiff competition. Fittest or strongest attribute can be acquired only by increasing profits.

Profit has mainly three components. They are reduction in cost, increase in sale and value addition. Arithmetically, profit is the difference of sale price and cost. The profit and its influencing components as expressed here are the final stage measurement, but the result is the sum of several individual small unit operations or steps starting from the initial stage of material procurement to ultimate sale of product or service. Each stage has resource utilization and outcome. In these stages there would be sale or no sale, but the corresponding resource utilization and outcome shall have influence over the profit. Therefore, in order to ascertain overall profit, we have to assess the stages involved. The efficiency of these stages is measured in terms of productivity. The productivity, in general, refers to the ratio of outcome to input. Therefore, enhancing productivity can be considered as reduction in resource use and /or increase in the outcome.

In this way, we see that it is very important for management systems to have better productivity. Various management principles would be applied to get better result. In dairy industry, which has highly perishable raw material as resource, the task of improved productivity is highly challenging. Use of operational research techniques like linear programming (LP) for optimizing product mix, product composition, procurement and market distribution transport routes have been very popular. Sensitive analysis using computers helps in right decision making. Other areas where modern technologies including use of computers have been possible in dairy industry include management information system. Timely capturing of procurement, operational, accounting and market data help in providing information timely and accurately. This has made it possible to give timely payment to suppliers including milk producers. Computer application has also made it feasible to reduce inventory and working capital requirement of dairy and its retail network.

2.2 MANAGING PRODUCTIVITY

i. Conception and Misconception about Productivity

There are some misconceptions about the term productivity. Some feels that productivity is confined to factories and manufacturing processes only. As a matter of fact, productivity pervades all spheres of activities and as such the productivity concepts can be successfully applied to administration, storage, distribution, public service, education and training etc. Another misconception about productivity is some body else, rather than me is responsible for productivity. Management considers workers to be responsible, workers blame management and both hold the government responsible for low productivity. As a matter of fact the productivity is everybody's concern. It is a way of life. Other type of misconception is related to consideration of productivity as hard and fast human work. In real term it is for the ease of human work to reduce fatigue, errors, accidents and ill health. People do have fear psychology of retrenchment or redundancy from productivity. But in real term increased productivity makes availability of better quality products at cheaper prices to increase market demand and so generate employment opportunities.

Productivity is considered as prosperity, which means an outcome of desirable and favorable attributes. We know that organizations exist for carrying out required processes to fulfill objectives by the way of involving various kinds of resources. Similarly, milk organizations exist for procurement and / or processing and marketing of milk and milk products to enhance socio-economic condition of people or profits in commercial organization. The universal definition of productivity is the ratio between output and input; the higher the ratio, the better. It is a measurement of how efficiently inputs or resources are converted into useful outputs, products, or results. Another way of looking at it is "ratio of result and resources". Mathematically, raising output, decreasing input, or both can increase this ratio. But in terms of operating or manufacturing decisions, what you really change is: 1) the amount of input; and 2) the process that converts input to output. Inputs would be decreased in practice only by changing process in terms of equipments, technology and management. Only after the process is improved, the input requirement eventually reduced or out put increased. In this way, productivity calls for finding ways of doing things smarter and better. In conventional terms, productivity means maximized outcome by utilizing available resources; whereas in modern term, the productivity means getting the required output with minimum input. The modern term is inclined towards obtaining output of required level to satisfy market, whereas the conventional term talks of rather conversion efficiency.

ii. Factor Affecting Productivity

These factors could be broadly classified into two categories:

a) External factors and b) internal factors

External factors includes infrastructure, communication, government policies, social and economical condition etc; whereas internal factors are plant and equipments, raw materials, energy, products, technology, human resource, management practice, work methods, systems and procedures etc. Higher productivity and therefore, the efficiency of enterprise is primarily concerned with the internal factors.

In achieving better productivity, two things are very important. One is doing right things and second is doing things rightly. First indicates planning and working to

achieve meaningful organizational objectives, whereas later one adopting appropriate means and methodology.

iii. Productivity Examples in Dairy Industry

Let us look at various examples of productivity in dairy industry. Some of these are given below.

a) Milk Procurement: Procurement of milk is one of the foremost & important work in dairy industry. The productivity in procurement work would be in terms of low procurement cost, maximized return to milk suppliers, low microbial count in milk, less time gap between milking and pouring, pouring and chilling and, chilling and final processing. Other productivity aspects are milk yield of animals, dry period of milch animals, quality of milk in terms of solids content, acidity of milk, salt balance and absence of any adulterant or hazardous substances etc In concise term, productivity of procurement could be measured as cost of milk procurement, quality of milk reaching to dairy, yield per collection center or per animal etc. Since raw milk cost is almost 80% of the total processing and manufacturing cost, hence, these factors has a great role in deciding the product quality and cost and so, the profit out of them and therefore, in cooperative organizations, overall reflection would be in the form of total payment to milk producers' against the milk supplies.

b) Manufacturing and Production: Manufacturing or Production processes, in reality, convert or transform raw inputs into value added products. Therefore, improvement in the productivity would mean optimizing use of various resources or minimizing losses. In industry, main resources for production are manpower, money, machinery and materials i.e four "M'. Controlling losses optimizes milk and ingredients consumption, whereas resource like manpower is improved by better utilization of their capabilities and skills. Other areas of productivity that need serious consideration happen to be the quality of utilities (e.g. refrigeration, steam, water, electrical and air) at the least expense. The paramount importance of utilities has been because of dairy process operations need required quality of these utilities for achieving desired quality of milk and milk products. For example, productivity of refrigeration system would be its coefficient of performance, or TR utilized or temperatures of chilled water or cold spaces. For heating processes, the quality of steam and fuel economy may be considered important. Similarly, power failure, power factor and units (KWHr) consumed per liter milk will be productivity consideration in electricity supply system. Quality, pressure and volume or flow rate of water and air will be another examples of productivity.

c) Packing and Distribution: Packing and distribution has productivity in terms of reduced packing loss, less damage of packages, use of less packing material, satisfactory content and labeling, proper design of packs, timely supplies to consumers and reduction in transportation cost etc.

Check Your Progress –1

1. What do you understand by the term " productivity"?

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2. What is the basic difference between the traditional and modern concepts of productivity?

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3. What are the major ways of measuring and monitoring productivity in dairy industry? Discuss in brief.

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iv. Optimization of Resources

As discussed above, the productivity has its situation dependent criteria for measurement. However in all situations, there is a need of optimization for achieving good productivity. In dairy industry productivity is measured and monitored in the following two ways:

a) Operation Efficiency: One of the important parameter of monitoring resource utilization is by way of measuring efficiencies of operations where they are consumed. The efficiency is indeed the utilization of resource in percent. In this manner we can see that higher the utilization efficiency or recovery of input resource, the less will be losses and the better efficiency of the operation. For example raw milk of X quantity is passed through pasteurizer, which gives X-X1 quantity of processed milk in the milk tank. Then (X-X1)* 100 divided by X will the milk recovery in this process. Similarly, pasteurizer has regeneration efficiency of heating and chilling. Extent of heat recovery from the hot milk will be the pasteurizer regeneration efficiency for heating, whereas extent of chilling of hot milk in percentage will be the regeneration efficiency of pasteurizer for chilling. In this category following efficiencies can be measured and monitored in dairy industry:

i) Handling loss in each unit process, each shift and in each plant

ii) Fuel economy of electricity generator, steam boilers, transport vehicles etc.

iii) Water, steam, electricity, air and refrigeration utilization in processes

iv) Yield of products in term of use of milk or ingredients,

v) Use of human resource per shift or per batch or per day production.

b) Utilization Efficiency of Equipments: This is normally measured in terms of capacity utilization or throughput from the equipments. Better the utilization in

comparison to the rated capabilities of equipment; more quantum will be handled in the same working time. The same hold true for procurement and transportation vehicle. Some times reduced capacity equipment becomes bottleneck in production process, hence proper care will increase the output.

Check Your Progress-2

1. Chilled milk of 5 degree centigrade is pasteurized at 72.5 degree centigrade and chilled to 4 degree centigrade. The milk temperatures after the regeneration out-let is 15 centigrade. Find out regeneration efficiency?

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2. In a butter churn, 3000 Kg of cream having 32% fat is loaded. After churning operation, 1150 Kg of white butter testing 82% fat is produced. Calculate the churning efficiency of butter churn in terms of fat recovery?

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v. Designing of Milk Procurement and Marketing Routes:

i) Some Basic Facts of Milk and Milk Shed Areas:

There are some basic issues in the milk business, which emphasis an care while selecting and designing milk procurement routes. These basic issues are:

a) Milk is available at ambient temperature in the milk-shed area, whereas temperature of market milk which is packed at 4 to 5 degree centigrate can rise due to high atmospheric temperature.

b) In very rare cases ambient temperature in our country is below 10 degree centigrade. For most of the period, it remains 30 degree centigrade or more.

c) Milk is very favorable medium for microbial growth. The growth rate is very high above the critical temperature of 10^0 C.

d) Fresh milk contains bacteria inhibitory chemicals, which remains for 3 hours and if milk is chilled within this period there is not much adverse effect on milk quality.

e) If milk is not chilled and stored at low temperature within 3 to 4 hours, the microbial growth produces high acidity, making milk sour.

In Indian condition, the milk collection per center is very low because of poor yield and less number of animals. To get sufficient quantity of milk for justifying

procurement vehicle capacity, the required route length is more. Therefore, looking at the influencing factors like permissible route length, village side connectivity and road conditions and time required for unloading of empty cans / loading of filled cans, one can design an optimum route that permits procurement of milk from number of collection points within a safe periods without adversely affecting the initial milk quality.

ii) Economical Route Design and Some Barriers

The economical route design has a great impact on the progress of milk-shed and economy of procurement cost. The milk costs approximately 75 to 80% of the manufacturing cost. It consists of price of milk, commission to collection centers / agent, transportation cost and cost of quality loss. Therefore, increase in the cost of milk on account of quality deterioration or less capacity utilization of vehicle has effect on the total cost and so the marketability and financial viability of organization.

iii) Mode of Transport in Milk Collection

Following modes of transport are generally used for collection of raw milk from collection centers to processing plant.

Table –2.1 : Mode of Transport

SL	Mode of Transport	Remarks on the Requirement and Feasibility
1	Head Load	Milk producers carry their milk on their own in small cans, buckets or other utensil, In the event of poor road conditions or due to less milk collection at the center, the centre's milk is sent to lifting point of route through head load.
2	Bullock /Camel cart/ Camel	When road condition do not permit route vehicle to touch the collection center or according to route design, this center has to send milk to lifting point, then this type of transport mode is used. Camel cart are more popular in the Desert area.
3	Cycle	— do-
4	Boat	When the collection center are off the road due to river, which are not connected by bridges, then boats are used in combination with the above one or more modes of transport.
5	Un-insulated motorized vehicles /trucks	These are mostly used for collecting milk from the lifting point and collection centers on routes. In case of sufficient volume independent vehicle is also sent for lifting milk of such collection centers. Depending upon the potentiality of milk collection, size of vehicle is decided. Normally Tata 407, 709 and trucks or other model of suitable capacity are used.
6	Insulated vehicles	In some cases, bulk cooler or small chilling center

	Insulated trucks or insulated road milk tankers	is provided to collect and chill the milk of adjacent collection center. Or collection centers may have bulk coolers. In such cases, either chilled milk is sent to processing plant through insulated cans in un-insulated vehicles, or normal cans in insulated vehicles for the sake of preventing increase in the milk temperature. Now a day for transporting market milk, distribution vehicles are insulated from all six sides. The doors are kept closed during distribution work.
7	Refrigerated vans	With the advancement of technology, refrigerated vehicles or tankers are used for procurement of raw milk. In some cases ice blocks are also used for lowering down raw milk temperature. Use of such modes help in coverage of more centers. During summer these type of van are used for covering distant markets and more number of retails out-lets Products like Butter, *ice-cream* and low shelf life indigenous products like *lassi*, flavored milk, frozen *paneer* etc. are distributed by such vehicles.

iv) Route Design Methodology

Quantum of milk varies greatly from season to season. If right decision is not taken with respect to size or capacity of vehicle, then during lean procurement season, milk procurement cost shall go up. Therefore, let us look at various considerations and methodology for designing milk procurement and distribution route. Similar types of information are also required for designing market distribution routes. Following information need to be gathered for initiating milk route design:

i) Details of milk shed with respect to number of collection centers, milk collection of each center throughout the year. In case of distribution details on retails network is required.

ii) Geographical map of the milk shed or market area, indicating road, river, railways connectivity.

iii) Distance map of collection centers or retail point.

iv) Availability of type of transport vehicle with capacity in the nearby area.

Considering above facts, optimized route design can be done manually or using computer programming for accurate and quick decision-making. Following such models are in use:

1) Special computer Algorithm for vehicle Scheduling model by Dentzjg and Ramsen (1959)

2) Traveling Salesman Model (1964)

3) Sequential programming Model by Schruber and Chiften (1968)

4) Simulation Technique by Neitzk (1974)

5) Vehicle Scheduling Model based on saving Concept by Kalra (1983)

6) Milk Route Optimization System by NDDB (1983)

These models optimize the route length of a vehicle subject to constraints on capacity of vehicle and total time taken from first pick up point to the final destination. Studies have shown reduction in the transportation cost from 6 to 40% by employing these models. Geographical Information System (GIS), which is fully computer based is used for timely capturing of all the relevant data using digital maps and be helpful in taking decision on route design.

If computer and heuristics are not available or capability to optimally utilize linear programming is not feasible, then following simpler methods can be used to arrive at the optimal route;

Step-1 Consider a route with all possible collection point

Step-2 Find out capacity of vehicle

Step-3 Trace distance of collection point from processing /chilling plant to nearest collection point and then between two consecutive collection centers on the road side.

Step 4 Decide earliest lifting of milk from the first point.

Step-5 Consider total procurement time from the 1st lifting point to final destination between 3 to 4 hours.

Step-6 Provide enough time for unloading and loading of cans.

Step-7 Find out number of cans of each society.

Step-8 Find out various possibility that allows maximum vehicle capacity utilization in less than optimum /desired time.

Check Your Progress-3

1. In a milk shed area following information are available. Find out the optimum route by manual calculation:

	Collection points								
Processing Plant	1	2	3	4	5	6	7	8	9
Distance in Km (s)	5	10	15	25	28	30	35	40	50
Milk collection, Lit (in one shift)	250	170	330	150	230	145	295	105	95

Time required per collection center for un-loading & loading: 15 minutes

Speed of vehicle: 20 Km per hour due to poor road condition

Maximum Capacity of vehicle is 40 cans per shift & Milk per can: maximum 40 liters.

Being hot climate, maximum permissible time from 1st point to final destination is 3.5 hours. There are also possibilities of joining left-out point by another route.

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Similarly in the early stage or during sluggish marketing period market distribution cost is very high. The similar difficulties are also seen in coverage of rural markets, which requires additional payment for distribution. All these have direct impact on the consumer price of milk and milk product. In order to optimize transportation cost following variables need consideration:

1. Market strategy and emphasis of product distribution cost;
2. Product category- new or old, fast moving or slow moving;
3. Vehicle type and transportation capacity;
4. Location of distribution network including retail points, warehouse;
5. Distribution period; and
6. Cost of transportation etc.

2.3 SIZING OF PROCESS EQUIPMENTS

One of the most important considerations in design of dairy is proper sizing or capacity of process equipments. Efficient and effective processing operations entirely depend on suitability of employed process equipment that has enough capacity and capabilities to process the raw inputs into final output or product of required quality. Equipment used for generating and supplying particular utilities are termed as service equipments, whereas the equipments required for processing and manufacturing of milk and milk products are termed as process equipments. The service equipment size must suit to the requirement of processing or process equipments, whereas sizing of process equipment should be appropriate to process available resources to produce desired quality and quantity of products.

Importance of proper sizing is highly desirable for optimizing initial investment and operational cost. It is observed that undersized equipment becomes bottleneck in production line, whereas over-sizing above desirable limit will ask for increased utilities for its operation leading to extra cost. Some times, over-sized equipment

attracts legal expenses. Such provisions include Non-IBR vs. IBR boilers, small scale vs. large size etc. In general, considerations given in table-2.2 be looked into while selecting the equipments:

Table – 2.2 : Considerations for Process Equipment Sizing

Sl	Equipment	Main Considerations	
		Capacity consideration	**Quality Consideration**
1	Steam boiler	To generate steam from normal water to meet processing requirement. For this hourly load is calculated to find out peak and normal load. Accordingly, size and number of boiler are decided to have economy of operation.	The steam pressure requirement for general milk process is approx. 3.5 Kg/Sq.cm, whereas for condensing and drying unit, high pressure steam to heat air upto 185 to 200 deg.C. is required. Clean and dry steam with culinary property is desirable.
2	Refrigeration plant	Refrigeration equipments include compressors, condensers, ice-bank tank or evaporator / chiller along with pumps and insulated piping. Chilled water is generated for milk chilling in pasteurizer, chiller, coolers, cooling of cream or mix storage tanks, whereas liquid refrigerants are used for maintaining low temperatures of cold rooms. The size of these equipment should have provision to meet normal and peak demand along with standby arrangement for maintenance.	Normally ice bank tanks are required to generate chilled water of 0 to 2 deg.Cent. In case of glycol chilling system, the water temperature goes below 0 deg. centigrade. Temperature of cold room for liquid pouch milk, flavoured pasteurized milk and lassi is 0 to 4 deg.cent, whereas temperature of cold room for dahi is 4 to 8 Deg. Cent. Ice-creams and ice candies storage desires less than - 25 Deg.C, temperature.
3	Water supply system	Dairy plants normally require water: 3 to 4 times of milk handling capacity. Suitable size of tube well and storage tank is required to meet the above requirement. Water softener and demineralization plant is required to get feed water for boilers and cooling of compressors.	The water should be clean and pollution free. Boiler feed water should have low hardness (less than 5ppm) and should be slightly alkaline to prevent corrosion of metal parts.

4	Air compressor	Compressed air required for pneumatic controls in various machines, pneumatic conveying of powder or air agitation of milk in silo. The compressor capacity should be to meet air requirement with the option of standby for maintenance.	Pneumatic controls normally require air at 6 Kg/sq.cm pressure Excessive moisture and lubricating oil is not detrimental.
5	Electrical supply system	External power supply through step down transformer and /or internal generation through generator is a normal phenomenon to operate all the plant machinery. Sizing of these equipment should consider total connected load, peak operation load, normal operation load, power factor utilization and tariff for maximum demand.	Electrical supply required should be of 55 Hz frequency, 3 Phase, 440 Volt and AC
6	Effluent treatment plant	The treatment plant has pumping set, holding & distribution chambers, oxidation pits with agitator, separators and sludge dryer. Each equipment should be capable to treat the effluent to satisfactory level of BOD and COD.	For disposal in irrigation land COD requirement: 50 ppm BOD requirement: 150 ppm
7	Raw milk	This section requires can conveyors, dump pit and weigh bowl, pump and chiller with raw milk storage tank. While deciding size of these equipment panning should include development of milk-shed area in future and peak load during flush.	Substandard milk should be segregated from good milk. Minimum time should be required to receive and chill raw milk. Proper sampling and weighing with accuracy is desired.
8	Milk processing	Milk processing includes milk pasteurization, separation/ clarification, recombination/ reconstitution and storage of processed milk and cream, along with cleaning facilities. The capacity of pasteurizer should match the panning consideration with respect to	Milk pasteurizer can be of LTLT or HTST types and accordingly capable of heating and chilling the pasterurized milk with enough holding time. The material of Construction of stainless steel with food grade

		milk procurement and milk marketing, whereas separator or homogenizer should be compatible with pasteurizer. Storage tank capacity and number should be sufficient i.e. at-least 2.5 times of rated capacity of plant.	and high temperature resistant gaskets. The equipment should be easy to drain and clean.
9	Milk packing and Storage	Capacity of milk packing and cold store should be enough to pack and store packed milk to meet market demand	Good sealing quality of required pack size. The milk temperature should not rise during packing and storage.
10	Other dairy equipments	Similar to the above equipment, sizes of other dairy process equipment can be determined to produce output without bottlenecks.	All the equipments should be capable of producing quality output to meet PFA requirement and have enough shelf life.

Check Your Progress - 4

1. Write down any five effects of equipment sizing?

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2.4 COMPUTER APPLICATION IN DAIRY INDUSTRY

Computer is used for varieties of purposes in dairy industry. The requirement has been increasing due to its attractive features. Its application as management information system (MIS) for effective decision making, optimizing product mix, product composition, procurement and distribution routes, inventory management and maintenance of plant –machineries etc. has been found very popular. We are discussing some of them here:

i. Computerized MIS in Milk Procurement:

a) Milk Billing: Analysis of data for number of milk supplying centers based on quality and quantity was a tiresome job before the computerized billing system came in dairy industry. One can visualize receiving milk in two shifts from

thousands of procurement centers. Added with this dynamics, there are other complex payment conditions relating to milk procurement and pricing policies {(good /sour/curdled), fat basis, double axis basis, total solids basis, incentives for promoting milk procurement quantity and quality, negative incentives for controlling non-genuine and poor quality milk etc.}. A number of persons were required in manual system to manage this, which was time consuming and less flexible too. But the computer application made it feasible to frequently bill and pay.

b) MIS for other procurement related activities: Similarly, computer application has proved a boon in managing huge information relating to milk collection, quality monitoring, technical inputs, monitoring of artificial insemination activities and providing timely payment to milk producers. Computerized information system can help to determine milk procurement cost and its impact on sale price. Quick analysis of milk value would be helpful in effective purchase of milk and conserve commodities.

c) Optimize scheduling of milk procurement routes: Data bank about milk routes, capacities of vehicles, reception timing and quality status helps in scheduling of routes (see para -2.2.5).

ii. Optimization of Product Composition

Operational research techniques are used in formulation of products to have optimization for PFA norms, nutritive value and cost factor. Linear programming by involving large number of variables is utilized in the optimization technique. Maximum and minimum limits of individual and group ingredients is included in the programming .

iii. Plant Automation

Automation with fully integrated or part wise is done to suit the dairy's requirement. Fully automatic plant employs automatic operations for the entire operations. As discussed earlier, data are captured on computer system for milk quantity and quality. Based on the collection and demand of the market for milk and milk product, planning is done. Full automation with on line displays/ messages keep informed for timely monitoring. All information regarding stock of milk and milk products, receipt /dispatches, losses etc. are known without any lapse of time to manage the operations. Computerized operations can control the product quality in better way. For this sensor or good sensitivity is employed to measure the process outcome. Sensor feed back is given to controller for adjustment of variable that are responsible for quality attribute.

iv. Product Mix Models

Based on the availability and cost of raw materials including milk, market demand, opening stock and value addition of products, a product mix decision is taken by using computer software employing linear programming models.

v. Computerized Accounting System

Computerized accounting is a normal phenomenon in most of the organization. All the input data of transactions are fed into the system on batch or on-line basis. The system gives all the report as per the management requirements. Finalization

of account is possible within a short time. All the financial reports including trading account, profit & loss account and Balance Sheet can be taken out promptly. Computerized system also helps in employees' salary payment, vendor payment and furnishing of all legal return along with deposition of contributions. Similarly accounting of milk and milk products to monitor and control handling losses is quite effective to have control over losses by the use of computers.

vi. Computerized MIS Application in HR Management

In manual system due to problem of speed, various personnel issues were not getting management attention leading to de-motivation. Personnel information can be effectively stored in data bank and utilized for boosting personnel moral.

vii. Networking for Wider MIS Application

Organizations are utilizing benefits of Networking by connecting one department and /or organization through computerized system. More information and better monitoring is feasible with the help of wide area networking applications. National Dairy Development Board (NDDB) Anand has developed computerized networking system by networking of all the milk unions and federations. Some of such usage of computer includes use of GIS, National Information Network (NIN) etc.

viii. Preventive Maintenance

The data /information of each equipment /machine with required periodicity is helpful in carrying out preventive maintenance effectively. Operator / Technician in manual system and auxiliary equipment in the automatic system will perform the operation of preventive maintenance as per the displayed instruction of computer based on the input data. This will help in automatic generation of break down and maintenance information required for management decision of optimum resource utilization.

ix. Utilities Management

Computer application in the monitoring of utilities is of a great importance. Dairy plant requires important utilities like refrigeration, steam, water and electricity. By the use of computer prompt information and control can be exercised to get quality service.

x. Application in Packaging and Statistical Quality Control

Computer application in packaging of products to ensure content, labeling, selecting source of content to pack is of a great value. Statistical quality control can be effectively implemented with the help of computers.

xi. Application in Vendor Development

Computer is used in material management function for inventory control, report generation, generation of orders and vendor performance assessment. This ensures cost effective sourcing of quality materials.

Check Your Progress – 5

1. How does computerized information system help in planning of economical production?

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2.5 LET US SUM UP

Ensuring productivity in the operation of dairy plant has its special importance due to high perishable nature, seasonal production and a great variation in consumption demand of milk. An attempt to effectively conserve and transform milk into fluid milks and milk products is the real issue. This is done by performing cost effective operation through the use of energy, efficient equipment, optimized composition and product mix. Effective decision making to achieve market oriented outputs or goods with the least expense of resources and time has been now possible due to application of computers. Computerized management information system by using its high speed, accuracy and problem solving capabilities is able to manage highly complex situations and decisions.

2.6 KEY WORDS

Productivity : Effective results

Managing : The act, art or manner of managing, controlling

Route : A regular course traveled. A road for traveling.

Production : The act or process of producing.

Scheduling : To plan for certain time.

Distribution : The process by which commodities get to consumers.

Computerize : To equip or operate, produce, control etc. by means of an electronic computer.

Information : Knowledge acquired in any manner

Output : The work done or amount produced in a given time

Input : what is put in (money, materials, energy etc.) a process or project

2.7 SOME USEFUL BOOKS

Katre, B.C. and Prasad, Sitaram, 2000, Improved management on operational performance in food industry with milk processing plant as a model, Indian Food Industry, 19(2):107-117

Katre, B.C. and Prasad, Sitaram, 2001, Quality management concepts for improved performance of dairy industry. Indian Food Industry, 20 (4):53-56

Manual in dairy plant management, 1970, I.C.A.R.Sub Committee on dairy Education

Sontakey, D.R. Productivity (1995), CBWE Publication, Nagpur-10

2.8. ANSWERS TO CHECK YOUR PROGRESS

Your answer should include the following points.

Check Your Progress-1

1. Productivity is considered as prosperity, which means an outcome of desirable and favorable attributes. The universal definition of productivity is the ratio between output and input; the higher the ratio, the better. It is a measurement of how efficiently inputs or resources are converted into useful outputs, products, or results. Another way of looking at it is "ratio of result and resources". Mathematically, raising output, decreasing input, or both can increase this ratio.

2. According to its definition, productivity can be raised either by improving output or decreasing input or giving treatment to both. To hold good this definition, the conventional or traditional concept of productivity means maximized outcome by utilizing available resources; whereas in modern concept, the productivity means getting the required output with minimum input. The modern term is inclined towards obtaining output of required level to satisfy market, whereas the conventional term talks of conversion efficiency and economy of operation.

3. The productivity in dairy is normally measured in terms of:-

   a) Efficiency of operations; b) Recovery of energy or material used, c) Capacity utilization or d) Obtaining rated output.

   Efficiency of operation can be measured by quality of product like composition of product, temperature of final product, microbial quality or flavor of product and so on. Higher productivity in terms of reduced packing, steam, electricity or water for processing and packing of milk and milk products. Productivity in the form of capacity utilization of plant or equipment, whereas throughput of equipments, process is another way to measure and monitor productivity in dairy industry.

Check Your Progress-2

1. Regeneration Efficiency = (Past.temp- Temp. of milk after Regeneration)*100 / Past. temp –Temp. of Incoming milk)

Therefore; Reg.efficiency = (72.5-15)×100/ (72.5- 4)

= 57.5 ×100 / 68.5

= 83.9 %

Pasteurizer regeneration efficiency is 83.9%

2. Given that Quantity of butter = 1150 Kgs, of 82 % fat, Quantity of cream = 3000 Kgs of 32% fat

Churning Efficiency in terms of fat recovery= Fat qty in Butter ×100/ Fat in cream

Quantity of fat in cream = 3000 * 35/100 = 960 Kg

Quantity of fat in Butter = 1150 * 82 /100 = 943 Kg

Therefore Fat recovery (%) in churning = 943 × 100 / 960

= 98.22 %

Churn efficiency in terms of fat recovery is 98.22%

Check Your Progress-3

Given: Time required per collection center for un-loading & loading : 15 minutes

Speed of vehicle: 20 Km per hour due to poor road condition

Maximum Capacity of vehicle is 40 cans per shift & Milk per can: maximum 40 liters

Being hot climate, maximum permissible time from 1st point to final destination is 3.5 hours

	Collection center (1 to 9)								
Processing Plant	1	2	3	4	5	6	7	8	9
Distance in Km (0)	5	10	15	25	28	30	35	40	50
Milk collection, Lit (in one shift)	250	170	330	150	230	145	295	105	95
No. of Cans	7	5	9	4	6	4	8	3	3
Cum Cans (Nos)	7	12	21	25	31	35	43	46	49
Cum Travel Time, Min	15	30	45	75	84	90	105	120	150
Load/Unload time, Min	15	15	15	15	15	15	15	15	15
Total cum time, min	30	60	90	135	159	180	210	240	290

We can see that according to time allowance the vehicle can collect cans up to collection center 7, but there is constraint of capacity, as the vehicle can carry up to only 40 cans, whereas up-to this point there will be total 43 cans.

Therefore the route for this vehicle to be up to collection center 6 only. Thus this route vehicle will carry 35 cans and reach the processing plant in 180 minutes that is 3 hours.

Check Your Progress - 4

Size of equipment has effect on:

1. Energy consumption per unit production
2. Optimum utilization of capacity
3. Utilization of space
4. Investment on plant and machinery
5. Design of stand-by arrangements

Check Your Progress - 5

The management information system using computer is very effective in generating the useful information for decision-making. Effective use of the system can help in optimizing product composition to have least cost of production, optimizing product mix to give maximize profit. Material management system with the computer application can prevent chances of over or under stocking, timely vendor rating to improve quality and economy of purchase along with supplier satisfaction by timely payments. Other MIS use is helpful in monitoring operations for productivity and controlling losses.