

AGRICULTURE

JOB ROLE: Dairy Worker
STUDENT WORKBOOK

CLASS 11



PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
(a constituent unit of NCERT, under MHRD, Government of India)
Shyamla Hills, Bhopal- 462 002, M.P., India
<http://www.psscive.ac.in>

AGRICULTURE

JOB ROLE: Dairy Worker

STUDENT WORKBOOK

CLASS 11



**PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
BHOPAL**

First Edition

July, 2017

PD

© PSSCIVE, Bhopal
National Council of
Educational Research and Training 2017

ALL RIGHTS RESERVED 2017

- No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.
- This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold, hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.
- The correct price of this publication is the price printed on this page, Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

Publication Team

Head, Publication Division :
Chief Editor :
Chief Business Manager :
Chief Production Officer (Incharge) :
Editor :
Production Officer :

PREFACE

Will be provided after the approval from the Joint Director

RAJESH P.KHAMBAYAT
Joint Director

PSS Central Institute of Vocational Education

New Delhi,
July, 2017

TEXTBOOK DEVELOPMENT COMMITTEE

MEMBERS

Dr. R.P.S. Baghel
Dr. Biswajit Roy

MEMBER-COORDINATOR

Dr. Kuldeep singh

COURSE OVERVIEW

A dairy worker establishes and manages a dairy farm and able to produce good quality milk. He/she takes various decisions for the viability and sustainability of the dairy farm. He / She ensures proper care of dairy animals, their health and production of high quality milk and promote animal well-being and comfort. The Dairy Worker should work independently, and has the ability to make various strategic and operational decisions pertaining to his / her area of work.

COURSE OUTCOMES: On completion of the course, students should be able to:

- Understand the importance of dairy farming in India
- Know the employment opportunity of dairy farming in India
- Know about the important dairy breeds
- Prepare the livestock accommodation
- Maintain livestock accommodation
- Establish livestock in their accommodation
- Monitor livestock in their accommodation
- Receive and store animal feed
- Prepare feed and water supplies for livestock
- Monitor and maintain the supply of feed and water to livestock
- make necessary arrangement for fodder conservation

SCHEME OF UNITS

This course for the Job Role of Dairy Worker is a planned sequence of instructions consisting of Units meant for developing employability and vocational competencies of students of Class 11 and 12 opting for vocational subject along with general education subjects. The unit-wise distribution of hours and marks for Class 11 is as follows:

CLASS 11			
Units		No. of Hours for Theory and	Max. Marks for Theory and

		Practical =260 (208 Teaching and Training + 52 Evaluation)	Practical = 100 (30 Theory and 70 Practical)
Part B	Vocational Skills		
	unit 1: Breeds of Dairy Animals	40	
	unit 2: Livestock Housing Systems -I	20	05
	unit 3: Livestock Housing Systems -II	20	05
	unit 4: Feeding and Watering for Livestock	30	05
	Unit 5: Management of Dairy Animals	20	05
			20
Part C	Practical Work		
	Practical Examination	06	15
	Written Test	01	10
	Viva Voce	03	10
		10	35
Part D	Project Work/Field Visit		
	Practical File/Student Portfolio	10	10
	Viva Voce	05	05
		15	15

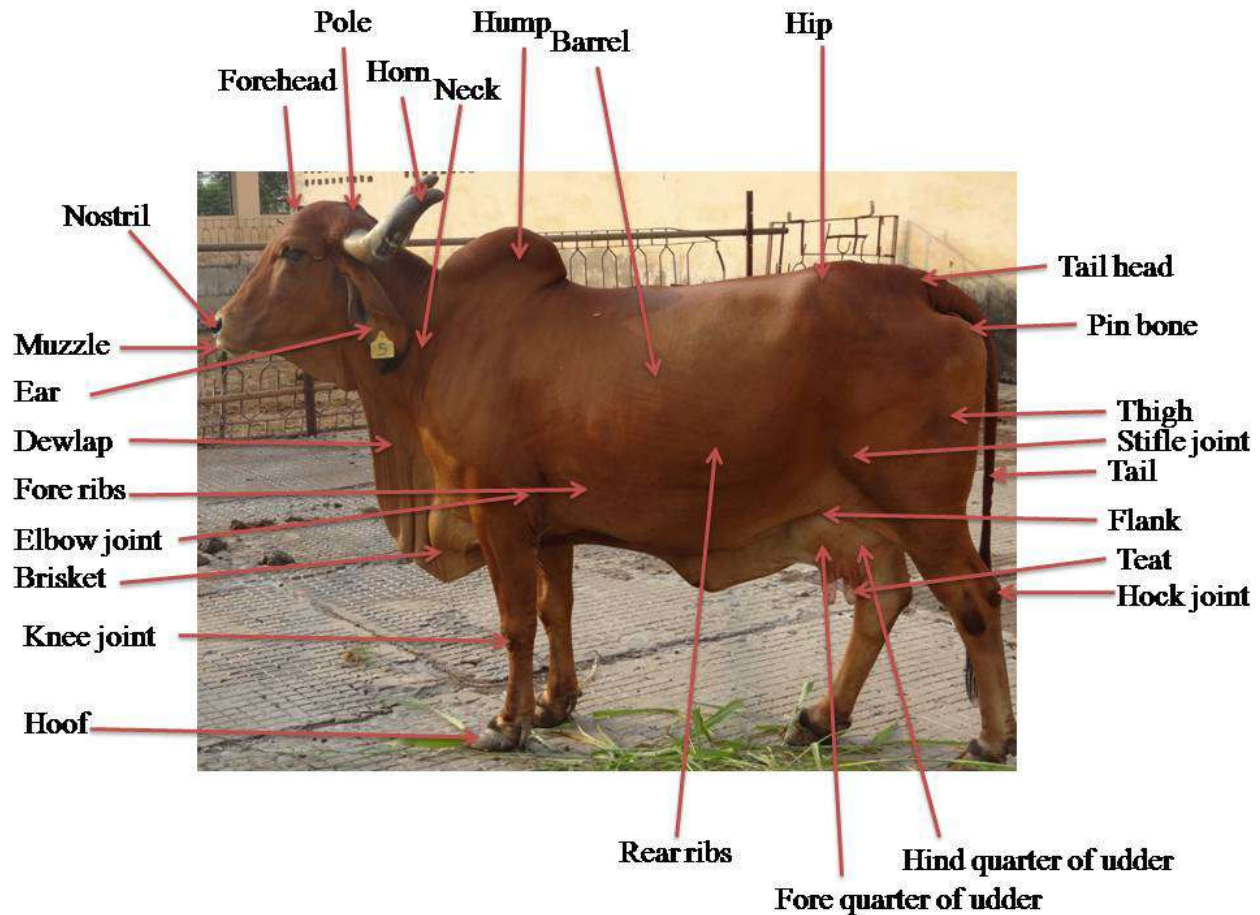
CONTENTS

FOREWORD	
PREFACE	
ACKNOWLEDGEMENTS	
Unit 1: Breeds of Dairy Animals	
unit 2: Livestock Housing Systems -I	
unit 3: Livestock Housing Systems -II	
unit 4: Feeding and Watering for Livestock	
Unit 5: Management of Dairy Animals	

SESSION 1: Breeds of dairy animals

i. Common body parts of cattle

An animal health worker must understand the various parts of the body of the cattle. The photographs 3.1 illustrate the various body parts of cattle.



Photograph 3.1: Common body parts of cattle

ii. Important dairy breeds of cattle and buffaloes

A breed is a sufficiently large group of animals developed by the efforts of human, members of which have common ancestry and possess similar morphological, physiological and economic characters that are inherited. In India, number of indigenous (desi) cattle breeds (Table 3.1) as well as crossbred cattle is involved in milk production. Crossbred cattle are

developed from the indigenous (*Bos indicus*) and exotic cattle (*Bos taurus*) breeds. Exotic dairy cattle breeds are having higher milk production potential and originated in different climatic condition. Exotic breeds are not well adapted to the Indian condition. Thus, crossbred cattle are developed by crossing between indigenous and exotic cattle breeds.

India has a pride of having best buffalo breeds in the world. Buffaloes are spread almost all parts of India with varying population density. Buffaloes are the backbone of the Indian Milk processing industry. More than half of the total milk produced in the country is contributed by the buffaloes, although their population is almost half of the cattle population of India. Indian Buffaloes are water buffaloes. There are about 13 well known indigenous breeds of buffaloes.

In India, large cattle population is mainly reared for milk and draft purposes. Only about 25 % of the population is classified as breed and rest is considered as non-descript. Based on the utility, cattle breeds are classified as milch purpose breed, dual purpose breed and draft purpose breed. There are about 39 well known indigenous cattle breeds of India of which only five breeds (Sahiwal, Gir, Red Sindhi, Tharparka and Hariana) are of milch type (Table 3.2).

Table 3.1: Indigenous dairy cattle breeds

Breed	Synonyms	Habitat	Color	General Description	Utility
1. Gir	Kathiawan Surti, Desan.	Kathiawan region of Gujarat.	Red mottling with almost black. A few spots of white sometimes.	Voluminous dewlap and moderately developed sheath. The hump is well developed and placed in front of the withers. The limbs are widely placed but are not so muscular.	The cows are good milkers on the whole but very a great deal in this respect. Bullocks are heavy and powerful animals, but are medium paced in movement.
2. Haryana		Haryana, West UP. and East Rajasthan.	White or light grey in color,	Poll on the top of forehead. Long narrow face and flat forehead. The short curved horns emerging from the outer angle of poll. Ears are sharp & small. Dewlap & sheath are small, well formed udder.	Bullocks are good work animals particularly for fast ploughing and road transport. Cows are good milkers.
3. Sahiwal	Montgomery, Lambi Ber, Lola	Montgomery district of Punjab of Pakistan	Reddish dun and white	They are of medium size. The forehead is broad with bright eyes and blunt thick horns. The hind quarters are well developed	Bulls are used both for ploughing and for cart. Cows are good milkers.
4. Red Sindhi	Sindhi or Scindhi	Karachi and Hyderabad regions of Pakistan	Deep dark red	A white mark on the forehead is present. Well proportioned head with moderate size. Thick horns which emerge laterally. Rounded drooping quarters, well developed hump, dewlap, sheath and milk vein.	Cows are very good milkers. Bullocks are used for heavy load on roads.
5. Tharparkar	Thari	Marwar region in Rajasthan and Gujarat	White or light grey	Animals are of medium size with short straight and strong limbs. They have moderately long face with broad poll and slightly bulging forehead. Males give a general impression of virility. Horns are of medium size. In young animal particularly there is a white or light grey line along the spine.	Bulls are used for ploughing and carting. Cows are very good milkers.

Table 3.2: Performance of milch cattle breeds of India

Breed	Age at first calving (months)	Calving interval (months)	Average lactation yield (litres)	Milk fat (%)
1. Gir	46.0	13.4	2110	4.6
2. Haryana	51.3	15.8	997	4.5
3. Sahiwal	41.7	15.6	2325	4.9
4. Sindhi	43.5	14.5	1840	4.5
5. Tharparkar	41.3	14.1	1749	4.8

Gir



Haryana



Sahiwal



Red Sindhi



Tharparkar



Photographs 3.2: Photographs of various indigenous milch cattle breeds

SESSION 2: Breeds of dairy animals**Exotic cattle breeds (*Bos taurus*)**

Exotic breeds of cattle have been used in India with the objective to improve the milk production. The important exotic dairy cattle breeds are Holstein Friesian, Brown Swiss, Jersey and Ayrshire (Table 3.3).

Table 3.3: Exotic cattle breeds

Breed	Habitat	Body colour	Average lactation yield (litres)	Fat (%)
Holstein Friesian	Holland	Black and white	6100-6200	3.5
Jersey	Island of Jersey in the English channel	Fawn with or without white marking	4000-4500	5.5
Brown Swiss	Switzerland	Distinctly brown	5200-5400	4.0
Ayrshire	Scotland	Light to deep cherry red with or without shades	4800-5000	4.1

Crossbred cattle

Crossbreeding is mating of animals from different established breeds, e.g., Holstein Friesian X Sahiwal. The progeny produced is called crossbred. The crossbred animals will exhibit the mixture of qualities of both the parents breeds. Crossbreeding programme of dairy cattle has played significant role in attaining India's top position as highest milk producer country of the world. Important crossbred cattle developed in India are enlisted along with their origin in (Table 3.4).

Table 3.4: Popular crossbred cattle available in India

Sl No.	Name of the crossbred	Cross between		Place of origin
		Indigenous breed (female)	Exotic breed (male)	
1.	Sunandini	Local cows (37.5%)	Brown swiss (62.5%)	Kerala
2.	Karan swiss	Sahiwal and Red Sindhi	Brown Swiss	Karnal, Haryana
3.	Frieswal	Sahiwal (37.5%)	Holstein Friesian (62.5%)	Millitary dairy farms
4.	Karan fries	Tharparkar	Holstein Friesian	Karnal, Haryana
5.	Phule Triveni	Gir (25%)	Holstein Friesian (50%), Jersey (25%)	Maharashtra

Indian buffaloes

In India, buffaloes available are of two types viz. the swamp buffalo and the river buffalo. They belong to the same species but have different nature. The swamp buffalo is prefers marshy lands, where it wallows in mud and feeds on coarse marsh grass. They are predominantly found in parts of Assam and Tamil Nadu, e.g., Toda. The river buffalo prefers clean water of rivers, irrigation canals and ponds to wallow. They are docile in nature. Important river buffaloes are Murrah, Nili-Ravi, Surti, Mehsana, Jaffarabadi and Bhadawari. They are extensively used for milk production with high milk fat percentage. The Indian buffaloes have been classified into five distinct groups as described in Table 3.5. Habitat as well as performance of major buffalo breeds of India is given in Table 3.6

Table 3.5: Classification of Indian buffaloes, their breeding tract and horn characteristics

Group	Breeds	Breeding tract	Horn characteristic
Punjab and Haryana	1. Murrah	Rohtak, Jind, Hissar, Bhiwani, Sonapat district of Haryana	Flat, short, tightly spirally curving inward
	2. Nili-Ravi	Ferozpur district of Punjab	Small and coiled tightly
Gujarat	1. Surti	Kaira and Baroda	Flat, sickle shaped and at the tip to form a hook.
	2. Jaffarabadi	Kutch, Junagarh & Jamnagar	Heavy horns, inclined to droop at each side of the neck and then turning up at point (drooping horns).
	3. Mehsana	Mehsana, Sabarkantha, Banaskantha	The horns are curled at the tip but not so tightly curled as in murrah horns are longer than Murrah and could be of irregular shape.
	4. Banni	Gujrat	Horns are vertical and upward in direction with inverted single or double coiling
Uttar Pradesh	1. Bhadawari	Bhadawari estate, Beh Tehsil in Agra, Gwalior and Etawah district, Uttar Pradesh	Horns are curling slightly outward, downward before running backward parallel and close to neck and finally turning upward
	2. Terai	Tarai region of Uttar Pradesh	Horns are long and flat, bending backwards and upwards having pointed tips

Central India	1. Nagpuri	Nagpur, Akola, Amarawati district of Maharashtra	The horns are long, flat and curved, bending backward on each side of the back (sword shaped horns).
	2. Marathwadi	Beed, Parbhani, Jalna, parts of Nanded, Latur, Hingoli and Osmanabad districts of Marathwada region	Horns are mostly round, comparatively short, slightly curved straight way going parallel to neck and not extended beyond hump.
	3. Pandharpuri	West Andhara Pradesh, North Karnataka, Hilly region of Andhara Pradesh and Odisha, Bilaspur district Chattisgarh	Long, sword shaped, sometimes twisted horns
	4. Kalahandi	Eastern part of Andhra Pradesh and adjoining areas of Odisha	Broad and half curved running backward at the tip
	5. Chilika	Surrounding the Chilika lake in Odisha	As the age of animal advances, the horns grow upward, lateral and finally inward to develop typical sickle shape. The tips of both horns often meet to make a full circle or sometimes leave very little gap.
South India	1. Toda	Nilgiri hills of Tamil Nadu	The horns are set wide apart curving inward, outward and forward forming a characteristic crescent or semicircle shape.

Table 3.6: Habitat, performance of major buffalo breeds of India

Breed	Habitat	Age at first calving (months)	Calving interval (months)	Average lactation yield (litres)	Fat (%)
Murrah	Rohtak, Karnal, Hissar, Gurgaon	42-52	14-16	1400-2300	6.9
Jaffarabadi	Gir forest of Kathiawar, Jaffarabad, Junagarh, Jumnanagar, Kutch (Gujarat)	40-45	14-15	1300-1400	9-10
Bhadawari	Bhadawari eastate (Agra), Gwahar, Etawah, UP	50-52	14-15	1100-1300	7.-13
Surti	Anand, Baroda & Surat (Gujarat)	36-38	15-16	1300-1400	7.5
Nili Ravi	Firozpur (Punjab)	41-53	15-17	2000	6.5

Mehsana	Mehasana (Gujarat)	34-36	16	1800-2700	6.6-8.1
Nagpuri	Nagpur, Wardha (Maharashtra) and Berar (Madhya Pradesh)	36-40		825	7.0

Murrah



Jaffarabadi



Bhadawari



Surti



Nili Ravi



Mehsana



Nagpuri



Photographs 3.3: Photographs of various Indian buffalo breeds

PRACTICAL EXERCISE

Activity 1: Identify the various breeds of cattle and buffaloes

Materials Required:

1. Breed chart of cattle and buffalo
2. Typical characteristics of various cattle and buffalo breeds

Step by Step Procedure:

1. Visit to a large dairy farm
2. Examine and record the various characteristics of the dairy animals
3. Identify the breed

CHECK YOUR PROGRESS**A. Multiple choice**

1. Which of the following is not an exotic breed of cattle			
a) Jersey	b) Holstein Friesian	c) Tharparkar	d) Brown Swiss
2. Which of the following is an breed of buffalo			
a) Murrah	b) Sahiwal	c) Tharparkar	d) Gir
3. Which of the following is not an crossbred cattle			
a) Karan swiss	b) Karan fries	c) Sunandini	d) Gir
4. Where pole is located?			
a) in the base of the tail	b) in the flank region	c) inbetween two horns	d) none of the above
5. In which of the following species dewlap is found			
a) Cattle	b) Buffalo	c) Both a and b	d) None of the above

B. Fill in the blank

-cattle are developed from the indigenous and exotic cattle breeds.
- is considered as best buffalo breed.
- Crossbred cattle, Sunandini is found in
- Sickle shaped horn found in..... breed of buffaloes.
- Scientific name of exotic cattle is

C. True or false

- Exotic cattle breeds are having higher milk production potential and originated in different climatic condition
- Exotic breeds are well adapted to the Indian condition.
- Jaffrabadi buffalo breed is found in Rajasthan.
- Jersey breed of cattle is mainly found in Denmark.
- Brown Swiss breed of cattle is mainly found in Switzerland.

D. Match the column

Column A	Write from column B	Column B
-----------------	----------------------------	-----------------

1. Sahiwal		Gujarat
2. Mehsanan		Switzerland
3. Sunandini		Punjab
4. Bhadawari		Kerala
5. Brown swiss		UP

E. Crosswords

2		5 J	4		
	6 M		U		3 T
1 M				A	
P	Z	S	T		I
			I		G
	L				

Side by side

1. Best milk producing buffalo breed

Up and down

2. Part of body found in indigenous cattle
3. Part of hind leg
4. Buffalo breed of Gujarat
5. Popular exotic cattle breed
6. Part of mouth

UNIT 2 : LIVESTOCK HOUSING SYSTEMS-I

LEARNING OUTCOMES

On completion of this unit the student will be able to:

- Prepare the livestock accommodation
- Maintain livestock accommodation

INTRODUCTION

Scientific housing is essential aspect of dairy animal management to obtain maximum productivity of the animals. A clean and comfortable shelter also increases the comfort level of animal and presenting positive impacts on the health of the animal. Improper planning in the arrangements of animal house may result in additional expenditure on labour and thus curtail the profit of the owner. The essential requirements for housing dairy cows must take care of animal health and comfort, hygiene, efficient and economical use of labour, provision of suitable environment for hygienic milk production. In absence of proper housing, many times animals will be exposed to various adverse environmental condition like extreme temperature, wind, cold, rains, snowfall, etc. which will adversely affect to their health, reproduction and production. This unit discusses the various aspects of dairy animal housing along with disposal of manures to maintain healthy environment.

SESSION 1: Basics of animal housing

i. Importance and need of livestock housing

An efficient management of dairy animal will be incomplete without a well planned and adequate housing. Improper planning in the arrangements of animal house may result in additional expenditure on labour and thus curtail the profit of the owner. The essential requirements for housing dairy cows are animal health and comfort, hygiene, efficient and economical use of labour, provision of suitable environment for hygienic milk production.

The purposes of animal housing are to protect the animals from adverse climatic conditions, for their efficient management, economical production and protection from the predators, theft and diseases, etc. The various purposes of animal housing are depicted in Chart-4.1:

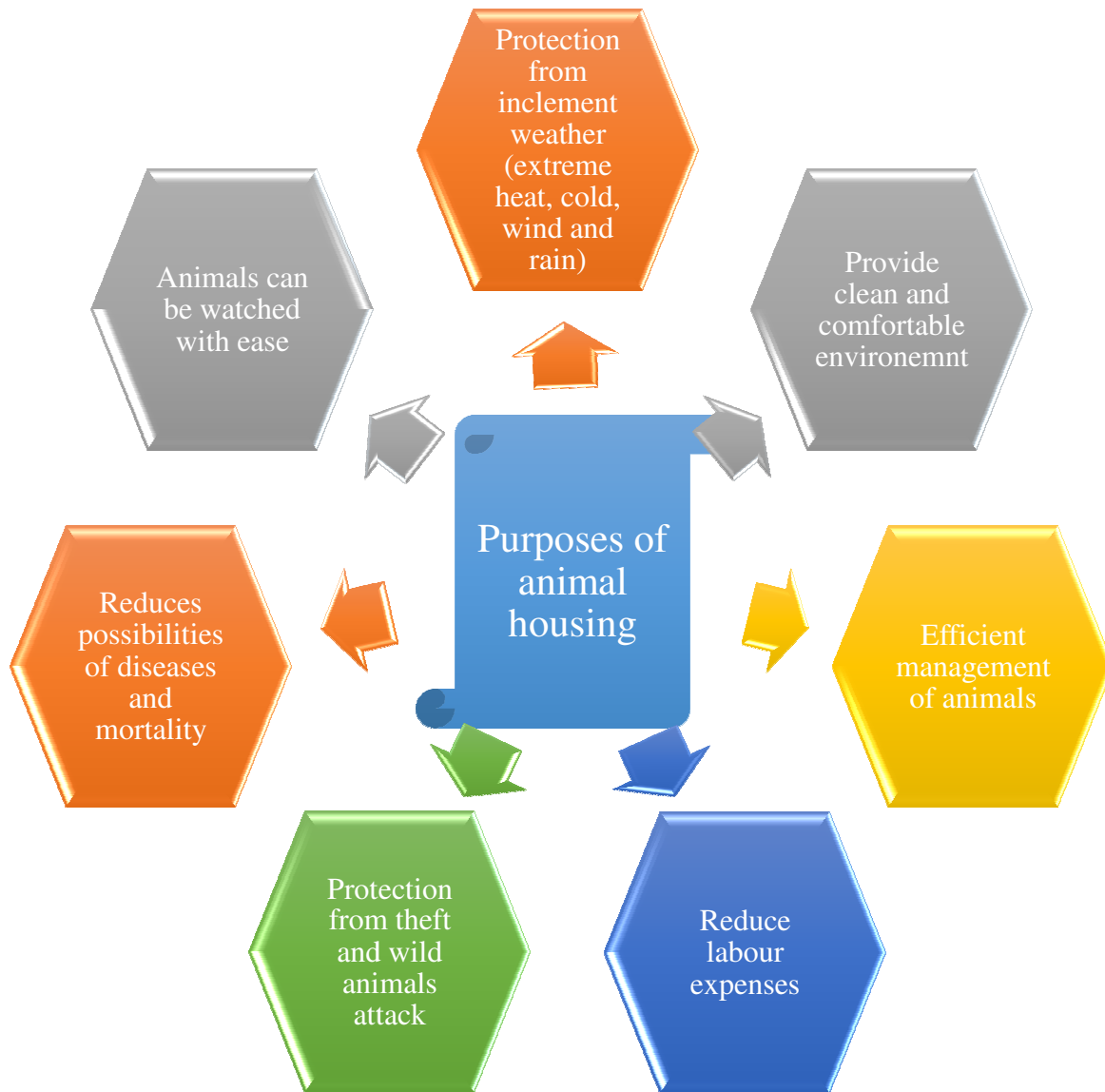


Chart 4.1: Purpose of animal housing

There are six key aspects of livestock housing namely:

- **Space:** Sufficiently spacious area, so that animals can walk to feed and water troughs without fear. The details in this regard are discussed in successive units.
- **Feed:** Make arrangement so that animals eat a palatable and well-formulated feed. The availability of feed must be at least for 21 hours daily.
- **Water:** Accessibility of clean water at least 21 hours daily.
- **Air:** Access to fresh and clean air.
- **Light:** Animals should be exposed to at least 6 hours daily to darkness.

- **Rest:** Space for taking rest at a dry and comfortable place to lie down for at least 13 hr/day.

ii. **Types of livestock housing**

The classification of housing system is given the Chart 4.2.

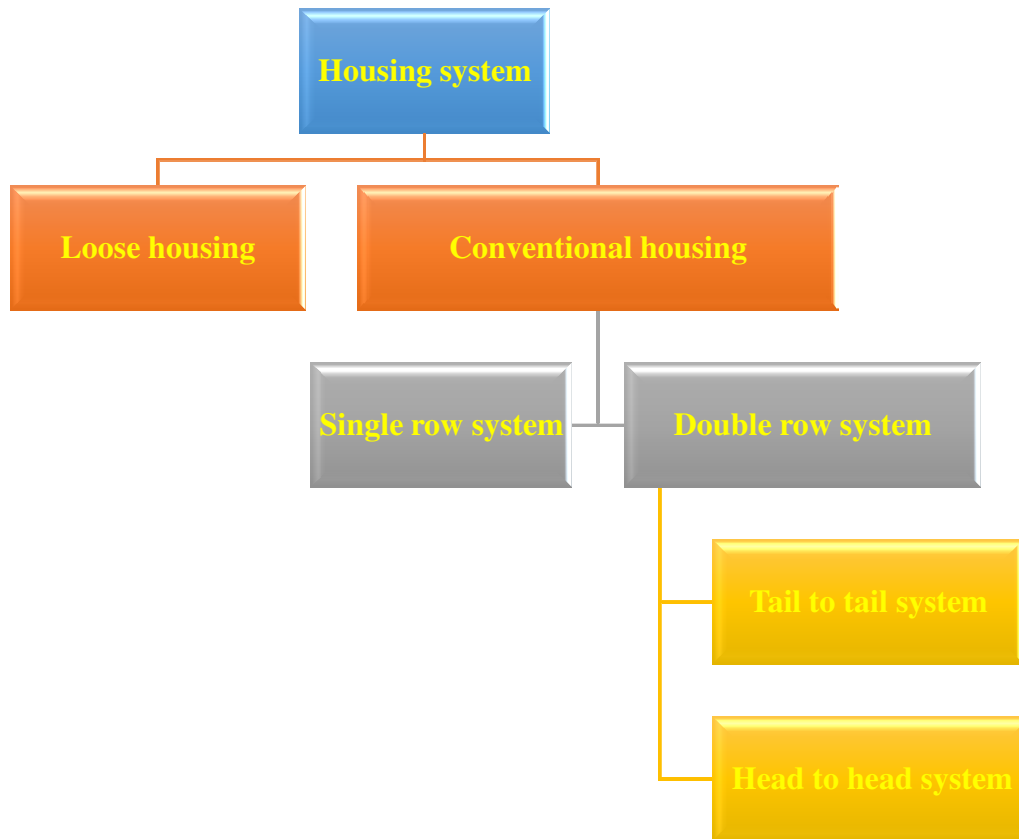


Chart 4.2: Types of livestock housing

A. Loose/extensive housing system

In the loose housing system animals are kept loose in a open paddock in group of 40-50 throughout the day and night except during milking and other specific purposes like treatment, breeding, etc., when the animals are required to be tied. A loose housing layout has open area or paddock and resting area.

The open area has a covered shed on one side (**Photo 4.1**) under which the animal can retire during the time of excessive heat, cold, rains, etc. In this system of housing, feed and fodder is offered in a common manger (**Photo 4.2**) and water is provided in common water tanks. Total area is protected by a compound wall or fencing of about 5 feet height (**Photo 4.3**).

There should be separate milking parlour or barn and a milk-house or milk-room with pertinent utilities for milking of the animals.

Such system is ideal for areas of low rainfall such as Punjab, Haryana, Rajasthan, Western Uttar Pradesh and parts of Gujarat, Madhya Pradesh and Maharashtra. In other areas this system can be used after making small modifications as per necessity.



Photograph 4.1: Cattle kept under loose house system having covered area (shed) and the loose area protected by fencing



Photograph 4.2: Buffaloes kept loose in loose house system having common manger



Photograph 4.3: Another view of loose house

SESSION 2: Basics of animal housing**Floor**

The inside floor of the barn should be of some impervious material which can be easily kept clean and dry and is not slippery. Paving with bricks can also serve ones purpose. Grooved cement concrete floor is still better.

Insufficient space for the animals leads to overcrowded condition which leads to development of abnormal behavior in animals, depressed body weight gain and other performance of animals. The following space per animal shall be provided for various categories of animals (Table 4.1):

Table 4.1: Floor space requirement for cattle and buffaloes as per BIS standard

Type of animals	Floor space required (m ²)		Maximum no. of animals in each group	Height of shed at eaves
	Covered area	Open area/ paddock		
Cows	3.5	7.0	40	175 cm in medium and heavy rainfall area and 220 cm in semi arid and arid areas.
Buffalo cows	4.0	8.0	40	
Bulls	12.0	24.0	1	
Down calver	12.0	12.0	1	
Young stock	2.0	4.0	30	
Calf	1.0	2.0	30	

Manger and water trough

For optimum performance of the animals space should be adequate for free access of feed and water to the animals round the clock with adequate quantity. Water trough should be located near the feeding area, but not in the resting area. Manger and water-trough may be constructed with reinforced cement concrete, brick with cement mortar or stone slabs with cement joining. Feeders or mangers should be designed with smooth surfaces for easy cleaning and easy intake

of feed by the animals. Feeding and watering space required in the paddock is given in Table 4.2. Water depth should be a minimum of 3 inches to allow the animal to submerge its muzzle 1 to 2 inches. Provide at least one watering point for every 15 to 20 cows. At least two watering locations should be provided for each group of cows. In very young calves, water should be given at times other than when milk or milk replacer is fed to avoid possible interference with curd formation.

Table 4.2: Feeding and watering space required in the paddock

Types of Animal	Linear length per animal (m)	Total manger length (m)/ 100 animals	Water troughs (m)/ 100 animal	Dimensions of manger/ water trough		
				Height of wall (cm)	Depth (cm)	Width (cm)
Adult cattle and buffaloes	0.6-0.7	60-75	6.0-7.5	60	40	50
Calves	0.4-0.5	40-60	4.0-5.0	40	15	20

Resting area

The resting area is a building or space where cattle can rest or lie down on a dry bed. It should provide shelter from cold winds, snow and rain; and exposure to winter/ sun, thus the area is roofed. Resting area should not be used as a holding or exit area for the milking parlour. Feeding and watering should be excluded in the resting area.



Photograph 4.4: Bedding in the resting area

Bedding has to be provided to the animals to keep them clean and comfortable. Bedding material will absorb the liquid manure. The bedding materials commonly used or are wheat straw, rice straw, shavings and sawdust. The desirable qualities of the bedding material are bulkiness, large liquid holding capacity, freedom from dust, etc. Straws are most commonly used bedding materials. About 2 to 3 kg of straw per cow per day is required for bedding. Floor should preferably be cemented. However, earth floors may be satisfactory for resting areas, providing they are 8 to 12 inches above the ground level and the surface outside is sloped away from the building to provide good drainage.

Benefits of loose housing system

The benefits of loose housing system are less cost of animal house construction, animals feel more comfortable, easier detection of heat, better labour efficiency, etc. The various benefits of loose housing system are depicted in Chart 4.3.

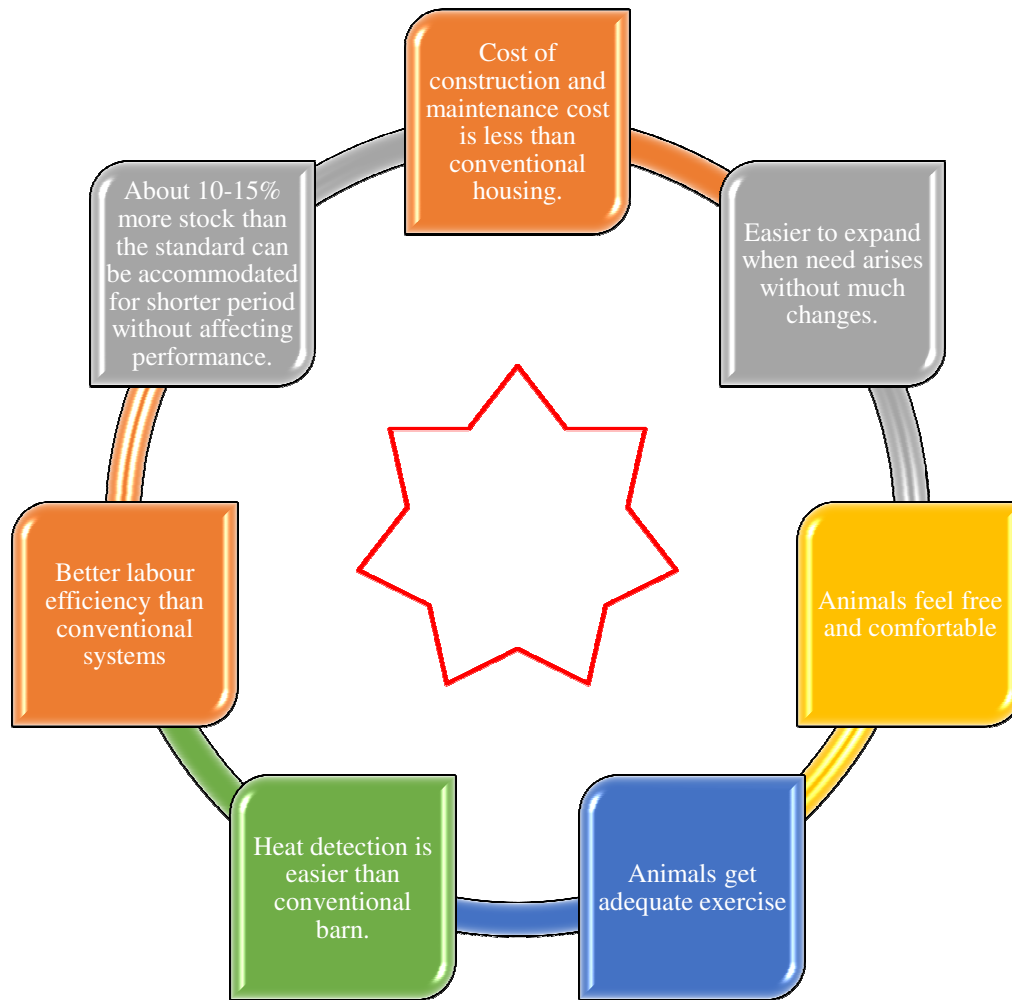


Chart 4.3: Benefits of loose housing system

B. Conventional barn/ intensive housing system

In the conventional barn, each animal is tied up in a stall for resting, feeding, milking and watering. In this system, animals are confined together on a platform and secured at neck by stanchions or neck chain. The barns are completely roofed and the walls are also complete with windows and/or ventilators. Feed is delivered in a trough in front of the cows. Milking is done individually in the stall using bucket or machine. Manure is collected in a gutter. This type of housing is most suitable in the temperate region to protect animal from heavy snow fall, rain and strong wind. When cows are tied up all year round they may get feet problems and become stiff. Heat detection demands more attention. Where winter is prolonged and severe, conventional barns are suitable. The distance between two sheds should not be less than 30 feet.

Cow house or shed or barn

The arrangement of the animals within the animal shed depends upon the number of animals. Single row system is advisable where the number of animal is up to ten. Above this double row housing system is desirable. One shed can accommodate 50-60 cows. However, under modern managemental condition one shed can accommodate even 100 cows. In double row housing, the barn should be so arranged that the cows face out (tail to tail system) or face in (head to head system) as preferred. Each animal is provided with a separate manger in barn.

Benefits of tail-to-tail system:

In the tail-to-tail system of housing (Photo 4.5), the animals are tied in the shed in opposite direction. In this system, the cleaning of the shed and milking of the cows becomes very easy and also the chances of disease transmission from animal to animal reduce. The problems in the hind quarter can be identified easily. In the system, animals get fresh air from outside and supervision of milking is very efficient (Chart 4.4)

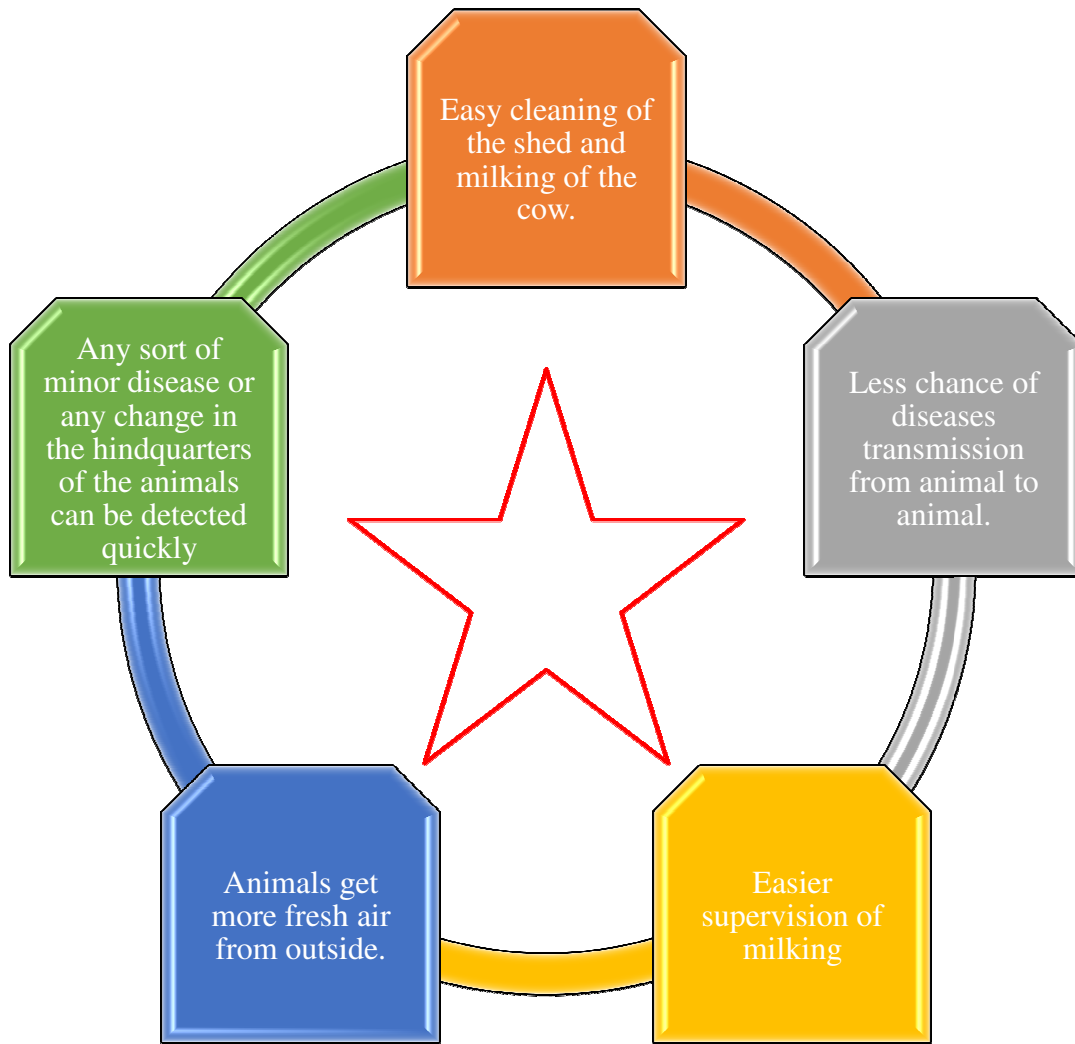


Chart 4.4: Benefits of tail to tail system of housing



Photograph 4.5: Photograph of tail to tail housing system

Benefits of head to head system:

In the head-to-head system of housing animals are tied facing towards front side (Photo 4.6). In this system, animals feel easier to get into their stalls and feed dispensing and its management becomes very easy. The sunrise falls maximum on the gutter and animals make a better show for the visitors because many heads are seen together (Chart 4.5).

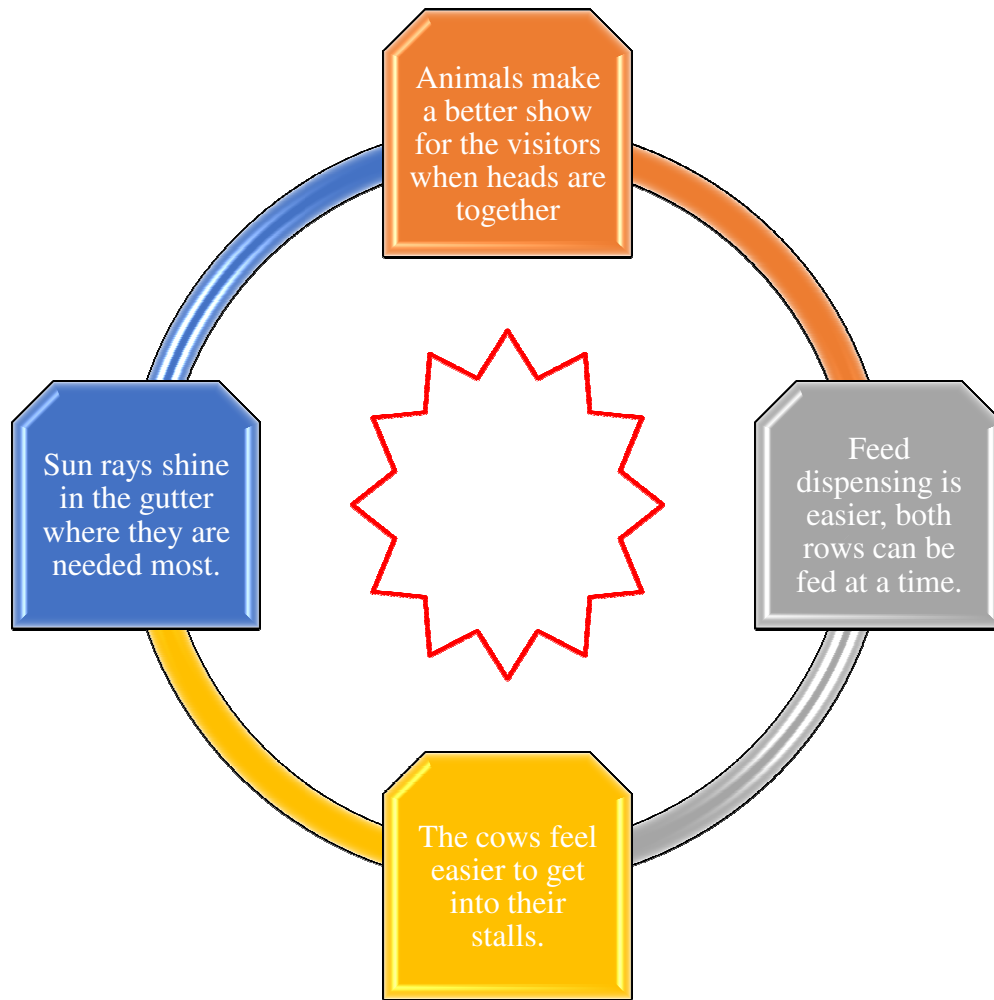
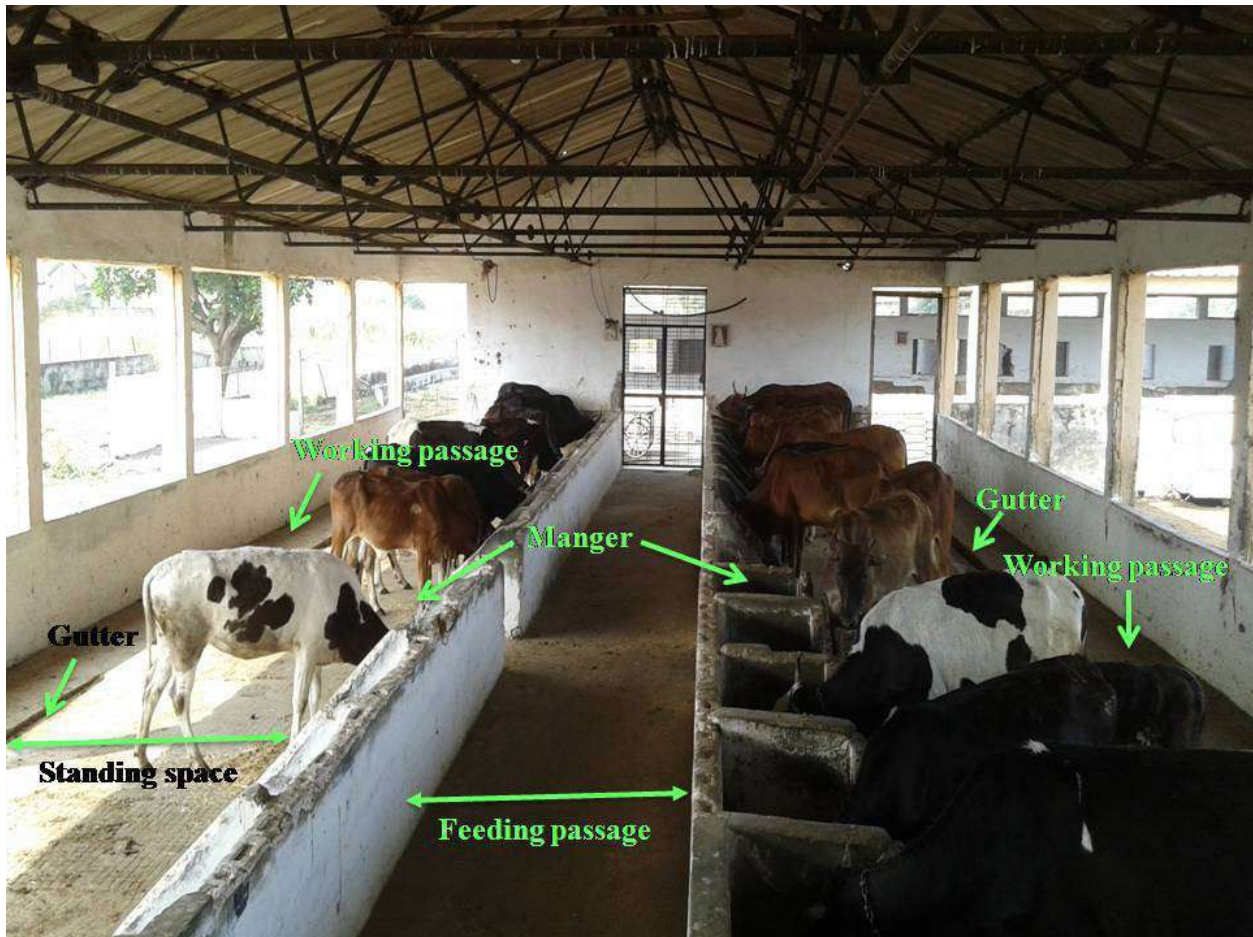


Chart 4.5: Benefits of head to head system of housing



Photograph 4.6: Photograph showing head to head system of animal housing

SESSION 3: Basics of animal housing

Equipments and machinery required for livestock housing

The type and quantity of machinery required for dairy farm depends on the level of mechanization and number of animals. However, some of the machinery and tools are essentially required like chaff cutters, milking utensils and other minor implements.





If the farm is situated in an area with extreme weather conditions, then there is a need of cooling and heating devices especially for young calves, ill or injured and pregnant cows. In case of a farm with more than 50 animals, milk cooling devices, generator set and utility vehicle are also essential for distribution, procurement and selling of milk, etc. In big farms it is always

economical to produce your own fodder. In this case farm equipments like tractor, seed sowing, fodder harvesting and processing equipments may also be required.

Following is a list of equipments and machinery required for small and medium dairy farm:

Section	Equipments and machinery
Fodder production	Tractor
	Trolley
	Large weigh bridge
	Fodder reaper cum binder
Feed processing	Chaff cutter (manual or motor operated)
	Feed grinder
	Feed mixer
Dairy section	Cooling system
	Heating system
	Generator
	Tube well with motor
	Milking machine
	Animal weigh bridge
	Electrical Dehorner
	Burdizzo castrator
	Tagging set
	Branding numbers
	Drenching bottle
	Hoof trimmer
	Ropes, fire controlling equipments, chains

	<p>Platform type electronic animal weigh bridge: Used to measure the body weight of animals</p>
	<p>Bull leader: Used for controlling of bull</p>
	<p>Electrical dehorner: Used for disbudding of horn of calf</p>
	<p>Metal drenching bottle: Used for application of medicine through oral route</p>

	<p>Bull nose ring: Nose rings are inserted through the nasal septum of bull. It helps in controlling of bulls.</p>
	<p>Ear tags and tag applicator: Used for identification of animals</p>
	<p>Branding numbers: Used for identification of animals by branding method.</p>
	<p>Burdizzo castrator: Used for castration of male calves</p>

	<p>Hoof trimmer: Used for trimming of hooves</p>
	<p>Bulk milk cooler: Used to cool the milk just after milking</p>

Photograph 4.7: Commonly used machinery and equipments in a dairy farm and their use

SESSION 4: Basics of animal housing

Standard workplace procedures within animal house

Dairying, by its very nature is a 365 days a year and all-weather activities. It is impossible for any manager to supervise all operations round the clock. Therefore, the labours must enjoy their work if they want to do a good job. Critical tasks such as operating milking machines, heat detection and many other aspects of dairy farming cannot be mechanized or easily measured.

Various routine activities of a dairy farm :

Various routine activities of a dairy farm can be classified in three major groups i.e. Daily routine, Monthly routine and Quarterly or Yearly routine. These activities has been classified and presented in the Chart 4.6



Chart 4.6: Various routine activities of a dairy farm

PRACTICAL EXERCISE

Activity 1: Examine the existing housing design of a dairy farm

Materials Required:

1. Tape
2. Camera
3. Notebook

Step by Step Procedure:

1. Visit to dairy farm.
2. Note down the various structures available at dairy farm.
3. Examine the structures available at dairy farm.
4. Draw a outline of the dairy farm.

CHECK YOUR PROGRESS

A. Multiple choice

1. The advantage of face to face system is			
a) Easier supervision of milking	b) Animals get more fresh air from outside.	c) Feed dispensing is easier, both rows can be fed at a time.	d) None of the above
2. For adult buffaloes, floor space requirement (m ²) under covered area is			
a) 3.5	b) 4.0	c) 7.0	d) 8.0
3. Loose housing system is suitable for which of the following state			
a) Punjab	b) Rajasthan	c) Maharashtra	d) All of the above
4. Which of the following housing system suitable temperate region			
a) Loose housing	b) Conventional housing	c) Both a and b	d) None of the above
5. Which of the following machineries are used in fodder production			
a) Tractor	b) Reaper cum binder	c) Cultivator	d) All of the above

B. Fill in the blank

1. A loose housing layout has open area or paddock andarea.
2. In a loose house, the height of the fencing of about.....
3. Single row system is advisable where the number of animal is up to.....
4. In conventional barns, the distance between two sheds should not be less than.....

5. Minimum number of watering location should be there in an paddock.

C. True or false

1. Improper planning in the arrangements of animal house may result in additional expenditure on labour.
2. In conventional housing system each animal is provided with a separate manger in barn.
3. Heat detection is easy in conventional barn.
4. In the loose housing system animals are kept loose in within the shed.
5. In big farms it is always economical to purchase fodder from the market.

D. Match the Column

Column A	Write from column B	Column B
1. Drenching bottle		Identification
2. Burdizzo castrator		Application of medicine
3. Dehorner		Castration
4. Bull nose ring		Dehorning
5. Branding numbers		Controlling of bull

E. Crosswords

	² P		³ B	
¹ M			G	⁴
	D		D	O
				D
R	C			
E	K		G	

Across

1. Area where feeds are offered for the animals
2. Open area for the animals

Down

1. Mixture of cow dung, left over feed and other organic matter in a dairy farm
3. Used within the animal shed which provide comfort to the animals
4. Structure is essential to move one place to other within a farm.

UNIT 3 : LIVESTOCK HOUSING SYSTEMS-II

Session 1

i. Principle of animal housing layout

The animal house should be designed in such a way that it can accommodate animals of all age groups separately. At the same time it must facilitate farm activities e.g. milking, feeding and cleaning in a safe and efficient manner. It must also provide comfort to the animals for optimal milk production and protection against unfavourable weather conditions (e.g. heat, rain, wind). The animal house should be constructed based on certain principles which are enlisted in the Chart 4.7.

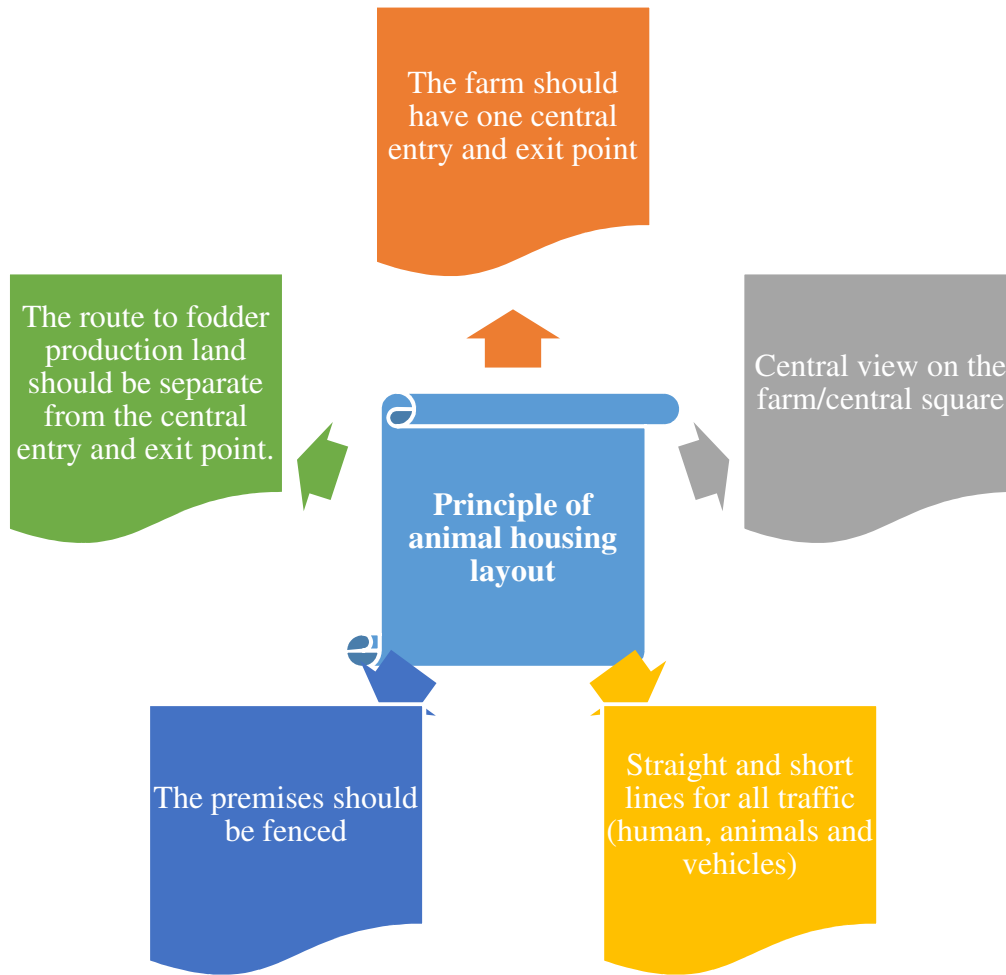


Chart 4.7: Principle of animal housing layout

ii. Grouping of cattle in a dairy herd

A dairy farmer must divide the dairy herd into multiple groups especially when the size of the dairy farm is large. The grouping of the animals is based on the nutritional as well as managerial requirements of the animals. Grouping of animals can separate groups of cattle such as heifers, lactating (early, mid and late) cows, dry cows, advanced pregnant cows, sick animals, breeding bulls, suckling calf, young calf. Proper grouping of animals reduces the labour requirement, reduces chance of fighting among the animals, better management of animals, etc. Terms used for different categories of cattle and buffaloes are described in Table 4.2.

Table 4.2: Terms used in cattle and buffaloes

Category of animal	Cattle	Buffalo
Adult male	Bull	Buffalo bull
Adult female	Cow	She buffalo/ buffalo cow
New born up to one year	Calf	Buffalo calf
Male above 1 year up to sexual maturity	Yearling male/ bull calf	Buffalo yearling male/ buffalo bull calf
Female above 1 year up to age at first calving	Heifer	Buffalo heifer
Castrated male	Bullock	Buffalo bullock
Act of parturition	Calving	Calving
Act of mating	Servicing	Servicing
Group of animals	Herd	Herd

iii. Layout of animal housing

A large dairy farm shall have three important sections of activity, namely, cattle section, dairy section and fodder production section. The various structures associated with these sections are given in Table 4.3

Table 4.3: Important sections of the dairy farm and their activities

Cattle section	Animal shed	Milking animal shed
		Dry animal shed
		Calving box or calving pen
		Heifer shed
		Calf shed
		Bull shed
		Milking parlour
		Sick animal shed
	Ancillary structure	Artificial insemination cum veterinary dispensary
		Concentrate godown
		Dry fodder godown
		Chaffing shed
		Handling yard
		Manure disposal area
		Silo
Travis		

		Wallowing tank
Dairy section		Milk receiving room
		Milking utensils storage room
Fodder production section		Implements and workshop shed
		Fertilizer and fodder seed storage room

Layout plan of large dairy farm (as per Bureau of Indian Standards):

The layout plan of large dairy farm as per Bureau of Indian Standards has been given in Chart 4.8.

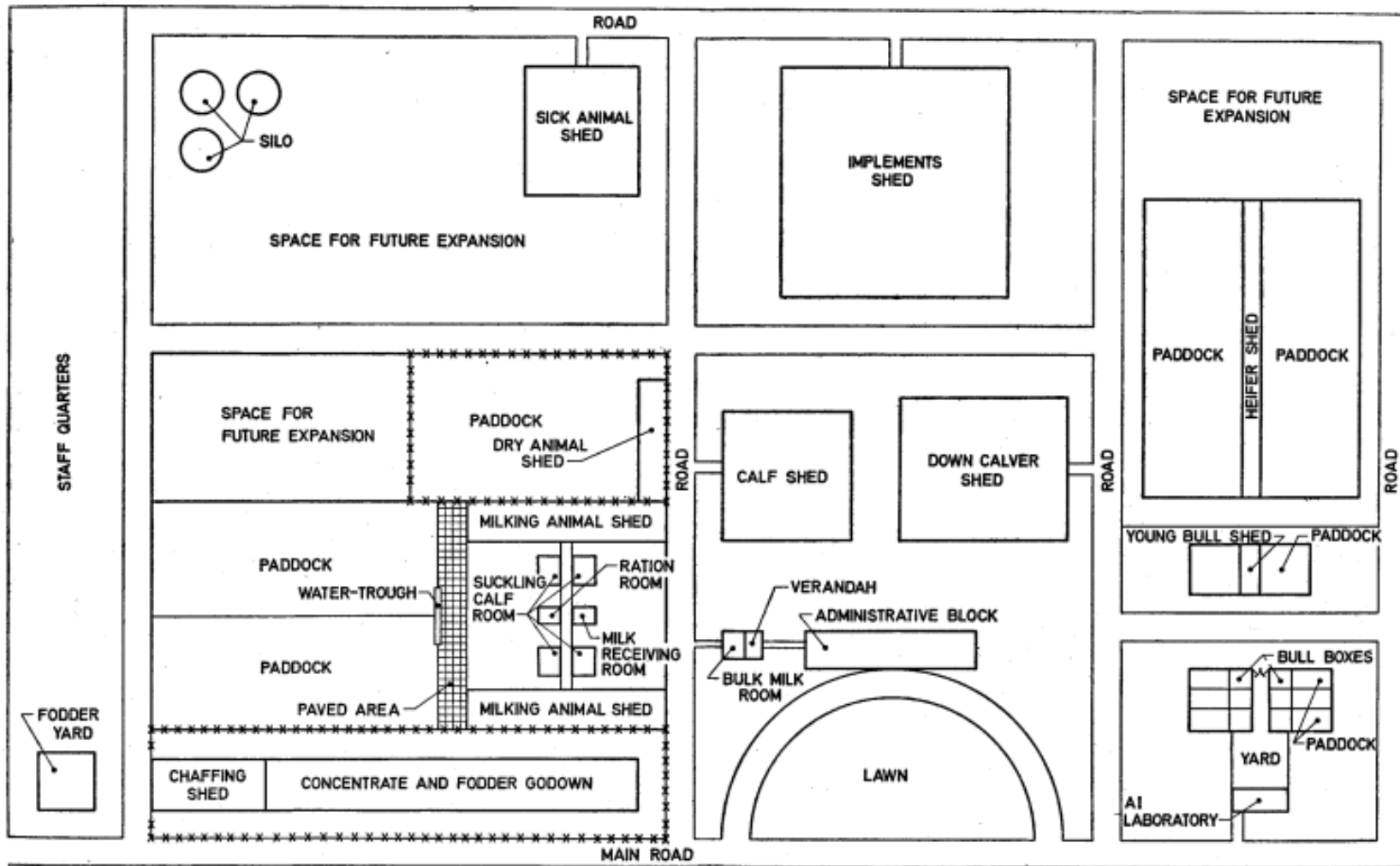


Chart 4.8: Layout plan of large dairy farm (as per Bureau of Indian Standards)

Session 2

LIVESTOCK HOUSING SYSTEMS-II

A. Cattle section

This is the most important section in a dairy farm. It has various units and all units shall be planned so as to provide for comfort, protection and operational conveniences.

1. Animal sheds

a) Milch animal shed

The length and width of the floor area shall be decided according to the average size of the animals. Per animal floor space requirement may vary from 1.5 to 1.7 m in length and 1 to 1-2 m in width. The width of the central passage may be 1.8 m. The central passage shall have slope of 1 in 25 from the central axis towards both the sides. There shall be two drains laid on either side of the central passage. There shall be two continuous mangers on outer side of the area. The floor shall be sloped 1 in 40 towards the drains.

b) Milking parlor

A milking parlour is part of a building where cows are milked on a dairy farm. Milking parlour is constructed where the animals are maintained in loose housing system. Cows are brought to the milking parlour to be milked and after milking the animals are returned to a feeding and/or resting area. Milking parlour is usually part of a larger complex known as the milking centre, which contains supporting structures and equipments for the parlour. A milking centre typically contains the following areas:

- **Holding area:** A paved area should be provided just outside the milking parlour entrance in which to hold the cows until they are wanted for milking. It may be open or covered with a space requirement is about 15 square feet per cow. The slope of the holding area should be opposite to the milking parlor entrances.
- **Milk room:** A room for keeping equipments for cooling and storing of milk and for cleaning and sanitizing the milking and milk storage equipment.
- **Utility room:** A room that houses, equipment such as vacuum pumps, refrigeration compressors and water heaters.

The dimensions of various units of milking parlour are given in Table 4.4

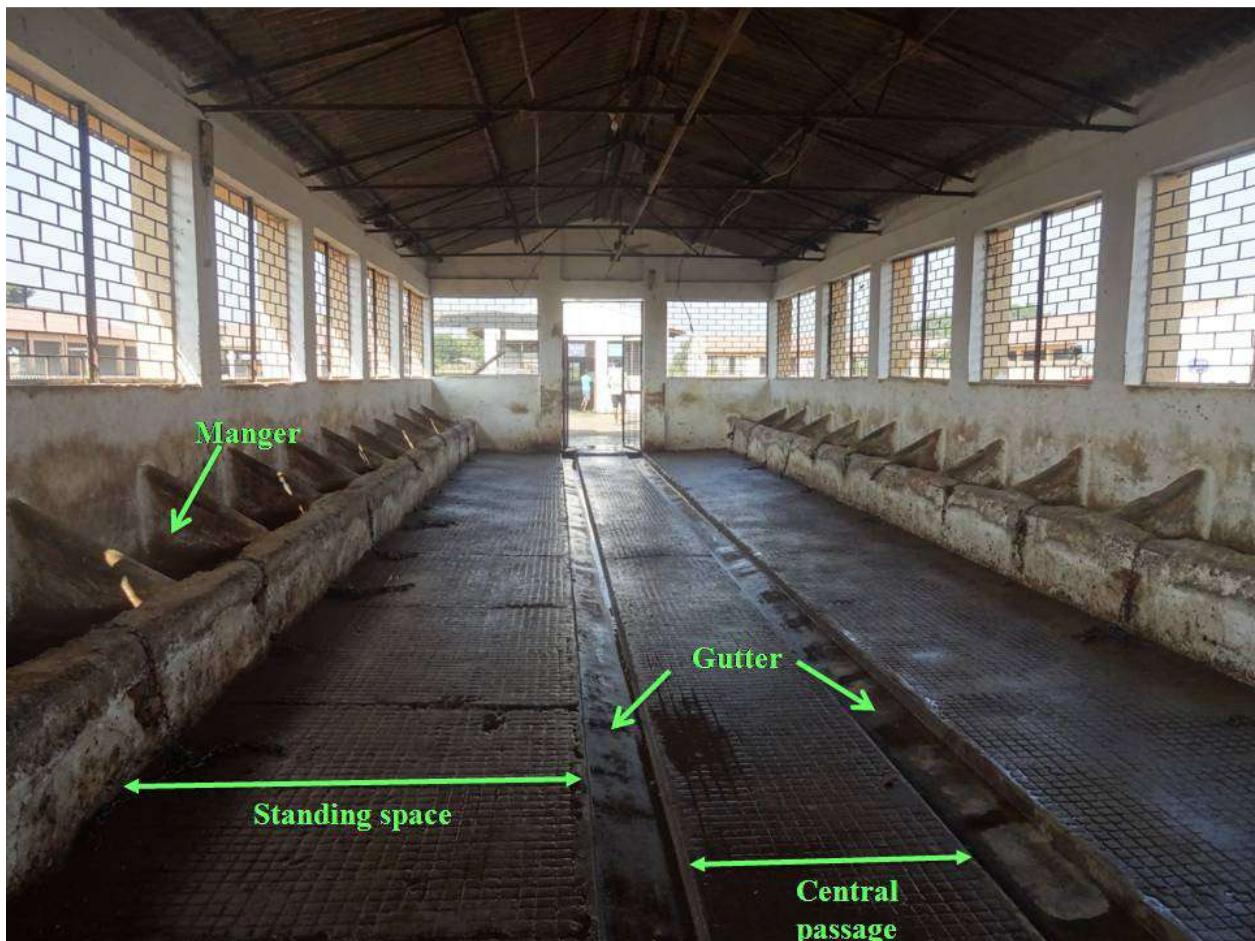


Photograph 4.8a: Milking Parlor



Photograph 4.8b: Milking Parlor

Double rows of standings can be arranged either tail to tail or head to head; the former is better. The number of standings required on a farm is thus equal to half to one third of the number of milch stock.



Photograph 9: Photograph of cleaned milking parlor

Table 4.4: Dimensions of milking barn/parlour

Length of standing space	: 1.5 – 1.7 m
Width of standing space	: 1.05 – 1.2m (80% of length, of standing space)
Width of central passage	: 1.5 – 1.8 m
Width of feed alley	: 0.75 m
Width of gutter	: 0.30 m
Width of manger	: 1.4 m

Suckling calves' room: When calves are unweaned, four rooms 4 x 5 m shall be provided between two milking animal sheds for housing suckling calves.

c) **Dry animal shed**

The shed may be of the loose housing type and may consist of centrally placed manger under a roof in the paddock. The manger shall be surrounded by a 2.2 m wide paved platform with drains.

d) **Calving pen**

Cattle and buffaloes live in herds but, when giving birth, the animals like a quiet, sheltered place away from the disturbance of other animals and humans. After calving, the cow needs to be with her calf to establish bonding between the cow and calf. In conventional housing system cows preferably remain in the same barn and give birth. In loose house when the cow is approaching calving, it should be removed from the herd and placed in an individual pen that is called calving pen. The calving pen has to be sufficiently spacious, well lighted, draught-free and easy to reach and clean. Advanced pregnant animals are transferred to a calving pen 2 to 3 weeks before the expected date of calving and remained there 3-5 days after calving.

There should be one calving pen for every 20 cows, i.e., 5% of the breedable animals. Special accommodation in the form of loose-boxes enclosed from all sides with a door should be furnished to all parturient cows. It should have an area of about 12 square metre with ample soft bedding. Sand can be used as bedding material with a minimum height of 30 centimeter sand. The floor of the calving pen must be non-slippery and each pen should be connected to an independent drain. The closed area of calving pen and Open area of calving pen are shown in photographs 4.10 and 4.11.



Photograph 4.10: Closed area of calving pen

Photograph 4.11: Open area of calving pen

e) **Calf shed**

New-born calves have to be individually housed during the first weeks. Since a calf is very susceptible to all kinds of infections, the death rate is the highest during first weeks. Therefore, special attentions have to be paid to hygiene and the climatic conditions. The calves are housed in individual pen (Photo 4.12) up to the age of eight weeks and then they are placed in group housing system.

Individual housing of calves: As the calf has a natural tendency to suckle each other, they should be housed separately. Suckling allows easy transmission of diseases. Individual pen has advantages of individual feeding, observation and reduced risk of cross-contamination. The pen should be constructed in such a manner, so that they should be able to see and hear other calves. Thus, single pen must have open or partly open sides and the sides of the outdoor exercise folds of single calf huts must also be open and they must be placed against each other. The height of the box partitions shall be at least 75 cm high. The feeding rack must be supplied with openings, through which the calf can put its head when it drinks and eats. Number of calf pen in a farm should be 5 per cent of the total breedable female.



Photograph 4.12: Individual calf pen

Group housing for calves: After about two months of individual housing, the calves can be housed in groups of 3-5 calves per pen, preferably on straw bedding. Calves should never be accommodated with adults in the cowshed. The calf house must have provision for daylight ventilation and proper drainage. Damp and ill drained floors cause respiratory trouble in calves to which they are susceptible.

In a large herd, it is useful to classify the calves below one year into three groups, namely, calves below the age of 3 months, 3 - 6 months old calves and those over 6 months for better management of calves. The floor space requirement per calf is about 20 - 25 square feet for below 3 months age group and 30 square feet for 3-6 months age group. The complete calf shed including paddock should be well protected from the birds, as it can create wound.

f) **Housing of heifer and young male**

The area of about 30 - 40 square feet for every heifer should be made available for shelter. The heifer should be separated from young male. Otherwise, undesirable mating may occur.

g) **Bull shed**

For safety and ease in handling, a comfortable shed for protection from weather and a provision for exercise are the key points while planning accommodation for bulls or bullocks. A bull should never be kept in confinement particularly on hard floors. Such a confinement without adequate exercise leads to overgrowth of the hoofs creating difficulty in mounting and loss in the breeding efficiency of the bull. The shed should have a manger and a water trough. From the bull shed, the bull should be able to view the other animals of the herd so that it does not feel isolated. The bull should have a free access to an exercise yard provided with a strong fence or a boundary wall of about 4 feet in height.

Session 3 LIVESTOCK HOUSING SYSTEMS-II

2. Ancillary structures

Ancillary structures are secondary structures which are very useful for day to day farm operations. These ancillary structures are required for all categories of housing system. Various ancillary structures are described below.

a) **Artificial insemination (AI) laboratory**

Adjacent to bull shed, there shall be a 10 m x 10 m service yard with a service crate in the centre for the collection of semen. AI laboratory should be attached to the service yard, where testing, processing and storage of semen have to be done. The minimum dimensions for laboratory shall be 3 m X 4 m and 3 m x 4 m each for wash-up room and room for supervising officer.

b) **Travis**

Travis can be used both for treatment and artificial insemination. It is a U-shaped structure, made up of 2 inches diameter galvanized steel pipes supported by five or seven pillars. One horizontal pipe shall be welded on the sides across the two rear pillars to protect the working technician from sidekicks. One adjustable pipe shall be affixed with a chain which may be put across the last two pillars through the clamps fixed on both sides of these pillars to prevent the animals from backing out. One iron ring for tying the animals shall be provided at the top of front pillar to prevent the animal from jumping off the crate. Typical dimensions of service crate

is length 195 cm, width 75 cm, height at front 165 cm and height at rear 140 cm. The two different type of travis are shown in photographs 4.13 and 4.14.



Photograph 4.13: One type of travis



Photograph 4.14: Cow is taken into travis for examination

c) Handling yard/ casting pit

The casting pit is the area where the animals are forced to lie down for the treatment or other activities. The casting pit contains about 6 inches of sand or saw dust or mixture of both which act as bedding material to avoid injuries to the animals. The casting pit is shown in photo 4.15.

In large farms, it is desirable and economical to construct one flexible handling yard that can be used for the three processes of animal handling, namely collecting, filling and control of individual animal for weighing, vaccination, treatment and marketing. The dimension of the casting yard is diameter 7.62m, depth 0.31m and height of the roof is 2.4m.

The size and number of different component pens depend on the herd of the stock handled. On small farms, provision of simple trevis/ cattle crush is sufficient for controlling the animals.



Photograph 4.15: Casting pit

d) Sick animal shed and veterinary dispensary

The sick animal shed should be located well away from the other animal sheds. The dimensions and arrangements for sick boxes and standings for animals should be the same as given for calving boxes. The paddock of the sick animals should be paved and should regularly be washed. A treatment crate should be placed at one of the corners of the paddocks.

There should be a room of at least 3 m x 4 m preferably having built-in dispensing counter, shelves and two or three cupboards. It should also be provided with a porcelain sink and a power plug for sterilization of materials. Adjacent to pharmacy room, there should be a diagnostic laboratory of at least 3 m x 4 m. This may also have built-in shelves and cupboards and a working table.

e) Isolation yard

Animals suffering from infectious diseases must be segregated soon from the rest of the herd. It should consist of a shed with attached yard. At least one isolation pen for every 40 animals should be available to the farm. The shed should be for 2 to 6 animals, the number depending upon the size of the herd maintained at the farm and should be away from other sheds.

The shed should have independent drain which should be connected to the main drain running behind the shed, so that no animal comes in contact with potentially infective discharges and washings. The yard should be suitably fenced. Each shed shall be provided with a manger and tie chain and a water-trough. The fly proof wire netting door should also be provided to the building. It should have a dimension of about 5 x 3 m (150 sq. ft) and have a stanchion or tie-stall in one corner. Loose boxes of about 150 square feet are very suitable for this purpose. They should be situated at some distance from the other barns.

f) **Post mortem platform**

A raised platform of 3 m x 4 m with a roof shall be provided to perform postmortem examination. It should be away from the other animal sheds. An incinerator may be provided to incinerate the carcass of animals suffering from contagious diseases.

g) **Concentrate and dry fodder go-downs**

Stores are very important ancillary structure of animal houses. For continuous supply of feed and fodder to the animals, sufficient amount of feed and fodder should always be ready in the feed and fodder stores. The size and type of buildings for stores can be decided on the basis of the quantity of feeds and fodders that are to be stored at a time on the farm. The concentrate godown shall be provided to keep requirements for three months. Usual space requirement for concentrate godown is 0.2 cubic meter livestock unit. There should be one main concentrate store-cum-feed mixing room in the farm and it is advisable to have small ration room nearer to the milking barn for storing prepared concentrate mixture temporarily for a day or two. On smaller farms perhaps one feed store near the milking barn will be sufficient. The feed room should be made damp and rodent proof.

The common dry fodders such as hay or crop by-products like straws are stored to feed the animals. Straws are available only at harvesting season at cheaper rate and thus the whole amount of straws required for the year needs to be stored. Space requirement shall depend upon the manner in which the dry fodder is stored. Adult stock consumes about 6 kg of dry fodder per day while young stock consumes about 3 kg per day. The size of the shed needed to store dry fodder can be thus calculated.

The hay godown may be sufficient to hold two-month's requirements of hay. Annual quantity of hay needed can be worked out on the basis of number of days in a year when hay is required.

h) **Ration room**

There shall be a room of at least 3 x 4 m near to the milking animal shed to store feed concentrates temporarily to meet the requirements of the animals for the day for a medium sized farm. The ration room should be made damp and rodent-proof.

i) **Chaffing shed**

The floor of the chaffing shed shall be sufficiently hard and preferably be constructed by cement concrete. It may have a gabled roof supported on wooden posts and trusses. The floor area shall be at least 14 m x 4 m. This should consist of two portions. One portion should be used for holding fodder to be chaffed and the other portion for realizing chaffed material. The chaffing shed should be so positioned as to facilitate the chaffing and removal of the chaffed fodder.

j) **Silos**

Silage is an important item of feed for dairy animals. Silage is obtained by ensiling chaffed green fodders in silos. Tower, pit and trench silos are in use, but under Indian conditions, trench silos will be more practicable and convenient. The silos should be made nearer to cow shed as far as possible. The silos should be constructed on elevated ground. They should be constructed to provide sufficient amount of silage during the lean period (May to June and October to November). The silage of a good quality should weigh 0.4 to 0.48 tonnes/m³. Adult cattle and buffalo can be provided with 10-13 kg silage per day.

k) **Wallowing tank for buffaloes**

Wallowing means roll or lie in mud or water to cool the body. Buffalo prefer to wallow in pond and muddy pools. In extreme hot conditions buffalo decrease their activity and submerge their whole body in the water to maintain the body normal temperature. In large buffalo farm, wallowing tank requires to be constructed to provide comfort to the buffaloes during summer months. The image of Wallowing tank used in the dairy farm is given in photograph 4.16.



Photograph 4.16: Wallowing tank for buffaloes

B. Dairy section

The primary function of the dairy farm is to produce milk. Therefore, suitable arrangement should be made for hygienic handling, processing and disposal of milk.

a) Milk house/receiving room

Collection of milk is the important activity in the dairy operation. Milk house is the place where milk is collected, weighed and stored in cans for small periods before disposal of milk to the milk plants or sends to the market. Milk recording cum milk receiving room should be of 3 m x 4 m dimension. It should be near to the milking parlour (in case of loose housing system) or near to the milking animals shed (in case of conventional housing system). To ensure clean milk production the door and the windows should be fly-proof. The flooring of the room should be of impervious and wear resistant. The milk may be received in the room through a funnel which should be provided with a movable lid operated by foot paddle. Dimensions of a milk house depend upon the quantity of milk handled daily. The detail dimension of the milk house are given in Table 4.5.

Table 4.5: Floor space requirement for milk house

Sl. No	Daily milk output (litres)	Floor space (metre)	Remarks
1	Below 100	3.7 x 3.0	Additional 0.37 m ² for every 40 litres output over and above 700 litres
2	100-200	3.7 x 3.7	
3	200-450	3.7 x 4.4	
4	450-700	3.7 x 5.1	

On very large farms the different components of the milk house i.e. recording cum-milk cooling room, milk utensils and equipments room and washing room may be constructed as separate units.

b) Bulk milk room and ancillaries

In a large dairy farm there should be separate bulk milk room. The floor area of the milk room should be at least 4 m x 5 m and area may vary depending upon the amount of milk produced per day. After collecting milk in the milk receiving room, it should be transferred through cans to the bulk milk room. Then milk cans should be placed in insulated tank filled to the neck of the cans with refrigerating water. To inhibit bacterial growth and to prevent spoilage of milk, the temperature of storage of milk should remain below 4-5°C. An office room, compressor room, utensil wash-up room should be arranged in one row by the side of bulk milk room.

C. Fodder production section

Continuous supply of green fodder to the ruminants like cattle, buffalo, sheep, goat, etc., is prerequisite for the health of the animals and economy of the farm. The structural requirements should be as follows;

a) Implements and workshop shed

Implements shed should be constructed to accommodate tractors and implements used for various farm activities. The width of the shed may preferably be 8 m. The eaves should project out about a metre. There should be a 10 m wide open space on the three sides and 13 m on the front side of the shed for easy turning and movement of vehicles Photo 4.17.



Photograph 4.17: Photograph of implement shed

b) Manure disposal area

Animal excreta often mixed with straw and used as fertilizer for soil is called as manure. Animal defaecates approximately 8 % of body weight during 24 hours. Large quantities of urine, left over feed and fodder, bedding materials, etc., are also produced from the livestock farm. Proper manure storage is an important part of manure management. Manure from cattle sheds should be removed at least twice a day. Manure can be disposed off either in solid form or in liquid form (slurry).

Solid manure disposal: Manure is handled as solid when the dry matter content exceeds 25%. Manure can be temporarily stockpiled. The height of the stack can be 1.5 to 2 metres. Stockpiled manure should be kept on a concrete pad, compressed clay pad, or plastic sheet at least 100 feet from all wells and water sources. These types of floors will prevent water from seeping from the manure into the soil where it may contaminate groundwater.

The manure may be loaded in a trolley or cart and hauled away to the compost pits or vermicompost unit. The dimensions of the compost pit may be 4 x 2 x 1 m or 5 x 2.5 x 1 m. The number of compost pits should vary according to the number of animals and the area of cultivation. In vermicompost unit earthworm is used to convert the solid manure into vermicompost. The Manure output observed in different farm animals is given in Table 4.6

Table 4.6: Manure output in different farm animals

Species	Manure output (kg/day)	Dry matter content (%)
Cattle	30-35	18-20
Buffalo	35-40	16-18
Sheep and goat	1.0-2.5	38-40

Manure pit: Manure pit should be sufficiently away from the animal houses as it is safe guard against smell and fly nuisance. It should not be far away, so that labour requirement for transportation would not be high. Manure pit should be cleared at 6 to 8 weeks interval.

Liquid manure disposal: Mixture of dung and urine is known as slurry. Manure with less than 20% solids has the consistency of thick slurry. Slurry may be directly disposed into the field by gravity, if slope permits or by collecting and pumping in the field.

Session 4 LIVESTOCK HOUSING SYSTEMS-II

iv. Daily scheduled dairy farm operations

Animals prefer to follow a certain routine. Any deviation of routine may create stress on animals. At the same time, certain work of the dairy farm like cleaning, feeding, milking, etc., consume majority of the time and it has to be finished on the same day. Cleaning of animal sheds and paddocks requires major inputs of labour. Therefore, proper scheduling of dairy farm operation is very much essential. Cleaning of cows before milking is very important. The cow with unclean back portion is shown in photo 4.18. While, perfectly clean cow is shown in photo 4.19.



Versus



Photograph 4.18: Animal with unclean back portion

Photograph 4.19: A perfectly clean animal

The dairy farmer must follow the schedule to manage the farm in efficient way. The tentative schedule of dairy farm operation is described below. However, one can set his/her own schedule. The schedule of daily farm operations at College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur is given in Table 4.7.

Table 4.7: Schedule of daily farm operations at College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur, Madhya Pradesh

Approximate time (hours)	Farm operations	Resource/ materials required
04: 00- 04: 30	Cleaning/brushing of milch animals	<ul style="list-style-type: none"> • Hose pipe • Water supply, • Grooming brush
04: 30- 06:30	Feeding half of the daily concentrate ration just before milking. Milking of animals	<ul style="list-style-type: none"> • Concentrate mixture • Measuring appliances • Towel • Milking bucket • Post milking teat dips
06: 00- 06: 30	Delivery of raw milk (in cans) to the milk venders	<ul style="list-style-type: none"> • Milk collection and storage container
	Washing and disinfections of milking barns.	<ul style="list-style-type: none"> • Hose pipe • Water supply
06: 30- 08: 00	Cleaning of milk cowsheds and paddock	<ul style="list-style-type: none"> • Hose pipe • Water supply

	Cleaning farm premises	<ul style="list-style-type: none"> • Hose pipe • Water supply • Broom
	Isolation of sick animals	<ul style="list-style-type: none"> • Rope
	Isolation of “in-heat” cows for artificial insemination.	<ul style="list-style-type: none"> • Rope
08: 00- 11: 00	Cleaning of calf pen, calving box, dry stock, bullock and bull shed.	<ul style="list-style-type: none"> • Broom • Disinfectants
	Feeding of dry/green fodder to milch stock	Dry/ green fodder, feed distribution trolley or tractor
	Feeding half of the daily concentrate ration to calves, pregnant cows and bulls	Concentrate, feed distribution trolley
	Exercising and grooming of bulls	Bull exerciser, grooming brush
	Treating sick animals	Isolation shed, medicines
	Breeding cows which are “in-heat”.	Materials required for artificial insemination
	Harvesting, chaffing and feeding of green fodder to all the stock.	Chaff cutter, feed distribution trolley or tractor
	Mangers in all sheds should be filled with green fodder.	Feed distribution trolley or tractor
11: 00- 14: 00	Lunch-cum rest period for labourers	
14: 00- 17: 00	Miscellaneous jobs of dairy farm stock identification; preparation of concentrate mixture; repair of farm fences, fittings and repair of equipments; rope and halter making; weekly scrubbing and white-washing of drinking water tanks; manure disposal/conservation; hay and silage making; periodical spraying of animal houses with suitable pesticides; periodical deworming of stock; clipping hair from sides and hind-quarters of cows ; grooming, hoof	

	trimming, dehorning of calves and attending to sale and purchase of livestock and their transportation ; fitting and training of cows for show.	
14: 30- 15: 30	Washing/brushing of milch cows by milkers.	Hose pipe, water supply
15: 30- 17: 30	Feeding the other half of daily concentrate ration to milch cows just before milking	
	Evening milking	Towel, milking bucket, post milking teat dips
	Cleaning calf pen, calving box, dry-stock and bull sheds and feeding the other half of concentrate ration to calves, pregnant cows & bulls	Hose pipe, water supply Broom
	Feeding of dry/ green fodder to milch stock	
16: 30- 17: 30	Delivery of milk (in cans) to milk vendors	
	Washing and disinfections of milking barns	
	Feeding dry and green fodder to calves, dry-stock and bulls	
16: 00- 17: 30	Cleaning of milch cow shed	
	Feeding green/ dry fodder to milch stock	
	Cleaning farm premises	
18: 30- 04: 00	Night watchman on duty	

Note:

- Use milkers @ one for every 12-14 cows, for all the above operations. Milkers go off duty by 8:00 AM and farm labour comes on duty at 7:00 AM.
- Animals should be taken for grazing (if practiced) between 9 AM and 2 PM in winter and between 6 AM and 10 AM and again between 5 PM and 7 PM in summer.
- The dairy manager should plan the jobs well in advance in such a way that they are evenly distributed over the week. Some jobs may require longer time and the labour have to work extra time on such occasions.

- Milkers come on duty by 15:30 hours and remain up to 17:30 hours whereas general farm labour go off duty by 17:00 hours.



Photograph 20: Unclean paddock requiring cleanliness



Photograph 21: Dairy workers cleaning the paddock area with specially designed spade (phawda)

PRACTICAL EXERCISE

Activity 1: Note down the dimensions of various housing structures present in the dairy farm.

Materials Required:

1. Tape
2. Notebook

Step by Step Procedure:

1. Visit to a dairy farm
2. Measure detail dimensions of the various sheds and allied structures present in the dairy farm.

Activity 2: Note down daily working schedule of a dairy farm

Materials Required:

1. Notebook

Step by Step Procedure:

1. Visit to a dairy farm early in the morning
2. Note down each and every activity of the farm along with time
3. Note down routine and periodical activities of the farm

CHECK YOUR PROGRESS

A. Multiple choice

1. Which of the following animals prefers to wallow			
a) Indigenous cattle	b) Crossbred cattle	c) Buffalo	d) Exotic cattle
2. In milch animal shed the width of the central passage preferably be			
a) 1.2 m	b) 1.8 m	c) 2.2 m	d) 2.5m
3. Holding area is related to			
a) Calving box	b) Calf pen	c) Milking parlour	d) Bull pen
4. Advanced pregnant animals are transferred to a calving penbefore the expected date of calving			
a) 2 to 3 weeks	b) One month	c) One and half month	d) Two months
5. To maintain proper biosecurity, it is essential to maintain one isolation box per number cows.			
a) 100	b) 150	c) 200	d) 40

B. Fill in the blank

1. Mixture of dung and urine is known as.....
2. Animal defaecates approximately% of body weight during 24 hours.
3. To inhibit bacterial growth and to prevent spoilage of milk, the temperature of storage of milk should remain below°C.
4. Number of calf pen in a farm should beper cent of the total breedable female.
5. In a milch animal shed, the central passage shall have slope of 1 in from the central axis towards both the sides.

C. True or false

1. The farm should have many entry and exit point
2. Milking parlour is constructed where the animals are maintained in loose housing system.
3. Damp and ill drained floors cause respiratory trouble in calves to which they are susceptible.
4. A bull must be kept in confinement particularly on hard floors.
5. Calves in their early life should be housed in a group.

D. Match the Column

Column A	Write from column B	Column B
1. Calving pen		For keeping calf
2. Calf pen		Controlling of animals
3. Travis		For keeping sick animals
4. Isolation shed		For the newly introduced animals in the farm
5. Quarantine shed		For keeping advance pregnant animal until calving

E. Crosswords

		¹ B			² P	
³	A		V			G
⁴ S			O			
	⁵ H		S			
		K				

Across

3. Act of parturition in cattle.
4. Place where green fodder is stored under anaerobic condition.
5. Type of pipe used for washing of dairy animal shed.

Down

1. Castrated adult male of cattle.
2. Confined area within a shed for keeping animals.

UNIT 4: Feeding and Watering for Livestock

LEARNING OUTCOMES

On completion of this unit the student will be able to:

- Receive and store animal feed
- Prepare feed and water supplies for livestock
- Monitor and maintain the supply of feed and water to livestock

INTRODUCTION

Feed alone accounts for more than 70 percent of the cost of dairy animal production. A good animal feed must be balanced properly with protein, carbohydrate, fat, mineral and vitamins. The feed should be of good quality, palatable in taste, economical in terms of costs, of such a composition as the animal can feed liberally, should be moderately bulky, laxative and free from toxins. Therefore, balanced and economical feeding of dairy animals can play a pivotal role in a successful dairy farming. The proportion of ingredients to be incorporated in the ration should be selected based on their prices in particular seasons to reduce the cost of feeding. The feed ingredients should be purchased when it is available at cheaper rate and stored for future use. Storage losses should be minimised to produce feed at cheaper rate.

SESSION 1: Animal feedstuffs, their characteristics, composition and quality

i. Types of animal feedstuffs

Animal feedstuffs are broadly partitioned into three categories depending upon percentage of crude fibre (CF) and total digestible nutrients (TDN) and additives. Depending upon the availability of different items, a dairy farmer can add or delete the nutrient items in various ways to fulfil the dietary needs of its livestock. The Chart 6.1 explains the broad concept of partitioning of feedstuffs into CF, TDN and additives.

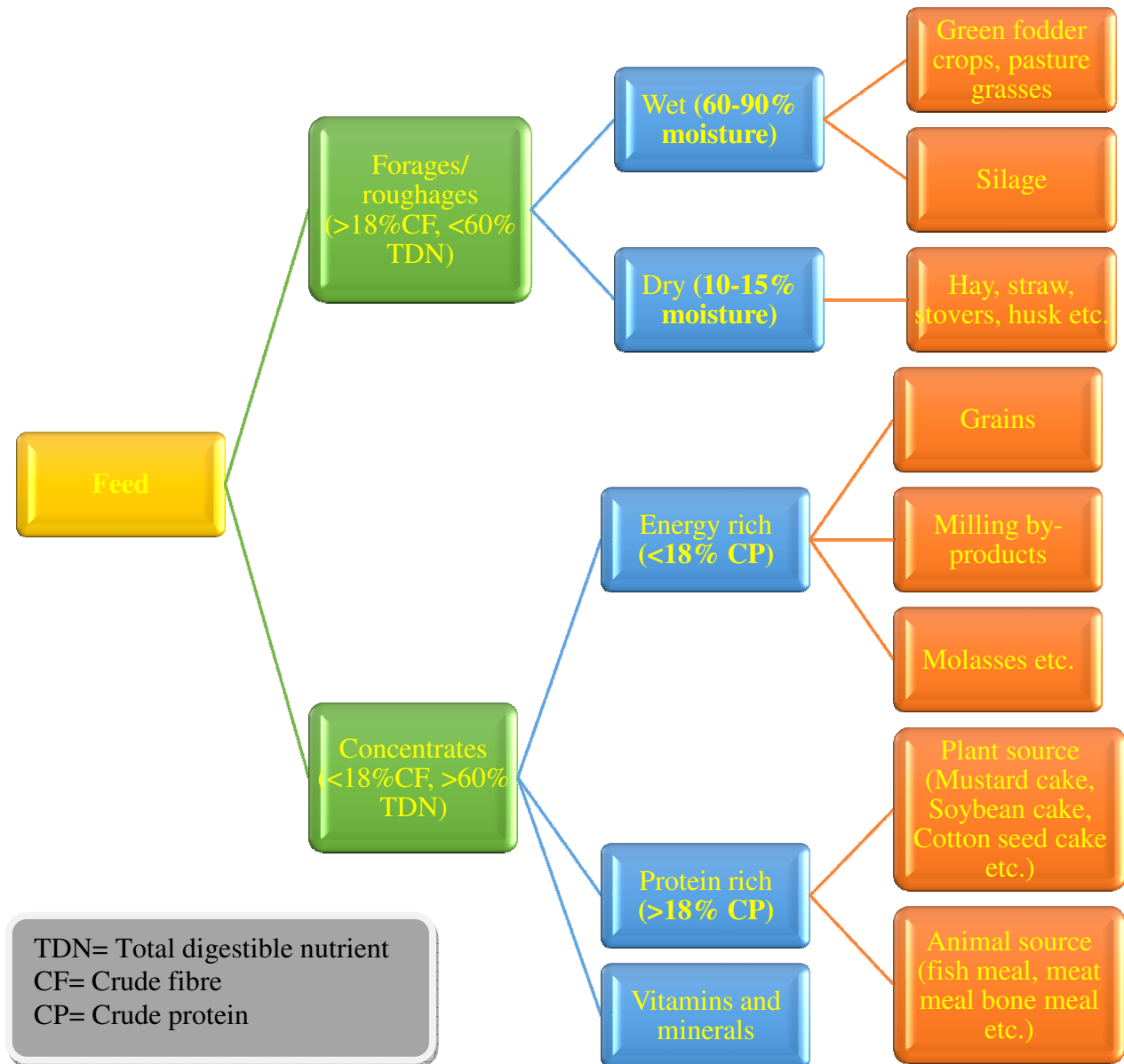


Chart 6.1: Types of animal feedstuffs

ii. Characteristic of a good animal feed

First and foremost the animal feedstuffs must be clean and fresh as far as possible. A good animal feed must be balanced properly from the view point of protein, carbohydrate, fat, mineral and vitamins, should be of good quality, palatable in taste, economical in terms of costs, of such a composition as the animal can feed liberally, laxative, should be moderately bulky and free from toxins (Chart 6.2).

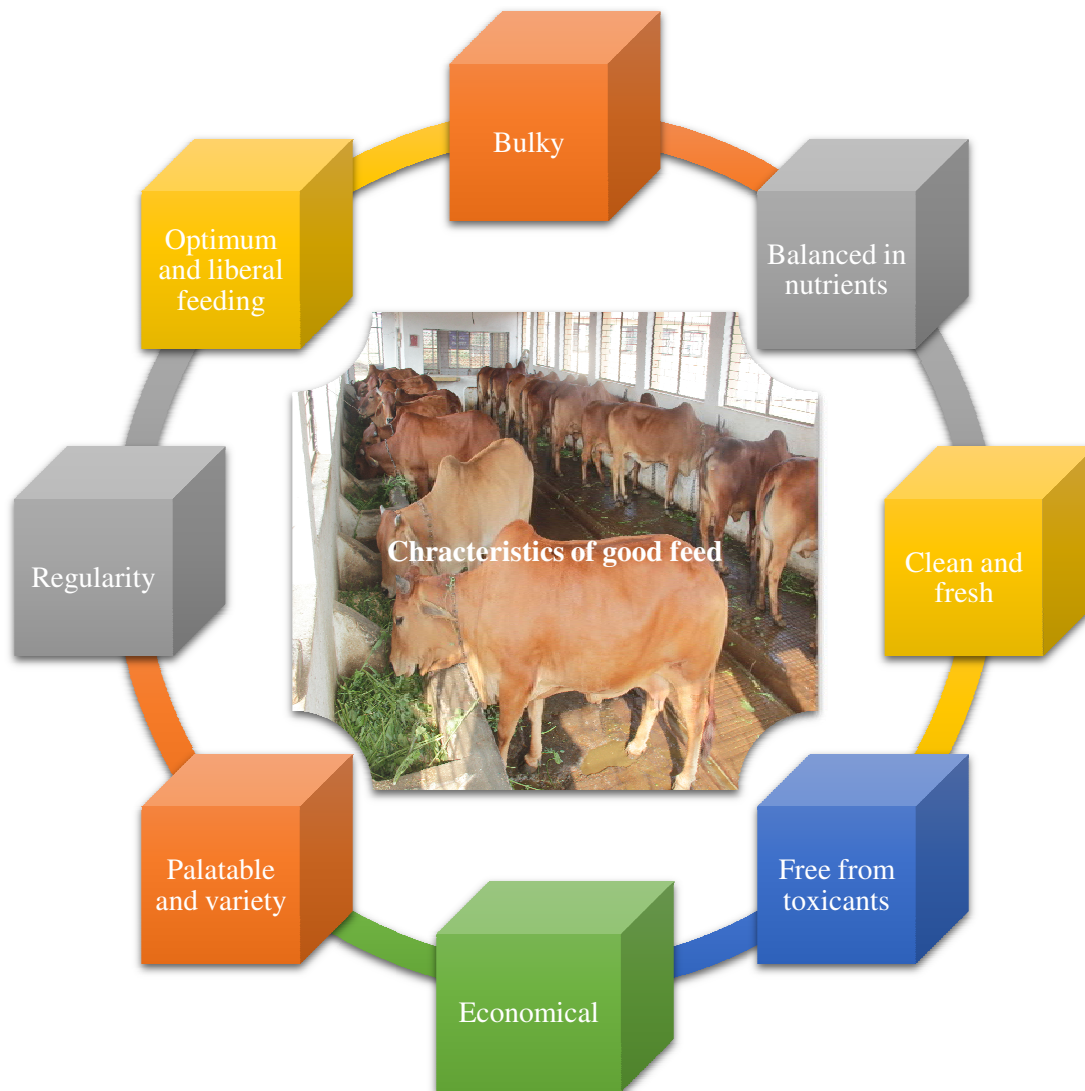


Chart 6.2: Characteristic of a good feedstuff for animal

iii. Feed composition and its quality

The animal feed can be approximately partitioned in six major components, i.e., water, ash, crude protein (CP), ether extract (EE), crude fibre (CF) and nitrogen-free extract (NFE). A good measurement of these 6 components in feed is important to understand the nature of the feed. The nature of the feed denotes to if the given feed is a fibrous feed, energy rich feed or protein feed.

The Chart 6.3 gives a broad division of any animal feed into component categories.

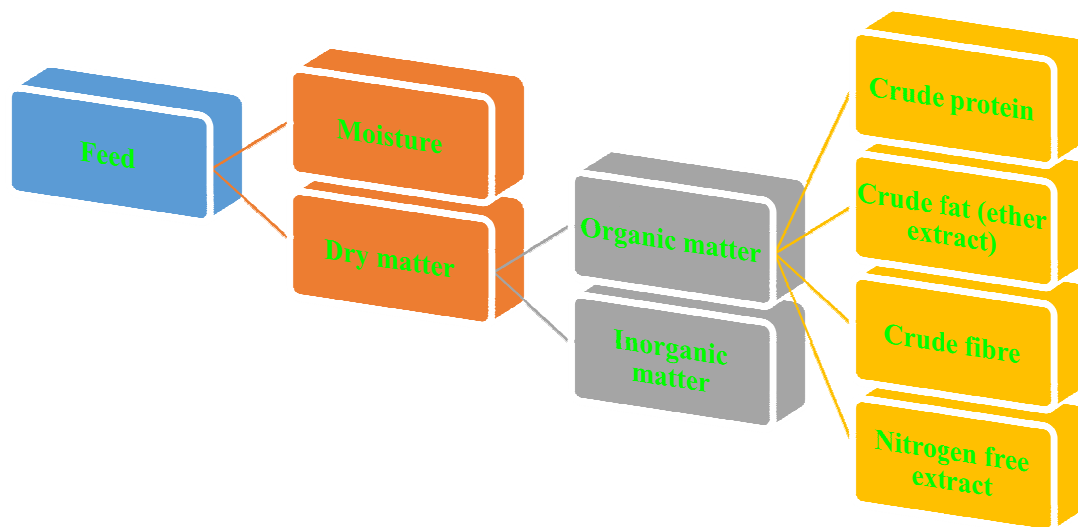


Chart 6.3: Feed composition

The animal feed consists of major six constituents. The details of the various components found in the feed are given in Table 6.1.

Table 6.1: Details of various components found in the six constituents of animal feed

Animal feed constituents			Components
Moisture			Water, volatile substances
Dry matter	Organic matter	Crude protein	Pure protein, amino acids, non-protein nitrogen compounds
		Ether extract (crude fat)	Fat, complex lipid, sterols, fatty acids, fat soluble dyes
		Crude fibre	Cellulose, hemicelluloses, lignin
		Nitrogen free extracts	Soluble carbohydrate, hemicelluloses, lignin, pectin, organic acids, tannin, water-soluble dyes
	Inorganic matter	Crude ash	Pure ash, organic residue

Standard values on major six components of the feed and the various substances contained in that component are widely available.

Measuring the quality of the animal feed: Animals require mainly two types of organic nutrients i.e., energy and protein. The feed is required to supply these two basic needs. The quality of feed is usually determined by the ability of the feed to supply energy and/or protein.

It has to be understood that whereas an animal can draw energy from CF, EE, NFE and CP, the animal can derive protein part of the diet only from CP content of the feedstuffs. This is explained in the Chart 6.4.

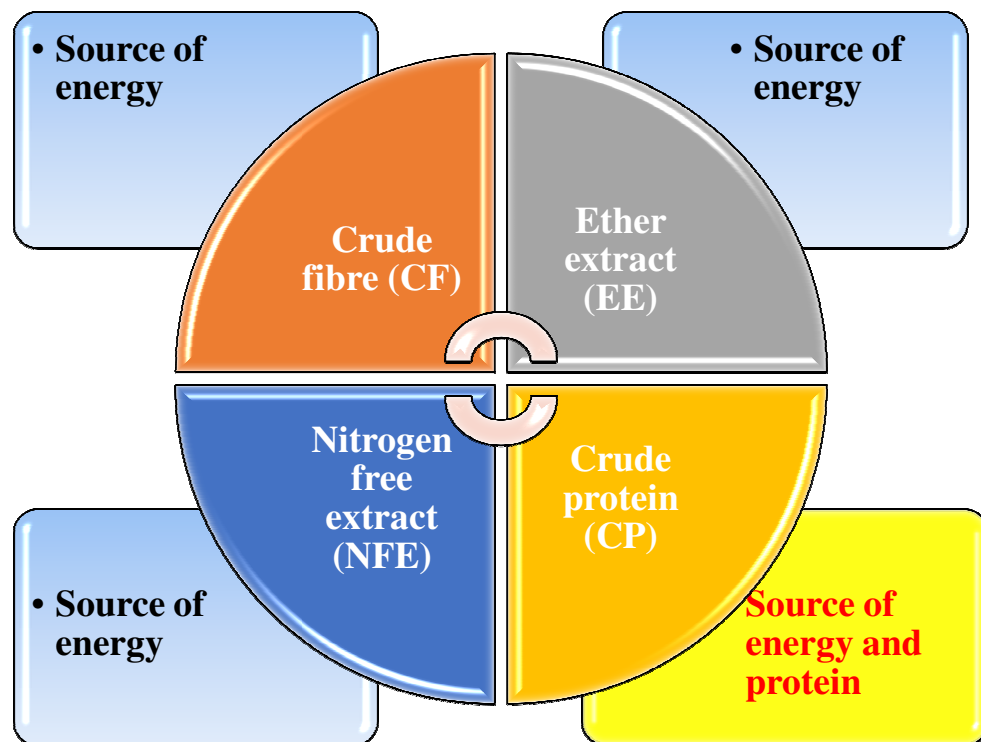


Chart 6.4: Source of energy and protein in animal feed

After consuming the feed the animal digests and metabolises the nutrient present in the feed. As is the case with human digestion i.e., the health of an individual depends not upon the total food consumed but on the digestibility of the consumed food. Similar is the case with farm animals.

In farm animals, digestible part of feeds/nutrients is that proportion of feed/ nutrients which is absorbed by the animal and not excreted in the faeces. Thus, the digestible part of the

feed determines the availability of nutrients available to the animals for various functions like maintenance, growth, reproduction, production and work (draft).

Measurement of energy quality in animal feed

Concept of total digestible nutrients (TDN): When we add digestible crude fibre (CF), digestible crude protein (CP), digestible ether extract (EE) and digestible nitrogen-free extract (NFE) of a feedstuff, we get TDN value of the feedstuff.

The values of TDN for a given animal feed convey the quantity of digestible crude fibre (CF), digestible crude protein (CP), digestible ether extract (EE) and digestible nitrogen-free extract (NFE) in the feed. The formula for calculation of TDN is given below. TDN is expressed as a percentage value.

$$\text{TDN (\%)} = \text{digestible CF (\%)} + \text{digestible CP (\%)} + (\text{digestible EE (\%)} \times 2.25) + \text{digestible NFE (\%)}$$

In the above mentioned formula of TDN, the multiplier of 2.25 is used with digestible EE because fat i.e., EE has 2.25 times greater energy density per unit weight as compared to per unit of carbohydrate or protein.

When the amount of nutrients of any feedstuff is multiplied with its digestibility value, we get an idea of the actual quantity of nutrients that might be absorbed from that feedstuff. TDN is a bit different concept as TDN indicates the relative energy value of feed to an animal.

The thinking behind TDN values of a feed is that not all feeds and fodders have equal nutritional profiles. Some feeds may fully fill the animal's gut and may provide it with small amounts of the energy for health, growth and performance. Some of the feeds are extremely efficient from the angle of utilisation of nutrients contained in them by the animal eating it. A high percentage of nutrients from such efficient feeds will be digested and used for energy. Generally, these efficient feeds are usually very expensive.

An animal's TDN requirements changes according to the stages of animal's life. For example, dry (out of milk) cows have much lower energy needs than lactating cows. Exotic and crossbred young heifers need more TDN than indigenous heifers. A calf will eat less kg of TDN as compared to a full grown cow.

At first site it may appear to you that TDN calculations can make livestock feeding much more complicated than is required. But it is a useful concept as knowledge of peak requirements of TDN of the animals should match with peaks in fodder quality (leafiness or matured stem) to achieve a lower cost of feeding. Animals have other nutritional needs besides energy. TDN is

just one aspect of animal feeding programme. But as an initial feeding programme TDN can be a helpful tool for the dairy entrepreneur.

Measurement of protein quality in animal feed

Crude protein: The crude protein content of the feed is determined with the basic assumption that all the nitrogen present in a feedstuff is contained in the form of different proteins and all such proteins contain approximately 16 per cent nitrogen. Ruminants (like cattle, buffalo, goat, sheep, etc.) have the ability to utilise and convert almost all the plant nitrogen into animal protein for different bodily functions.

The moisture, crude protein and total digestible nutrients found in different feed and fodder are given in Table 6.2.

Table 6.2 : Average nutritive value of common feeds / fodders on fresh weight basis

Feed ingredients	Moisture (%)	CP (%)	TDN (%)
Concentrate feeds/by-products			
Maize	10.0	9.0	82.0
Barley	10.0	9.5	75.0
Jowar	10.0	7.2	70.0
Bajra	10.0	6.6	65.0
Gram	10.0	14.4	80.0
Wheat	10.0	12.8	80.0
Oats	10.0	10.4	75.0
Wheat bran	10.0	15.0	60.0
Rice bran	10.0	9.6	65.0
Groundnut cake	10.0	45.0	75.0
Mustard cake	10.0	36.0	74.0
Cotton seed cake	10.0	21.6	70.0
Til cake	10.0	45.6	78.0
Green fodders			
Berseem	85.0	2.4	13.0
Jowar	75.0	0.7	16.0
Maize	75.0	1.6	17.0
Oats	75.0	1.8	17.0
Bajra	75.0	1.2	15.0
Hybrid napier	75.0	1.5	15.0
Different types of straw			
Wheat straw	10.0	3.0	40.0
Rice straw	10.0	2.0	40.0

Oat straw	10.0	7.2	55.0
Maize Kadbi	10.0	1.8	40.0
Jowar Kadbi	10.0	1.2	40.0
Bajra Kadbi	10.0	1.2	40.0
Sugarcane tops	30.0	1.2	42.0
Different types of hay			
Dub hay	15.0	4.5	45.0
Berseem hay	10.0	15.0	60.0
Different types of silage			
Maize silage	70.0	1.2	18.0
Oat silage	70.0	1.4	18.0

PRACTICAL EXERCISE

Activity 1: Enlist feed ingredients and available fodder along with moisture and CP content in a dairy farm

Materials Required:

1. Feed ingredients
2. Fodders

Step by Step Procedure:

1. Visit to a dairy farm
2. Enlist feed ingredients and fodder available in the dairy farm
3. Note down nutritive value

CHECK YOUR PROGRESS

A. Multiple choice

1. The requirement of feed for which function of the animals			
a) Maintenance	b) Growth	c) Lactation	d) All of the above
2. Which of the following is not considered under crude protein			
a) Pure protein	b) Non-protein nitrogen compounds	c) Amino acids	d) Lignin
3. Which of the following is not a feeding standard for animals			
a) NRC	b) ARC	c) ICAR	d) ICMR

4. In TDN estimation which one of the following component is not included			
a) Crude fibre	b) Ether extract	c) Minerals	d) Crude protein
5. Which of the following is not a characteristic of good feed			
a) Bulky	b) Clean and fresh	c) Rich in protein	d) Free from toxins

B. Fill in the blank

1. Feed constitute % of the total cost of animal production
2. Wheat straw contains dry matter is about%.
3. In calculation of TDN, digestible EE is multiplied with
4. EE hastimes greater energy density per unit weight as compared to per unit of carbohydrate or protein.
5. The crude protein content of the feed is determined with the basic assumption that proteins contain approximatelyper cent nitrogen

C. True or false

1. An animal's TDN requirements changes according to the stages of animal's life.
2. Silage is considered as concentrate feed.
3. A good animal feed must have high carbohydrate content.
4. Concentrate feed is more expensive than roughage.
5. Inorganic matter present in the feed categorized as minerals.

D. Match the column

Column A	Write from column B	Column B
1. Ether extract		Amino acid
2. Crude fibre		Hemicelluloses
3. Ash		Fat
4. Crude protein		Cellulose
5. NFE		Minerals

E. Crosswords

	¹ H	² L		³ B
⁴ M			Z	

	Y	G		
				E
⁵ T		N		
				M

Across

4. Grain commonly used in concentrate mixture
5. Total digestible nutrients

Down

1. Process of conservation of green fodder
2. Major portion of crude fibre consist of
3. Popular leguminous fodder cultivated in rabi season

SESSION 2: Feeding of dairy animals

Dairy animals consume mainly two types of feeds; concentrate and fodder (Chart 6.5). Fodder may be either in green form or dry form. It is always better to meet an animal's fodder requirement from the green feeds. Nutritive value of good quality green fodder is equivalent to concentrate mixture. One can replace concentrate requirements by good quality green fodder to certain extent.

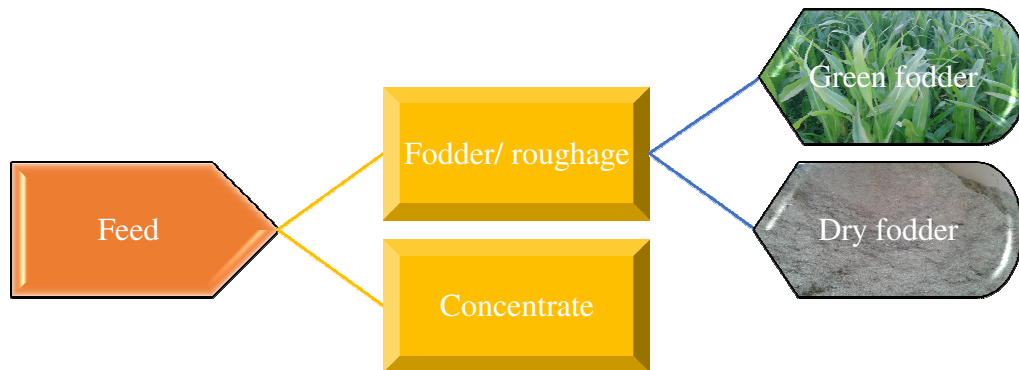


Chart 6.5: Broad classification of feed

Animals require feed for various purposes such as maintenance, growth, lactation, pregnancy and work i.e., draft. The major purposes for which feed is uniquely needed for special function in the animal are explained in the Chart 6.6.

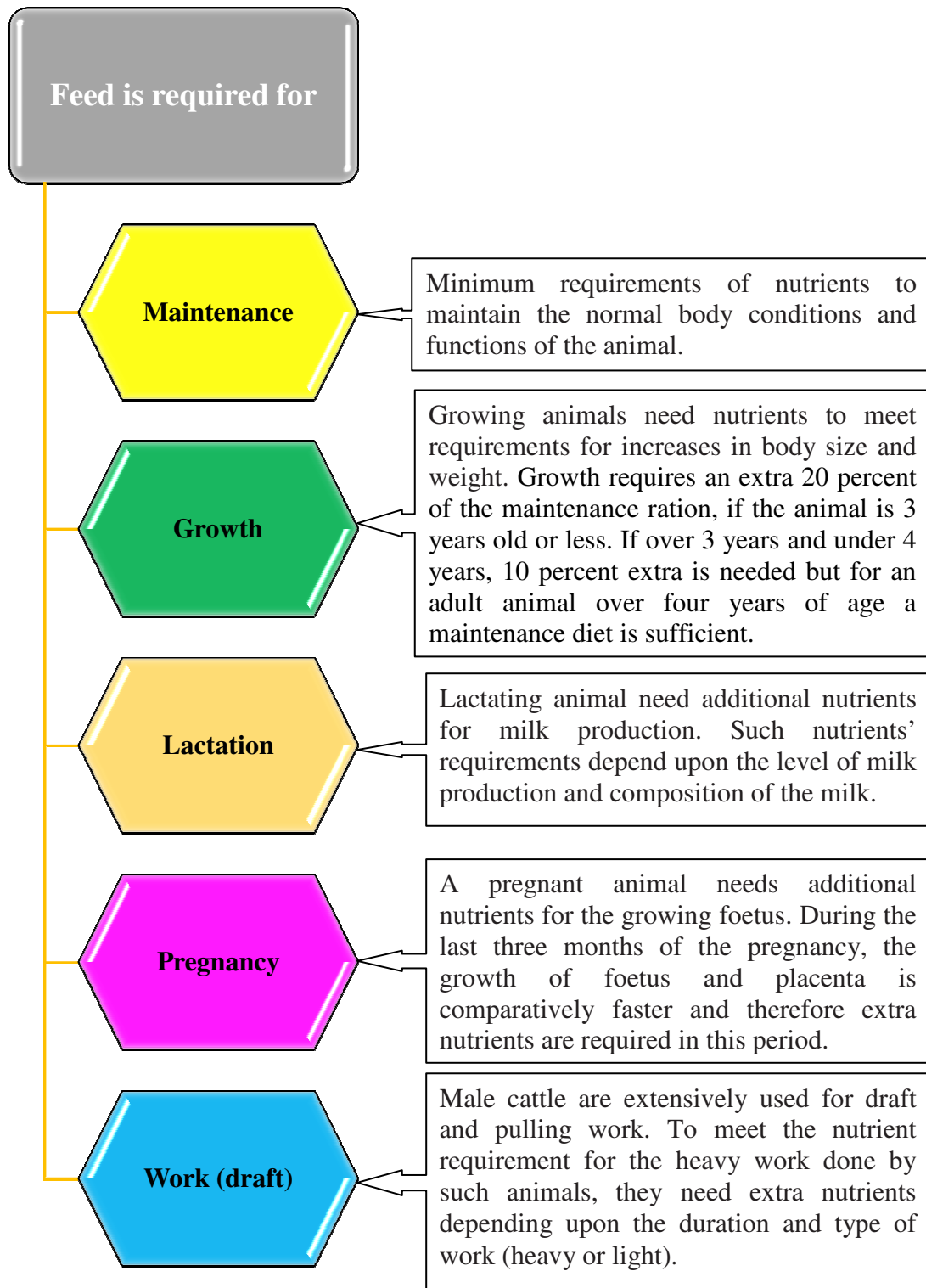


Chart 6.6: Purposes for which feed is required by the animals

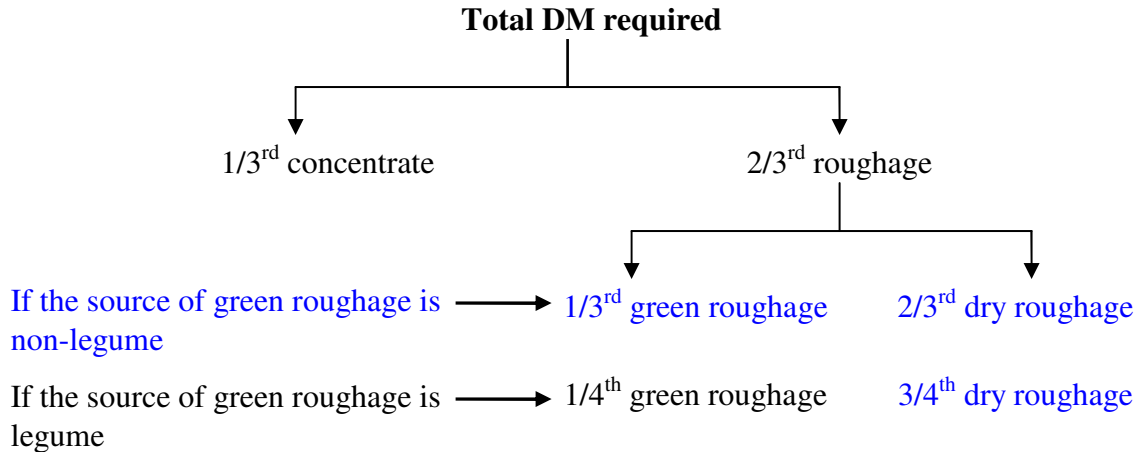
i. Feed requirements based on thumb rule methods

Following two thumb-rules are followed to calculate the feed requirement of cattle and buffaloes

A. Estimation of maintenance feed requirements of animal on the basis of dry matter content

All feeds contain some amount of water. If all the water of a feed is taken out the remaining content of the feed are termed as dry matter (DM). DM intake is the amount of feed the animal consumes per day less the moisture content in that feed. Animals need to consume a certain amount of DM per day to maintain health and production. Daily DM requirements of indigenous breeds of cattle are about 2.0-2.5% of their body weight. Crossbred cattle and buffaloes daily consume higher DM i.e., 2.5-3.0% of their body weight.

Another largely followed simple thumb-rule of animal feeding followed by majority of farmers is to meet the total DM requirement of the animal in such a fashion so that one third of the DM is met from the concentrates and two third is met from the roughages. Availability of leguminous green roughage, however significantly allows for increased consumption of dry roughages are explained below.



B. Estimation of feed requirements of animal on the basis of various stages of production

Based on various stages of production of the animal and to more completely meet the animal’s nutritional need, a more refined rule of thumb exists for the help of the dairy farmer. It is presented in detail in Table 6.3.

Table 6.3: Straw/dry fodder and concentrate requirement for various stages of production

Category of animals	Stages of production				
	Maintenance		Milk production	Pregnancy (extra feed for pregnant animal over 5 months)	Growth (extra feed for growth)
	Straw/dry fodder (kg)	Concentrate (kg)	Concentrate	Concentrate (kg)	Concentrate (kg)
Indigenous cattle	4-5	1.25	0.4 kg / litre milk yield	1.25	1.00
Crossbred cattle	4-6	2.00	0.4 kg / litre milk yield	1.75	1.00
Buffaloes	4-6	2.00	0.5 kg / litre milk yield	1.75	1.00
Breeding bull	As per free choice of the animal	2.50	---	---	---
Bullock (working over 4 hrs. daily)	As per free choice of the animal	3.00	---	---	---

Besides the quantity of straw/dry fodder and concentrate as shown in the above table, about 15-20 kg green fodder should be provided to the animals to fulfill the total nutritional requirement.

ii. Feed requirements based on scientific feeding standards

Feeding standards are description of the exact quantity of all the nutrients required by the animals for health and production. In calculating these standards body weight of the animal is the primary criteria. Besides this, for every litre of milk production corresponding requirement values are given. Feeding standards have been developed from large number of experimentations. These feeding standards are modified and upgraded from time to time and contain nutrients' requirements in tabular form.

Some of the popular feeding standards are NRC (National Research Council) feeding standard of America and ARC (Agricultural Research Council) feeding standard of UK. Now, in India, ICAR feeding standard is available.

iii. Feed supplements for optimum growth and production

Feed supplements are substances which are added in small quantities to a ration to stimulate growth, improve efficiency of feed utilization and overall health of the animals. Feed supplements are non-nutritive in nature and added to the diet to:

- a) preserve nutritional properties of stored feeds (i.e., antioxidants and mould inhibitors)
- b) facilitate feed pelleting (i.e., in their action as emulsifiers, stabilisers and binders)
- c) facilitate growth (i.e., antibiotics and hormones)
- d) facilitate feed ingestion and consumer acceptance of the product (i.e., colours)
- e) supply essential nutrients in purified form (i.e., vitamins, minerals, amino acids, cholesterol and phospholipids).

iv. Major ingredients for feed preparation

Like human, animals need a balanced diet for maintenance of body and production of milk, meat, etc. A single feed ingredient cannot meet the total nutrient requirement of the animals. Therefore, various ingredients need to be mixed to get the well-balanced ration which can fulfil the nutrient requirement of dairy animals. The major categories of feed ingredients used for preparation of rations for dairy animals are given in Table 6.4.

Table 6.4: Major categories of feed ingredients used for preparation of rations

Categories	Common ingredients
Cereals	Maize, wheat, barley, sorghum, millet, etc.
Oil cakes	Soybean, groundnut, rapeseed, cottonseed, sesame, mustard, etc
By-products	Wheat bran, rice bran, rice polish, broken rice, dal chunnies, etc.
Animal proteins	Fish meal, meat and bone meal, blood meal, etc.
Mineral sources	Di-calcium phosphate (DCP), limestone, oyster shells, dolomite stone, etc.
Other items	Molasses, vegetable oils, jiggery, etc.

Various feed ingredients have been shown in different photographs below:-



Maize



Canola Meal



Wheat Bran



Cotton Seed Cake



Rice Bran



Dicalcium Phosphate



Limestone Powder



Oyster Shell



Molasses

Photograph 6.1: Photographs of various feed ingredients use for preparation of concentrate mixture

PRACTICAL EXERCISE

Activity 1: Estimate concentrate requirement of lactating buffalo producing 10 litre milk

Step by Step Procedure:

1. Calculate the concentrate requirement for maintenance requirement for the buffaloes
2. Calculate the concentrate requirement for milk production for the buffaloes
3. Add maintenance requirement and requirement for milk production.

CHECK YOUR PROGRESS

A. Multiple choice

1. Daily DM requirements of indigenous breeds of cattle are aboutof their body weight.			
a) 1.0-1.5%	b) 2.0-2.5%	c) 3.0-3.5%	d) 4.0-4.5%

2. Animals require feed for which purposes			
a) Growth	b) Lactation	c) Maintenance	d) All of the above
3. Which of the following is not considered as cereal			
a) Maize	b) Wheat	c) Barley	d) Mustard cake
4. Which of the following is considered as agriculture byproduct			
a) Rice polish	b) Soybean cake	c) Groundnut cake	d) Rapeseed cake
5. Which of the following is the Indian feeding standard			
a) ARC	b) NRC	c) ICAR	d) Kearl

B. Fill in the blank

1. Dairy animals consume mainly two types of feeds; concentrate and.....
2. Minimum nutrients required to maintain the normal body conditions and functions of the animal is known as.....
3. When water is taken out from the feed, then the remaining part is termed as.....
4.are substances which are added in small quantities to a ration to stimulate growth, improve efficiency of feed utilization and overall health of the animals.
5. As per rule of thumb, in buffaloes one kg concentrate is required for every kg milk production.

C. True or false

1. Fodder is always available in green form.
2. Nutritive value of good quality green fodder is equivalent to concentrate mixture.
3. All feeds contain some amount of water.
4. In young animal, a single feed ingredient can meet the total nutrient requirement of the animals.
5. Feed supplements are non-nutritive in nature.

D. Match the column

Column A	Write from column B	Column B
1. Cereals		Fish meal
2. Oil cakes		Di-calcium phosphate
3. Animal proteins		Rice polish
4. Mineral sources		Maize

5. By-products		Mustard
----------------	--	---------

E. Crosswords

	¹ M	² S		
				³ G
⁴ F				
	T			
D	A	E		
⁵		A	F	
	D			H
R				

Across

5. Another term used for animal power

Down

1. Type of oil cake
2. Oil cake which contain more crude protein
3. Nutrient requirement of young animals other than maintenance
4. Feedstuff used specifically to feed domesticated livestock, such as cattle, buffaloes.

SESSION 3: Preparation of animal feed

i. Equipments used for the preparation of animal feed

Basic equipments/ machines required for the preparation of green fodder: Dry fodder like wheat straw can be fed to the animal as such without any preparation which requires machines. However, green fodder requires chaffing before feeding to the animals. Chaff cutter (Photo 6.1) is used to chaff the green fodder. It makes the fodder into small pieces. Chaffed fodder is more palatable to the animals. It reduces fodder wastage from the manger. Two types of chaff cutter are available in the market: manual and electrically operated.



Photograph 6.1: Electrically operated chaff cutter

Basic equipments/ machines required for the preparation of concentrate:
Concentrate is the mixture of various feed ingredients. It can be prepared in the farm itself. Feed ingredients like grains, cake flakes need to be grinded to get uniform mixture of feed items. The feed grinder most commonly used in the farms is given in Photo 6.2. Feed grinder is required to grind these items. Now, all the feed ingredients and feed supplements are added as per feed formula. All these feed items should be mixed. Mixing can be done manually on the mixing floor or with the use of electrically operated mixer Photo 6.3.



Photograph 6.2: Feed grinder



Photograph 6.3: Feed mixer

Maintenance of equipments/machinery: Machines should be cleaned regularly and kept in safe and working condition. All measuring devices used in the manufacture of feed and feed ingredients should be tested regularly for accuracy. Records of all maintenance carried out on equipment/machinery should be kept for future reference.

ii. Preparation of feed at the farm by the dairy farmer

Ingredients used for preparation of concentrate mixture

Different feed ingredients are rich in different nutrients. To get the balanced feed, different feed ingredients are mixed in suitable proportion. This type of mixture is known as concentrate mixture or compound cattle feed. The composition of cattle feed varies according to the type of animals, milk production, season, etc. This concentrate mixture is fed to the animals

along with roughages (green and or dry). Concentrate mixture could be in the form of mash, pellets, crumbles, cubes, etc. Various feed items included for preparation of concentrate mixture given in Table 6.5.

Table 6.5: Various feed items included in the concentrate mixture

Grains	Maize, sorghum, wheat, oat, barley, millets, etc.
Brans	Rice bran, wheat bran, de-oiled rice bran, rice polish
Oil cakes	Cakes of mustard, cotton seed, groundnut, soybean, rapeseed, sunflower, linseed
Animal protein source	Fish meal, bone meal, meat meal
Chunies	Moong, arhar, gram, guar, tur and other locally available pulses
Agro-industrial byproducts	Molasses, tamarind seed powder, tapioca waste, etc.
Minerals and vitamins	Mineral mixture, di-calcium phosphate, common salt, vitamin A, D ₃ and E

Composition of concentrate mixture

Since animal feed alone accounts for more than 70 percent of the total cost of milk production, balanced and economical feeding of dairy animals can play a pivotal role in a successful dairy farming. Animal ration should be balanced in all nutrients and simultaneously the ration should be economical. The proportion of ingredients to be incorporated in the ration should be selected based on their prices in particular seasons. The usual proportion of various ingredients in daily concentrate mixtures in dairy cattle ration given in Table 6.6.

Table 6.6 : Usual proportion of various ingredients in daily concentrate mixtures in dairy cattle ration

Ingredients	Proportion
Grain	35-40
Oil cakes	32-35
Agricultural by-products (brans, chunies, agro-industrial byproducts, etc.)	25-28
Mineral mixture and vitamins	2
Salt	1
Total	100

Steps in preparing concentrate mixture at farm level :

The flowchart explains the various stages in the preparation of concentrate mixture at the farm level by a dairy farmer (Chart 6.7). Various steps used for preparation of concentrate mixture are shown in Chart 6.8.

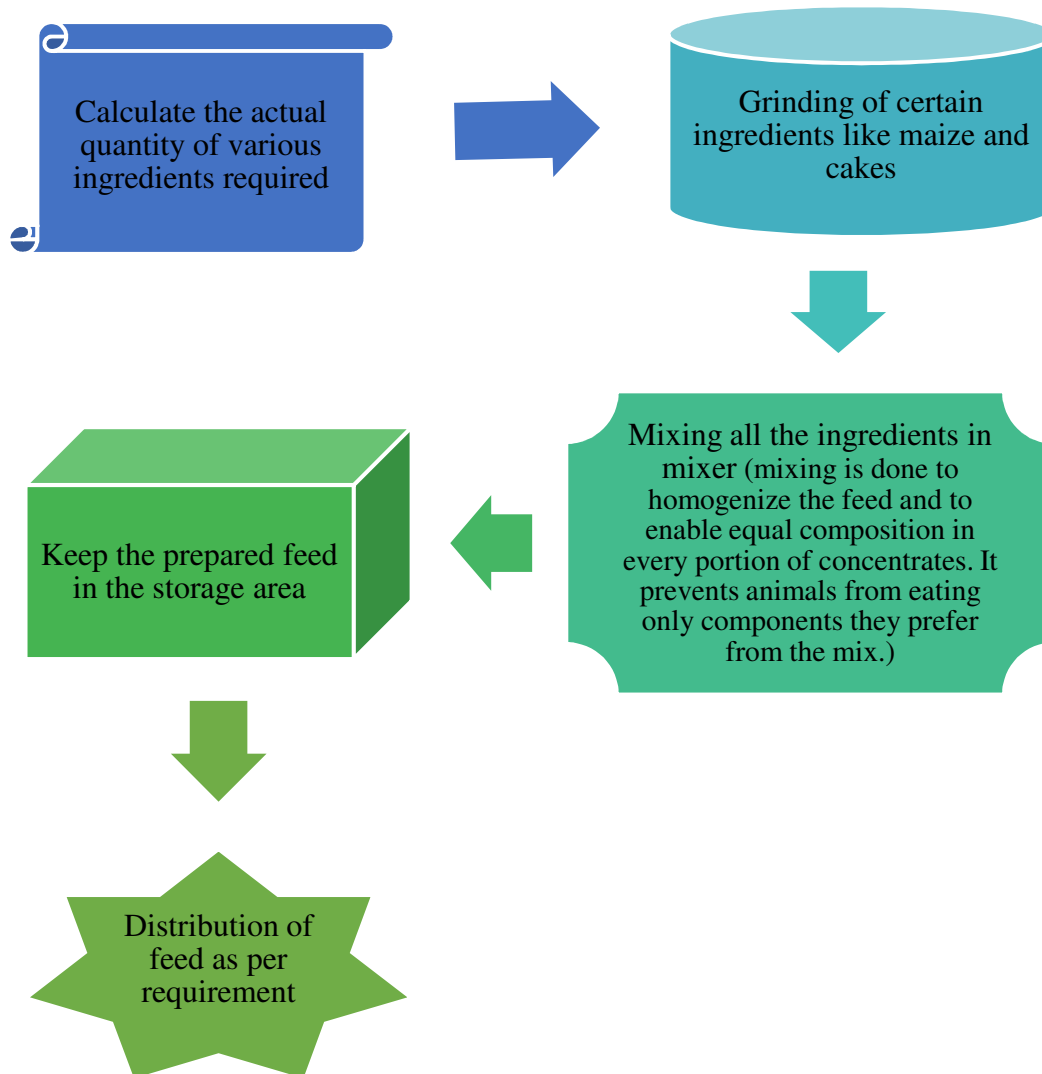


Chart 6.7: Various stages in the preparation of concentrate mixture at the farm level

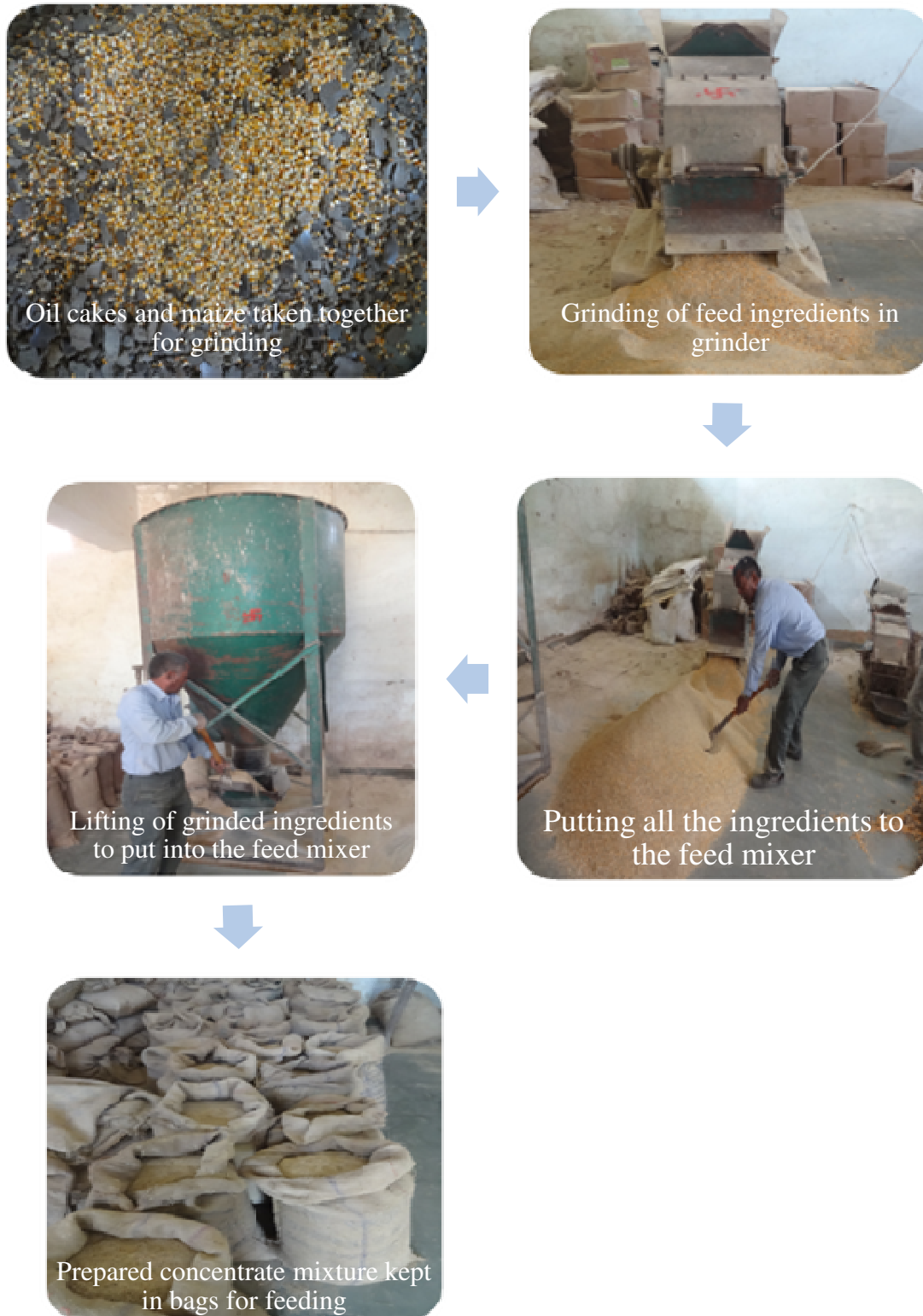


Chart 6.8: Steps of preparation of concentrate mixture

Following precautions should be taken during concentrate mixture preparation:

- i. Grind maize and other grains shortly before use.
- ii. The grinding process releases the oil in the germs of the grains which are grinded for preparation of concentrate mixture. This oil contains polyunsaturated fats and a limited amount of natural antioxidants. Therefore, rancidity will occur within days or weeks after grinding, necessitating immediate inclusion of ground grain in the concentrate mixture.
- iii. Storage areas for raw materials and finished products should be separated to prevent cross-contamination.
- iv. Keep feed dry to prevent fungal or bacterial growth. The moisture content of feed should be less than 12%.
- v. Store feed in closed bags in a cool dry place.
- vi. Prevent rodent and insect infestation.
- vii. Stock inventory should be properly managed to ensure that neither raw materials nor finished feeds deteriorate prior to use or during storage.

iii. Maintaining feed inventory

Periodic actual counting of different feed items in storage area is termed as feed inventory. As already explained feed cost is one of the largest expenditure in dairy farming. Careful monitoring of feed inventory helps the dairy farmer in controlling the feed costs and maximizes profitability. Feed inventory can be a valuable tool for determining available feed supply and estimating needs of total feedstuffs for the herd. The inventory should be adjusted for losses caused on account of storage and losses during feeding animals. A simple feed inventory for the incoming feed is indicated in Table 6.7 for the beginners in dairy farming business.

Table 6.7: A sample feed inventory

S. N.	Date of receipt of feed	Source/ supplier of feed	Description	Quantity	Storage area	Sampled (yes/no)	Signature of the person handling the feed

iv. Why concentrate mixture prepared at farm level is cheaper than concentrate mixture procured from market

Feed costs account about 70% of total costs in a dairy farm. Underfeeding of animals will lead to low productivity and poor health condition. Overfeeding causes loss of nutrients and increased expenditure on feed. Hence, animal should be fed as per their exact feed requirement. Many dairy entrepreneurs choose to manufacture concentrate mixture at own farm level to save on feed costs. In order to produce concentrate mixture of high quality, the dairy entrepreneur should purchase good quality feed ingredients from market and endeavour to prepare concentrate mixture as per feed formulation formula.

Farmers often have little or no control over the quality of feeds that they purchase from market. Therefore, problems might be faced in quality of feed ingredients. The use of substandard feed ingredients will result in low production and poor returns to the farmer. In many instances, adulterants are used in the feed by the feed manufacturer to satisfy the laboratory testing. From an economic point of view, farm-made concentrate mixture appears to be the cheaper option compared to concentrate mixtures available in the market. Therefore, if possible it is better to prepare feed at the farm itself.

v. Procurement, checking and receiving of animal feed in dairy farm

We have so far learned that for calculation of feed requirements of the animals, following factors should be given due consideration:

- a) Protein content and protein quality of feedstuffs
- b) TDN content of feedstuffs
- c) Feed requirement of different categories of animals
- d) Major feed ingredients required to formulate a given concentrate.

Based on an understanding of the above mentioned factors requirement of animals' feed is calculated on daily or monthly basis. Besides the above aspects, attention must also be paid to the following factors while making supply order for feed items. Various factors considered for display of order are given in Chart 6.9.

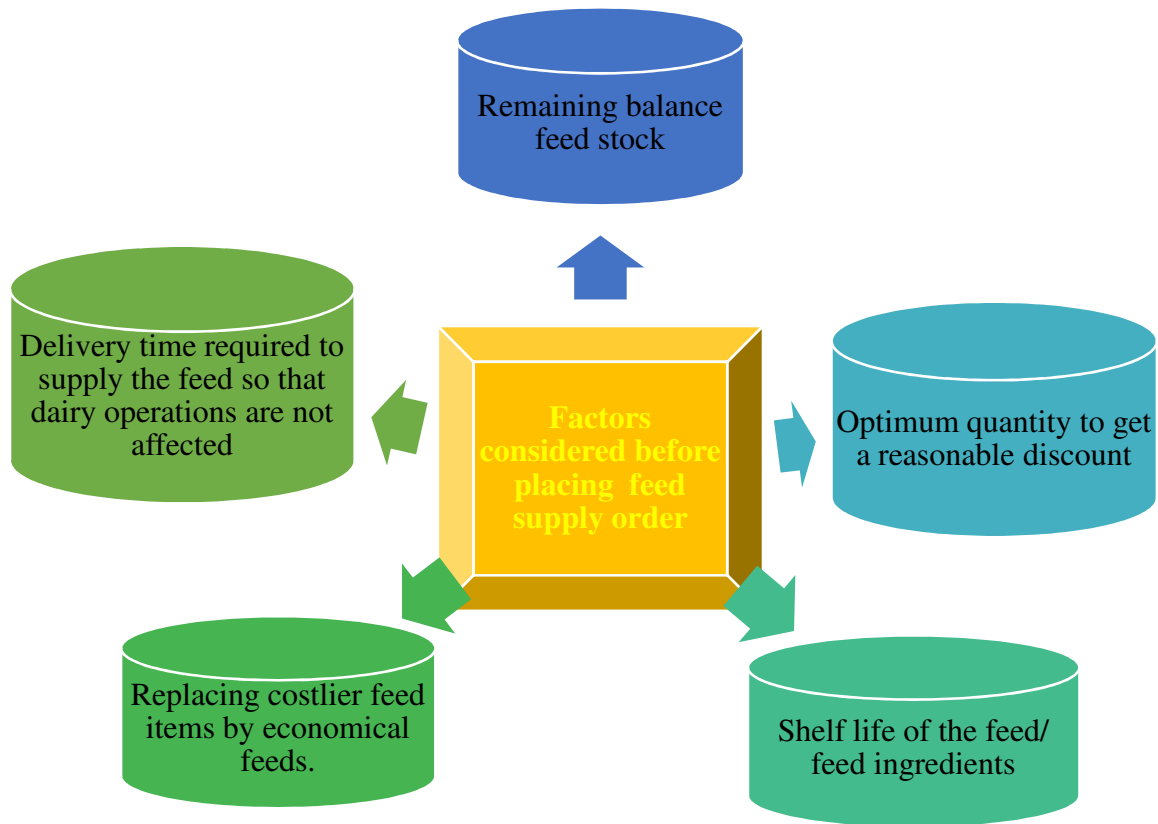


Chart 6.9: Factors considered before placing feed supply order

Broadly, three categories of feeds and fodders are required for a dairy farm; green fodder, dry fodder (hay, straw) and concentrate. A dairy entrepreneur can grow green fodder in own farm if sufficient land is available. Dry fodders like hay can be prepared in own farm from the cultivated green fodder and stored for future use. Straw is an agricultural by product, which is available only at the time of harvesting of crops; therefore, it would be economical for the farmer to store sufficient quantities of straw on the farm for future use.

Concentrates are prepared by mixing a number of feed ingredients to maintain the nutritional balance of the ration. All feed ingredients required for preparation of the concentrates may not always be available locally and therefore need to be purchased through suppliers. Special care must be given to ensure good condition of the feed items. It must also be ensured that no mouldy or sub-standard feed items are included in the feed preparation.

The various activities included in procurement, checking and receiving of animal feed in a dairy farm are explained with the help of the flowchart. It is shown in Chart 6.10.

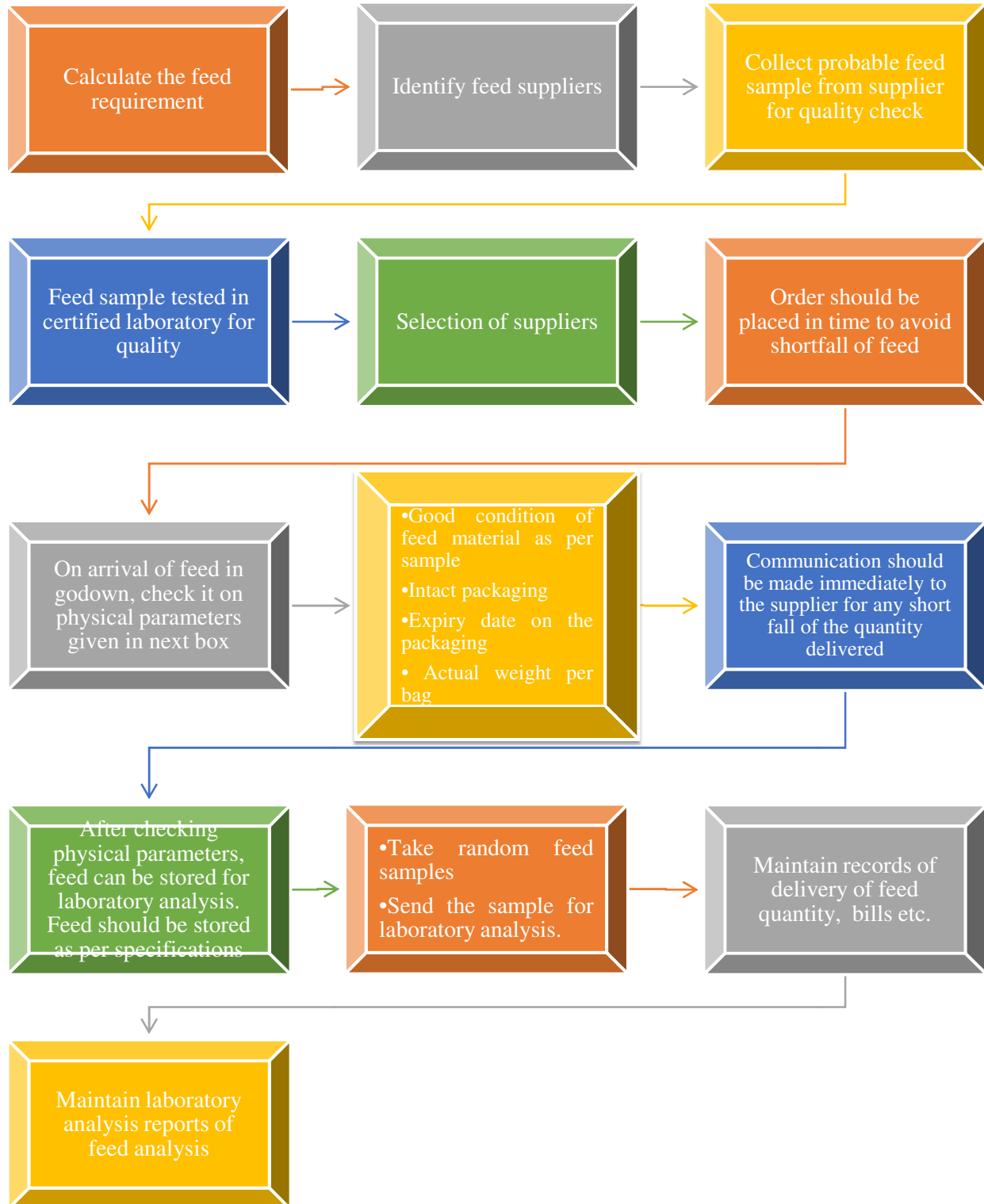


Chart 6.10: Procurement, checking and receiving of animal feed in a dairy farm

vi. Storage of animal feeds

Large amounts of stored feed are usually consumed by rodents or damaged by insects. Due to insect infestation, there are substantial losses of nutrients and its palatability decreases. Insect infestation also leads to mould and other harmful growth. Under such condition of infestation, accumulation of harmful toxins may occur in the feedstuffs. Therefore, proper storage of the feed has economic importance for the dairy farmer.

Safe and scientific storage of animal feeds

Following factors should be considered for safe and scientific storage of animal feeds:

- a. **Site selection:** The storage structure should be located on a raised and well-drained site. The feed store should be easily accessible. The site should be free from dampness, excessive heat, insects, rodents, termites, etc.
- b. **Selection of proper structure for storage:** The structure for storage of feed should be selected based on the quantity of feed to be stored and the period of storage. In case of godown storage and CAP (cover and plinth) storage, sufficient space should be provided between two stacks, between stacks and the walls so that proper aeration is available.
- c. **Cleaning of bags:** Always use new gunny bag. In case of second hand gunny bags, it should be disinfested by boiling disinfectant solution which should be subsequently dried before filling the feed.
- d. **Cleaning and fumigation of storage structures:** The feed storage structure should be properly cleaned and fumigated before storing the feed in it. There should be no cracks, holes or crevices in the storage structure.
- e. **Drying of feeds:** Feed ingredients should be properly dried to avoid quality deterioration before storing them.
- f. **Height of the platform:** The storage platform should be sufficiently high so that store is free from moisture/water seepage (Photo 6.4).



Photograph 6.4: Feed godown having a raised platform

- g. Proper aeration:** Proper aeration should be provided during dry and clean weather but care should be taken to avoid aeration in rainy season to protect the stock from moisture.
- h. Height of the stored materials:** On concrete floor the feed materials may be stored up to a height of 5 meters only, shown in Photo 6.5.



Photograph 6.5: Feed ingredients stored in bags and arranged in stacks

- i. **Separate storage for new and old stock:** To prevent contamination in new stock from the old stock, it is advised to store them separately.
- j. **Regular inspection:** To maintain proper health and hygiene of stock, regular inspection of stored feed ingredients is necessary. Periodic fumigation should be carried out in case of storage for long duration.

Common structure for storage of feedstuffs

Storage structure should be selected based on the available structural material and type of feedstuffs to be stored. Traditionally, feed ingredients are stored in country made storage structures prepared from the locally available materials. Now-a-days, improved storage structures are available to store large quantity of ingredients with proper protection to prevent storage losses. Following structures are available to store the feed ingredients. The Chart 6.11 easily explains the different types of structures for storage of animal feeds.

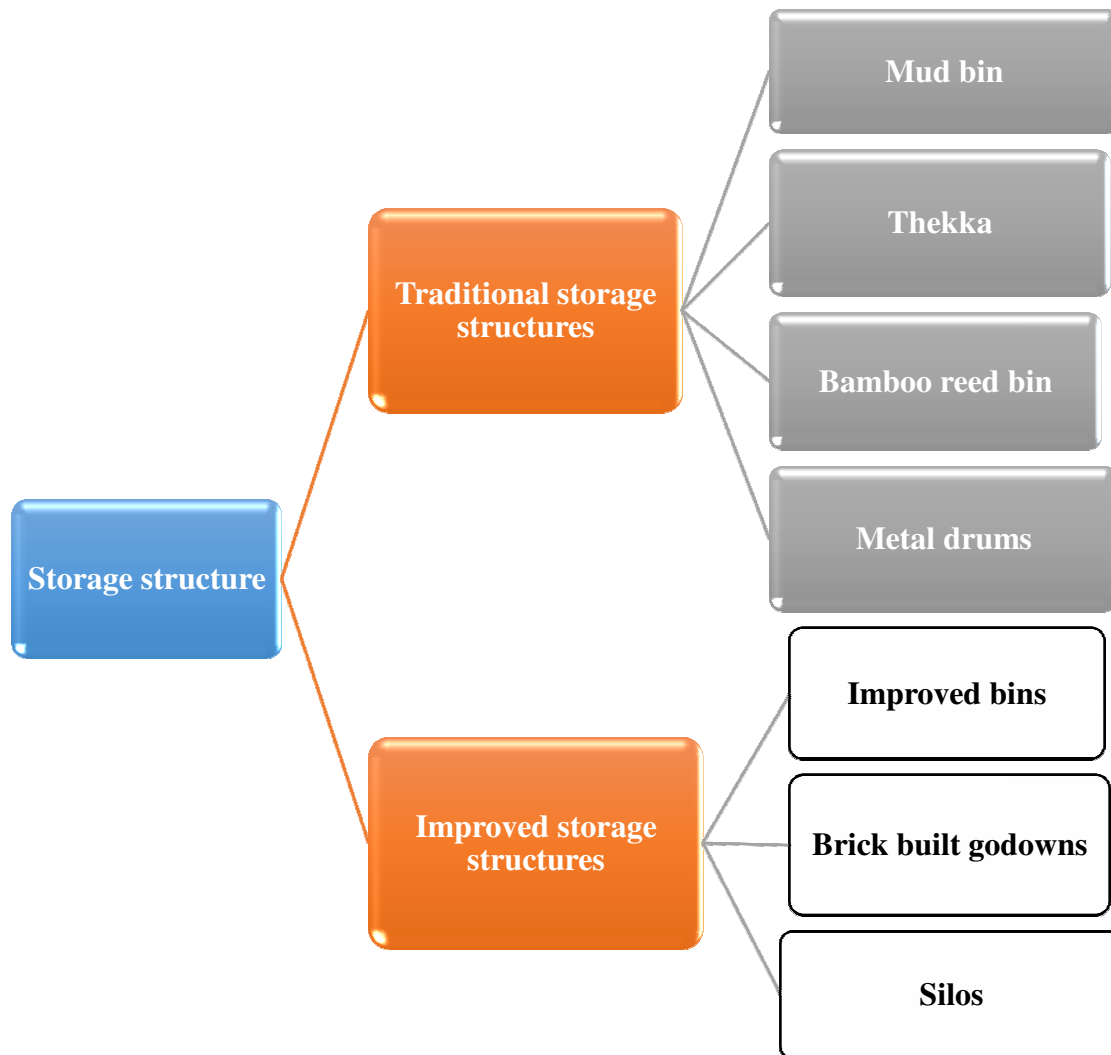


Chart 6.11: Various structures for the storage of animal feeds

PRACTICAL EXERCISE

Activity 1: Steps for the preparation of concentrate mixture

Materials Required:

1. Feed ingredients
2. Feed Grinder
3. Feed mixer

Step by Step Procedure:

1. Calculate the actual quantity of various ingredients required
2. Grinding of ingredients like maize and cakes in feed grinder
3. Mixing all the ingredients in feed mixer
4. Keep the prepared feed in the storage area

CHECK YOUR PROGRESS

A. Multiple choice

1. Which of the following feed storage structure is considered traditional storage structure			
a) Silo	b) Brick built godowns	a) Improved bins	b) Mud bin
2. In which form the concentrate mixture is offered to the animals			
a) Mash	b) Pellets	c) Crumbles	d) All of the above
3. Salt is added to the concentrate mixture for cattle @			
a) 1%	b) 2%	c) 3%	d) 5%
4. What type of ingredients are commonly used for the preparation of concentrate mixture			
a) Grain	b) Oil cakes	c) Mineral mixture	d) All of the above
5. Feed supplements are used in the animal feed to			
a) Facilitate feed pelleting	b) Preserve nutritional properties of stored feeds	c) Facilitate growth	d) All of the above

B. Fill in the blank

1.is used to grind the feed items.
2. To get the balanced feed,are mixed in suitable proportion.
3. For the storage of the feed, the moisture content of feed should be less than.....%.
4. Proper aeration should be provided during dry and clean weather but care should be taken to avoid aeration inseason to protect the feed stock from moisture.
5. Large quantities of stored feed are usually damaged by.....

C. True or false

1. Rice polish and wheat bran is used in concentrate mixture as a source of protein.
2. All feed ingredient used in the concentrate mixture need to be grinded before mixing.
3. Chaffed fodder is less palatable to the animals.
4. Animal ration should be balanced and economical.

5. The feed storage platform should be sufficiently high to avoid theft.

D. Match the column

Column A	Write from column B	Column B
1. Silo		Mix the feed after grinding
2. Mud bin		Grind the feed ingredients
3. Mixer		Improved feed storage structure
4. Grinder		Traditional feed storage structure
5. Chaff cutter		Chaffing of green fodder

E. Crosswords

¹ G				D		R
O						
²	R		³ M			
		⁴ S			O	
			X			
N						
			R			

Across

1. Grains grind in the machine
2. Traditionally feeds are stored in a structure
3. Large feed storage structure usually maintain anaerobic condition

Down

1. In a farm feeds are temporarily stored in a place before offering to the animals
2. After grinding of the feed ingredients, the machine used to mix the feed ingredients uniformly.

SESSION 4: Maintaining feed and water supply

Dairy animals require regular supply of feed and water. Systematic planning is required to ensure that uninterrupted feed and water is available to the animals. Following three components are involved in planning regular feed and water supply to the animals.

- a) Material (feedstuffs and water)
- b) Man (labour)
- c) Machinery (such as water pump, feed grinder and mixer, etc.)

If any one component gets disturbed, the supply of feed and water will be hampered. The broad plan to ensure the availability of feed and fodder is presented in Table 6.8. While, the broad plan for to ensure the availability of water is given in Table 6.9.

Table 6.8: Broad plan to ensure the availability of feed and fodder

Type of feedstuff	Planning
Concentrate mixture	Most of the ingredients used for the preparation of concentrate mixture are readily available during the harvesting season. However, long term storage of these items may lead to infestation and damage by insects and rodents. Therefore, these losses can be kept in mind before storing these ingredients for longer period.
Feed supplements	Feed supplements are regularly added to the ration of the animals. After evaluation of the price and quality, these feed supplements can be purchased and stocked if necessary.
Dry fodder (wheat straw, etc.)	During harvesting season, wheat straw is readily available at discounted prices. Once stored properly, it can be used for a longer period. Quantity of straw required for the whole year should be estimated in advance. Accordingly they should be stored in the farm in such a way that it can be used till the next harvesting or procurement season.
Hay and silage	These are usually prepared on the farm itself. During the scarcity of green fodder, hay and silage is usually fed to the animals.
Cultivating forage for feeding of	Green fodders can be grown throughout the year. Cultivation, harvesting and supply of green fodder to the animals should be planned.

animals	
---------	--

Table 6.9: Broad plan to ensure regular supply of water

Water required for	Planning
Drinking	Watering point should be constructed in such a way that every animal has free access to water throughout the day and night. Quality of the drinking water should be assured. In summer months, animals need more water. Thus, sufficient water supply should be ensured.
Cleaning of sheds and surrounding	Daily cleaning of the sheds and surrounding is required, otherwise chances of disease incidence will be higher.
Washing of animals	Milking animals are regularly washed just before milking. Other categories of animals may be washed daily. In summer, at least two times washing is required to avoid stress due to extreme heat.

Water requirement of dairy animal

Water is the major constituent in the animal body. Adult animal body contains about 65% water. Deprivation of water for a short period would result in death of the animal, while deprivation of food for the same period would not consequence the same. Water is continuously lost from the body through urine, faeces, expired air and skin (by evaporation). In addition, milking cows lose water through milk (contain about 87% water). The requirement of water increases along with milk yield, high protein diet, non-availability of succulent green fodder and climatic condition (hot summer months). Preferably water should be available to the animals throughout the day and night. Besides drinking water, a large amount of water is required in a dairy farm for washing of animals and cleaning of animal shed. Various factors which affect the water requirement of dairy animals is given in Chart 6.12.

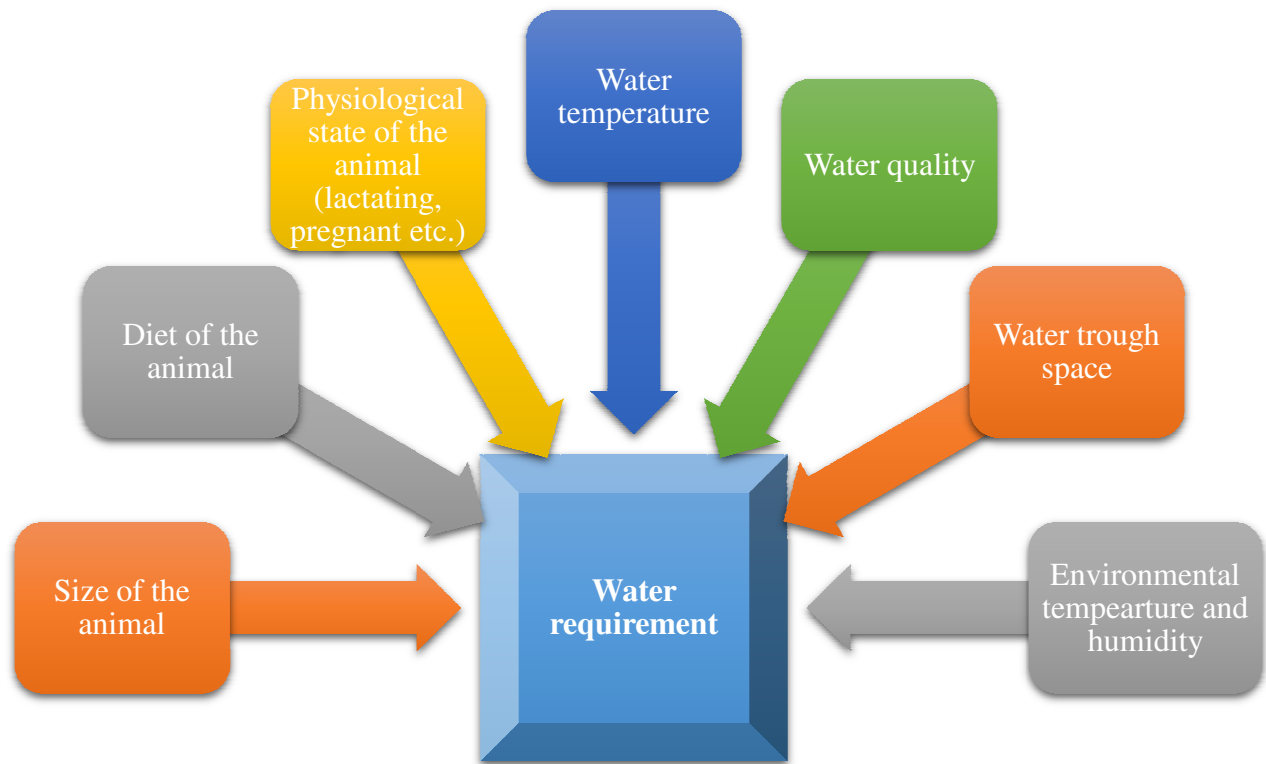


Chart 6.12: Factors affecting water requirement of dairy animals

Salient points regarding watering of animals

- Water is consumed several times per day and generally is associated with feeding or milking.
- Cows may consume 30 to 40 percent of their daily water intake within 1 hour after milking.
- **Water temperature:** Cows prefer to drink water with moderate temperatures (17-27°C) rather than very cold or hot water.
- **Minimum water depth in the waterer:** Water depth should be a minimum of 3 inches to allow the animal to submerge its muzzle 1 to 2 inches.
- **Watering point:** At least two water locations are needed in the paddock area for each group of cows.

As a rule-of-thumb, water intake is about 8-10 % of body weight during favourable environmental condition. It may reach to 13-14 % of body weight during hot weather.

Total drinking water requirement per day (litre)

$$= 10\% \text{ of body weight} + 1.5 \text{ times of milk production}$$

Thus, a 400 kg cow produce 10 litres of milk, should be provided with; $[(400 \times 10\%) + (1.5 \times 10)]$ litres = $[40 + 15]$ litres = 55 litres of drinking water. In addition to this, about 70-75 litres of water is required for washing of animals and cleaning of shed. Total water requirement would be $55 + 75 = 130$ litres.

i. Salient aspects of planning feed and water supply to animals

- a) The dairy farmer should understand the basic behaviour of the animals and treat them accordingly. The farm workers need to be trained on the importance of maintaining cleanliness and hygiene.
- b) Feed and fodder should be supplied at least twice daily. Therefore, total required quantity of feed and fodder should be divided into according parts and supplied to the animals at regular intervals.
- c) It is better to mix chopped green fodder, straw and concentrate mixture to increase the feed intake and better utilisation of feed by the animals (Chart 6.13).

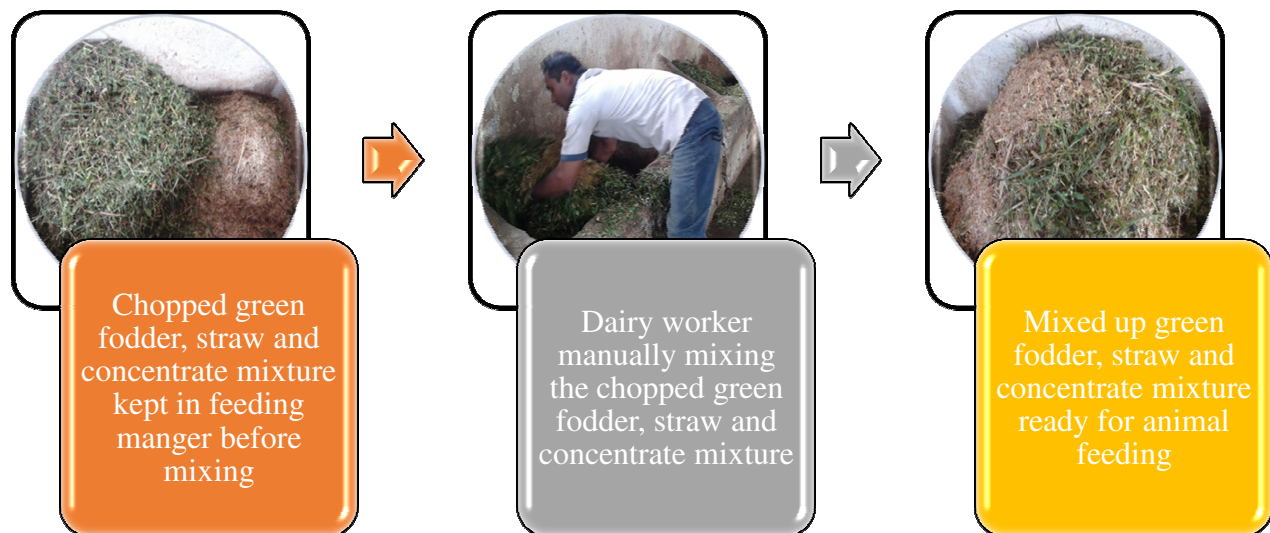


Chart 6.13: Mix chopped green fodder, straw and concentrate mixture to increase the feed intake and better utilisation of feed by the animals.

- d) Feed should be given to sick animals as per veterinarian's recommendations.
- e) In extreme summer months, major quantity of feed should preferably be supplied during nights.
- f) Regular observations on feeding and drinking habits of animals must be made. Marked changes in feeding and drinking pattern of particular animal is an indication of adverse health conditions.
- g) Feeding manger should be cleaned daily. Any leftover/stale feed should be discarded as per standard waste disposal methods.
- h) The equipments and machineries used for feed and water supply should be cleaned regularly and maintained properly.
- i) Waterers should be cleaned in every 15 days to check the growth of algae. After cleaning and drying lime should be painted on the inner walls of the waterers to check the growth of algae.
- j) Special attention should be given to the young animals, sick/injured animals and advanced pregnant animals.
- k) The workers serving feed to the animal should have a compassionate approach towards the animals.
- l) During feed transport, it should be ensured that feed should reach to the sick animal shed at the end; otherwise, disease can be spread out.

ii. Causes of feed wastage and measures to minimize it

In every farm some amount of loss of feed is inevitable. Feed losses on farm occur during following stages:

- a) **Storage of feeds:** During storage of feed a major amount of feed is wasted due to the infestation of insects, rodents, etc.
- b) **Preparation of feeds:** During grinding and mixing of feeds some amount of feed is liable to be wasted.
- c) **Feeding of animals:** It is common for animals to spill or waste feed. This wasted feed is often wet and covered with saliva. If this feed is left in manger, animals will not consume it. Thus, leftover feed is susceptible to spoilage. Wasted, spilled and rotten feed is a breeding ground for flies and attracts vermin like mice and rats.

Following efforts must be made to minimise feed wastage:

- a) Choose an appropriate storage container
- b) Proper rodent control programme should be ensured.
- c) Feed should be stored in cool and dark place.
- d) At the time of purchase of feed ingredients, it should be ensured that the feed ingredients contain acceptable level of moisture.
- e) Manger should be designed to reduce feed wastage.
- f) Manger should be cleaned on regular basis so that spoiled or rotten feed can be removed.
- g) Feed should be offered to the animals strictly as per requirement.
- h) In case of group feeding in continuous manger, proper grouping of animal (on the basis of body size or age) must be ensured.

PRACTICAL EXERCISE

Activity 1: Calculate the water requirement for a lactating cattle during summer
Step by Step Procedure:

1. Measure body weight of the cattle
2. Note down milk of the cattle
3. Calculate water requirement for the maintenance and milk production as per formula "10% of body weight + 1.5 times of milk production"
4. Calculate water requirement for washing of shed.
5. Calculate extra water requirement during summer season
6. Add all the requirements

CHECK YOUR PROGRESS

A. Multiple choice

1. Which of the following animal feeds are to be chopped before feeding			
a) Wheat straw	b) Green fodder	c) Concentrate	d) None of the above
2. Continuous manger is suitable for			
a) Group feeding	b) Individual feeding	c) Both a and b	d) None of the above
3. Water requirement of the animals depends upon			

a) Body weight	b) Diet	c) Environmental temperature	d) All of the above
4. Long term storage of ingredients (for concentrate mixture) leads to			
a) Insect infestation	b) damage by rodents	c) Loss of moisture	d) All of the above
5. Which of the following is important in planning regular feed and water supply to the animals			
a) Labour	b) Machinery	c) Feedstuffs	d) All of the above

B. Fill in the blank

1. About..... litres of water is daily required for adult cattle.
2. Average dry matter consumption of indigenous cattle is% of body weight.
3. Waterers should be cleaned in everydays to check the growth of algae.
4. Water depth should be a minimum ofinches to allow the animal to submerge its muzzle 1 to 2 inches.
5. As a rule-of-thumb, water intake by the cattle is about% of body weight during favourable environmental condition.

C. True or false

1. Adult cattle consume more dry matter than adult buffalo.
2. Hay contains more moisture than silage.
3. Feed and fodder should be supplied at least twice daily.
4. Leftover feed is susceptible to spoilage.
5. During storage of feed a major amount of feed is wasted due to the infestation of insects, rodents, etc.

D. Match the column

Column A	Write from column B	Column B
1. Grinder and mixer		Wastage of feed during storage
2. Insects and rodents		Leftover feed
3. Manger		Usually feed supplied in night
4. Summer		Provide drinking water
5. Waterer		Preparation of concentrate

		mixture
--	--	---------

E. Crosswords

¹ W		²	H			G	
		U					
		³ M		N			
⁴ C			A			N	G
⁵ S		R		W			

Across

1. Process of cleaning of shed by flushing of water
2. Along with materials and machineries, this is essential for regular supply of feed and fodder to the animals

Down

3. During this season water requirement of the animal increases.
4. It should be done regularly within the shed to make the animal healthy
5. Type of dry fodder offered to the animals.

UNIT 5: Management of Dairy Animals

SESSION 1

INTRODUCTION

Farm animals follow a specific routine for various farm activities like feeding, milking, cleaning, etc. They also suffer due to illness or injury. Abnormal behaviour or specific symptoms shown by the animals are the sign of illness. This unit discusses the various aspects of management of livestock within their accommodation. Dairy farmer must inspect regularly their animals to check any abnormality to identify the problem at earliest. Animals are transported for various purposes. However, care should be taken to avoid stress towards the animals during transportation. The farm workers who involve in the day to day management of the animals should be protected from any injury or risk. Finally, large quantity of manure is produced in the dairy farm which has to be disposed properly otherwise it would be a potential source of infection as well as environmental pollution.

i. Standard practices to maintain health of dairy animals

The farm supervisor should make daily inspection and observe the animals carefully for any illness or injury. The daily routine of feeding, milking and caring should be followed. Any major change in the daily routine may affect the health and production of animals. Observe the animal for abnormal behaviour or specific symptoms of illness as discussed in the Chart 5.1.



Chart 5.1: Symptoms of illness

The steps to be followed to supervise and maintain the health of the dairy animals are presented in the Chart 5.2.

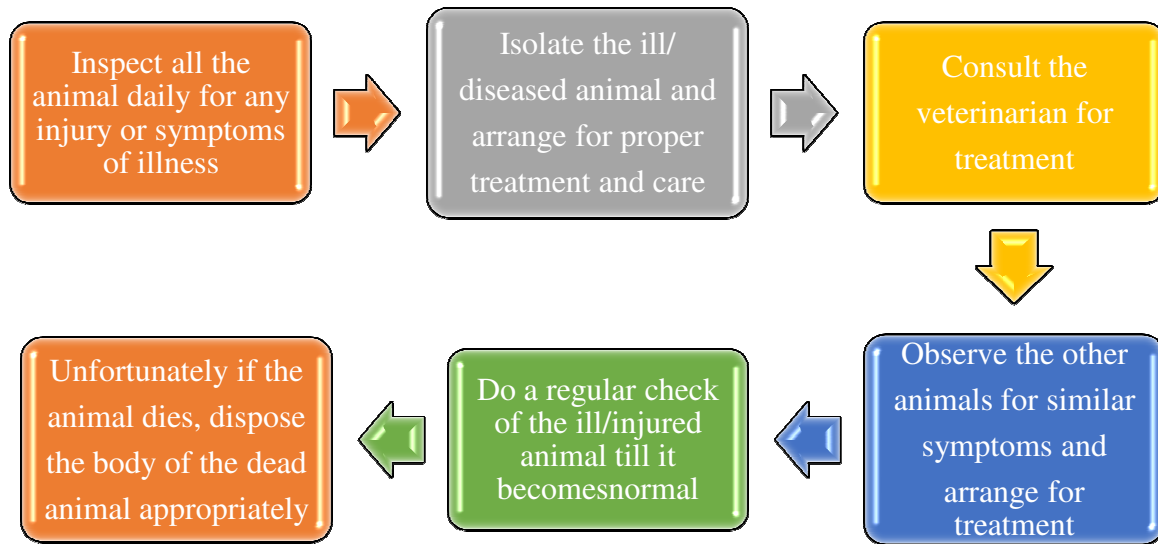


Chart 5.2: Steps to be followed to supervise and maintain health of the dairy animals

ii. Vaccination

Farm animals, just like human being, are susceptible to various fatal diseases which are either caused by bacteria, viruses, fungi and parasites. Disease causes substantial loss to a dairy farm. Therefore, wherever possible the animal should be protected from these diseases thereby reduce burden of disease and the associated distress to the animals. The major diseases in cattle requiring vaccination are given in Chart 5.3. Vaccination is used primarily to promote animal health by preventing disease outbreaks that can have a devastating effect on animal production, as well as on human and animal health.

A vaccine is a fluid containing attenuated or killed microorganisms that helps the animal's body to become immune to a disease caused by certain germs or microorganisms. The vaccine contains some part of the germ or the poison that the germ produces. The vaccine does not make the animal sick. It rather helps the animal's body to protect itself from getting diseased in future. Vaccination means the administration of a particular vaccine into the animal's body for producing immunity in the body of the animal against a specific disease. The vaccines may be administered usually either subcutaneously or intramuscularly based on standard instructions prescribed for administration of that vaccine. As a thumb rule, vaccines are administered to healthy animals only.



Chart 5.3: Major diseases in cattle requiring vaccination

Vaccination schedule for cattle and buffaloes

The recommended vaccination schedule for important diseases in cattle and buffalo are given in the Table 5.1.

Table 5.1 : Vaccination schedule for important diseases in cattle and buffalo

Vaccine	Primary vaccination	Booster	Revaccination
FMD vaccine	6 - 8 wks of age	6 months after 1 st dose	annually
HS vaccine	6 months and above	–	annually
BQ vaccine	6 months and above	–	annually
Anthrax vaccine	6 months and above	–	annually in endemic areas

Brucella vaccine	4-8 months female calf	–	–
-------------------------	------------------------	---	---

Most of the vaccines used in farm animals are developed from live infectious organisms. Vaccines are very sensitive to temperatures variations. Proper handling and administration of vaccines is very important for its effectiveness.

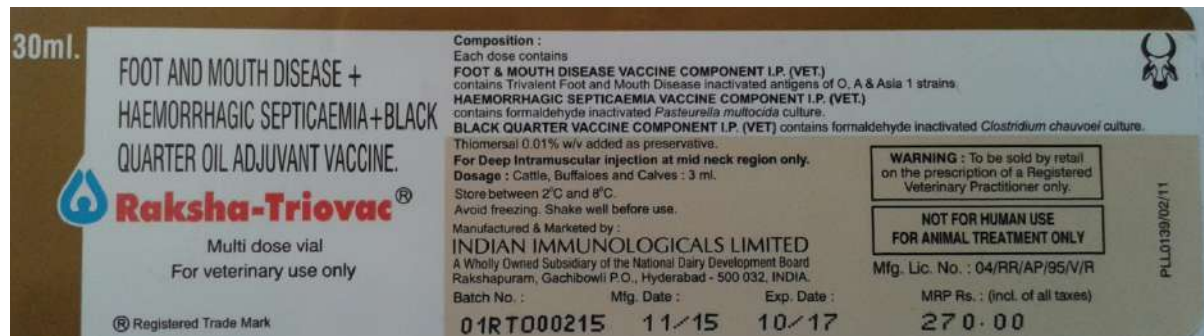
Documentation of vaccination

Proper documentation of vaccination program is important for many reasons like legal proof of vaccination status especially whenever there is an outbreak of disease in that area and for monitoring adverse reactions in the animals in which vaccination has been carried out.

The following information should be recorded in the vaccination record of each animal:

- Name of the vaccine administered, manufacturer's detail, lot or serial number, date of expiry
- Date of administration of vaccine
- Route of administration of vaccine

The manufacturer's label can be removed (Photo 5.1) from the vaccine bottle and pasted on the register or record book. It is easier to maintain such records in a computer.



Photograph 5.1: A specimen of vaccine manufacturer's label showing 1) name of vaccine, 2) route of vaccination, 3) vaccination dosage, 4) optimum temperature for storage of vaccine, 5) batch number, 6) manufacturer's detail, etc.

iii. Establishing suitable environmental conditions in dairy animal house

Farm animals are homoeothermic animal (no change in body temperature). Metabolic heat is produced in the animals. This heat is released to the atmosphere as sensible heat by means of convection, conduction and radiation and as latent heat by means of evaporation of moisture from the lungs and skin. The heat and moisture produced by the animals within the animal house is accumulated and creates unusual environment which may cause stress to the animals and

ultimately leads to distress and diseases. Thus, intensive livestock housing should be equipped with an environmental control system to maintain animal health and welfare. Environmental modification is usually accomplished by ventilation (natural or mechanical), heaters for extreme cold conditions and cooling equipment for hot conditions.

Following environmental conditions should be maintained for optimum milk production:

a) Temperature

The favourable temperature within the animal shed is between 15°C to 27°C. Deviation in the temperature may cause significant loss in productivity and health of the cattle.

b) Relative Humidity

Optimum relative humidity of dairy animal house is about 40% to 60%. Variation in the relative humidity can cause stress in animals.

c) Ventilation

The animal feels calm and comfortable when they are kept in well ventilated animal house. Obnoxious gases produced within the animal house come-out from the animal shed when the shed is properly ventilated. Overcrowding of the animal within the animal shed must be avoided.

d) Wind Velocity

The animals feel comfortable when wind speed is about 5-8 km/hr. Planting of green belt (with tree) in areas with high wind velocity will reduce the wind speed and help in minimising the disturbance in the environment.

e) Optimum and natural light

Artificial or bright lights can disturb the routine of animals and affect their health and productivity. Extra care should be given to weak, ill or injured, pregnant and young animals.

iv. Handling process to minimize stress in dairy animals

The common factors responsible for creating stress in dairy animals is given in Chart 5.4.



Chart 5.4: Causes of stress in dairy cattle introduced in the new farm

Cattle are social animals that prefer to stay in herds. The overall behaviour of cattle is called herd behaviour (**Photo 5.2**). They do not like to be isolated. Cattle should always be able to see other animals of the herd. Cattle are large animals that can move quickly and be aggressive and more so if mistreated and provoked. Stressed and agitated cattle are a risk to livestock handlers and to themselves. Rough or aversive handling leads cattle to become frightened of people and to be stressed in their presence.



Photograph 5.2: Cattle showing herd behaviour

Improving handling and animal care requires that we understand more about how cattle react to people, the types of handling animals find aversive and the reasons that animal handlers use rough handling.

v. Transportation of dairy animals

The transport of livestock involves a series of operations including handling, loading and unloading, unfamiliar environments and in some cases, isolation, social disruption, confinement, fluctuations in environmental temperature and humidity, feed and water deprivation and other factors.

The objective of any method of transportation is to ensure the safety, security and comfort of the animal, while moving it efficiently to its destination. Transportation can result in significant stress for the animals. Transportation stress can be categorized as physical (changes in temperature, humidity, or noise), physiological (limited access to food and water) and psychological (exposure to new individuals or environments).

Purpose of transportation: Animals are transported for a number of reasons like change of ownership, marketing, re-stocking, from drought areas to better grazing, treatment, exhibitions (krishi mela) and animal fair.

Modes of transportation: The usual transportation modes are:

- a) On foot (walking/trekking)
- b) Road
- c) Rail
- d) Sea
- e) Air

Loading and unloading ramps (elevators) for livestock: Ramp is the sloping surface used to allow access from one level to a higher level. It is used to load and unload the animals in the vehicle or train. Loading and unloading ramps must provide nonslip footing to prevent slippage and falling. On concrete ramps, stair steps provide good footing. The recommended angle of the loading ramp is 20° or less.

a) Transport of livestock on foot

Cattle and buffalo can be successfully moved on foot. The journey should be planned, paying attention to the distance to be traveled, opportunities for grazing, watering and overnight rest. Animals should be walked during the cooler times of the day and, if moving some distance to a railhead, they should arrive with sufficient time for rest and water before loading. The maximum distances that these animals should be moved on foot depend on various factors such as weather, body condition, age, etc., but the distance given in the Table 5.2 should not be exceeded.

Table 5.2: Maximum distances for trekking

Species	One day journey	More than one day	
		First day	Subsequent days
Cattle/Buffalo	30 km	24 km	22 km
Sheep/goats	24 km	24 km	16 km

The specifications for transportation of animals on foot are presented in Table 5.3. No animal shall be made to walk under conditions of heavy rain, thunderstorms or extremely dry or

sultry conditions during its transport on foot. No person shall transport on foot an animal before sunrise or after sunset. For short distance transport, it is the most easiest and economical method. The disadvantages of transporting by foot are time consuming; animals may expose to extreme environmental conditions and loss of body weight.

Table 5.3: Specification for transportation of animal by foot

Species	Maximum distance travel (km/day)	Speed (km/ hr)	Maximum hours traveling in a day	Period of rest, drinking and feeding	Temperature range (°C)	
					Max	Min
Cows	30	4	8	At every 2 hours for drinking and at every 4 hrs for feeding	12	30
Buffaloes	25	3	8	At every 2 hours for drinking and at every 4 hrs for feeding	12	30
Calves	16	2.5	6	At every 1½ hours for drinking and at every 3 hrs for feeding	15	25

b) Transport of livestock by road

Truck is commonly used for road transportation of livestock. The body of the truck should be cleaned with broom. Bedding materials should be provided to the floor of the truck. Sand (10-12 cm depth) or straw bedding (15 cm) can serve the purpose. The truck should be connected to the loading ramp. Open the rear door on the loading ramp and cover the gap between the door and body of the truck by a plank. Then load the animal inside the truck gently pushing the animal from behind. Inside the truck partitions should be made with bamboo for individual animals. Make sure that the attendant is present all the time when truck moves.

While transporting the cattle, the goods vehicles shall not be loaded with any other merchandise; and to prevent cattle being frightened or injured, they should preferably, face the engine. The animals can be placed either head to head or tail to tail on the truck. Feed and water should be supplied at an interval of 8 to 10 hours. The attendant should accompany the animals to look after them during the journey. The animals should be removed from the truck at an interval of 10 to 12 hours journey and should be given rest and a little exercise on the ground. Then they should be again placed in the truck and the journey should be continued in this way.

The number of cattle per truck for safe loading is given in the Table 5.4.

Table 5.4: Number of cattle permitted per truck for transportation

Size of the truck	Average live weight (kg)				
	300	350	400	450	500
4 metre truck	11	10	9	8	7
5 metre truck	14	13	12	11	10
6 metre truck	18	16	15	13	12
7 metre truck	22	20	18	16	15

The advantages of road transport are suitability for long distance transport, freedom in choice of time of movement of the animals and direct transport of the animals at the destination. The disadvantages are that the animals are exposed to extreme stress condition, higher chance of injury and higher body weight loss due to stressful condition.

c) Transport of livestock by rail

The size of the wagon and the size of the cattle determine the number which can be loaded in a wagon. For comfort in transport the wagon should be loaded heavily enough so that the animals stand fairly close together; however, crowding should be avoided. An ordinary goods wagon shall carry not more than ten adult cattle. Following points should be kept in mind while transporting of cattle by train

- 1) Every wagon shall have at least one attendant.
- 2) Cattle shall be loaded parallel to the rails, facing each other.
- 3) Cattle wagon should be attached in the middle of the train.
- 4) Two breast bars shall be provided on each side of the wagon, one at height of 60 to 80 cm and the other at 100 to 110 cm.
- 5) Cow in milk shall be milked at least twice a day and the calves shall be given sufficient quantity of milk to drink.
- 6) As far as possible, cattle may be moved during the nights only.

The advantages of railway transport are less stress to the animals as compared to road transport, long distance can be covered in short span of time, reduced chances of bruising and other injury during handling. Disadvantages are timing of transport in accordance with the railway schedule and small number of animal transport may not be suitable.

d) Transport of livestock by sea

For centuries, animals have been transported by sea, as well as across lakes and rivers. It usually involves a long period of journey. The animals which are of high valued and to be used for breeding purposes are usually transported by sea route. About 40 square feet is required for cattle. The animals transported in crates should have dimensions like 5 feet long, 3 feet wide and 3 feet high. At every 2 to 3 hours interval, the attendant should examine the animals.

e) Transport of livestock by air

Usually highly valued animals are transported by air. Race horse, poultry parent stock are usually transported via air. But, in certain circumstances other livestock are also transported.

Animals not suitable for transport: The condition in which animals are not suitable for transport as follows:

- a) Weak newborns, emaciated animals, animals with severe injuries or animals that have great difficulty walking must never be transported.
- b) Animals that are nearing the time of parturition should not be transported.
- c) Advanced pregnant animals should not be transported except under exceptional circumstances.
- d) Pregnant animals should not be accepted for transportation when pregnancy days exceeds the number of days of pregnancy as given in the Table 5.5

Table 5.5: Species of animals and days of pregnancy restricted for transportation.

Animals	Maximum no. of days of pregnancy
Cow	250 days
Mare	300 days
Doe	115 days

Ewe	115 days
-----	----------

- e) Animals that have given birth during the preceding 48 hours.
- f) Transportation of aged animals should be avoided.
- g) During very hot or cold weather or heavy rains, transportation of animals should be avoided.

PRACTICAL EXERCISE

Activity 1: Identify sick animals and note down sign and symptoms of sick animals

Materials Required:

1. Thermometer
2. Mask
3. Apron

Step by Step Procedure:

1. Visit to a dairy farm
2. Identify the sick animals
3. Note down sing and symptoms of diseases
4. Examine body temperature of the sick animals

Activity 2: Vaccination of dairy animals

Materials Required:

1. Notebook
2. Farm records

Step by Step Procedure:

1. Visit to a dairy farm
2. Find out the vaccination records
3. Note down the detail vaccination carried out to the dairy farm
4. Note down vaccination schedule followed to the farm

CHECK YOUR PROGRESS

1. During transportation of animals by foot, the maximum distance travelled in a single day journey for cattle should be			
a) 10 km	b) 20 km	c) 30 km	d) None of the above
2. Animals need is required to be transported for			

a) Change of ownership	b) Selling	c) Slaughter	d) None of the above
3. Which one of the following is not a vaccine			
a) Cotton strain-19	b) Rakshvac-T	c) Dewormer	d) B.Q. precipitated
4. Primary symptoms of illness in cattle are			
a) Lethargy, dull or depressed	b) Teeth grinding	c) Decreased rumination rate	d) All of the above
5. Preferable relative humidity in the animal house should be			
a) Less than 20%	b) 20-40%	c) 40-60%	d) Above 60%

B. Fill in the blank

-is the sloping surface used to allow access from one level to a higher level.
- For short distance transport, the most easiest and economical method of transport is
- The recommended angle of the loading ramp is
- Cattle are animals used to living in herds.
- The frequency of vaccination against Black quarter is

C. True or false

- Transportation of aged animals should be avoided.
- During transportation of cattle by rail, the cattle wagon should be attached at the end of the train.
- Animals that are nearing the time of parturition should not be transported.
- Vaccination is done to treat the animals.
- Rough or aversive handling leads cattle to become frightened of people and to be stressed in their presence.

D. Match the Column

Column A	Write from column B	Column B
1. Brucellosis		20°
2. FMD		40% to 60%
3. Angle of the loading ramp		25°C

4. Optimum relative humidity of dairy animal house		Viral disease
5. The favourable temperature within the animal shed is between		Bacterial disease

E. Crosswords

	¹ B	²	³ R			K
	⁴	O		D		
			P			
	L					
	L					
	⁵ R		L			

Across

- Vehicle used for road transport
- Usual mode of transportation of animals
- One of the mode of transportation by which comparatively large number of animals can be transported at a time

Down

- Vaccine which is applied once in their early life usually in female.
- Structure required for loading and unloading of animals

SESSION 2: Safety measures for farm workers and disposal of manure

i. Personal protective equipment (PPE) for dairy worker

In dairy farms, it must be ensured that dairy workers are protected from injury or impairment of any bodily function that might occur through absorption, inhalation or physical contact. The dairy worker must wear protective clothing; respiratory devices; shields; barriers; and adequate protective equipment for eyes, face, head and extremities.

When considering health and safety precautions, personal protective equipment (PPE) is the last resort and should only be considered after all other means of controlling the risk have been exhausted. This is because PPE only protects the individual and does not prevent the accident from happening. Critically, it often only partially protects the wearer reducing the severity of the effects.

Common PPE used by the dairy workers

Personal protective equipment often used includes the following.

- a) **Gloves:** Gloves to protect hands from contact with hazardous substances, hot or cold surfaces, stings, rough textures or sharp tools. Single-use gloves is used when treating sick animals or assisting births.
- b) **Safety shoes or boots:** Safety shoes or boots - depending on their characteristics, to provide protection from materials that may be dropped, livestock that may tread on you, snake bites, weeds, slippery surfaces, sharp item penetration, water penetration.



Photograph 5.3: Gumboot



Photograph 5.4: Gloves

- c) **Goggles:** Goggles to protect the eyes from foreign particles and fumes. Goggles should be used when weeding, welding, cutting and working in the workshop.
- d) **Earplugs and earmuffs:** Earplugs and earmuffs to protect your hearing from the high noise levels emitted from some machinery, such as chainsaws, or animals, such as pigs, when housed.
- e) **Face protection:** Face protection must be used while welding to protect eyes, nose and mouth from fumes, heat and stray metal. Face protection also to be worn when mixing, spraying or applying chemicals or using solvents and when grinding metal and cutting timber.
- f) **Hard hats:** Hard hats to prevent injuries from falling objects.
- g) **Breathing apparatus:** Breathing apparatus when working in confined spaces such as in silos.

The person should wear all necessary and prescribed protective clothing and equipment while operating machines as per manufacturer specifications. Avoid loose clothing while operating machines, tractor, etc., to prevent the clothes of dairy farm worker getting caught into moving parts.

ii. Safety measures during the process

- a) Always read instructions on labels of chemicals, pesticides, fumigants or disinfectants before use.
- b) Use chemicals as prescribed by the manufacturer.
- c) Use protective clothing as specified by the manufacturer while handling chemicals.
- d) Appropriately dispose chemical containers and medical waste to minimise environmental damages.
- e) Take immediate medical help or assistance in case of accidents due to chemicals.
- f) Keep necessary emergency equipments and first aid accessible as per manufacturer's specifications while handling chemicals.
- g) Keep chemicals away from reach of children and animals.

The risks associated with the dairy farm worker are as follows:

- a) Problems of transmission of diseases
- b) Problems related to the handling of the animals
- c) Problems of the working environment

The common problems encountered in the farm and their remedial measures are given in the Table 5.6.

Table 5.6 : Common problems and their remedial measures.

Common problem	Remedial measures
Damage to clothing	Wear comfortable overalls without lengthy projections that can be trapped. Wear industrial shoes or water-proof footwear
Burns and scalds	Wear hair covering. Wear gloves when handling items containing hot items, toxicants, etc.
Dust inhalations	Wear face masks to filter out dust
Cut at fingers, wrists	Wear gloves

iii. Collection of manure and washing

Manure is the breeding place for a large number of pathogens and insects having parasitic importance. Under best managmental conditions, solid manure is usually collected and removed from the animal shed twice daily and flushing of the floor of the animal house. In other

conditions, manure is removed from the animal house by flushing out both liquid and solid manure with water pressure by the hosepipe.

Solid waste from livestock farm is dumped in the manure pit. These wastes are gradually changed into manure by the bacterial activity after few months. The manure pit should be about 100 meters away from the animal shed and other buildings. It helps in avoiding foul smell originating from the manure pit along with safeguard against flies and insects menace. As manure is the breeding place for the flies and insects. Manure pits should be easily accessible from different parts of the farm. It should be away from the water source. A roof may be provided over the pit to protect it from rain.

Liquid manure and washing run out by the shallow drain located longitudinally to the long axis of the shed. Each shallow drain of the shed is connected to the sub-drain and subsequently to the main drain. Main drain finally connected to the liquid manure storage tank or the same can be treated by effluent treatment plant. The treated water can be reused for agricultural purposes.

iv. Method of disposal of manure

There are various methods of handing and utilization of animal waste as depicted in the Chart 5.5.

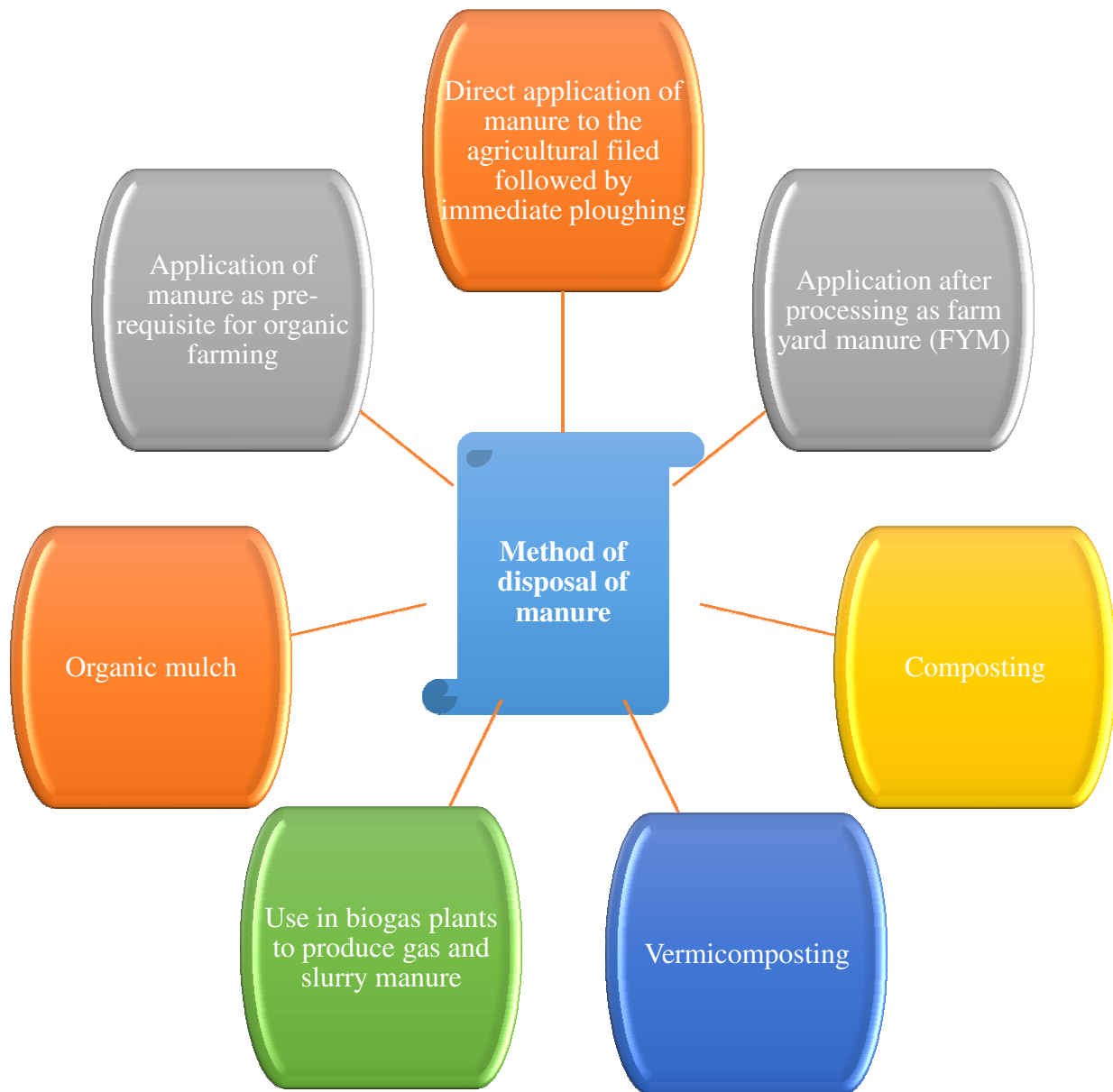


Chart 5.5: Various methods of disposal of manure

A. Utilization of Manure

There are various methods for handling and treating animal waste. Methods that are available for applying animal excreta into the soil include;

- i. Farm yard manure (FYM)

- ii. Conversion into compost
- iii. Vermicomposting
- iv. As a feed stock in biogas plants to produce gas and slurry manure.
- v. Organic mulch: A layer of organic material designed to protect exposed soil or freshly seeded areas from erosion by eliminating direct impact of precipitation and slowing overland flows.

i. Farm Yard Manure (FYM)

The FYM is the decomposed mixture of dung and urine of farm animals along with litter, left over feed and fodder fed to the animals. A well decomposed FYM contains 0.7-1.3% N, 0.3-0.8% P_2O_5 and 0.4-1.0% K_2O on dry weight basis. However, composition depends on the type of animals, its ration, age, species, etc.

ii. Composting

Composting is a natural process in which organic matter is decomposed by microorganisms. This process is in practice for centuries by farmers who stock dung into piles or in pits (Photo 5.5). Composting can be either aerobic or anaerobic. The advantages of aerobic decomposing are shorter stabilization time, no foul smell and destruction of weeds and pathogens. During composting, temperatures can reach 150°F. Most pathogens that are harmful to humans can be destroyed at 131°F or higher.



Photograph 5.5: Photograph showing compost pit

Composts must be handled carefully. An immature compost has a high “temperature” which can damage plants and in some areas immature composts created pest problems. Mature manure composts are considered the safest to use and it ranked as the best type of organic fertilizer. Older composts are best and judged by their colour and moisture. Black, dry compost is likely to be mature, whereas yellow wet compost is young and, therefore, not ready for use.

iii. Vermi-composting

The term vermi-composting means the use of earthworms for composting organic residues. Vermi-composting is the process by which earthworms are used to convert organic materials (usually wastes) into humus-like material. The goal is to process the farm waste as quickly and efficiently as possible.

Earthworms can consume practically all kinds of organic matter and eat their own body weight per day, e.g. 1 kg of worms can consume 1 kg of residues every day. Vermi-compost is nothing but the excreta of earthworms, which is rich in humus and nutrients (Photo 5.7). The excreta (castings) are rich in various soil nutrients like nitrogen, potassium, phosphorus, calcium and magnesium. Castings contain: 5 times the available nitrogen, 7 times the available potassium

and 1½ times more calcium than found in good topsoil. *Eisenia foetida* and *Lumbricus rubellus* (red worm) species of earthworms are commonly used for vermi-composting. Earthworms not only convert garbage into valuable manure but keep the environment healthy.



**Photograph 5.6 Earthworm used in
vermicompost preparation**



Photograph 5.7: Manure

Benefits of vermicomposting; Vermicomposting has lot of benefits. The benefits of vermicomposting have been given in the Chart 5.6.

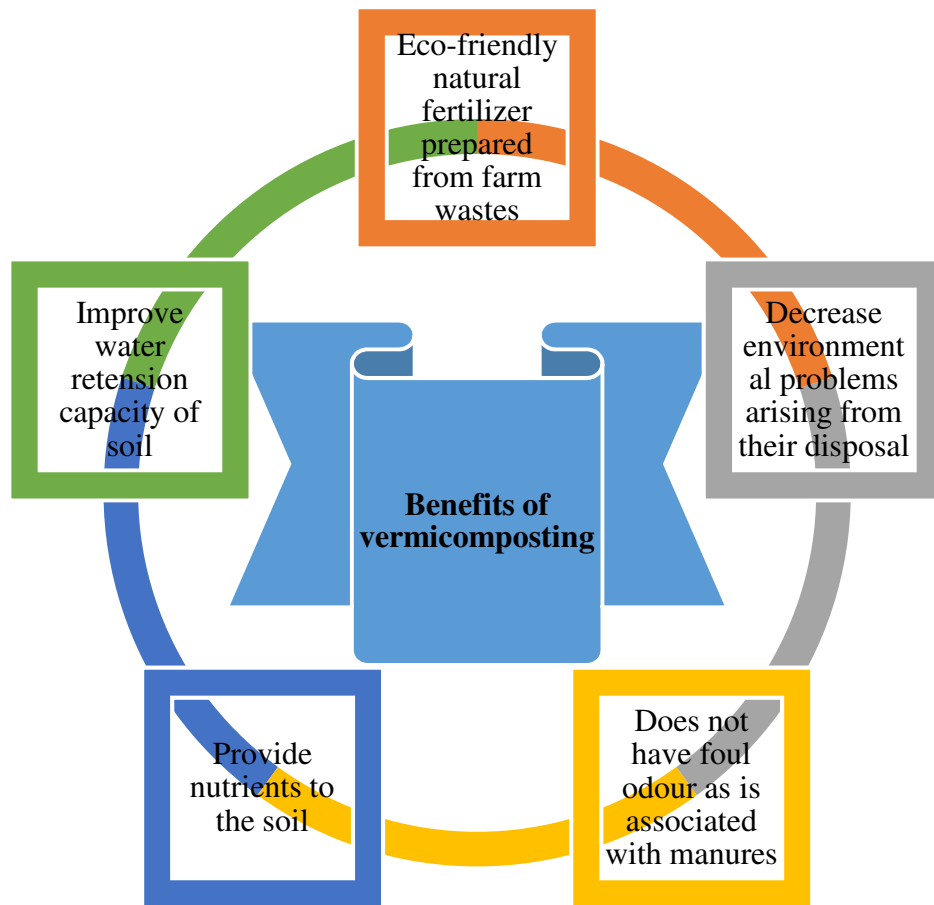


Chart 5.6: Chart describes the benefits of vermicomposting

iv. As a feed stock in biogas plants to produce gas and slurry manure

According to estimates, one kg of cattle dung produces about $.073\text{m}^3$ (1.3ft^3) of biogas at atmospheric pressure. The availability of dung from a medium size cow is approximately 10 kg per day. For the smallest plant producing 1.7m^3 (60ft^3) of biogas, waste from at least 5 head of cattle is necessary. Biogas (1.7m^3) produced from this small plant is considered sufficient to meet the cooking and lighting needs of a family of four. Two products are obtained from the plant, biogas and fermented slurry.

Biogas is non-poisonous, with a characteristic odour, which disappears on burning. When mixed with air, it burns with a non-luminous blue flame without producing any smoke. It has a very low level of inflammability. Biogas is used for household cooking, lighting and power. Special lamps are available for lighting where biogas can be used. For a 100 candle power mantle lamp, approximately 0.13m^3 (4.5ft^3) fuel gas is required per hour. Regarding the production of power, about 0.48m^3 (17ft^3) of biogas is required to run an engine of 1 horse

power for one hour. Combustion engines, commonly available, can be run with biogas. To do this, a special attachment is fitted to the combustion engine. Such attachments are readily available. The biogas-spent slurry is better than Farm Yard Manure (FYM) since it is well digested and has high nutrient contents.

v. Organic mulch

Mulch is a layer of material applied to the soil surface. It reduces water loss by reducing evaporation from the soil. Mulch also keeps the soil cooler, reduces weed growth, reduces run-off and reduces erosion. Manure can be used as mulch but are best mixed with other mulches, especially if the manure is fresh. Like compost, manure decomposes rapidly, so it needs frequent replenishment.

PRACTICAL EXERCISE

Activity 1: Prepare vermicompost

Materials Required:

1. Manure
2. Earth worm
3. Waste fodder, leaves
4. Water
5. Covered area

Step by Step Procedure:

1. Vermicomposting unit should be in a shady area
2. Prepare a layer of chopped dried leaves/fodder of about 15-20cm as bedding material.
3. Cow dung and waste fodder or leaves are mixed in the proportion of 3: 1 and are kept for 7-10 days.
4. After partial decomposition of material the size of the bed should be 6ft x 2ft x 2ft.
5. About 1500 to 2000 earthworms should be released on the upper layer of vermicompost bed.
6. Sprinkled water immediately after the release of worms.
7. Try to maintain sufficient moisture content in the beds by daily sprinkling of water and covering with gunny bags.
8. To maintain proper aeration within the bed, it should be turned once after 30 days.
9. Compost gets ready in 45-50 days.

CHECK YOUR PROGRESS

A. Multiple choice

1. The dairy farm worker must wear protective equipments to protect			
a) eyes	b) face	c) head	d) all of the above
2. Composting is done by			
a) aerobically	b) anaerobically	c) both a and b	d) none
3. For which purpose biogas is used			
a) household cooking	b) lighting	c) power	d) all of the above
4. Which of the following condition is associated with the risk of a dairy farm worker			
a) Problems of transmission of diseases	b) Problems related to the handling of the animals	c) Problems of the working environment	d) all of the above
5. Mulch over the soil helps as			
a) soil cooler	b) reduces weed growth	c) reduces erosion	d) all of the above

B. Fill in the blank

1. PPE stands for
2. The manure pit is generally dug out on a dry and fairly elevated land about meters away from the animals houses.
3. Manure is removed from the animal shed..... times daily
4. Vermi-compost is nothing but the excreta of....., which is rich in humus and nutrients.
5.is the decomposed mixture of dung and urine of farm animals along with litter, left over feed and fodder fed to the animals.

C. True or false

1. Liquid waste from livestock farm is dumped in the manure pit.
2. PPE only protects the individual and does not prevent the accident from happening.
3. Slurry is obtained from FYM.
4. Black, dry is the indication of immature compost.
5. Mulch is a layer of material applied to the soil surface.

D. Match the Column

E.

Column A	Write from column B	Column B
1. Natural process in which organic matter is decomposed by microorganisms		Manure pit
2. Use of earthworms for composting organic residues		Mulch
3. Solid waste from livestock farm is dumped		Slurry
4. A layer of material applied to the soil surface.		Composting
5. Manure in liquid form		Vermicomposting

F. Crosswords

				¹ B		
	² G					
³ C		⁴ M	P		⁵ S	
	G			A		
		C		S	E	
		H				
	S					

Across

- Vehicle used for road transport
- Usual mode of transportation of animals
- One of the mode of transportation by which comparatively large number of animals can be transported at a time

Down

- Vaccine which is applied once in their early life usually in female.
- Structure required for loading and unloading of animals

Management of Dairy Animals : Conservation of forages

LEARNING OUTCOMES

On completion of this unit the student will be able to:

- Make necessary arrangement for fodder conservation

INTRODUCTION

Feed alone constitutes about 70% of the total cost of animal production. Fodder crops are essential and the cheapest source of feed for ruminants. Thus, fodder crop based feeding strategies are required to reduce the cost of animal production. Land availability for the cultivation of fodder crops has been decreasing day by day. Hence, there is tremendous pressure of livestock on available total feed and fodder. Intensive fodder production as well as judicious use of fodder should be ensured to support the better animal productivity. If a dairy entrepreneur is to excel then he/she must pay special attention to the aspect of fodder cultivation and conservation.

SESSION 1: SCOPE AND IMPORTANCE OF GREENHOUSE INDUSTRY

i. Fodder crops for dairy animals

Under the category of fodders are included a wide range of crops and pastures species that are grown, harvested and may or may not be lightly processed. The fodders are directly fed to the animals or preserved for the future use as animal feed. Forage crops are plants which, when grown as a crop, have been found to produce high yields of plant biomass, which are also high in nutrients and suitable for animal's requirement for maintenance and production. Natural pasture is a forage but is not grown as a crop, so is termed forage, not a forage crop.

Feed alone constitutes about 70% of the total cost of animal production. Fodder crops are essential and the cheapest source of feed for ruminants. Therefore, fodder crop based feeding strategies are required to reduce the cost of animal production. Land availability for the cultivation of fodder crops has been decreasing day by day. Hence, there is tremendous pressure of livestock on available total feed and fodder. Intensive fodder production as well as judicious use of fodder should be ensured to support the better animal productivity. If a dairy entrepreneur

is to excel then he/she must pay special attention to the aspect of fodder cultivation and conservation.

Indian Grassland and Fodder Research Institute, Jhansi is the premier institute of forage resource development in Asia. The institute has developed many suitable technologies for maximizing fodder and fodder seed production in different agro-climatic situations and under various crop rotations. Year round fodder production technologies have been developed to meet the requirement for fodder for dairy animals' whole year and especially during lean period. Various post-harvest technologies and machines for fodder cultivation have been developed and popularized.

Types of cultivated fodder crops based on seasons

In India, agricultural crop production seasons are divided into kharif, rabi and zaid seasons. The Chart 7.1 illustrates the major cultivated fodder crops during these seasons.

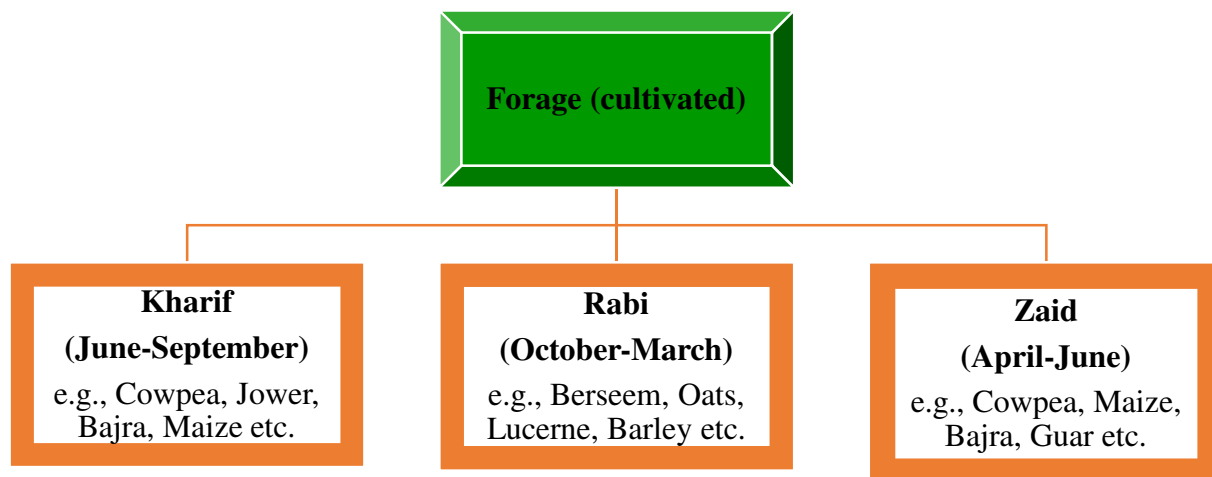


Chart 7.1: Classification of cultivated fodder crops based on seasons

Fodder crops containing high amount of crude protein

Fodder crops are broadly divided into leguminous (containing very high protein content) and non-leguminous (containing average protein content). The Chart 7.2 illustrates that common leguminous fodder crops such as berseem, lucerne and cowpea contain average protein content of 2.0-2.5% on fresh basis, whereas non-leguminous fodder crops such as maize, jower, bajra, oat, etc. contain average protein content of 0.7-1.5% on fresh basis.

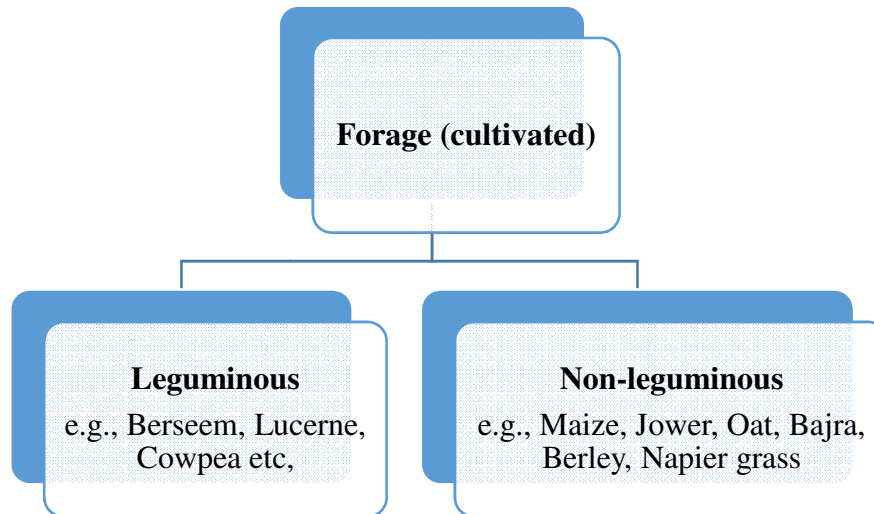


Chart 7.2: Classification of cultivated fodder crops based on leguminaceae

Summary of common fodder crops in India

A dairy entrepreneur should have a good idea of per hectare yield of fodder crops if he/she plans to grow the foddors on the farm itself. The Table 7.1 gives an idea of the combination of leguminous and non-leguminous fodder crops that may be grown by the dairy farmer.

Table 7.1: Season-wise list of foddors can be cultivated in a dairy farm

Season of availability of fodder crops	Name of fodder crops	Fodder yield (quintals/ hectare)
Kharif	Non-leguminous fodder crops	
	Maize (<i>Zea mays</i>)	350-450
	Sorghum (<i>Sorghum bicolor</i>)	650-1050
	Hybrid Napier (<i>Pennisetum perpureum</i>)	1200-1500
Rabi	Leguminous fodder crops	
	Cowpea (<i>Vigna sinensis</i>)	300-350
	Non-leguminous fodder crops	
	Oats (<i>Avana sativa</i>)	400-450
	Barley (<i>Hordeum vulgare</i>)	400-450
	Leguminous fodder crops	
	Berseem (<i>Trifolium alexandrinum</i>)	750-800
	Lucerne (<i>Medicago sativa</i>)	800-1000

Zaid	Non-leguminous fodder crops	
	Maize (<i>Zea mays</i>)	350-450
	Sorghum (<i>Sorghum bicolor</i>)	650-1050
	Hybrid Napier (<i>Pennisetum perpureum</i>)	1200-1500
	Para grass (<i>Brachiaria multica</i>)	750
	Leguminous fodder crops	
	Cowpea (<i>Vigna sinensis</i>)	300-350
	Lucerne (<i>Medicago sativa</i>)	800-1000

Photographs of some of the common green fodders are shown in Photo 7.1.



A good stand of Sorghum/ Jower fodder crop



Maize grown at dairy farm



Oat grown at dairy farm



Berseem grown at dairy farm



Para-grass grown at dairy farm



Guinea grass grown at dairy farm

Photograph 7.1: Photographs of some of the common green fodders

ii. Harvesting of fodder crops

Harvesting, the fodder crops means cutting and removal of forages from the field. Harvesting is done at particular stage of growth of the fodder crop so as to optimise both quantity and quality of biomass. Harvesting at a very young stage of the plant may results in higher protein content, but with low biomass yield. On the other hand as the plant matures the protein content rapidly decreases. Especially at the onset of the flowering stage, the protein content of the leaves and stems drastically reduces and total biomass yield increases. Some forages likes sorghum should not be harvested at very early stage of growth because of the presence of anti-nutritional factors such as Dhurrin. Therefore fodder crops should be harvested at proper stage to get optimum quality and quantity of forages.

Purpose of harvesting

Forages can be fed as pasture, in green chopped form, silage, or hay. If animals are allowed to graze on a large land area (i.e., pasture), much of the forage will be trampled, contaminated with manure or otherwise wasted. Green chopped fodder is very similar to intensive grazing as far as bio-availability of nutrients to the animal is concerned. Whereas additional energy requirements for harvesting and green chopping the fodder crops involve some costs (equipment, energy and labour costs), there are definite savings in the form of reduction of fodder wastage and loss due to trampling of fodder crops in the pasture by the animals. Animals can also be fed tree leaves as a green fodder during times of scarcity and therefore such tree leaves can also be harvested and stored. The Chopped green fodder ready for feeding the animals has been given in the Photo 7.2.



Photograph 7.2: Chopped green fodder ready for feeding the animals

Losses of biomass as well as nutrients caused due to hay and silage making are mainly during harvesting and storage stages. Harvest and storage losses are greatest for hay and silage, but if proper silage and hay making practices are followed, these losses can be minimized.

Harvesting serves the following purposes:

- Provide green fodder to the animals.
- Provide optimum nutrients to the animals.
- Facilitate more biomass yield from a particular field.
- Storage of excess fodder in the form of hay, silage, etc., for use during lean period.
- Maintain desired plants species combination in the pasture.

Methods of harvesting

Harvesting is usually done by either of the following methods:

- i). **Manual:** Sickle is most commonly used tool for harvesting the fodder crops. The sickle has to be sharp, curved and serrated for efficient harvesting. Other traditionally designed tools are used in different parts of the country for harvesting and cutting the crops or tougher portions of the plant.
- ii). **Mechanical:** In mechanical method, harvesting is done with the use of implements or machines such as tractor-attached fodder cutter.

Harvesting time

a) Optimum time for harvesting the fodder crops

All fodder crops change in nutritive profile as they mature. Fodder crops at very early stages of growth have high protein content and are usually highly digestible, but yields are low. As the plant grows, yield (i.e., total volume or biomass) increases but the digestibility and protein content decline. A proper balance between yield and quality therefore needs to be assessed when deciding when to harvest the fodder crops. The harvesting time of major fodder crops has been given in Table 7.2.

Table 7.2: Harvesting time of major fodder crops

Fodder crops	Growth stage and time of harvesting
Jowar	<p>Single-cut varieties: Immediately after flowering to 50% flowering stage of the plant.</p> <p>Multi-cut varieties: 1st cut should be taken 2 months and subsequent cuts at 35-</p>

	40 days interval.
Maize	Usual harvesting time is 60-70 days after sowing when the plants are in milk stage. As green fodder: Harvesting should be started at cob formation stage and completed before milk stages. For silage preparation: Harvesting should be done when cobs are soft or glazed stage for high-energy content.
Bajra	Usual harvesting time is at boot leaf stage or immediately after a few plants has already flowered. In case of multi-cut varieties, subsequent cuts can be taken 30 to 40 days interval.
Oat	When oat is cultivated as pure crop, harvesting should be done at the initiation of flowering to 50% bloom stage. However, in mixed cropping both the crops should be cultivated jointly before attaining over-maturity. First cut should be taken 60-70 days after sowing.
Cowpea	Single cut varieties: Harvesting should be done at 70 to 90 days after sowing. Double cut varieties: 1 st cut after about 50 to 55 days after sowing and clipped 15cm above the ground level. 2 nd cutting is taken 45-50 days after 1 st cutting. Three cut varieties: 1 st cut after about 45 to 50 days after sowing and subsequent two cuttings after every 25 to 30 days.
Berseem	First cut at 45-50 days. Subsequent cut at 20-25 days interval and in all, 4 to 5 cuttings may be obtained
Lucerne	First cut in lucerne can be taken 45-60 days after sowing. Subsequent cuts are taken at 20-30 days interval. The crop can be retained for 3-4 years in the same field.
Hybrid napier grass	The first cut is taken 9-10 weeks after planting. Subsequent cuts are taken after four to six weeks or when the plant attains a height of 1.5 m. Annually, at least six to eight cuts are possible.
Para grass	The first harvest takes about three months after planting when the grass attains a height of about 60 to 75 cm. Subsequent cuts are taken at 30 to 40 days interval.

PRACTICAL EXERCISE

Activity 1: Process of hay making

Materials Required:

1. Sickle
2. Wood or metal fork
3. Tractor

Step by Step Procedure:

1. Mowing/cutting: Harvest the fodder to be used for hay making
2. Curing: Drying of fodder upto the right moisture content of 15 to 20 per cent.
3. Storage: Hay is generally stored as loose hay, baled hay or chopped hay, etc.

CHECK YOUR PROGRESS

A. Multiple choice

1. Indian Grassland and Fodder Research Institute (IGFRI) is situated at			
a) New delhi	b) Kolkata	c) Jhanshi	d) Bareilly
2. Which of the following is considered as kharif fodder			
a) Berseem	b) Maize	c) Barley	d) Oat
3. Which of the following is considered as rabi fodder			
a) Berseem	b) Maize	c) Cowpea	d) Sorghum
4. Which of the following is considered as leguminous fodder			
a) Sorghum	b) Mustard	c) Lucerne	d) Maize
5. Harvesting of fodder serves which of the following purpose			
a) Provide optimum nutrients to the animals	b) Facilitate more biomass yield from a particular field.	c) Provide green fodder to the animals	d) All of the above

B. Fill in the blank

1. Scientific name of Sorghum is.....
2. Sorghum should not be harvested at very early stage of growth because of the presence of anti-nutritional factors such as.....
3. Usual harvesting time for maize fodder isdays after sowing when the plants are in milk stage.
4. Scientific name of Lucerne is.....
5.leguminous fodder is grown in khariff season.

C. True or false

1. Fodder crops are essential and the cheapest source of feed for ruminants.
2. Leguminous fodder containing very high protein.
3. As the plant grows biomass yield increases.
4. Year round fodder production facilitates storage of fodder.
5. As the plant matures the protein content rapidly decreases.

D. Match the column

Column A	Write from column B	Column B
1. Berseem		<i>Vigna sinensis</i>
2. Lucerne		<i>Sorghum bicolar</i>
3. Cowpea		<i>Hordeum vulgare</i>
4. Sorghum		<i>Trifolium alexandrinum</i>
5. Barley		<i>Medicago sativa</i>

E. Crosswords

	¹ R		² B			
	³ K				I	F
⁴ B	A		R			
⁵ J	⁶	W		R		
			Y			
	T					

Across

- Another name of fodder cultivation in rabi season.
- Another name of fodder cultivation in rainy season.
- Non-leguminous fodder grown in kharif season
- Scientific name of the fodder is *Sorghum bicolar*

Down

- Non-legumiuous fodder grown in rabi season.
- Non-legumiuous fodder grown in rabi season.

SESSION 2: Methods of conservation of forages and judging their quality

i. Conservation of forages

Fodder is the primary feed of all the ruminants (cattle, buffalo, sheep, goat, etc.). Fodder is not sufficiently available throughout the year. In India, during rainy season plenty of greens are available but they are not properly utilized by the farmers due to lack of knowledge about fodder conservation. Thus, surplus fodder can be conserved in the form of hay and silage during periods of excess availability. By adopting this approach good quality fodder can be supplied during the lean periods (May to July and October to November). The conserved fodder can be used for consumption at the dairy farm or it can be sold. Besides this, during natural calamities, conserved fodder can be a good source of nutrients for the ruminants.

ii. Favourable conditions for forage conservation

The favourable conditions for conservation of forages are depicted in the Chart 7.3.



Chart 7.3: Favourable condition for fodder conservation

iii. Equipments and machines required for forage conservation

The information about the various equipments and machines generally required for conservation of forages is furnished in Table 7.3. All the equipments and machines used for this purpose should fulfil the requirements of occupational health and safety standards. The photo of Electrically operated Chaff cutter and Sickle is given in Photographs.

Table 7.3: Equipments and machines along with their functions required for forage conservation

Equipments and machines	Functions
Mower	Mower is a machine to cut fodder crops and leave them in swath. Swath is the path through a crop made during a single passage of a mowing machine.
Sickle	Sickle is a simple harvesting tool used by manual power. It consists of metallic blade (plain/serrated) and a wooden handle.
Wood or metal forks	Required for turning, tedding, loading and stacking.
Tractor	Required for transportation of fodder.
Chaff cutter	Used to chaff fodder into small pieces. Both manually-operated and electrically-operated chaff cutters are available in the market.
Baler	Baler is used to compress and compact the hay into bales. The baler is attached to the tractor.



Electrically operated chaff cutter



Sickle

Photograph 7.3: Common machine and equipment used for forage conservation

iv. Methods of forage conservation

Commonly practiced forage conservation methods are described below:

a. Hay

When the forage crops are preserved by reducing their moisture content from 70 - 90% to 15-20%, we get the hay form of the forage crop. Fodder crops with hollow stems are most suitable for hay making. The process of hay making turns the green and perishable forage into a product that can be safely stored and easily transported without danger of spoilage. Nutritive values of given hay is comparable to the forage from which the hay is made. Maintenance requirement for all classes of animals can be fulfilled by feeding hay solely.

Following are the main steps involved in the process of hay making.

- i. **Mowing/cutting:** The fodder should be harvested at proper stage of maturity.
- ii. **Curing:** This is the process of drying of fodder upto the right moisture content of 15 to 20 per cent. Curing starts in the field after cutting when the material is left to wilt. Wilting period varies with type of material and weather conditions. Various methods of drying are practiced for hay making which are discussed below:
 - a. **Artificial conditioning:** Rapid drying of fodder crops with machinery and fans.
 - b. **Turning and tedding:** It allows uniform drying of the swath and helps to dissipate heat and reduce the danger of mould development and fermentation.
 - c. **Windrowing:** The process of putting the cut herbage into rows for further handling and collection and for protection at night is called windrowing. In hot arid conditions, windrowing protects the crop against shattering and bleaching.
 - d. **Trussing:** It includes making small heaps during intermediate stages of drying and is largely practiced in manual systems of conservation.
- iii. **Storage:** Hay can be kept for long periods if properly made i.e., if it contains moisture upto maximum of 15%. The hay is generally stored as loose hay, baled hay or chopped hay, etc.

The essential steps of process of hay making is given in Chart 7.4.

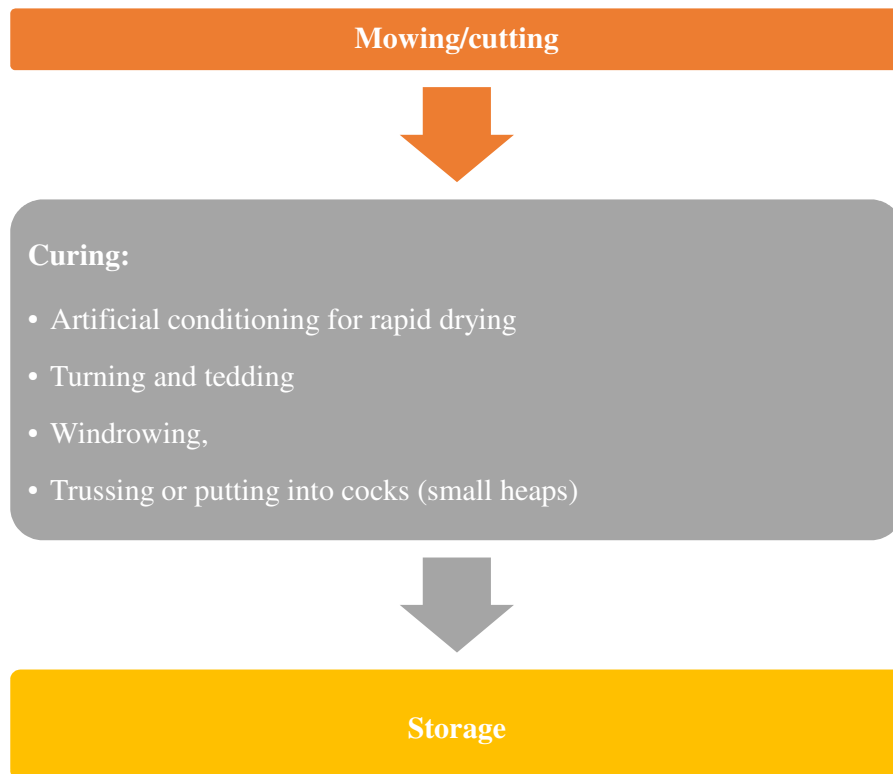


Chart 7.4: Essential steps of process of hay making

b. Silage

Silage is obtained by fermentation of forages under anaerobic conditions. The process of conserving green fodder in this way is known as ensiling. The containers in which material is fermented are called silo. The structure of bunker type Silo is given in Photo 7.4. Silage is also called “pickled grass”. Silage is wet forage with about 70% moisture content. Fodder crops having thick stems are suitable for silage making.

Details of the various steps of silage making has been depicted in Chart 7.5.

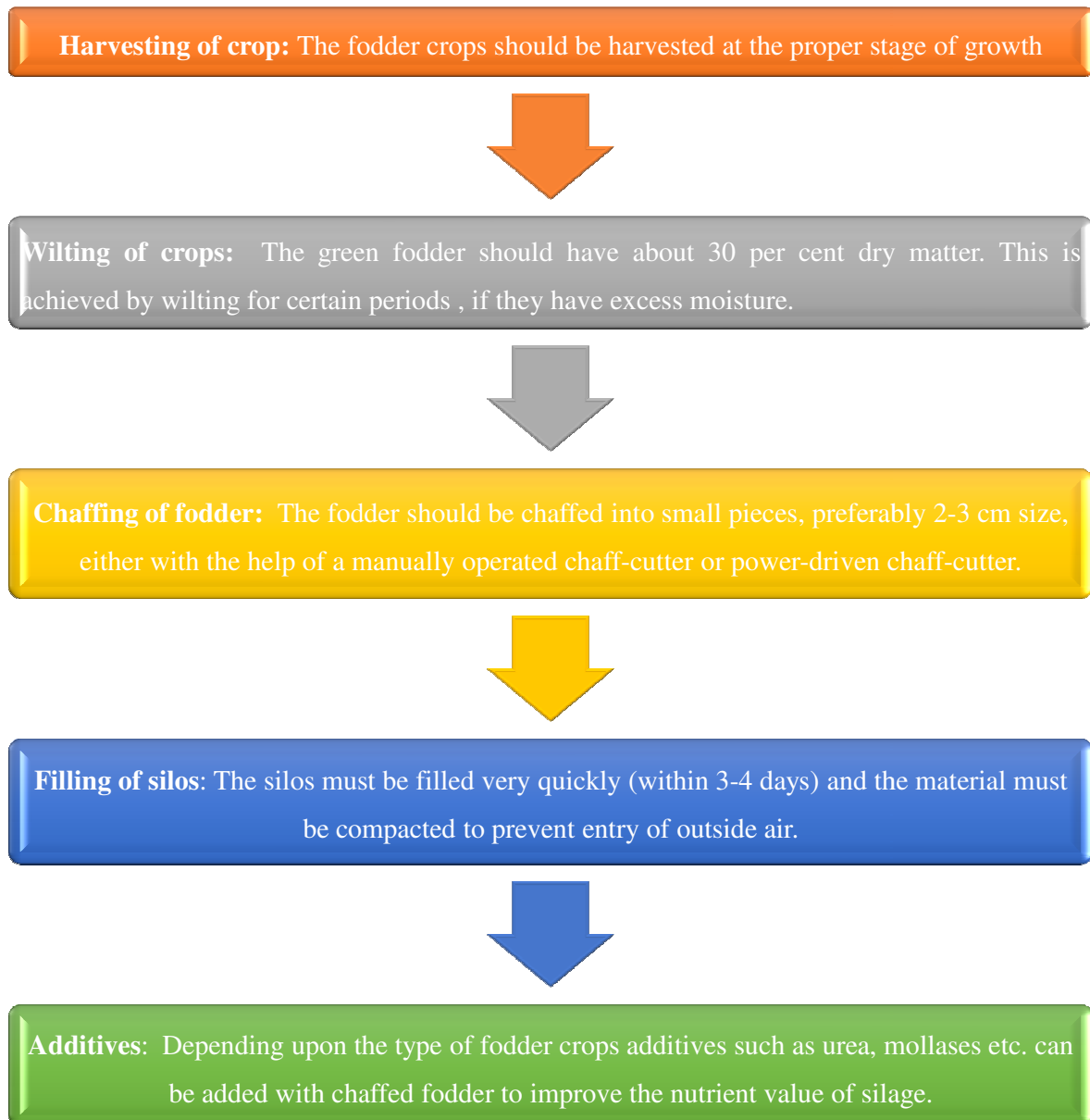


Chart 7.5: Steps of silage making



Photograph 7.4: A bunker type of silo

c. Straws and agriculture waste

After harvesting of grain crops, the remaining plant materials can be used as dry fodder for the animals. Straws and agricultural waste can be preserved for long duration without much effort. Straws can be easily stored in the hay/straw godown and fed to the animals as and when required (Photo 7.5)



Photograph 7.5: Godown for storing straw (i.e., bhusa)

v. Methods for judging quality of the conserved forage

Judging the quality of silage

Silage quality is usually judged based on the following characteristics-

- i. smell (butyric acid)
- ii. colour : Good silage keeps a greenish yellow colour
- iii. wetness, structure
- iv. soil contamination

Judging the quality of hay

Quality of hay is judged based on the following criteria

- a) Hay colour - Yellow/Green -Good
 - Yellow/Grey -Medium
 - Brown/Black -Poor
- b) Mould, dust, smell to be checked
- c) Presence of weeds, thorns, etc.

vi. Ways to minimize environmental impact

The forage debris can attract the vermin and cause losses to the stored hay. Proper disposal of the waste and debris generated from the feed storage are therefore essential to minimize harmful environmental impact. Following points should be considered in this regard.

- i. Regular cleaning of the surroundings around the storage structure.
 - ii. Regular checking of the stored feed material to avoid possible spoilage.
 - iii. Chemicals should not be used for artificial curing of the hay; otherwise it may have negative impact on the environment.
 - iv. Routine cleaning and servicing of machinery and equipments should be done in accordance with manufacturer's specifications.
 - v. Effluents are generated from the conserved forage structures like silos, therefore, make suitable arrangement for the run-off of the effluents to the effluent treatment plant.
- vii. Assessing the requirements of conserved fodder**

The quantity of fodder required for a particular farm depends upon number of factors. Various factors influencing the fodder requirements of dairy farm are presented in Chart 7.6

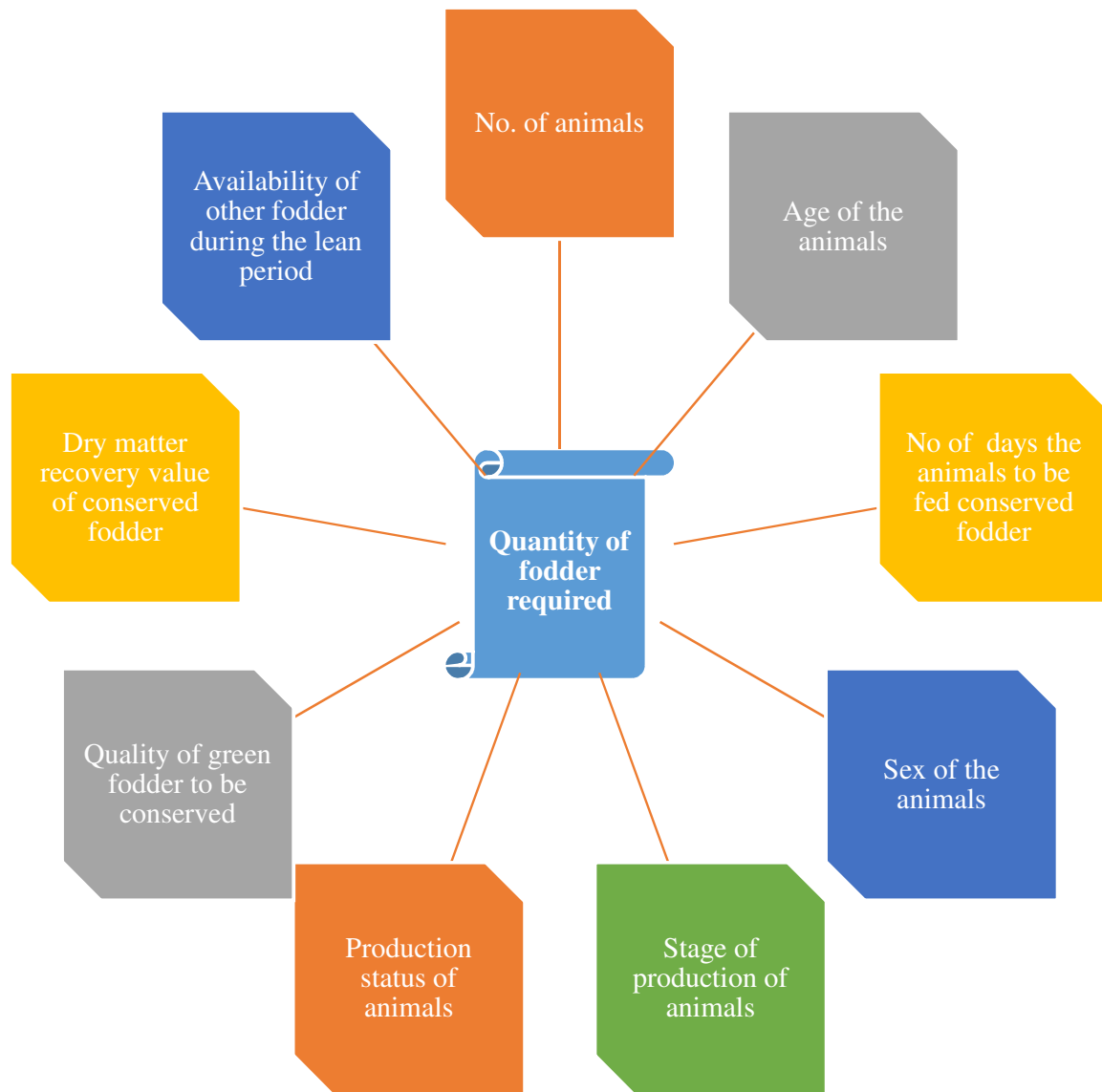


Chart 7.6: Factors influencing fodder requirements of a dairy farm

As a rule of thumb, a cow can eat 20-25 kg of silage per day. For a unit of ten cows, approximately 240 quintals of silage is required for feeding during the fodder scarcity period i.e., four months ($10 \times 20 \times 120$). Similarly, adult animals consume about 5-6 kg hay per day, besides other feeds. For a unit of ten cows, approximately 72 quintals of hay is required for feeding during the fodder scarcity period i.e., four months ($10 \times 6 \times 120$).

PRACTICAL EXERCISE

Activity 1: Process of hay making

Materials Required:

1. Sickle

2. Wood or metal fork
3. Tractor

Step by Step Procedure:

1. Mowing/cutting: Harvest the fodder to be used for hay making
2. Curing: Drying of fodder upto the right moisture content of 15 to 20 per cent.
3. Storage: Hay is generally stored as loose hay, baled hay or chopped hay, etc.

CHECK YOUR PROGRESS

A. Multiple choice

1. Dry matter content of silage preferably be..... %.			
a) 10	b) 15	c) 20	d) 30
2. Fodder is not the primary feed for which animals			
a) Cattle	b) Buffalo	c) Pig	d) Goat
3. Which of the following also known as “pickled grass”			
a) Hay	b) Silage	c) Dry fodder	d) None of the above
4. The smell of a good quality silage is due to its			
a) Butyric acid	b) Acetic acid	c) Propionic acid	d) None of the above
5. Which of the following equipments and machines not generally required for conservation of forages			
a) Sickle	b) Baler	c) Chaff cutter	d) Rotavetor

B. Fill in the blank

- i. stem crops are suitable for hay making.
- ii. Dry matter content of stored hay preferably be..... %.
- iii. After..... days of sealing of silo, silage will be ready to feed the animals.
- iv. Colour of the good silage is
- v. Colour of the good hay is

C. True or false

1. Hollow stem crops are suitable for silage making.
2. Silage is prepared under aerobic condition.
3. Baler is used in the preparation of hay.
4. Fire hazard is the problem of silage.
5. Brown/black colour of hay indicating it's poor quality.

D. Match the column

Column A	Write from column B	Column B
1. Mower		Required for turning, tedding, loading and stacking
2. Wood or metal forks		Transportation of fodder
3. Tractor		Baler is used to compress and compact the hay into bales.
4. Baler		Used to chaff fodder into small pieces
5. Chaff cutter		Machine to cut fodder crops and leave them in swath.

E. Crosswords

		¹ B	A	L	E	
	² C	U	R	I	N	G
		T				
		Y				
	³ G	R	E	E	N	
		I				
⁴ S	I	C	K	L	E	

Across

- Hay can be stored in this form.
- This is the process of drying of fodder upto the right moisture content of 15 to 20 per cent for hay making.
- Colour of good quality silage.
- It is a simple harvesting tool used by manual power and consists of metallic blade (plain/serrated) and a wooden handle.

Down

- Normal smell of the silage due to this acid.

GLOSSARY

- **Dairy:** A dairy is a business enterprise established for the harvesting and/or processing of milk for human consumption.
- **Dairy farmer:** A dairy farmer manages dairy cows and milking operations to ensure maximum milk production. Farmers' responsibilities vary according to the sizes and types of farming operations they manage.
- **Indigenous animals:** Animals which belongs to descript/non-descript breeds of indigenous origin.
- **Exotic animals:** Animals which are developed in other countries are described as exotic animals. The most important exotic dairy cattle breeds in India are Jersey and Holstein Friesian (HF).
- **Cross-bred animals:** Animals which are produced by crossing indigenous animals with exotic breeds or indigenous animals which have exotic inheritance are described as crossbred animals.
- **Livestock:** Domestic animals, such as cattle, buffalo or horses, raised for home use or for profit, especially on a farm.
- **Paddock:** A small enclosed field, often for grazing or training horses, usually near a shed.
- **Dairy animal:** Animals reared for milk production
- **Records:** Information or data on a particular subject collected and preserved
- **Transportation:** The act or process of moving animals or things from one place to another
- **Feed:** It is food for livestock
- **Roughage:** Feeds those generally are higher in fiber (cellulose), less digestible, and lower in energy.
- **Concentrate:** Feeds that generally are high in energy, low in fiber, and usually are highly digestible.
- **Ration:** Ration is the feed allowed for a given animal during a day of 24 hours. The feed may be given at a time or in portion at intervals.
- **Milking:** The act of drawing milk from cows, goats, or sheep for human consumption.
- **Fodder:** It is the plants or parts of the plant eaten by livestock. A plant purposely grown for livestock feeding.
- **Forage:** Natural growing grass species

- **Hay:** Dried fodder used as animal feed.
- **Silage:** It is a stored fodder that fermented and preserved in high-moistured condition usually fed to ruminants.
- **Waste:** Unwanted or unusable items generated from a unit

FURTHER READING

Websites

<http://www.igfri.res.in>

<http://www.ivri.nic.in>

<http://www.nbagr.res.in/>

<http://www.ndri.res.in>

<https://agriculture.gov.in>

<https://dahd.nic.in>

<https://www.nabard.org>

www.fao.org

www.icar.org.in

www.nianp.res.in/

www.tanu.edu

Books

Banerjee, G.C. 1998. Textbook of Animal Husbandry. 8th edition. Oxford and IBH Publication, New Delhi.

Biswajit Roy and Sudipta Ghosh. 2015. Dairy Animal Production. IBDC, Lucknow

ICAR. 2002. Handbook of Animal Husbandry 3rd Ed. ICAR.

Jagdish Prasad and N.S. Niraj 2007. Principles and Practices of Dairy Farm Management . 5th Edition. Kalyani Publishers, Ludhiana

Ramadhar Singh. 2009. Essentials of Animal Production and Management. Kalyani Publishers, Ludhiana

Thomas, C.K. and Sastry, N.S.R. 1991. 2006. Livestock Production and Management. Kalyani Publishers, Ludhiana

Thomas, C.K. and Sastry, N.S.R. 1991. Dairy Bovine Production. Kalyani Publishers, Ludhiana.