PRACTICAL MANUAL

ON

Rangeland and livestock Management

FNR 220 2(1+1)

For B.Sc. Forestry IV Semester students

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2020

College of Horticulture & Forestry
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Rangeland and Livestock Management FNR 220 2(1+1)

Syllabus: Study of grassland and rangelands in the area. Different tools/instruments used in livestock management; Routine management practices followed on livestock farms; Identification of feedstuffs and their nutritive value; Nutritive requirement animals; Study of housing systems and requirements; Preservation of fodder as hay, silage and leaf meal.

Name of Students .....

Roll No. .....

Batch .....

Session .....

Semester .....

Course Name : .....

Course No. : ..... Credit .....

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This is to certify that Shri./Km. .....ID No.....has completed the practical of course.....course No. ..... as per the syllabus of B.Sc. (Hons.) Agriculture/ Horticulture/ Forestry ..... semester in the year.....in the respective lab/field of College.

Date: Course Teacher

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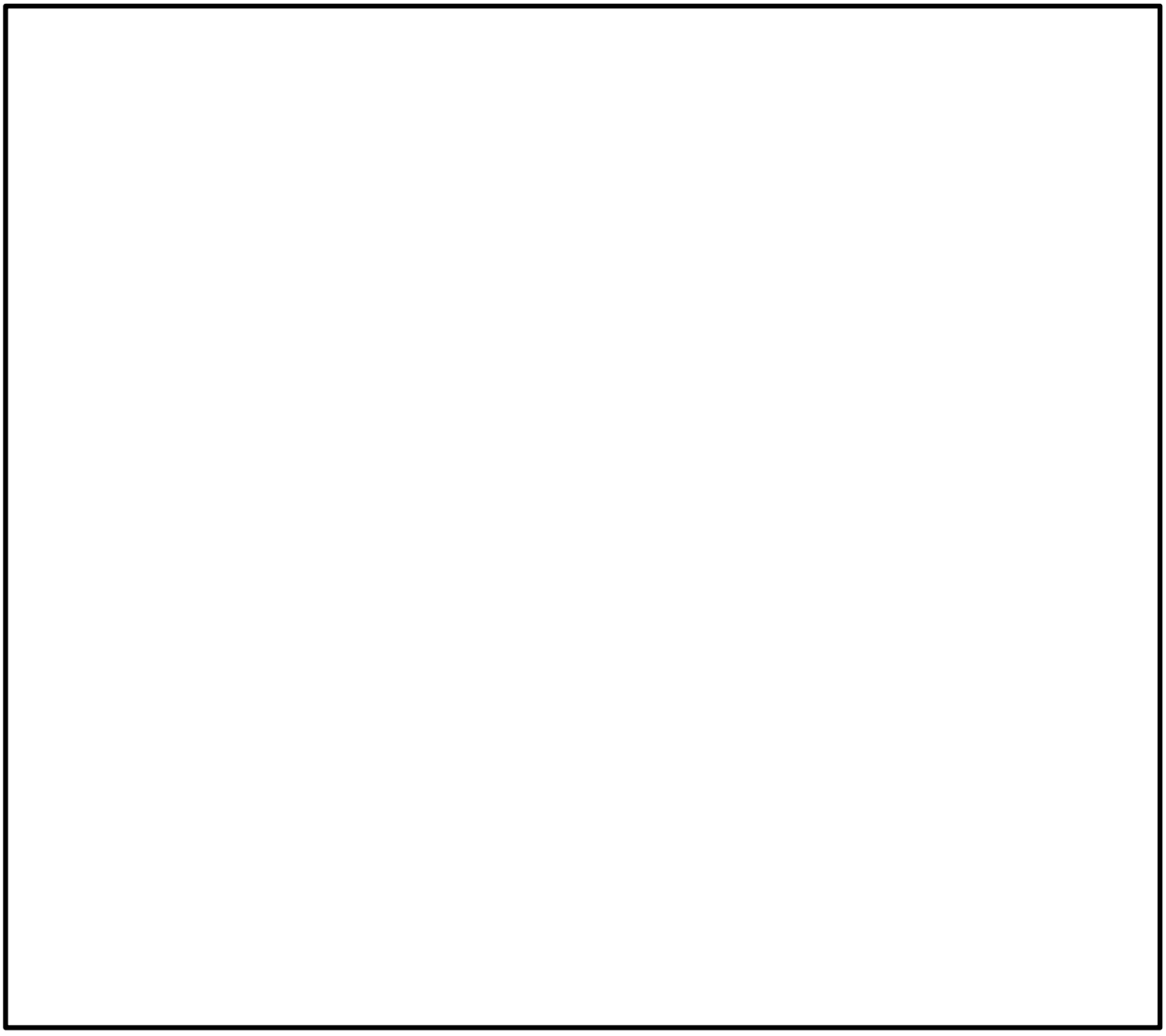
Practical No. 1

Objective: To study body parts and points of cattle

Problem: Draw a well-labelled sketch of cow and describe its body part and indicate in the figure.



Head……

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Neck……

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Body or Barrel……..……..

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Fore Quarters ……..……

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Hind Quarters ……

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Practical No. 2

Objective: To acquaint students with different tools/ utilities used in livestock management

To manage the livestock there are many tools and utilities are used. The students must know these tools and their uses.

Name	Uses	Diagram
Muzzles		
Mouth Gag		
Halter		

Nose String		
Bull Leader		
Side Stick		

Travis or Crush		
Twitch		
Cradle		
Bridle		

Practical No. 3

Objective: To study grassland /rangeland of the local area

Type	Distribution	Site Factor	Vegetation Composition		Management
			Perennial	Annual	
Sehima/ Dichanthium					
Dichanthium/ Cenchrus					
Phragmites/ Saccharum					
Bothriochola					

Cymbopogon					
Arundinella					
Deyeuxia/ Arundinella					
Dischampsia/Deyeuxia					

Practical No. 4

Objective: To make routine observation on the livestock farm

Procedure of routine operations: ……

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Time	Routine Operations

Practical No. 5

Objective: To study important dairy farm records

Registers Pertaining of financial and Account Matter ……

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Register Pertaining to Accounting of Animals ……

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Cattle Yard Report: ……

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Roll Call Register:

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Roll call Register Month……									
Date	Cows	Heifers	Bulls	Bullocks	Male Calves		Female Calves		Others
					≤1yr	≥1yr	≤1yr	≥1yr	

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Cattle Yard Report				
Date	Herd Strength and Events of Animals	Treatment/Vaccination	Events of Feeds and feeding	Remark/Weather

Herd Register: ..…….....

Birth Register: …….....

Birth Register Place……Year…….											
Sr. No. of Birth	Name & No of Dam	Name & No of Sire	Date of Fertile service	Date of calving	Male Calves		Female Calves		Gestatio n Period of Dam	Age of first calving (Days)	Rem ark
					Name & tattoo No.	Birth wt (kg)	Name & tattoo No.	Birth wt (kg)			

Death Register:

Sr. No.	Name & No. of Animal	Breed Group	Sex	Class	Date of Birth/Death	Post mortem done or not	Post mortem report and reasons of death

Register Pertaining to milk production:

a.----------

b.----------

c. ----------

d.----------

Register Pertaining to Reproduction

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Cattle yard report: ……

Service Book: ……

Service book Month……..…Year……..…				
Date	Name and No ofCows/Buffalo	Name and No ofbull/Buffalo bull	Natural services of AI	Remarks

Service Ledger:

Sr. No.	Service ledger (Classified/individual service register)							
	Name & No of Heifer/ Cow	Date of Calving	Service	Records (Dates of AI/PD)				
			1st	2nd	3rd	4th	5th	Remark

History Sheet: ……

Practical No. 6

Objective: To classify feed stuffs of livestock

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Practical No. 7

Objective: To identify feed stuffs- grasses and fodder legumes

SN	Common name	Botanical name	Identification features	Sketch/ photo
1		*Cenchrus ciliaris*		
2		*Pennisetum purpureum*		
3		*Cynodon dactylon*		
4		*Brachiaria mutica*		
5		*Panicum maximum*		
6		*Pennisetum purpureum*		
7		*Cenchrus setigerus*		
8		*Medicago sativa*		
9		*Trifolium alexandrinum*		
10		*Vigna sinensis*		
11		*Crotalaria juncea*		
12		*Avena sativa*		
13		*Sorghum vulgare*		

Practical No. 8

Objective: To evaluate different feeds resources for their proximate principles by using Weende's system of analysis

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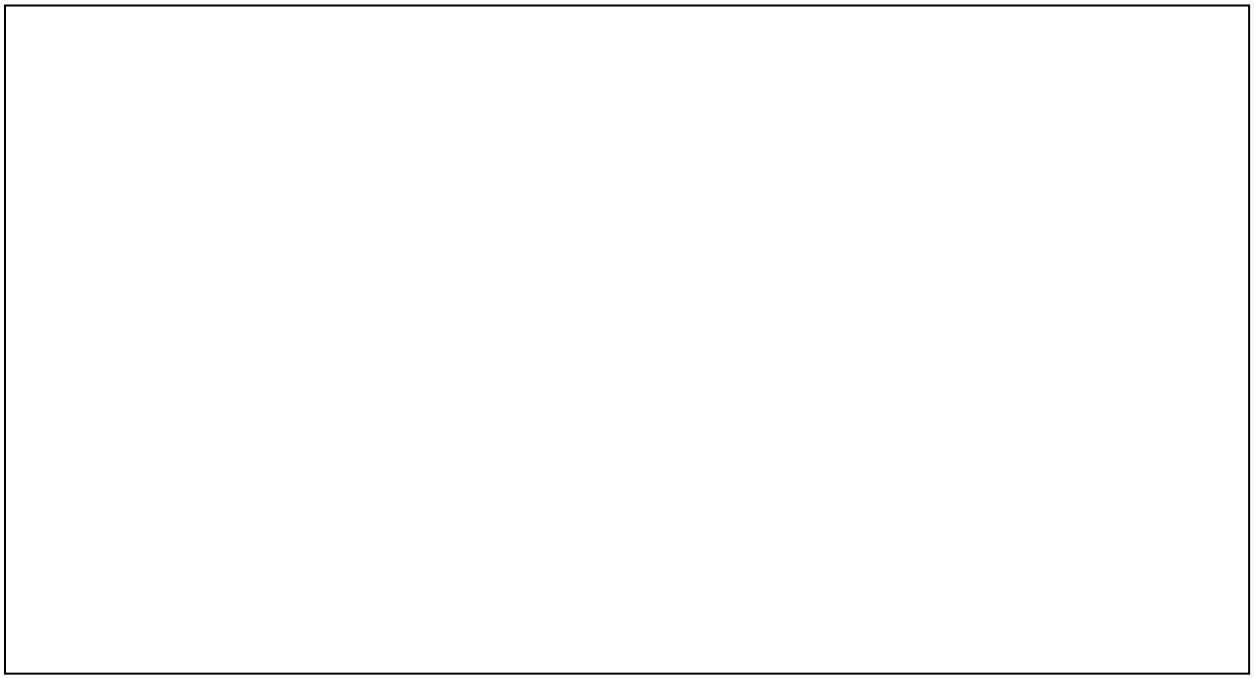
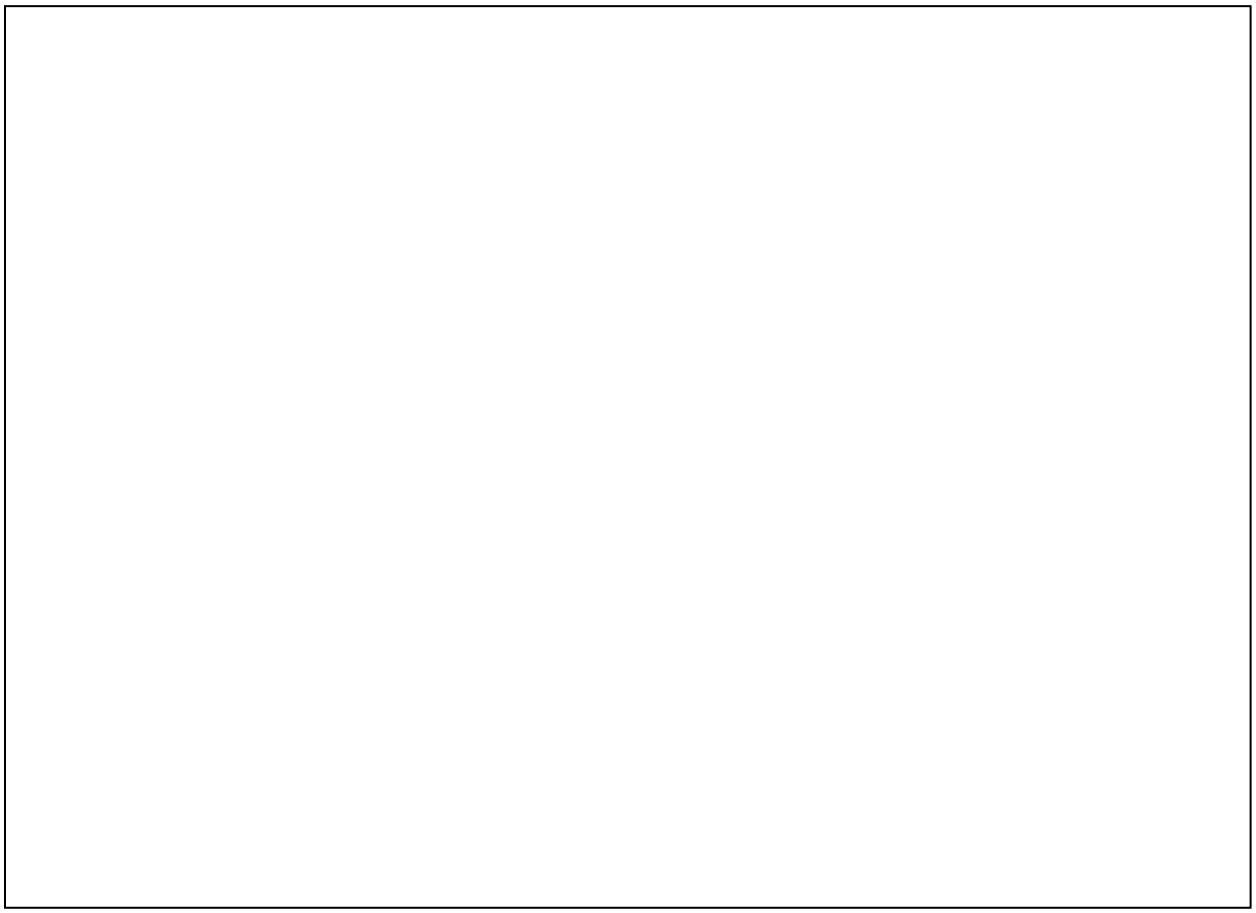
The scheme of Weende proximate analysis



DRAW FLOW DIAGRAM FOR PROXIMATE ANALYSIS



Practical No. 9

Objective: To determine dry matter and moisture in feed samples

Equipment required: ……..

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Procedure: ……

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Observations:

W_0 [Weight of empty dishes or tray (g)] : …….

W_1 [Weight of dishes/tray with fresh sample (g)] : …….

W_2 [Weight of dishes/tray with the completely dried sample (g)] : …….

Calculations:

Dry matter (%) = ……...

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Moisture (%) = ……...……...

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Result:

Moisture content in given sample is.....%.

Dry matter content in given feed sample is.....%.

Practical No. 10

Objective: To estimate crude protein (CP) content in the feed sample

Equipment and Glass wares required: ……

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Reagents: ……

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Procedure: ……

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Observations:

Volume (ml) of the N/10 H_2SO_4 consumed for titration of sample (V1) =

Volume (ml) of the N/10 H_2SO_4 consumed for titration of blank (V) =

Weight of the oven dried sample taken for digestion (W) =

Total volume of aliquot made by digested sample (D) =

Aliquot taken for distillation (A) =

Calculations:

% N =

% CP =

Precautions: ……

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Practical No. 11

Objective: To estimate crude fibre (CF) fraction in the feed and fodder samples

Equipment and Glass wares required: ……

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Reagents: ……

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Procedure: ……

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Observations:

Weight of crucible + residue before ashing Wg = ……

Weight of crucible+ ash W1g = ……

Weight of feed sample W2g = ……

Calculation:

CF % (on DM basis) = … .

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CF % (on DM basis) = … .

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Precautions: ……………………………………………………………………………………………………...…

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Results:

The given sample contains ……..…….%CF

Practical No. 12

Objective: To calculate water and feed requirement of dairy herd

Requirement of nutrients for maintenance: ……

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Daily maintenance requirement for various nutrients

B.W. (kg)	DCP (g)	TDN (kg)	Ca (g)	P (g)

Requirement of nutrients for production: ……

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Nutrient requirement for milk production

Fat %	DCP (g)	TDN (g)

Requirement of nutrients for growth:

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Daily Nutrient requirement in terms of DCP and TDN for growth

ADG (g)	DCP (g)	TDN (g)

Requirement of nutrients for Work allowance: ……

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Daily nutrient requirement for working bullocks

B.W. (kg)	DCP (g)	TDN (g)

Pregnancy allowance:

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Breeding bull: ……

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Daily allowance for breeding bull over and above the maintenance

B.W. (kg)	DCP (g)	TDN (kg)
400	380	3.6
500	450	4.5
600	530	5.4

Practical No. 13

Objectives: To compute ration for cattle and buffaloes

Principle: .....

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Formulation of ration: .....

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Problems

1. Compute a balanced ration for a cow weighing 450 kg and producing 5 litre milk/day of 5% fat. The animal is in advanced pregnancy. The feedstuffs available are wheat straw, green sorghum, maize grain, wheat bran and ground nut cake.
2. Formulate the ration for a buffalo weighing 500 kg and producing 12 liters of milk of 6% fat in the month of November.

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Practical No. 14

Objectives: To study housing of dairy cattle

Deciding the location of dairy / building ……

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Type of Housing: ……

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Practical No. 15

Objective: To determine total solids in Milk

Materials needed: ……

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Procedure: ……..

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Observations:

Weight of empty moisture cup W 1g

Weight of moisture cup + milk W 2g =

Of milk taken W2-W 1g =

Weight of moisture cup + total solids W 3g =

Weight of total solids in milk (W3 =W1g) =

Calculation: Per cent total solids in milk =

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Practical No. 16

Objective: To demonstrate the methods of silage making

Procedure: ……

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Practical No. 17

Objective: To demonstrate the methods of hay making

Procedure of Hey Making ……

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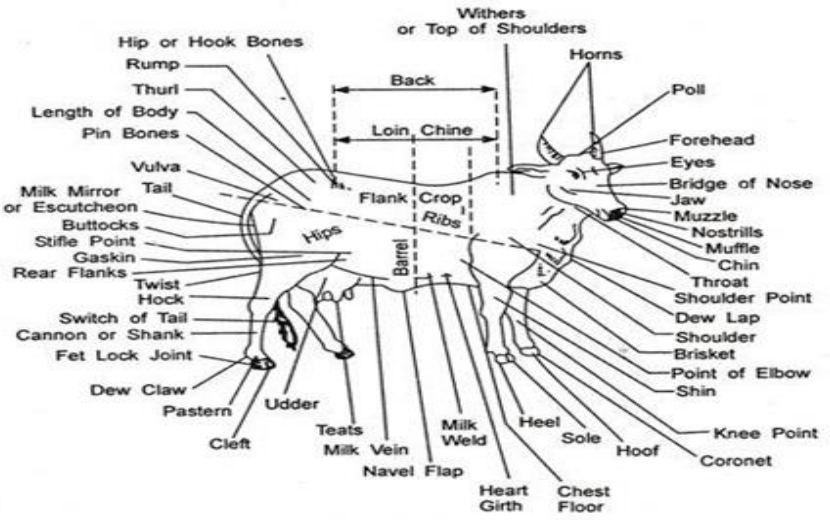
BODY PARTS AND POINTS OF CATTLE

1. To judge the utility of animal. The degree of development of certain body parts of the animal body has a direct relationship with the utility of the animal. e. g. size of udder has a direct relationship with milk production. Similarly, the development of legs has a direct relationship with work capacity of bullocks etc.
2. The knowledge of external body parts is essential for classification / recognition / registration of breed of animal.
3. To provide correct information to the concerned experts during sickness, injury, theft or sale and purchase of animal etc.
4. To know about the sex as well as the general heath/sickness of the animal.
5. The student must be acquainted with terminology of different body parts.

Head:



Mouth: It is the organ of prehension and chewing of food. It consists of lips, tongue, teeth, gums, dental pad and jaws.

Chin : A fleshy pink colored bulging portion between the nose and upper lip

Muzzle: A roughly square blackish portion in front of face on the upper lip. It is generally black in most animals. But some animals may have spotted/mottled muzzle also. It is always moist with water drops in healthy animal and dry in sick animal. Like fingerprints, muzzle prints are used for medico-legal issues in animals.

Muffle: A hairy whitish periphery around the muzzle is called muffle.

Nostril: Two openings on either side of upper corners of muzzle. There is a nasal septum between nostrils.

Nose: A prominent ridge like structure in front of face.

Face: It is the portion below the level of two eyes up to the muzzle.

Cheeks: The lateral portion of face below the level of eyes on both the sides.

Eyes: Two in number, consist of eyebrows, eyelids, eyelashes and eyeballs, cornea sclera. Eye lids/lashes protect the eyes from entry of foreign materials.

Ears: Two in number, consist of the tip, the base and the fringe. They are of different shape & size and erect or drooping in different breeds. Ears are useful in herd management, viz. for applying identification marks and for handling/restraining the animal.

Horns: Two long or short hard appendages on both the upper corners of the animal's head used for self-defense. They consist of the base, the shaft and the tip. They are generally black in young age and yellow black in old age. In some breeds (Khillar) horns are pinkish yellow. The rings present on the horns of cattle are used for their ageing

Forehead: A roughly square front portion of head between the head crest & the level of two eyes. It may be flat, dishy or bulging in shape as per the breed of animal.

Head crest: A prominent ridge like portion joining the base of two horns.

Poll / Nimbory: It is the bulging portion present in the center of head crest.

Neck:

Neck crest: It is the upper ridge like portion of the neck between the poll and the point of withers. It is the portion where yoke is placed in bullocks.

Dewlap: A wavy loose thick skin folds hanging below the neck from throat to brisket. It is more developed in zebu cattle than the taurus and crossbreds, & it helps in heat dissipation i.e., body temperature regulation.

Brisket: A flashy bulging mass situated between and in front of two forelegs.

Throat: A slightly bulging hard portion below the neck just behind the angles of jaws.

Jugular groove: A groove, furrow or depression running down the neck on either side above the trachea/wind pipe. Jugular vein passing through this groove is used for blood collection or for 1/V administration of drug in animals.

Body or Barrel:

Hump: The prominent fleshy mass present between neck crest and point of withers in zebu cattle. It is absent in exotic and cross bred cattle and in buffaloes.

Point of withers: The highest point just behind the hump located between the two shoulder blades. It is the point from where highest of the animal is measured.

Back: The portion between the point of withers and the last ribs.

Loin: The triangular portion formed by joining the heads of last ribs to the hook bones.

Sacrum/Croup: The ridged portion extending from the center of two hook bones up to the root of tail.

Rump: A slightly sloppy portion on either side of croup/sacrum between the hook bones and the pin bones.

Hook Bones: The prominent bones present on either side of the loin.

Pin bones: The prominent bones present on either side of the root of tail.

Tail: A distinct flexible tapering appendage present at the rear end of the animal's body, used to remove flies/insects, dust etc., from the body. Identification marks/numbers are given below the root of tail in some animals.

Switch: A bunch of hair at the end of tail is called switch.

Anus: The posterior most opening of the digestive / alimentary tract, through which feces comes out.

Vulva: It is external uro-genital organ of the female.

Chest/Throat: The portion between two fore limbs just behind the points of elbow.

Heart girth: It is the circular measurement of chest taken from the point of wither and passing near the two points of elbow.

Ribs: Flat curved bones forming chest wall. There are thirteen pairs of ribs in all ruminants.

Hollow of the flank: A roughly triangular depressing of the abdominal cavity between the last ribs and hook bones on either side of the loin. It is used to reflect whether the animal is well fed/hungry or is suffering from digestive upset/bloat.

Flap of the flank: It is thick skin fold between the hind legs and the abdomen.

Navel/Umbilicus: A small skin flap on the lower side of the belly, left out by dropping of the navel chord, thought which fetus was exchanging the nutrients and gases with the mother;

Blood Udder: The structure containing mammary glands of cows/buffaloes. It has four quarters, each having its own teat. It may be round, troughy, goaty or pendulous in shape. The degree of development of udder generally shows the milk production capacity of the cow.

Milk vein: A prominent wavy / zigzag rope-like structure running from udder to the chest wall on either side of lower abdomen. It carries impure blood from the udder to the heat.

Milk well: It is the point on either side of the chest where milk vein enters on to the thoracic cavity.

Milk mirror: A roughly triangular yellowish/ pinkish hairless potion extending from below the vulva up to the base of udder. It also reflects milk production capacity. Also, called Escutcheon.

Supernumerary teats: The extra teats, which are non-functional, may be removed at an early age.

Fore Quarters /Fore Limbs

Shoulder: The portion between the point of withers and point of shoulder.

Point of shoulder: It is prominent joint between the shoulder and the arm, from where body length is measured.

Arm: The portion between the point of shoulder and point of elbow.

Point of elbow: The prominent joint present between the arm and forearm.

Forearm: The portion between the elbow joint and the knee joint.

Knee Joint: It is the prominent joint between the fore arm and the shank.

Shank/Cannon: The portion between knee joint and the fetlock joint.

Fetlock joint: It is the joint between shank and pastern, where dewclaws area attached.

Pastern: A small round portion between the fetlock joint and the coronet.

Coronet: A hairy streak just above the hoof.

Hoof: A horny hard black lowest portion of the foot. It has two digits. The space between two digits is known as inter-digital space.

Dew claw: Rudimentary / false hooves, two in number on each leg behind the fetlock joint.

Hind Quarters / Hind Limbs

Point of hip: The prominence formed over the hip joint between the hook bones and the pin bones on either side of sacrum.
Stifle joint: The joint situated between the upper and lower thighs at the flap of the flank.
Thigh: The muscular region between the hook bone and pin bone on upper side the hock joint on lower side. It is divided in to two parts.
Upper thigh: Portion from hip joint up to the stifle.
Lower thigh: Portion from stifle up to hock joint.
Hock joint: The prominent angular joint formed between lower thigh and the hind shank.
Point of hock: The upper extremity / projection of the hock joint.
Tendo Achilles: The large tendon of high muscles attached to the point of hock. The milk-man's rope is tied on these tendons of cow at the time of milking. The parts and points below the hock joint in hind limbs are similar to those below the knee joint in fore limbs.

Special Points of bull/Bullock

Scrotum: It is a skin pouch in which testicles are situated outside the body. It protects the testicles and provides thermo regulation to the tests.
Tests/Testicles: Two round or elliptical freely moving structure present inside the scrotum. They produce male gametes-sperm and male sex hormones- testosterone.
Penis: It is the external uro-genital organ or copulatory organ of male.
Sheath/Prepuce: The outer skin covering of the penis extending from scrotum up to near umbilicus below the belly.
Rudimentary teats: These are non-functional teats in bull/ bullock.

CATTLE and Buffaloes

Herd: A group of cattle/buffaloes is known as a herd.
Calf: A young one of bovine of either sex below one yr. of age.
Bull calf: A male young one of ox under one year of age.
Heifer-calf: A female young one of ox under one year of age.
Heifer: A female cow of over 1 yr age, which has not yet calved. After calving she becomes a cow.
Cow: A mature female ox which has produced a calf at least once.
Bull: An adult uncastrated male ox used for breeding purpose.
Bullock: A castrated male ox over two years of age.
Beef: The meat of cattle/buffaloes is called beef.
Veal: The meat of young calves slaughtered below six months of age.
Calving: An act of giving birth to young one by a female bovine.

SHEEP

Flock/band: A group of small animals like sheep/goat/rabbit.
Lamb: A young one of sheep of either sex under 6 months of age.
Gimmer /Ewe lamb: A male young one of sheep.
Tup lamb/Ram lamb: A male young one of sheep.
Hogget: Female sheep above six months of age, till maturity, kept for breeding.
Ewe: An adult female sheep which has lambed at least once.
Ram/Tup: An uncastrated adult male sheep used for breeding.
Wether /Weddar: A castrated adult male sheep.
Mutton: The meat of sheep is known as mutton.
Lambing: An act of giving birth to young one by a female sheep.

GOATS

Kid: A young one of goat of either sex not exceeding 6 months.
Doeling /Goat ling: A female goat over one year but not exceeding two years.
Buck ling: A male goat above 6 months of age, but not exceeding 2 years of age.
Buck: An uncastrated male goat/rabbit used for breeding.
Doe/ Nanny: An adult female goat who has given birth to a young one at least once.
Chevon: The meat of goat/rabbit is called chevon.
Kidding: An act of giving birth to young ones by a female goat.

Weaner: A newly weaned rabbit
Fur: Wool
Pelt: Skin with wool intact

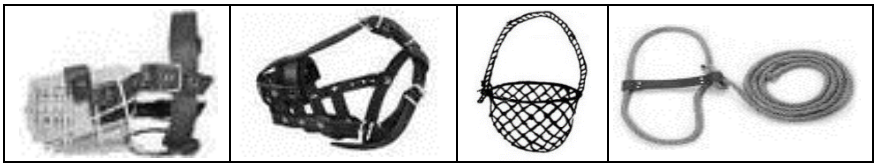
PRINCIPLES AND TOOLS USED IN RESTRAINING LIVESTOCK

The farm animals are reared for economic purposes. Therefore, it becomes necessary to work and handle them frequently for various purposes, viz. Milking, Draft purpose, treatment, castration, casting, breeding, giving identification mark, transportation of the animals after purchase, sale or for shows and exhibitions. The improper way of approach and wrong method of handling may lead to accidents as well as loss in production. In the present exercise the students will learn the methods of approach and proper methods of handling of animals.

Tools/Instruments used in farm animals: While taking work from the farm animals or while handling them for milking, treatment, castration, applying identification marks etc, it becomes necessary to restrict some of their activities or undue movements. This process of restricting the undue activities or movements of animals is called restraining and the devices used for this purpose are called restraints. Some of the common restraints are as under:

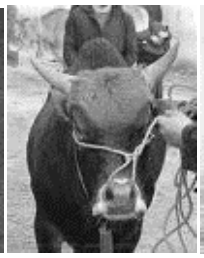
Tools/Instruments used in farm animals: While taking work from the farm animals or while handling them for milking, treatment, castration, applying identification marks etc, it becomes necessary to restrict some of their activities or undue movements. This process of restricting the undue activities or movements of animals is called restraining and the devices used for this purpose are called restraints. Some of the common restraints are as under:

Muzzles: Muzzles are used to prevent cattle/buffaloes eating their bedding, calves suckling their dams or bullocks eating grasses/crops while inter-culturing by applying over the muzzle/mouth of the animal. There are various kinds of muzzle like Wire muzzle, or Coir muzzle, Leather box muzzle.



Mouth Gag: Gags are metallic or wooden devices used for keeping the jaws of animal apart for examination of mouth/buccal cavity, for rasping overgrown teeth or for passing the probang into the stomach. Drink-water's mouth gag is most suitable for cattle.

Halter: Halter made up of cotton/nylon ropes are used to restrain/control growing as well as docile animals like calves, cows, and bullocks. Leather halters are used for show purpose.



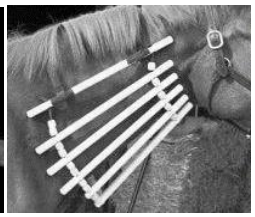
Nose String: A thin cotton/ nylon rope passed through a hole made in the nasal septum and tied behind the base of horns is called nose string. It is commonly used to restrain relatively strong animals like bullocks.

Bull Nose Ring: It is generally made of two semi-circular pieces of non-rusting metals like steel, aluminium, brass or copper joined together. A hole is first punched in the nasal septum with the help of trocar and cannula or Bull nose punch and then bull nose ring is fixed by proper screwing. It is used for

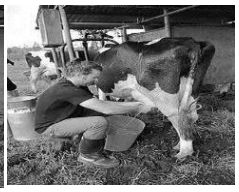
restraining powerful bulls.

Bull Leader: It is about 1- to 1.5-meter-long wooden stick with a sliding hook at one end. It is used to control/lead a powerful / vicious hull safely from a close distance when applied on the bull nose ring.

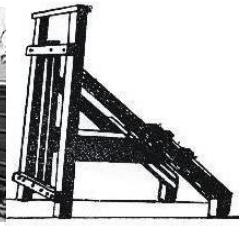
Side Stick: It is a specially prepared bamboo stick of desired length with holes on either ends, or a simple strong stick, used to prevent self-suckling in cow or to prevent the animal licking some toxic medicine applied on the forelimbs or hind limbs. It's one end is tied with the halter and the other end is held in position parallel to the body by means of a rope.

Milk-Man's Rope: It is a thin cotton rope about 2 meters in length. It is used to prevent a cow kicking while milking by applying around the hind legs just above the hock joints in an English "8" fashion and finally making a quick release knot of the free ends towards the milker's side.

Travis or Crush: This is made of hard seasoned wood or metal tubing to restrain the animal in standing position for clinical examination, treatment, pregnancy diagnosis etc. Now-a-days trevises for large animals are available in various designs for specific purposes

Twitch: A twitch consists of a piece of stout wood about one-meter length with a hole at one end. A loop of a piece of rope is inserted through this hole. For applying a twitch, the horse should be haltered and held by an assistant. The loop is applied on the muzzle with left hand while holding the stick with right hand. After adequate grip on the upper lip, twist ups the loop by means of stick. A twitch should always be removed as soon as its purpose is served.


Cradle: Ten or twelve pieces of wood are strung on two pieces of cord. Two short pieces of wood bored longitudinally are kept on either side of long pieces. It is useful to prevent a horse getting his head to a fore or hind limb in cases of blistering or wounds. It allows very little vertical or lateral flexion of head.

Bridle: It is driving harness for a ho rse. It is made of leather with an iron bit which acts as mouth piece. There are various types of bridles available for special purposes.

Nose Peg: Dromedary camel nose pegs are normally made out of wood or plastic. They give very good control over handling a camel and are used in most parts of the world today. For the camel's protection a breakaway link is used between the nose peg and reins. Camels should not be tied together with the nose peg line.


GRASSLAND /RANGELAND OF THE AREA

Rangelands are vast natural landscapes in the form of grasslands, shrublands (bushy lands, woodlands and deserts. Types of rangelands include tall grass and short grass prairies, desert grasslands and shrublands, Woodlands, savannas, chaparrals, stepps and tundras. It is perhaps easier to define rangelands by clearly describing what they are not. Rangelands are not barren desert, farmland, closed canopy forests or land covered by solid rock, concrete and /or glaciers

Types of Rangeland

Prairies are considered part of the temperate grasslands, savannas and shrublands biome by ecologist, based on similar temperate climate moderate rainfall grasses Herbs and shrubs rather than trees as the dominant vegetation type.

Grasslands are areas where the vegetation is dominated by grasses and fobs (non woody plants). Grassland occurs naturally on all continents except Antarctica.

Steppe: The term is used to denote the climate encountered in regions too dry to support a forest, but not dry enough to be a desert.

Shrub land is a plant community characterized by vegetation dominated by shrubs, often also including grasses, herbs and geophytes. Shrubs land May either occur naturally or be the result of human activity

Woodland is a low dense forest forming open habitats with plenty of sunlight and limited shade. Woodlands may support an understory of shrubs and herbaceous plants including grasses.

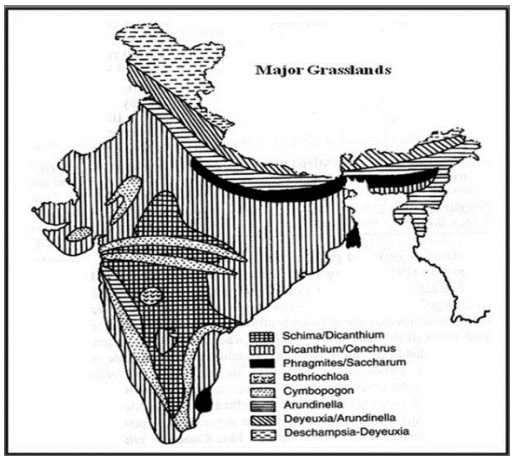
Savanna is a grassland ecosystem characterized by the trees being sufficiently small or widely spaced so that the canopy does not close. The open canopy allows sufficient light to reach the ground to support grasses.

Desert (less than 250 mm rainfall/ year) is a landscape or region that receives an extremely low amount of precipitation, less than enough to support growth of most plants.

Tundra is a biome where the tree growth is hindered by low temperatures and short growing seasons. The term tundra means treeless mountain tract. In tundra, the vegetation is composed of dwarf shrubs, grasses, mosses and lichens. Scattered trees grow in some tundra. The eco-tone (or ecological boundary region) between the tundra and the forest is known as the tree line or timber line.

The Indian Council of Agricultural Research had Carried a grassland Survey of India in 1954 Wnyte, Venkatraman and Dabadghao had established eight grassland types in the country occurring in different environment.

	Grassland type	Environment
1	Schima/Dicanthium	Black Soils
2	Dicanthium / Cenchrus	Sandy loams
3	Phragmites/Sacchrarum	Marshy localities
4	Bothriochloa	Paddy tracts and high rainfall belt
5	Cymbopogon	Low hills
6	Arundinella	High mountains
7	Deyeuxia/Arundinella	Mixed temperate climate
8	Deschampsia/Deyeuxia	Temperate alpine climate



ROUTINE OBSERVATION ON THE LIVESTOCK FARM

The Principal Object of running a dairy farm is to produce milk from the animals and sale the same profitably. All the routine operation is therefore scheduled to meet with this object. The work of production and sales of milk is to be done twice daily throughout the year without any holiday.

Importance of Regularity

1. Daily twice the milk has to reach the customer's doors at the appointed time. In order to achieve this, the timing of all different operations, to be done daily on the farm is fixed. It is very necessary to observe the fixed timings.
2. Dairy animals are creatures of habit. They become nervous if the regularity or time schedule is not observed. This leads to loss in production.
3. Dairy farm is a very busy concern. Unless the timings and sequence of all the routine operation are decided and scrupulously observed, there will be mismanagement.
4. **Groups of routine operations:** For the sake of convenience, the different routine operation on the dairy farm can be broadly grouped under the following heads.

Production and Distribution of the Milk:

- Milking twice both morning and evening.
- Recording the milk and bulk weighing.
- Sealing and dispatch of cans for retail vending /customers.
- Distribution of milk to individuals or agencies.
- Receiving the coupons, sales and handling loss etc.
- Accounting Production, both morning and evening.

Caring for the Animals:

- Feeding concentrate and roughages
- Grooming and/or bathing.
- Heat detection and breeding.
- Treatment of sick animals if any.
- Attending to parturition /calving.
- Identification mark to calves.
- Grazing and /or yarding /paddocking.

Planning, Production and Timely supply of the fodder:

- Preparing, land for the new crop, irrigation and cultivation (manuring ploughing) harrowing etc.,)
- Sowing the new crop.
- Irrigation manuring and inter cultivation of standing crops.
- Harvesting and hauling fodder from field or store.
- Chaffing the fodder.
- Distribution in mangers at appointed time and
- Preservation of fodder, hay and silage making.

Cleaning of Sheds and Yards:

- Lifting and removal of dung, refused/ leftover fodder and soiled bedding.
- Sweeping, washing and disinfection of yards.
- Replacing the bedding and
- Washing the water trough.

Cleaning and Washing of Dairy utensils and appliances:

- Washing and cleaning milk room
- Washing and milking pails, cans, measurer, milk weighing pails etc. with ordinary water, hot water soda /detergent and again with water.
- The scalding and sterilization of the above.
- Cleaning / wiping of the weighing scale.
- Cleaning and washing of butyrometer, pipettes beakers bottle etc. and
- Cleaning and washing of the cream separator if used.

Co-ordination

All the above five groups of activities are more or less specialized fields of activities. These are required to be looked after by some responsible person. All these have to work/ function in complete harmony i.e., if there is some change in one, there should be corresponding change/adjustment in the other, so that there is no dislocation of the routine operation. For this, it is necessary that there is one man who notice these changes, and makes the suitable corresponding changes by way of simultaneous adjustment in related groups of activity.

Time	Routine operations
4:30 am to 6:30 am	Bringing milch cows to milking parlor, milking, weighing and recording of milk produced by each cow and sealing of milk cans feeding of milk to calves.
6:30 am to 7:30 am	Supply of milk to the Amul Dairy Accounts and receipt of milk given cleaning and washing of dairy utensils e.g., milking, pails, cans measure etc.
7:30 am to 11:30 am	Cleaning and washing of cowsheds yards, calf pens, calving boxes, and bullocks sheds etc. disposal of manures soiled bedding and left-over feeds, spraying of disinfectants.
7:30 am to 9:30 am	Heat detection and isolation of sick animals, harvesting, hauling and chaffing of green fodder, hauling of dry roughage from Dutch barn.
8:30 am to 9:30 am	Distribution of concentrate in managers from calves, heifers and advanced pregnant animals. AI, pregnancy diagnosis and examination of repeat breeders. Treatments of sick animals. Records writing and maintenance. Periodical vaccination and de-worming of animals as per schedule.
9:30 am to 10:30 am	De-horning and identification making of young calves, if any.
10:00 am to 12:00 am	Distribution of chaffed fodder in sheds/ managers. Transportations of silage and hay to dairy farm wherever needed.
1:30 pm to 12:00 am	Cleaning of cow-shed. Periodical and cleaning and washing of water troughs. Fortnightly white washing of calf pens/Calving boxes and water troughs.
2:00 pm to 3:30 pm	Repair of halters, baskets cows' chains shovels, spades etc. Repair and maintenance of fences, carts, balance etc. replacement of old nose-strings and halters. Castration hoof trimming and washing of animals.
3:30 pm to 4:30 pm	Distribution of remaining quota of concentrate mixture to milch cows/ advanced pregnant animals. Distribution of chaffed fodder in different sheds sweeping of farm premises & maintenance of manure pit.
4:30 pm to 6:30 pm	Bringing milch cows to milking parlor, grooming and washing of the cows. Milking weighing and recording of milk and sending the cans to Amul Dairy. Cleaning and washing of dairy utensils/equipment's. Feeding of milk to calves.

Other Activities to be attended are:

1. Attending emergency duties at any time e.g., calving and seriously sick animals, Care of new born and parturient cow, Feeding colostrums to the calf, Care and treatment of seriously sick animals.
2. Purchase of lime, ropes, Sticks common salts etc., once or twice in a year from local market,

DAIRY FARM RECORDS

Dairy business cannot be carried out without maintaining the necessary set of accurate records. Records are essential for the following purpose.

Importance of Records:

1. Records are the mirrors of a farm. They are necessary from genetic improvement of dairy cattle. Records are necessary to know the milk production efficiency of the dairy animals and based on this information. We can retain or cull the cows or their off springs. Hence without a set of records properly, accurately and reliably maintained, improvement of livestock by breeding is not possible.
2. Records give us the information about the financial status of the dairy farm. Whether it is making profit or incurring loss or is just maintained. They also give the information about the extent of profit or losses.
3. Profit can be increased by reducing the wasteful and undue expenditure. To know such items, it is necessary to have detail record on each item of expenditure viz. feeds, labours, interest, depreciation of farm building and farm equipment, animals and miscellaneous items like medicine, vaccination breeding charge etc. The sales of milk, sale of culled animals, sale of manures, sale of empty gunny bags etc., are also recorded.

Classification of Records: Records required to be maintained on the dairy far can be classified into four major group or categories.

1. Register Pertaining to Financial and Account Matter.
2. Register Pertaining to Accounting of Animals.
3. Register Pertaining to Milk Production.
4. Register Pertaining to Reproduction
    1. **Registers Pertaining of financial and Account Matter:** It includes registers such as cash book, ledger book, Milk coupes, bill book, receipt book, demand &collection register, dead stock register, concentrate and forage register etc. These registers are more pertaining to administration and account side rather than the technical side and hence not discussed in detail over here.
    2. **Register Pertaining to Accounting of Animals:** These include registers such as cattle yard report/daily dairy roll call register, herd register, birth & death register. This group of register is concerned with increase or decrease in the herd strength. The increase in herd strength may be by birth, purchase of animal and farm transfer. The decrease in herd strength could be due to death, sale and farm transfer of animal.
        - **a.** **Cattle Yard Report:** This is a primary record, maintained daily and is also called daily diary. It is a key register on the livestock farm. Entries in all other register are made from this register. This register gives herd strength and detail of all changes in the strength. It also records details of sickness & treatment, vaccination, deworming, estrus, breeding/service to the heifers and cows, pregnancy diagnosis, feeding etc. Any other item thought to be important is also noted in this register such as extreme change in climate, rainfall, cloudy or windy weather, cyclone etc.
        - **b.** **Roll Call Register:** This is an annual register-maintained month wise. It is changed every year on 1st April. It gives the number of animals in each class or the herd. Change in the number of animals in any class is noted and detail of change is given. The number of animals in each class on the last day of the month is recorded and carried over to the first date of next month, after actual counting the herd strength.

Roll call Register
Month……

Date	Cows	Heifers	Bulls	Bullocks	Male Calves		Female Calves		others
					≤1yr	≥1yr	≤1yr	≥1yr	

Cattle Yard Report

Date	Herd Strength and Events of Animals	Treatment/Vaccination	Events of Feeds and feeding	Remark/Weather

Herd Register: This is also an annual register. It is changed every year on 1st April. In this register all the individual animals in different classes of the herd are listed according to their date of birth. The animal as on 31st March is listed class wise on 1st April of the next year according to their birth date. The details of each animals, viz. name and number, date of birth, parents etc. are given. Any new addition of animals in each class after 1st April is demarcated by a line. The details of removal of animals from the herd during the year should be given in the respective columns.

Birth Register: This is an annual register, which give information about the number of births on the farm, sex of calves born (male & female). Birth weight of the calves, name of sires & dams, Date of last service of dam, gestation period, number of heifers becoming cows, their age at the first calving etc. Average of the above characters for the year is made at the end of the year.

Birth Register
Place……Year…….

Sr. No. of Birth	Name & No of Dam	Name & No of Sire	Date of Fertile service	Date of calving	Male Calves		Female Calves		Gestation Period of Dam	Age of first calving (Days)	Remark
					Name & tattoo No.	Birth wt (kg)	Name & Tattoo No.	Birth wt (kg)			

Death Register: Like birth register, it is also an annual register. It gives information about total death during the year and their cause. The frequency of a particular disease can be seen from this register. The responsible person must sign the register, as it is concerned with final write off of the animal.

Sr. No.	Name & No. of animal	Breed Group	Sex	Class	Date of Birth/Death	Post mortem done or not	Post mortem report and reasons of death

Register Pertaining to milk production: These include 4 register viz. daily milk production register, Monthly Milk Production register, Lifetime milk production register (monthly progress register) and history sheet.

Daily Milk Production Register: This is written daily both morning and evening or sometime thrice a day. Cows are listed in this register according to their breed group and date of calving. The daily total milk production is divided by the number of milking units (Both morning & evening milking unit) gives "wet average". If the milk production is divided by total number of cows, then it gives "herd average". By watching carefully, the fluctuation in the wet average as well as correcting the reason efficiency of the milk animals is maintained by taking care to breed the animals within 2-4 months postpartum. This is included in the column of date of last service. The total milk production of each cow for a month is transferred into the monthly milk yield register.

Monthly Milk Production Register: It is an annual Register cows in the milk on 1st April are entered in this register according to their date of calving up to 31st March is entered at the top of the register from April the entries are made till the cow dries -off or till the total milk production of incomplete lactations completed. if not, the total milk production of incomplete lactation is carried over a new register next year. Lactation day are also shown at the bottom. This register gives information like name & number of cows, which have completed their lactation, their lactation milk yield, length of LP, length of previous dry period etc. If the cow has calved again, this information is then entered into the history sheet of concerned cow completing the lactation.

Life Time Production Register (Monthly Progress Register): This register gives the information about the milk yield of the individual cow from first calving till death or sale. That is the performance of entire productive life of each cow is available from this register. Annual milk production each year and also the progressive annual average (PAA) are calculated from this information. The PAA figure indicates the upward and downward trend in the productive efficiency of the cow. This figure can be used in taking decision for culling or retaining the animal.

History Sheet: This register gives overall milk productive capacity of the cow. One page is allotted to each heifer on calving. At that time all details of their parentage/pedigree, breeding, description of phenotype, birth date, date of calving, age of first calving etc. are entered on the upper part of the page. Relevant information about service, date of calving, calf born, sex of calf etc. are entered in the lower part in respective columns. On completion of lactation, lactation milk yield, milk yield of first 300days,

lactation period, dry period, gestation period etc., are entered and the average are calculated. The average daily milk production from first to latest calving is a good indicator of the increase or decrease in overall efficiency of the animal to produce milk and to reproduce, from the lactation to lactation.

Register Pertaining to Reproduction: It includes cattle yard report, service book, service ledger and history sheet.

Cattle yard Report: Some details are already given under group 1 register. This gives information like cows & heifer coming in heat, date of heat, date of service, (natural or artificial) name & number of sire/ bulls used etc. These entries should be made promptly. Otherwise calves with unknown sire well be born. These entries of the service are transferred into service book later on. Finding of rectal palpation of repeat breeders, pregnancy diagnosis etc., from this register are transferred to service ledger.

Service Book: This is maintained monthly. Service to heifers and cows are written in this register from cattle yard report. This is useful in making the list of cows/heifers due for pregnancy diagnosis. Similarly, list of advanced pregnant animals and the list of animals expected to calve in current month are made from this register.

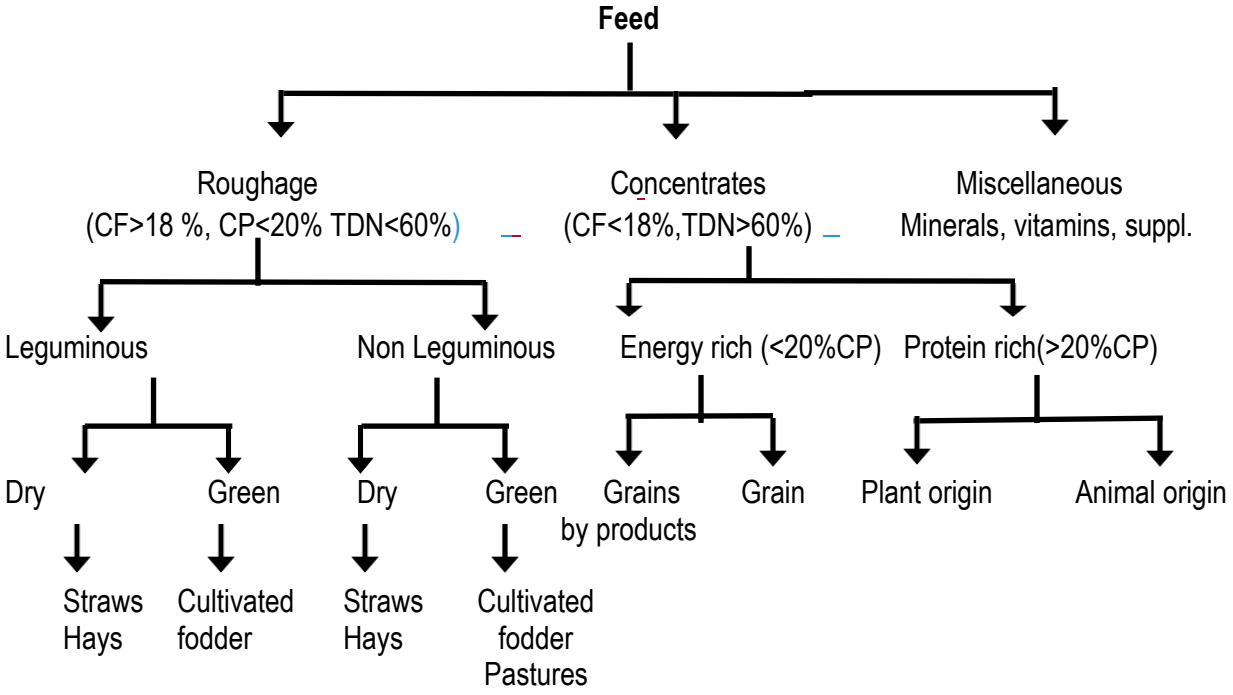
Service book Month…….. Year……				
Date	Name and No of Cows/Buffalo	Name and No of bull /Buffalo bull	Natural services of AI	Remarks

Service Ledger: This register gives the information of near past history and current state of reproduction of each breedable female in the herd. The list of examination of repeat breeder and anestrus animals can be prepared from this register.

Sr. No.	Service ledger (Classified/individual service register)							
	Name & No of Heifer/ Cow	Date of Calving	Service Records (Dates of AI/PD)					
			1st	2nd	3rd	4th	5th	Remark

History Sheet: Some information about this register is given in group1. It gives information about overall reproductive efficiency of each cow e.g., age at first calving, Length of dry period, calving interval for all lactation etc. of individual cow.

Classification of Feed Stuffs of Livestock: Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration. An attempt is being made in this chapter to familiarize the students, to the important feed stuffs that are commonly used for feeding of ruminants and non-ruminant animals. The various feeds and fodders can be divided into following major categories.



ROUGHAGES: Roughages are bulky feeds having large amount (>18%) of crude fibre (less digestible material) and low total digestible nutrients (TDN <60%) content on DM basis.

Succulent Roughages: Succulent feeds usually contains moisture from 60-90%, For the sake of convenience succulent feeds are again classified into 'pastures, cultivated fodder crops, tree leaves, silage and root crops.

Pastures: The word pastures refer to land on which different types of edible grasses and other plants grow or are grown for grazing livestock. Permanent pastures are those covered with perennial or self-seeding species of plants. Temporary pastures are those planted with quick growing crops like Sudan grasses and millet to provide supplemental grazing during lean season.

Cultivated Fodder Crops: ***Leguminous***: Leguminous fodder such as Cowpea, Berseem, Lucerne etc. belong to "Leguminosae" family and very palatable to the animals. Legumes contain 2-3% DCP and 12% TDN on fresh basis. If, legumes are fed liberally to cattle and buffaloes, then there is no need to incorporate another protein supplement in diet up to 6-7 litres of milk per day Sudden changes in feeding from non- leguminous to leguminous and early morning feeding of leguminous fodder should be avoided to reduce the possibility of bloat due to accumulation of gases in rumen.

Non leguminous: Contains lower percentage of nitrogen 0.5 to 1.0% DCP and 11-15% TDN, these include many cereal crops, cultivated grasses, indigenous grasses and introduced grasses. e.g., Maize, Jowar, Bajra Oat etc.

Tree Leaves/Top feeds: Tree leaves are also fairly good source of nutrients and may serve as potential feed resource wherever feed sand fodders are in acute shortage e.g., Babul, Lucaena, Mulberry, Banayan

Root Crops: Root crops sometimes may be used as alternate feedstuffs during the natural calamity and scarcity period. They contain low crude fibre (5-11 %). e.g., Tapioca, Turnips, Sugar beet, Carrot

Silage: Silage is an anaerobically fermented feed prepared from green fodder whenever the supply of green fodder is in plenty. It possesses all the characters of green fodder and very high nutritive value.

Dry Roughages: Contains only 10-15% moisture. Dry roughages are dried plant materials, which are preserved for usage in summer and in adverse climatic conditions.

a) **Hay:** Leguminous crops harvested at pre flowering or half blooming stage is air dried to reduce the moisture content <15% and preserved in the form of hay. The moisture content of hay reduced to desirable level to check the enzymatic fermentation and fungal infestation during storage. Lucerne is best crop for hay making rather than berseem and cow-pea due to their hollow and thick stems, whereas under non-leguminous category oat is best crop for hay preparation. Due to high lignification, different nature of fibre and less palatability of non-leguminous fodder than the leguminous fodder, hay is generally not prepared from non-leguminous fodder.

b) **Straws/Stover:** The crop residues left after harvesting the main product of crop (i.e., grains) are known as straws/stovers. Straws are deficient in protein, mineral, vitamins and energy. Due to its high crude fibre, low TDN and high degree of lignification, strategic nutrients supplementation is pre requisite with straw feeding.

CONCENTRATES: Generally, contains less than 18% crude fibre and more than 60% TDN. These are less bulky and more digestible than roughages.

Energy rich concentrates: The crude protein is generally less than 20% in energy rich concentrates. These are also called as basal feeds.

a) **Cereal Grains:** Cereal grains are rich in soluble carbohydrates e.g., Maize, Barley, Rice, Oats etc.

b) **Millets:** e.g., Ragi (Nagli), Jowar and Bajra.

c) **Mill by products:** The by-products of milling cereal grains i.e., Bran (rice, wheat), flour, hulls, polishing and embryo of seeds are used as a part of concentrate mixture.

d) **Molasses:** By product of sugar factories used in feeds as binding agent for pelleting and as readily available source of soluble carbohydrates.

e) **Roots and tubers:** e.g., Roots - turnip, sugar been, carrot. Tubers - potato, sweet potato.

Proteins rich concentrates: The crude protein is more than 18% in protein rich concentrates.

a) **Plant origin:** Oil seed cakes, pulses, pulse chuni, pulse churi, Brewer's yeast and grains etc.

b) **Animal origin:** The by-products of slaughter houses i.e., meat, blood and bones are dried and made in to powders to be mixed in concentrate feeds. e.g., Meat meal, meat cum bone meal etc. The marine by-products are also used as animal protein source for feeding of livestock e.g., fish meal. Poultry-byproduct meal and feather meal are avian origin animal protein sources which can be used for livestock feeding.

FEED SUPPLEMENTS:

Mineral Supplements: Those supplements which are given to the animals for providing the major or minor minerals in desired quantity. Many mineral mixtures are marketed under the different trade names. Generally, salt, calcium carbonate, zinc sulphate and copper sulphate supplements improve production and reproduction.

Vitamin Supplements: Various Vitamin supplements for poultry, pigs and cattle are marketed in India under different names. For poultry Vit A, B and D synthetic vitamin supplements are marketed.

FEED ADDITIVES: Feed additives are a group of feed ingredients that can cause a desired animal response in a non-nutrient role such as pH shift, growth or metabolic modifier. These are the products used for the purpose of improving the quality of feed and the quality of food from animal origin, or to improve the animals' performance and health, e.g., providing enhanced digestibility of the feed materials.

Hormones: Some of the hormones have growth promoting properties like oestrogens, androgens, progestogens, thyroxine and pituitary growth hormones. Synthetic oestrogenic hormones like stillbestrol and hexestrol are being used in many countries as growth promoters. There are certain side effects in the animals fed on synthetic hormones, like restlessness, milk secretion from rudimentary teats, etc. The most serious danger in the human beings arising from the residues of synthetic oestrogen in the meat which has carcinogenic properties.

Probiotics: Many microbial feed additives for animals have been used which include bacterial and/or fungal cultures from both ruminal and non-ruminal sources. Most commonly used products are based on *Aspergillus oryzae, Saccharomyces cerevisiae, Lactobacillus spp.*

Antibiotics: Antibiotics are not classified under nutrients, but are considered as feed supplements. At the lower intake antibiotics are known to stimulate the growth of animals when added to their feed and drinking water. There are number of antibiotics which have been tested for the growth promotion effect like chlortetracycline, penicillin, oxytetracycline, bacitracin, streptomycin, terramycine, neomycin, erythromycin, flavomycin etc. In India penicillin, terramycin, tetracycline, flavomycin etc. are being used as a feed supplements in poultry, pigs and pre-ruminant calves.

Various feeds and fodders for livestock

A.	**GRASSES**	
	Sewan	*Lasiruss indicus*
	Bhurat	*Cenchrus biflorus*
	Dhaman	*Cenchrus setigerus*
	Anjan	*Cenchrus ciliaris*
	Elephant grass	*Pennisetum purpureum*
	Dub	*Cynodon dactylon*
	Para grass	*Brachiaria mutica*
	Guinea grass	*Panicum maximum*
	Napier grass	*Pennisetum purpureum*
B.	**TOP FEEDS**	
	Mango	*Mangifera indica*
	Beri (pala)	*Zizyphus nummularia*
	Neem	*Azadirachta indica*
	Ardu	*Ailanthus excelsa*
	Subabool	*Leucaena leucocephala*
	Sares	*Albizia lebbek*
	Khejri (loong)	*Prosopis cineraria*
C.	**SHRUBS**	
	Phog	*Colligonum polygonoides*
	Ker	*Caparis aphylla*
	Kheemp	*Leptadenia pyrotechnica*
	Cinia	*Crotolaria burhia*
D.	**CULTIVATED FODDER**	
	Legumes	
	Lucerne	*Medicago sativa*
	Berseem	*Trifolium alexandrinum*
	Cowpea	*Vigna sinensis*
	Sun hemp	*Crotalaria juncea*
	Non-Legumes	
	Oat	*Avena sativa*
	Jowar	*Sorghum vulgare*
	Bajra	*Pennisetum typhoides*
	Maize	*Zea mays*
	Barley	*Hordeum vulgare*
E.	**CROP RESIDUES**	
	Wheat bhusa (Tudi)	*Triticum aestivum*
	Paddy straw	*Oryza sativa*
	Bajra straw (Kadbi)	*Pennisetum typhoides*
	Moth straw	*Phaseolus aconitifolius*
	Groundnut straw	*Arachis hypogaea*
	Guar straw (phalgati)	*Cyamopsis tetragonoloba*
	Moong straw	*Phaseolus aureus*
	Soyabean straw	*Glycine max*
	Sugarcane bagasse	*Saccharum officinarum*
	Sugar beet pulp	*Beta vulgaris*
F.	**CONCENTRATED FEEDS**	
	Wheat bran	*Triticum aestivum*
	De oiled rice bran	*Oryza sativa*
	Guar churi/guar korma	*Cyamopsis tetragonoloba*
	Moth churi	*Phaseolus aconitifolius*
	Groundnut cake	*Arachis hypogaea*
	Cotton seed cake	*Gossipium hirsutum*
	Tumba cake	*Citrullus colocynthis*
	Mustard cake	*Brassica campestris*
	Soybean meal	*Glycine max*

Food: Any edible substance, which satisfies the instinct of hunger and supplies nutrients, is called food. The food of animal is known as feed. It contains organic as well as inorganic nutrients, which nourish the body.

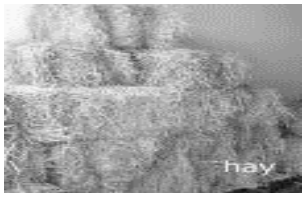
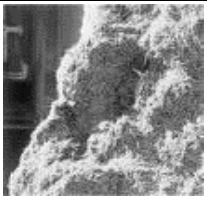
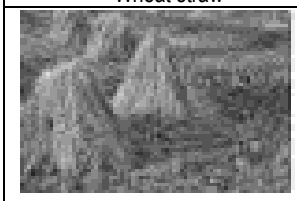
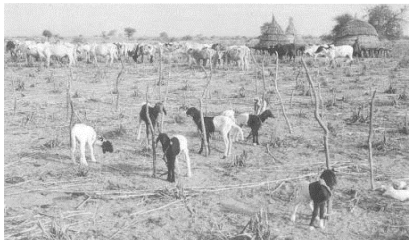
Nutrient: Any element/compound of food (or group of food constituents with same general chemical composition) that helps in supporting the life. These substances/nutrients are essential for the existence of life.

Proteins, Fats/Lipids, Carbohydrates, Vitamins, Macro-micro-Minerals and Water are the six principal food nutrients.

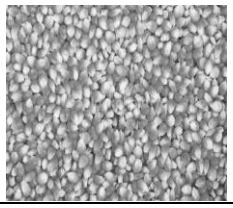
Ration: It is the number of different feeds fed/given to an animal during the period of 24 hrs. This may be given at a time or in portions at different intervals. It does not specify nutrient supply.

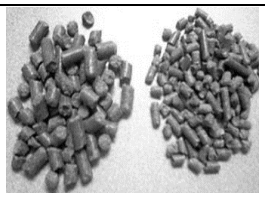
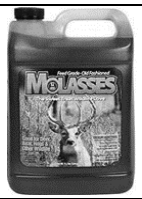
Balanced Ration: It is a ration, which provides all the essential nutrients to the animal in such a proportion and amount that are required for the proper nourishment of the particular animal for 24 hrs.

Roughages:

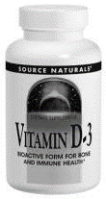
			
Wheat straw	Wheat straw	Hay	Baggasse
			
Paddy straw	Silage	Sorghum	Maize fodder
			
Oat fodder	Berseem fodder	Lucerne fodder	Cowpea fodder
			
Pasture		Dry Pasture	

Concentrates:

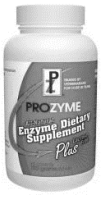
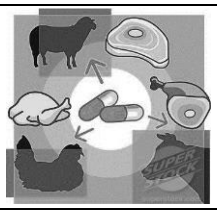
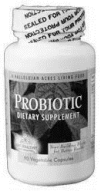
			
Maize Grain	Wheat bran	Rice bran	Groundnut

			
Pelleted Conc.	Readymade Conc.	Mustard Cake	Molasses

Feed Supplements:

			
Vitamin D-3	Vitamin B Complex	Nutri- Sacc	Bestmin

Feed Additives:

Green Pasture: When green plants are grazed directly by the animal from the pasture land, it is called green pasture e.g., alfa-alfa, zinzvo etc.

Soilage: It is the freshly harvested green fodder/forage crop having more than 75% moisture and fed to the animal as fresh e.g., green maize, green sorghum, green oat, green lucerne, green cowpea, green napier hybrid etc.

Silage: It is the product of green/succulent fodder harvested and preserved in succulent form under anaerobic fermentation in a closely air tight structure called silo. Silage contains 65% moisture and 35% dry matter e.g., maize silage, sorghum silage, oat silage etc. Silage is considered as a pre-digested feed for ruminants.

Dry Pasture: Dry standing plants grazed from the pasture land is called dry pasture.

Hay: It is a specially prepared dry fodder containing 10-15% moisture only. It is prepared by harvesting the crop at flowering stage or dent stage, when it has maximum nutrient contents e.g., sorghum hay, lucerne hay, oat hay etc. Hay is generally more nutritive than the straw.

Straw: It is the byproduct of the cereal crop available after threshing the grains e.g., bajra straw, paddy straw, wheat straw, sorghum straw, maize straw etc.

Gotar: The byproducts (straws) available from pulse crops/legumes after threshing the seeds are called gotars e.g., gram gotar, mung gotar, Guar gotar, cowpea gotar, groundnut gotar etc.

Husk/Bran: The outer coverings of grains/seeds available during threshing of crop e.g., bajra husk, rice husk, rice bran, maize bran, wheat bran etc.

Chuni: Broken lentils of pulse/leguminous seeds available during preparation of "dal" e.g., gram chuni, mung chuni, udid chuni, tur chuni etc.

Complete Feed: The feed, which contains all the ingredients of ration (roughages & concentrates) in a well-blended form to avoid selective eating by the animal and is a sole source of feed.

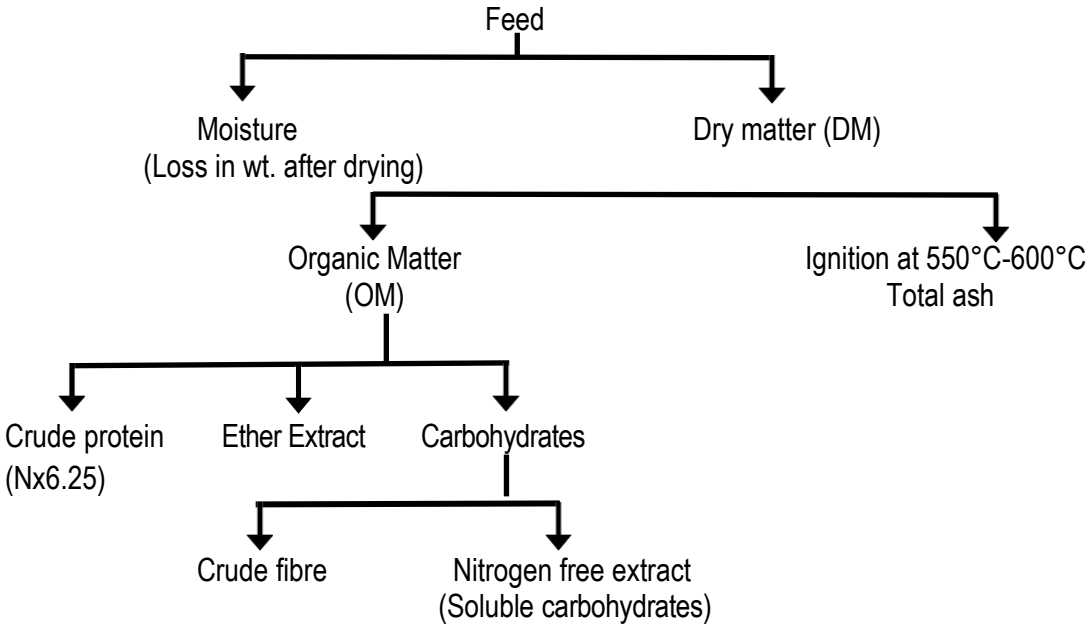
Unconventional Feeds: Those feeds/fodders which are not fed traditionally to the animals, but are given only during scarcity or famine just to keep them alive e.g., neem/pipal/mango tree leaves, forest tree leaves, banana leaves1'stems, cassia tora seeds. Su-babul pods/ seeds, mango seed kernel, Azolla etc.

Haylage: Fodder prepared by harvesting the crop at flowering stage, when hay making is difficult. It contains 50% moisture.

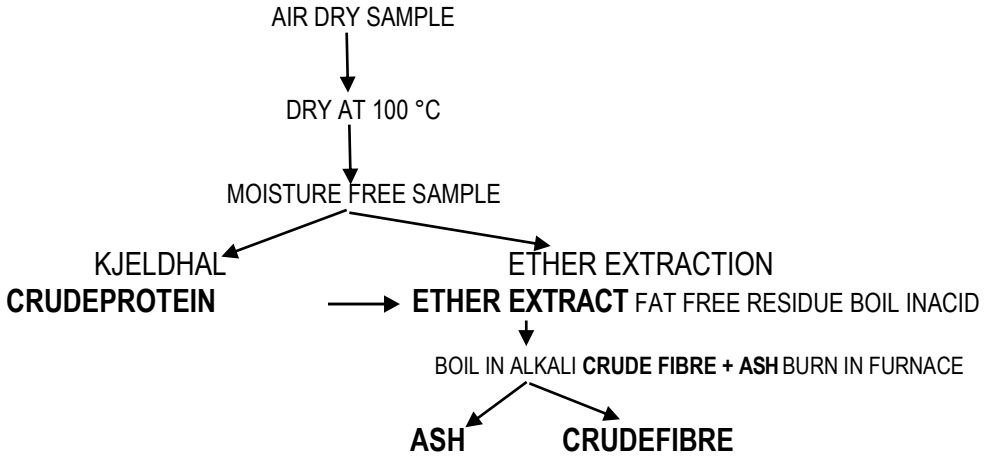
EVALUATION OF FEEDS RESOURCES FOR PROXIMATE PRINCIPLES BY USING WEENDE'S SYSTEM OF ANALYSIS

Proximate analysis is a scheme for approximating the nutritive value of a feed or any organic/biological material without actively using the feed in a feeding trial. This system of analysis was developed at Weende Research Station in Germany in 1865 by Wilhelm Hennberg (1825-1892) and Fredrich Stohmann (1832-1897), hence, it is also called Weende system of analysis. It forms the basis for description of feed composition tables, purchasing feed, ration formulation and is the starting point for more detailed analysis for specific nutrients. In this system various nutrients that had some common properties were grouped together and analysed. It partitioned the biological materials into moisture, crude protein, ether extract or crude fat, crude fibre, nitrogen free extract and total ash. These are called proximate principles. One important reason for development of the proximate analysis scheme was to allow comparison of feeds on a specific basis. It is often stated that one cannot compare apples with oranges, but one can compare the protein as a percentage of dry weight in apples and oranges, and in doing so, make some realistic judgments about the nutritional value of each fruit. By the same token, proximate analysis allows one to make legitimate comparisons of feeds on the basis of specific nutrients, allowing one to judge how much better one feed is than another in terms of specific nutrients.

Scheme of Weende proximate analysis



FLOW DIAGRAM FOR PROXIMATE ANALYSIS



FRACTIONS OF FOOD/FEED ACCORDING TO WEENDE'S SYSTEM

Fraction	Components
Moisture	Water and volatile acids and bases, if present
Ash	Essential elements **Major:** Ca, P, Mg, Na, K, S, Cl **Trace:** Fe, Cu, Co, I, Zn, Mn, Mo, Se, F, V, Cr, Sn, As, Si, Ni **Non-essential elements:** Al, B, Pb, Ti, Silica
Crude protein	Proteins, amino acids, amines, nitrates, nitrogenous, glycosides, glycoproteins, B-vitamins, and nucleic acids
Ether extract	Fats, oils, organic acids, pigments, sterols, waxes and vitamin A, D, E and K
Crude fibre	Cellulose, hemicellulose and lignin
Nitrogen free extract	Cellulose, hemicellulose, lignin, sugars, fructans, starch, organic acids, pectins, tannins, resins, pigments and water soluble vitamins

DETERMINATION OF DRY MATTER/MOISTURE IN FEED SAMPLES

The weight of a feed has no significance unless its water or moisture content is not considered. The chemical composition and nutritive value are always expressed on dry matter basis. The difference in the nutritive value of feeds is due to the variations in their moisture content, therefore, dry matter forms the basis of the comparison of different feeds. The routine procedure for dry matter determination works well for most feeds, but with some feeds, especially high-moisture, fermented feeds, some problems can be encountered. High-moisture feeds usually contain volatile nutrients that can be lost with 100°C oven drying. Volatile nutrients of greatest importance are short chain fatty acids (acetic, propionic, butyric, etc.), but essential oils (menthol, camphor) also can be important with some feeds. Drying samples at 100°C can volatilize some of these materials, resulting in greater moisture (lower dry matter) values than expected.

Principle: A measured quantity of the feed sample is heated in hot air oven (100±2°C) to remove its moisture content till the weight becomes constant. The percentage of sample left after removing the moisture is known as per cent dry matter.

Equipment: Analytical balance, hot air oven, aluminum dishes or trays or moisture cup, desiccators (with calcium chloride or silica gel), metallic tongs

Procedure:

1. Weigh representative samples of approximately required quantity in a clean, dry and pre weighed aluminum tray or glass Petri dish
2. Place aluminum trays/dishes in hot air oven at 100±2°C for 8-12 h (overnight) till weight becomes constant
3. Remove the tray from hot air oven and place immediately in dessicator with the help of metallic tongs and allow it to cool
4. After cooling, remove the tray from desiccator and weigh as quickly as possible
5. Difference in weight is expressed as moisture per cent from which DM per cent can be calculated

Observations:

Weight of empty dishes or tray (g) : W_0

Weight of dishes/tray with fresh sample (g) : W_1

Weight of dishes/tray with the completely dried sample (g) : W_2

Calculations:

$$\text{Dry matter (\%)} = \frac{W_2 - W_0}{W_1 - W_0} \times 100$$

$$\text{Moisture (\%)} = 100 - \text{Dry mater (\%)}$$

Result:

Moisture content in given sample is.....%.

Dry matter content in given feed sample is..... %.

Determination of Crude Protein (CP) Content in the Feed Sample

The nitrogen content of the feedstuffs is estimated by Kjeldahl procedure which is developed by Johan Kjeldahl in 1880's. The method can be conveniently divided into three phases: digestion, distillation, and titration. In general, Kjeldahl analysis provides a fairly good estimate of the true protein content of most mixed feeds, hays, grains, and seed meals. The final question is "where does the 6.25 factor in the calculations come from?" Most original work with proteins showed that they averaged around 16% nitrogen. Thus, if nitrogen content is known, one can simply multiply it by 100/16 = 6.25 to estimate protein content.

Nitrogen of protein and other compounds is oxidized by sulphuric acid in the presence of catalyst and converted into ammonium sulphate [(NH4)2SO4]. Addition of NaOH to this acid digest releases ammonia which is distilled and collected into boric acid in

the form of ammonium borate. Which is then titrated against standard acid (HCl or H_2SO_4) of known strength and nitrogen in sample is calculated. The crude protein is obtained by multiplying the nitrogen content with factor 6.25% (16% nitrogen in protein for most of the feeds in general).

Reactions:

a. Digestion:

Organic Nitrogen +Conc. H_2SO_4 $\longrightarrow$ $CO_2 + NH_3 + H_2O +$

SO_2 2 $NH_3 + H_2SO_4$ $\longrightarrow$ $(NH_4)_2SO_4$

b. Distillation:

$(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3 + Na_2SO_4 +$

$2H_2O$ $3NH_3 + H_3BO_3 \longrightarrow (NH_4)_2BO_3$

c. Titration:

$2(NH_4)_2BO_3 + 3H_2SO_4 \longrightarrow 3(NH_4)_2SO_4 + 2H_3BO_3$

Equipment and Glassware: Digestion bench, Kjeldahl's digestion flask (500-800 ml) Macro Kjeldahl's distillation assembly Analytical/Electronic balance, Volumetric flasks, Conical flask/ Beakers (200 ml capacity) Burettes, Pipettes (10 ml)

Reagents: Concentrate sulphuric acid (H_2SO_4), Digestion mixture ($CuSO_4$ and K_2SO_4 in ratio of 1:9), 40% Sodium Hydroxide solution., 2% Boric Acid, N/10 H_2SO_4; Tashiro's indicator (dissolve 0.3125 g methyl red and 0.2062 g methylene blue in 250 mL of 95% ethanol. Stir for 24 h)

Procedure:

Digestion:

1. Weigh about 1-2 g oven dried sample and transfer into ash less filter paper, folded to prevent loss of sample then transfer it carefully to a Kjeldahl flask.
2. For urine - measure 5 ml of urine sample into kjeldahl flask.
3. Add about 5 g of digestion mixture with a measuring scoop.
4. Add 20 ml concentrate sulphuric acid (10 ml/g of feed)
5. Place the flask in inclined position on digestion bench placed in digestion chamber. Turn blower 'n' for digestion rack and burners on '5' setting. Rotate flasks about every 15 min to speed the oxidation of carbon. If excessive foaming occurs, cool flask and add about 0.5g of purified paraffin wax. Heat the contents for 2-3 h till the solution becomes clear without leaving any undigested black particles. Turn off the heater & allow the flask to cool.
6. If the digested sample cooled to a solid stock, dissolve the solids by adding tap/distilled water and swirl.
7. Transfer the contents after cooling into volumetric flask by dissolving with nitrogen free tap water or distilled water followed by 5-6 repeated washings. Make up the final volume up to the mark aftercooling.
8. Similarly, run a blank without sample and subtract the amount of acid titrated for the blanks from the amount of acid titrated for samples.

Distillation:

1. Take 25 ml of boric acid solution containing Tashiro's indicator in a conical flask and place it at the end of condenser of Kjeldahl distillation apparatus. Care should be taken to see the tip of the condenser is completely dipped inside the containing boric acid solution to avoid escape of released ammonia during distillation.
2. Take 25 ml aliquot of digested sample from the volumetric flask into the distillation unit.
3. Add 30-50 ml 40% NaOH solution to make the contents alkaline. Wash with small quantity of distilled water and close the receiving immediately, seal the funnel with little amount of distilled water to avoid escape of ammonia.
4. Turn on the water for the condenser then turn on the heater for distillation.
5. Collect about 50-70 ml distillate (at least 2 times the quantity of boric acid solution taken). Faint red to pink color turns to green as the reduced ammonia is absorbed by boric acid solution.
6. Remove the conical flask with distillate after washing the tip of the condenser with distilled water.
7. Replace receiving flask with a beaker containing 400 ml of deionized water. This water will be sucked back into the kjeldahl flask as it cools, washing out the condenser tube.

Titration:

1. Titrate the distillate against standard N/10 H_2SO_4 solution taken in a burette till the original faint red to pink color of boric acid reappears.
2. Note the volume of N/10 H_2SO_4 consumed.
3. Run reagent blank through all the steps of the procedure and subtract the blank titration value from the sample titration value.

Observations:

Volume (ml) of the N/10 H_2SO_4 consumed for titration of sample	=	V1
Volume (ml) of the N/10 H_2SO_4 consumed for titration of blank	=	V
Weight of the oven dried sample taken for digestion	=	W
Total volume of aliquot made by digested sample	=	D
Aliquot taken for distillation	=	A

Calculations:

$$\% N = \frac{(V_1 - V) \times 0.0014 \times D}{W \times A} \times 100$$

$$\% CP = \% N \times 6.25$$

Precautions:

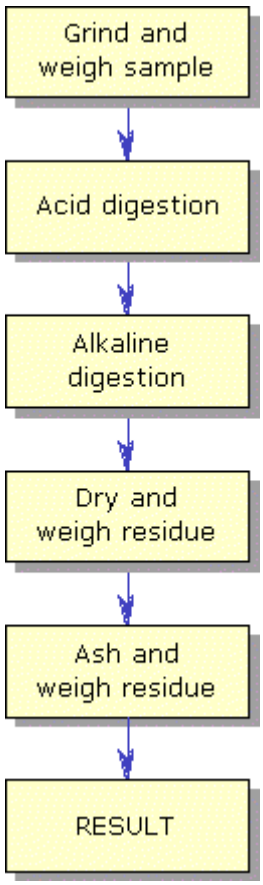
1. To avoid bumping during digestion, glass beads should be added.
2. Set the conical flasks containing boric acid before adding 40%NaOH.
3. The tip of condenser should be dipped in boric acid to avoid any loss of ammonia.
4. As far as possible digest the sample in the open environment.
5. Do not cool the heated Kjeldahl flask under water to avoid cracking of the flask

ESTIMATION OF CRUDE FIBRE (CF) FRACTION IN THE FEED AND FODDER SAMPLES

The moisture and fat free sample is refluxed with dilute acid and then with dilute alkali solution, each followed by filtration and repeated hot water washings. The organic and inorganic residue comprising of ligno-cellulose and silica is collected on a filter paper. The loss in weight on ignition is expressed as crude fibre.

Equipment and Glassware: Hot plate, Muffle furnace, Hot air oven, Spout less beaker (500-600 ml capacity) Round bottom condenser /bulb condenser, Muslin cloth, Wash bottle Spatula, Buckner funnel Suction pump, Crucibles

Reagents: 1. 1.25% H_2SO_4 (0.255 NH_2SO_4); 2. 1.25% NaOH (0.312 NNaOH); 3. Ethyl alcohol (as antifoaming agent, if necessary)



Procedure:

1. Transfer the ether extracted/fat free sample from the thimble into a spout less beaker of 500-600 ml capacity.
2. Add 200 ml 1.25% H_2SO_4 to the spout less beaker containing sample.
3. Place the beaker on a previously warmed hot plate and cover it with round bottom condenser.
4. Turn on the water circulation through condenser.
5. Reflux the contents for 30 minutes from the start of boiling (add a few drops of ethyl alcohol, if necessary).
6. Remove the beaker and cool by adding around 200 ml of water.
7. Filter the contents through muslin cloth with the help of Buckner funnel with suction pump and wash 4-5 times with hot water to make it completely acid free.
8. Transfer the residue to same spout less beaker carefully with smooth steel spatula followed by a little washing of muslin cloth, if necessary.
9. Add 200 ml 1.25% NaOH to the beaker.
10. Again, reflux the contents on hot plate for 30 minutes from the onset of boiling with condensation arrangement.
11. Remove the beaker, add 200 ml water and filter through muslin cloth as described previously.
12. Transfer the residue to a clean silica/porcelain crucible of suitable capacity with the help of smooth steel spatula.
13. Dry the residue of crucible in hot air oven at 100 ± 2°C to a constant weight. cool in a desiccator and note the weight of residue along with silica crucible/basin.
14. Ash the contents of silica crucible in muffle furnace at 550-600°C for 1-2 h or until all carbonaceous matter is burnt.
15. Weigh the crucible with ash after cooling in desiccator.
16. The difference in oven dried and ashed weights gives the weight of crude fibre.
17. Dry the content of silica basin in hot air oven at 100°C to a constant weight. Cool it in a dessicator and note the weight of dried residue along with silica basin.

Observations:

Weight of crucible + residue before ashing = W g Weight of crucible+ ash= W_1g

Weight of feed sample = W_2g

Calculation:

$$\text{CF \% (on DM basis)} = \frac{\text{Loss of wt. on ignition}}{\text{Wt. of oven dried feed sample}} \times 100$$

Or

$$\text{CF \% (on DM basis)} = \frac{W - W_1}{W_2} \times 100$$

Precautions: Do not scratch the muslin cloth with spatula as it may spoil the texture of cloth. Make sure that muslin cloth placed on the funnel tightly for efficient suction. Avoid spillage of residue from muslin cloth while filtering and washing. Make sure that the residue is completely acid or alkali free when required. Transfer of residue should be done carefully without losing any fibre particle.

Results: The given sample contains ……..……% CF.

WATER AND FEED REQUIREMENT OF DAIRY HERD

Problem: 1. Calculate nutrient requirement of cattle and buffaloes for maintenance, growth, milk production, field work and pregnancy in terms of DCP and TDN

2. Determine the requirement of bovine for DCP and TDN to perform various productive functions like growth, milk production, field work and pregnancy

The nutrient requirements viz. DM, DCP and TDN vary with body weight, intensity of production, intensity of work, average daily gain and gestation month etc. the requirement of a particular animal for performing a specific function is compile in tabular form which is known as feeding standard. Thus, the feeding standard may be defined as tabulated statement of the requirement of nutrients of animals for performing various body functions. Feeding standards broadly are divided into three categories namely comparative, digestible nutrient type and production type feeding standards. There are various agencies in the world such as NRC, ARC, CNCPS, ICAR etc. which provide the information about the nutrient's requirement of animal. The Indian feeding standards prepared by ICAR is basically based on the average value of Morrison feeding standard. ICAR (1985) feeding standard describe the nutrient requirement in terms of DM, DCP, TDN, Ca and P based on recommendations of scientific panel on nutrition and physiology. This standard includes recommendation based on experimental work carried out in India over the past several years. The figures given for TDN can be converted to DE and ME by taking 4.4 Mcal DE and 3.6 Mcal ME per kg TDN, respectively. The requirements for maintenance are the same for buffaloes as that for Indian cattle.

Requirement of nutrients for dairy bovine:

DM Requirement: DM Requirement of different animals depends on the body weight of animal and species.

For indigenous cattle: 2.0-2.5kg/100kg BW

For cross bred cattle and buffalo**:** 3.0 kg/100kg BW

The DM supplied by the dietary feed ingredients will furnish the nutrients required by the animal for different body functions viz. for maintenance, milk production, pregnancy, field work etc. The requirement of DCP and TDN, which are the measures for expressing the protein and energy need of the animal, respectively, depend on the body weight and intensity of production.

Maintenance Requirement: This is the minimum requirement of the nutrients for the animal to perform various vital functions of the life like respiration, circulation, transportation of nutrients, metabolism of nutrients and secretion of hormones etc. the maintenance requirement of particular animals depends on his/her body weight. The nutrients requirement in terms of DCP and TDN at different body weight has

Daily maintenance requirement for various nutrients

B.W. (kg)	DCP (g)	TDN (kg)	Ca (g)	P (g)
250	168	2.02	6	6
300	197	2.36	7	7
350	227	2.70	8	8
400	254	3.03	9	9
450	282	3.37	10	10
500	296	3.64	11	11
550	336	4.00	12	12

been given in Table.

Production requirement: production requirement varies animal to animal and species to species e.g., in cow and buffalo additional allowance of nutrients required to produce milk while in sheep it is for wool production and in goat for meat production. The production requirement in dairy animal get change with the level of production and not only with quantity of milk but the quality is also important specifically the fat per cent. The production requirement is given to the animal in addition to the maintenance requirement. Nutrients requirement in terms of DCP and TDN for producing 1 litre of milk with varying level of fat has been given in Table

Nutrient requirement for milk production

Fat %	DCP (g)	TDN (g)
3.0	48	275
3.5	51	300
4.0	55	325
4.5	58	350
5.0	62	375
5.5	65	400
6.0	68	425

Growth: growth is a function of the nutrients, which require protein and energy in addition to the maintenance. The requirement of DCP and TDN depends on the daily gain in body weight. The table given below gives an idea about the nutrient requirement for growth at different body weight and different average daily gain

Daily Nutrient requirement in terms of DCP and TDN for growth

ADG (g)	DCP (g)	TDN (g)
45	150	800
70	220	1300
100	260	1900
200	400	3000
300	470	4000

Work allowance: The allowance for working bullocks depends on the intensity of work. The nutrient requirement describing the protein and energy requirement in the form of DCP and TDN is given in the table as under for normal working bullocks

Daily nutrient requirement for working bullocks

B.W. (kg)	DCP (g)	TDN (g)
200	240	2000
300	330	3100
400	450	4700
500	560	4900
600	660	5800

Pregnancy allowance: In addition to the maintenance requirement, an additional allowance should be given to female animals during pregnancy especially in last three months for the development of foetus. Generally, 140 g of DCP and 700 g of TDN daily is sufficient for the pregnant animal.

Breeding bull: The nutrient requirement for nutrients again depends on the body weight of animal, which must be given in addition to the maintenance requirement.

Daily allowance for breeding bull over and above the maintenance

B.W. (kg)	DCP (g)	TDN (kg)
400	380	3.6
500	450	4.5
600	530	5.4

Problems:

1. Calculate the DCP and TDN requirement of a cow weighing 450 kg yielding 10 liters of milk with 4.0 % fat. The cow is in advance stage of pregnancy.
2. Compute the nutrient requirement in terms of DCP and TDN of a male buffalo weighing 500 kg and working in the field for 6 hrs. in a day.

COMPUTATION OF RATION FOR CATTLE AND BUFFALOES

Objectives: To provide balanced ration to farm animals in view of production Scientific approach for feeding of farm animals and to make economical use of available feed resources.

Principle: Computation of ration includes translating the recommendations contained in feeding standards into actual formulation of feed mixture and feeding practices. In formulation of ration for ruminants DM, DCP, energy in terms of TDN, minerals and vitamin A is given consideration.

Formulation of ration: Ration may be defined as total allowance of the feed given to an animal during 24 hrs period to perform the various functions. The ration of animal may be divided for the sake of convenience into two parts, one for maintenance and other for production or reproduction whatever the case is. The word “balanced ration” means feeds or mixture of feeds which contain all essential nutrients in right quantity and in good proportion to meet the needs of the animal for maintenance and production.

Points to be consider while formulating the ration: a. Live weight of the animal b. Age of the animal c. Condition of the animal d. Producing or non-producing e. Production level-high or low f. Types of the feed and fodders available

Ration for dairy cattle: The computation of ration must be done in a systematic manner otherwise it will be a cumbersome exercise. The steps involved in ration formulation given under in tabular form:

Step-I	Determination of dry matter requirement
Step-II	Distribution of required DM to different category of feeds
Step-III	Determination of DCP and TDN requirement of animal for maintenance
Step-IV	Determine the DCP and TDN requirement for production or reproduction function over and above the maintenance requirement
Step-V	Sum up the maintenance requirement of nutrients with production/reproduction requirement. This will be total requirement of the nutrients for particular animal in a day for maintenance and production/reproduction
Step-VI	Refer the chemical composition of the available feed resources to fulfill the DCP and TDN requirement as per the allocation of DM to particular feed category and at the cheapest price.
Step-VII	Calculate the nutrients supplied through roughage and concentrate according to DM allocation and also calculate the quantity of individual feedstuff on fresh and dry basis.
Step-VIII	Match the supply of nutrients with their requirement for one day. It should be exactly same or somewhat higher than the requirement but if anyone is deficit then readjust the level of individual feed ingredient within the category and according to deficit nutrient.
Step-IX	Preparation of ration

Note: Mineral mixture @ 2 per cent and salt @ 1 per cent of the ration should be given to the animal.

Chemical composition of feedstuffs: The quantity of individual feedstuff in the ration cannot be fixed until unless you have the idea about its chemical composition. Different principles of the composition may be analyzing in the laboratory or may refer from the books. The composition of some common feed ingredients in terms of DCP and TDN is given in table

DCP and TDN content of some common feed stuffs

The nutritive value of some important feeds are as follows:			
(a) Dry roughages			
FEEDS	**DM**	**DCP**	**TDN**
Wheat straw	90	0.0	42
Bajra	90	0.8	48
Jowar straw	90	1.0	50
Rice straw	90	0.0	35
Berseem hay	90	9.0	60
Lucerne hay	90	14.0	50
(b) Green succulent roughages			
Green bajra	30	1.0	15
Green jowar	30	0.8	16
Green maize	30	1.2	17
Green berseem	20	2.8	13
Green Lucerne	20	3.0	12
(c) Concentrates			
Guar	90	29	71
Moth	90	8	78
Barley	90	19	72
Wheat bran	90	10	62
Cotton seed cake	90	17	72
Groundnut cake	90	42	72
Til oil cake	90	30	78
Linseed cake	90	28	65
Gram	90	12	75
Guar churi	90	38	74
Moth churi	90	25	75
Gram churi	90	38	72

Problems: Compute a balanced ration for a cow weighing 450 kg and producing 5 litre milk/day of 5% fat. The animal is in advanced pregnancy. The feedstuffs available are wheat straw, green sorghum, maize grain, wheat bran and ground nut cake. Formulate the ration for a buffalo weighing 500 kg and producing 12 liters of milk of 6% fat in the month of November.

Housing of Livestock

Objectives:

1. To protect the animals from extreme/harsh climate conditions.
2. To protect them from the predators.
3. To increase the efficiency in the herd management in terms of feeding cleaning, watering, health control handling etc.
4. To increase the efficiency of labour utilization in carrying out the farm work.

Point to be considered while deciding the location of dairy / building

1. **Topography and drainage.** The site should be at a high elevation than the surrounding is for better drainage of rain water and liquid farm waste water, and to avoid water logging and parasitic problem.
2. **Road:** There should be accessibility (nearness) of all season roads.
3. **Distance from noisy place:** the farm should not be near to highways, main road, rail tracks, aerodromes etc. to avoid disturbance to the animals.
4. **Water supply:** There should be adequate supply of soft, clean and fresh drinking water round the year.
5. **Electricity:** There should be sure supply of electricity round the clock.
6. **Laborers:** Laborers must be available easily and at reasonable wage.
7. **Market Facility:** The farm should be near to the main market for sale of milk, Milk Products and purchase of farm requirements viz, concentrates, ropes, medicines etc.
8. **Nearness to human habitat:** The farm should not be very near to human habit / residential areas to avoid complaining of pollution.

Type of Housing: Two Systems

I. Conventional Housing or Stanchion Barn: In this System the animals are tied throughout the day and night in a completely enclosed structure or barn. Feeding, Watering, Milking, Treatment etc., is carried out at the same place. This system is followed in countries having cold climate such as European countries. Facilities for heating or cooling the internal air are also provided to the barn through heater or coolers and used according to the season. Management is also mostly through automation.

2. Loose Housing System: Here the animals are kept lose all the while except a temporary tying at the time of milking and treatment. Facilities of suitable manager under shed and water through in paddock under the tree shade are provided to the animals for free access to feed, water and rest. This s stem is widely practiced in hot tropical countries including India due to its many advantages over conventional system.

Advantages of Loose Housing:

1. Animals move freely and are most comfortable to get feed, water, sunlight exercise etc., at their wall.
2. The construction cost is less because of its simplicity in design.
3. Expansion of building/sheds is easy, if required in future.
4. The sheds have flexible utility. A cow shed can be utilized for heifers and vice —a versa.
5. It is labour saving—less labourers required for feeding, watering cleaning etc.
6. Detection of heat, sickness and such problems are easy since the animals can manifest them through their behavior.

Limitations of Loose Housing System:

1. Separate milking parlor is required to be constructed.
2. More labour is required in catching and handling of animals.
3. Chance of spread of contagious disease are more as the animals move freely and are in intimate contact to each other and there is common feeding and watering.
4. It is difficult to disinfect the animal shed regularly and completely.
5. Powerful or bossy animals do not allow sufficient space for feeding, watering rest etc. to the mind or weak animals.

DETERMINATION OF TOTAL SOLIDS IN MILK

Principle: Total solid of milk means the residue left after complete evaporation of water from milk, which includes fat, protein lactose and mineral matter of milk.

Materials needed: 1. Oven 2. Pipette 3.Balance 4. Dessicator 5. Moisture cup

Procedure:

1. Bring sample to about 20ºC, mix well until homogenous by pouring into clean receptacle and back repeatedly, and promptly weigh or measure test portion. If lumps of cream do not disperse, warm sample in water bath to about 38ºC and keep mixing until homogenous. Where particle and fat remain dispersed, cool warmed samples to about 20ºC before transferring test portion.
2. Weigh 2.5 to 3.0 preferred sample into weighed flat bottom dish.

3. Heat on steam bath for 10-15 minutes exposing maximum surface of dish bottom for evaporation.
4. Heat for 3 hours in hot air oven at 98 to100ºC.
5. Cool in dessicator and weigh quickly.
6. Repeat heating, cooling and weighing until the loss in weight between successive weighing does not exceed 0.5 mg. the lowest weight should be recorded. Report percent residues as total solids.

Observations:

Weight of empty moisture cup	= W1 g
Weight of moisture cup + milk	= W2 g
Weight of milk taken	= W2-W1 g
Weight of moisture cup + total solids	= W3 g
Weight of total solids in milk	= W3-W1g

Calculation: Per cent total solids in milk= W3-W1/W2-W1 x 100

Notes:

1. do not exceed temperature of oven more than 100ºC as higher temperature will cause charring of solids
2. In case of sour milk, the result is usually low on account of losses of volatile matter.

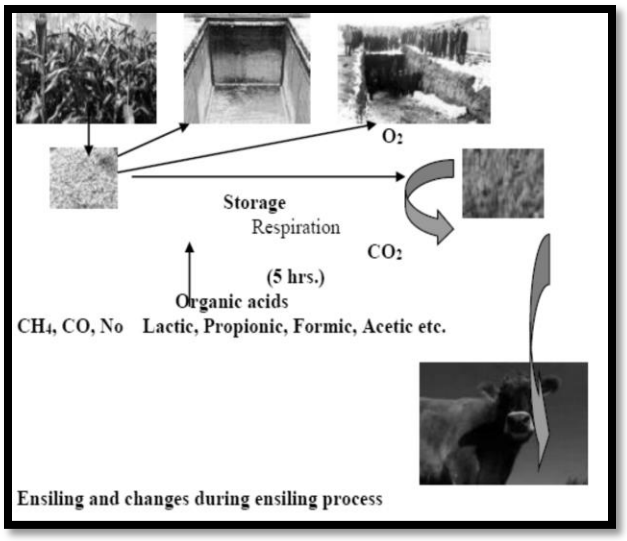
SILAGE AND HAY MAKING

Problem: To demonstrate the laboratory methods of silage making to the students and to give exposure to students for hay making and its utility during scarcity period

Process of making silage is called ensiling. The green fodder harvested at proper stage is stored, packed and compressed in silo and it is then tightly covered to prevent the contact with fresh air. Thus, the forage is preserved by controlled microbial anaerobic fermentation in a silo with minimum loss of nutrients for use as a succulent fodder during lean months (scarcity) and this form of preserved fodder is known as silage. The acid (Lactic acid) formed in ensiled feed for silage inhibits the microbial growth thereby preserving the greenfodder.

Following points should be considered during silage preparation

- Crops having thick, solid stems and rich in soluble carbohydrate are best for silage preparation e.g., maize, sorghum, bajra etc. Silage can also be prepared from oats, berseem etc. after wilting to 35-40% DM.
- Dry matter content in fodder crops for ensiling should be between 30-40 per cent (average 35%) and should have sufficient soluble sugars for acid production during fermentation.
- The crop harvested in bloom stage is the best for silage preparation.
- If a crop deficient in soluble carbohydrates, is to be ensiled (e.g., legumes), then a carbohydrate source like sugar industry byproduct is added.
- Silage having acidic flavour and pH 3.5 to 4.2 is considered to be excellent.
- The crop should be properly trampled / pressed to remove the air out of the silo.
- The crop is chopped into small pieces for better microbial action due to increase surface area and sufficient acid production.



Ensiling and changes during ensiling process

Crops suitable for silage making: Crops rich in soluble carbohydrates are most suitable for silage making e.g., maize, sorghum, pearl millet, napier, oats etc. The crops at the time of ensiling should have about 35 per cent dry matter.

Stage of crops suitable for ensiling

Crops	Stage of ensiling
Maize	Dent stage
Oats, Sorghum, Bajra	Milk or dough stage
Berseem, Lucerne	20-25% bloom stage
Natural grasses	At flowering stage

Steps in silage making:

1. Thecropsuitableforsilagemakingisfirstcutintosmallpiecesofabout2-4cm length and wilted up to 35% DM.
2. Silage additives like molasses (@ 3 to 3.5%) can be added to provide soluble carbohydrates for efficient bacterial fermentation.

3. To improve palatability and nitrogen content salt (0.5%) and urea (1%) can be added respectively.
4. The whole material is thoroughly mixed and then filled tightly in bag/bucket.
5. Care has to be taken to avoid dead space inside the bag/bucket.
6. After proper filling the open end is sealed airtight and bag/bucket is kept inside the metal or cement tub and free space is filled with soil, mud or sand.
7. The silo is opened for sampling after 4-6 weeks.

Characteristics of good quality silage:

1. Colour : green, yellow or golden brown
2. Smell : pleasant or vinegar type
3. Texture : firm
4. pH : 3.5-4.2
5. Butyric acid : No/traces

Advantages of silage making

1. It is palatable, slightly laxative in nature, provide succulent feed during scarcity.
2. In this method nutrient loss is minimum as compared to other methods of preservation. Less storage area is required as compared to hay.
3. It helps in biological control of pests and insects by preventing them to complete their life cycles due to early harvest of crops.
4. It can be prepared in all seasons.
5. Silage can be prepared from plants which have thick stems and thus are not suitable for hay making and also when the weather does not permit for haymaking.
6. The organic acids mainly VFA produced in the silage are similar to those produced in rumen and therefore are utilized in the same manner.

Disadvantages of Silage making

1. Silo construction is costly.
2. Loss of nutrients may be very high, if silos are not properly prepared.
3. Due to fermentation, there is 5-20% loss of dry matter.
4. If air enter silo, carotene loss is much.

Haylage: It is between hay and silage. It is low moisture silage. It is a product of legumes and/ or grasses, which are wilted to about 50 % moisture before ensiling in upright so. The lower moisture content of haylage makes it difficult to pack sufficiently to exclude air from the mass, which results in greater spoilage.

Advantages of Haylage: Where the climate is not conducive / favorable (heavy continuous rain) for hay making, haylage can be prepared. Animals also consume more dry matter in the form of haylage than the silage. Feeding value of the forages when feed as hay or haylage is about the same, when proper procedure for both is followed.

Hay Making: Forages, which are harvested before seed formation i.e., at flowering/ bloom dent silage and dried to near 85 – 90 % dry matter form hay. Indian hay just like straw consists of dry grass on which seeds have been ripened and leaves usually has been shed. For hay making, forages are dried (cured) either under the sunray or inside the barn or in the machine. i.e., sun curing barn curing or machine curing is used to prepare hay.

Harvesting and field curing and hay: The best time for cutting the crop for hay making is when it is 1/3rd to ½ in bloom. The crop cut early is higher in protein, lower in crude fiber and contains more vitamins i.e., more nutritive. Such hay is more palatable and will shatter less. It is best to let the crop lie in the field for few hours until it is well wilted or about 1/3rd to 1/4th dried cured. It should be raked in the small bundles called windrows. It is necessary to handle the hay only early in the morning to avoid loss of leaves.

Requisites/ Characteristic of Good Quality Hay

1. It should be leafy. Leaves are rich in protein vitamins and minerals.
2. Color of hay should be green parrot like, which indicates the amount of carotene- a precursor of vitamin – A present in it.
3. If should be soft and pliable in texture.
4. It should be free from dirt, dust and fungus/ mould growth.
5. It should have smell or aroma characteristic of the crop from which it is prepared.
6. It should be free from weeds and stubbles.

Losses of Nutrient in Hay Making

1. Losses of leaves by shattering. Gentle handling in early morning prevents shattering.
2. Losses of vitamins due to bleaching by sun and fermentation by bacterial action. Avoid bacterial action by complete drying/ curing of material.
3. Losses of carbohydrate due to fermentation starch in oxidized into CO_2 & water.

4. Losses of soluble nutrients by leaching in heavy rain
5. When hay is not properly dried, more heat will be produced by fermentation in staked hay and have a chance of spontaneous combustion.

Kinds of Hay

Leguminous hay: It has got more of digestible protein and other nutrient viz. carotene vit – D & E as it's is prepared from leguminous crop like Lucerne, berseem etc.

Non–leguminous hay: It contains less protein, minerals and vitamins and is less palatable as it is prepared from non – leguminous crops like jowar, grasses etc.

Grain Crop hay: It is made from crops like barley, oat, harvested at dent stage.

Mixed hay: Prepared from mixed legume and non-Legume crops, has balanced nutrients.

Physical forms of Hay (Treatment of Dry Roughage)

Long hay: Forages that are cut dried and then stored as such in the barn.

Chopped hay: Dry Hay cut into small pieces of 2.0 – 2.5"in size and then stored.

Baled hay: Hay is tied in the form of bales of about 1m x 1m x1m size. It requires less storage space than the chopped or long hay.

Pelleting: Grinding and pelleting of hay results in a product, which is easy to handle and store than then previous three forms. Pelleted hay is consumed in greater amount than the other forms, resulting in faster body weight gain. The processing cost in however little higher under Indian condition.

Waferring of Cubs: Hay is packed in form of 2-3" long x 1.25" wide x 1.25" high blocks/cubes. It requires less space for storage (25 lbs/cubic feet), because of small size and compactness. It also requires fewer laborers for transport, Storage and feeding.