



Nutritional Terms in Animal Nutrition

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Nutritional Terms in Animal Nutrition

•**Nutrition:** Nutrition is **study of nutrients** present in feeds and fodders. It includes the processes like ingestion, digestion, absorption, utilization, excretion of end products etc by which an animal's obtain feed which is used to provide energy and materials for its life sustaining activities.

•**Nutrients:** It is defined as any **substances** like carbohydrates, proteins, fats, vitamins, minerals and amino acids etc naturally occurring or artificially manufactured that helps in support of animal life.

•**Feedstuffs:** Feeds and fodders covering all **edible material in livestock ration** and having nutritive value are feedstuffs. These include naturally occurring plants, animal products, by-products of milling and other processing industry.

•**Feed:** It is **any material / substance given to domestic animals** or eaten by animals as a part of their ration is called as feed. In **Animal Nutrition**, it is used in place of food. There are two basic types, fodder and forage. Used alone, the word "feed" more often refers to fodder.

•**Food:** Food is **any substance consumed by human beings** to provide nutritional support for its body activities. It is usually of plant or animal origin, and contains essential nutrients, such as fats, proteins, vitamins, or minerals. The substance is ingested by an organism and assimilated by the organism's cells to provide energy maintain life, or stimulate growth.

Nutrients includes

Fats

Minerals

Carbohydrates

Vitamins

Water

Protein

•**Roughages:** Roughages are **bulky / low density feeds**, containing **more than 18% of crude fibre and less than 60% TDN**. Therefore, they are low in energy content. e.g. hay, straw, hull, husk, stovers etc.

•**Hay:** Hay is the **grass, legumes, or other plants** that have been cut, **dried under sun light**, and stored for use as animal fodder, particularly for grazing animals.

•**Straw:** Straw is an **agricultural by-products; dry thick stalks** of cereal plants, after the **grain cobs have been removed**. It has many uses, including fuel, livestock bedding and fodder, thatching. It is usually gathered and stored in a straw bale, which is a bundle of straw tightly bound with twine or wire.

•**Stover:** Stover is the **leaves and stalks of field crops**, such as corn/maize, sorghum or soybean that are commonly left in a field after harvesting the grain. **It is similar to straw**, the residue left after any cereal grain or grass has been harvested at maturity for its seed.

•**Pasture:** Pasture is **land used for grazing**. Pasture lands in the narrow sense are enclosed tracts of farmland, grazed by domesticated livestock.

•**Husk (or Hull):** Husk or hull is the **outer shell or coating of a seed**. It often refers to the **leafy outer covering** of an ear of maize (corn), groundnut husk as it grows on the plant.



Jowar / Maize straw



Jowar / Maize stover

Difference?



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Maize Husk or hull



Rice Husk or hull

•**Fodder:** Fodder is the **entire above ground part plant** of nearly mature corn / sorghum / legume plant in fresh or cured form.

•**Forage:** Crops used in the **whole plant form (except roots)** like pasture, hay, green crop for feeding purpose.

•**Fodder Crops:** are crops that are **cultivated primarily for animal feed**. By extension, **natural grasslands and pastures** are included whether they are cultivated or not. Fodder crops may be classified as either temporary or permanent crops. The former are cultivated and harvested like any other crop.

•**Silage:** Silage is **fermented, high-moisture** stored green fodder which can be fed to ruminant animals. It is fermented and stored in a process called ensilage, **ensiling or silaging**, and is usually made from grass crops, including **maize, sorghum or other cereals**, using the entire green plant (not just the grain). Silage is made either by placing cut green vegetation in a silo pit covered with plastic sheet, or by wrapping large bales in plastic film.

•**Ensilage:** Ensiled refers to the plant materials preserved by anaerobic fermentation and typically stored in a bag, bunker, wrapped bale or upright silo.



Jowar fodder



Maize fodder



Roots Removed



Forage

•**Ration:** A ration is a **24 hours allowance of a feed** or of the mixture of feeding stuffs making up a diet. Ration refers to the 24-hour feed allowance for an individual animal.

•**Meal:** Meal is an **eating occasion (e.g. feast)** that takes place at a certain time & includes specific, prepared food or feed, or feed eaten on that occasion.

•**Diet:** In nutrition, diet *is* the **sum of food consumed** by a person or other organism.

•**Balanced Ration:** A balanced ration is ration that **furnishes nutrients** in such a proportions and amounts that, it will properly nourish a given animal for 24 hrs. (Morrison, 1956). It can also be defined as a complete feed formulated to provide a specific animal species and class with appropriate amounts of all nutrients **required for maintenance and a given level of performance.**

•**Digestion:** Digestion is the **breakdown of large insoluble food molecules** into small water-soluble food molecules so that they can be absorbed into watery blood plasma. In certain organisms, these smaller substances are absorbed through the small intestine into the blood stream. Digestion is a form of catabolism that is often **divided into two processes** based on how food is broken down: **mechanical and chemical digestion.** The term mechanical digestion refers to the **physical breakdown** of large pieces of food into smaller pieces. In chemical digestion, enzymes break down food into the small molecules the body can use.

- Concentrates:** They are **high density** feeds or feed mixtures, which are highly digestible and containing **more than 60% TDN and less than 18% crude fibre**.
- Energy or basal feed:** These are the **grains and its by-products** which contain **not more than 20% crude protein and 18% crude fibre**. Nutritionally, these are energy concentrates rich in starch & sugars. Average **protein content ranges from 8-12%** & EE content is 5%, e.g., grains of maize, jowar, wheat, bajra.
- Supplements:** A supplement single feed or feed mixture is **used to improve the nutritional value** of the ration complementing the nutrients **in the base feed**. A supplement is rich in one or more of protein, energy, vitamins or minerals, and, in combination with the base feeds, produces a more complete feed.
- Protein supplements:** They are the products containing **more than 18% of protein**. Animal by-products, viz., marine by-products–fish meal and avian by-products –avian meal.
- Mineral supplements:** Mineral supplements are those which **supply minerals** in sufficient quantity and quality depending upon the requirement of animals.

- Proximate Principles:** Proximate principles are an organic compound that formed as a part of some other more complex substance (various sugars, starches, and albumins etc). They are moisture/DM, EE, CF, TA, NFE, CP etc.
- Dry Matter:** dry matter or dry weight is a measurement of the mass of feeds and fodders when completely dried. The dry matter of plant and animal material would be its solids, i.e. all its constituents excluding water.
- Crude Protein:** Crude protein in animal feed is calculated as nitrogen x 6.25 (the assumption is that proteins of typical animal feeds contain **16% nitrogen** in average). The nitrogen value is obtained by the **Kjeldahl method**.
- Crude Fibre:** CF also known as **Weende cellulose**. CF is **insoluble residue** of an acid hydrolysis followed by an alkaline one. This residue contains true cellulose & insoluble lignin.
- Ether Extract (Crude Fat):** Crude fat is an estimate of the **total fat content** of feeds taken from older collection of methods. Crude fat is estimated using ether extraction. Crude fat contains true fat (triglycerides) as well as alcohols, waxes, terpenes, steroids, pigments, ester, aldehydes and other lipids.
- Total Ash:** The ash content is a measure of the total amount of minerals present within a feed, whereas the mineral content is a measure of the amount of specific inorganic components present within a feed or food, such as Ca, Na, K and Cl.

- Acid Insoluble Ash:** Acid insoluble ash is the **residue** remaining after a feed sample is ignited in a furnace at $525^{\circ}\text{C}\pm 25^{\circ}\text{C}$ and the ash treated with hydrochloric acid (HCl) and filtration through Whatman paper No. 42.
- Nitrogen-Free Extract (NFE):** In the analysis of foods and animal feedstuffs, the fraction that consisting of carbohydrates, sugars, starches, and a major portion of materials classed as hemicellulose in feeds. When crude protein, fat, water, ash, and fibre are added and the sum is subtracted from 100, the **difference** is NFE.
- Nutritive Value (NV):** Nutritive value refers to a feed's protein, mineral and energy composition, availability of energy, and efficiency of energy utilization.
- Palatability:** Palatability **refers to appeal & acceptability** of feedstuffs to an animal. It is affected by feed's odour, texture, moisture, physical form and temperature because quality includes intake & palatability is required for high levels of intake.
- Wet Chemistry Analysis:** Wet chemistry is a term that collectively **refers to a number of scientific techniques** involving direct analyses with solvents and other traditional laboratory methods used to analyze feed samples. Wet chemistry methods are the **most accurate methods** for determining nutrient values of feeds / forages and are frequently **used for quality assurance purposes.**

•**Proteins:** Proteins are large biomolecules, or macromolecules, consisting of one or more long chains of amino acid residues.

•**By-pass Protein:** The portion of intake protein that has a slow rate of degradability in the rumen. It is fed so that it may **escape digestion in the rumen**, reach the lower gastrointestinal (GI) tract essentially intact and be digested directly in the small intestine as it would be in non-ruminants. This can provide a balance of amino acids unaltered by microbial digestion and synthesis. By-pass protein is also known as **un-degradable intake protein (UIP)**, **rumen un-degradable protein (RUP)** or **escape protein**.

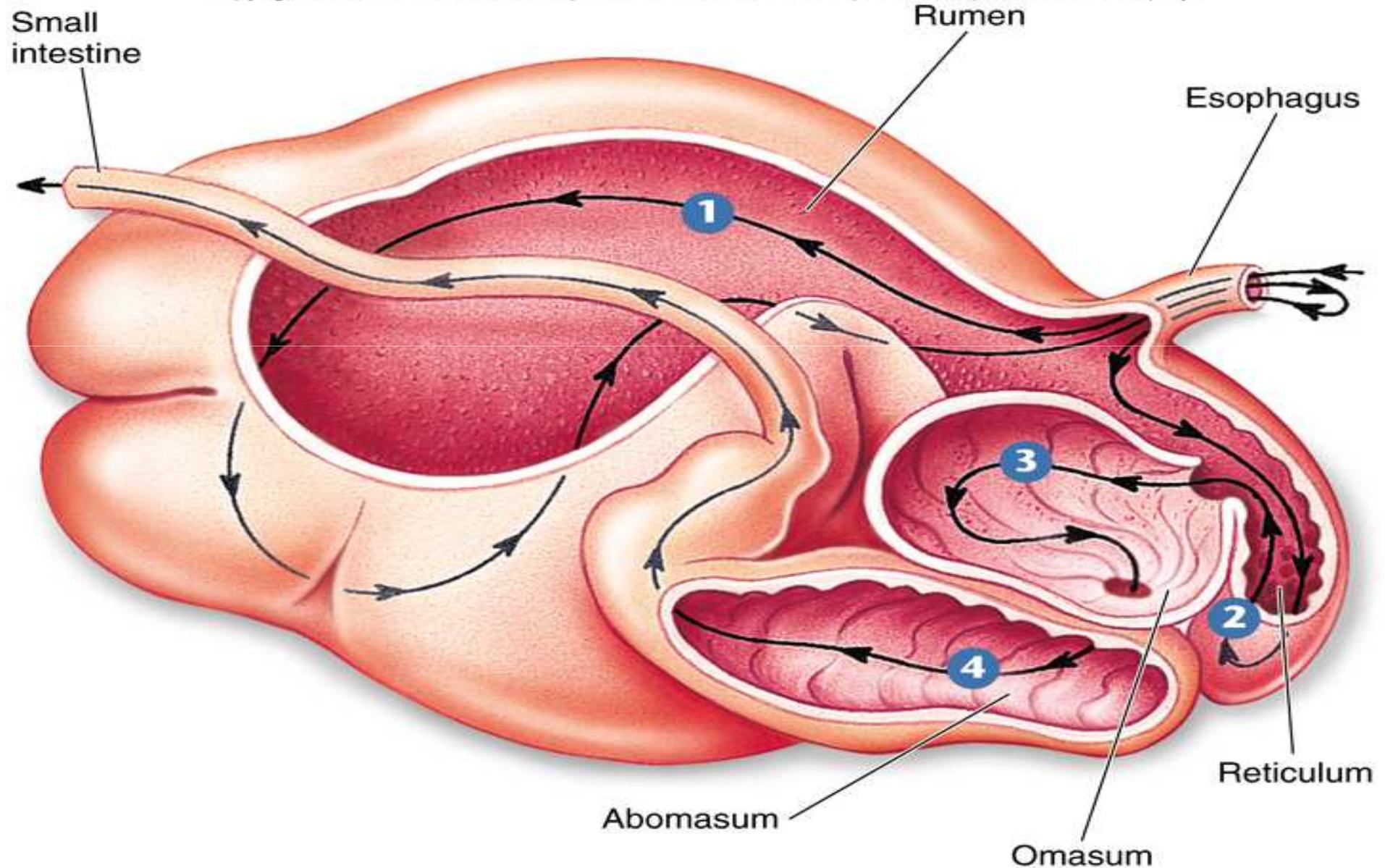
•**Un-degradable Intake Protein (UIP):** UIP is sometimes used as another name for by-pass protein, escape protein or Rumen Un-degradable Protein (RUP). The use of UIP is generally refers to material that is **not degraded in the rumen** but is **degraded in the abomasum and thus is not truly “un-degradable.”**

•**Non-protein Nitrogen (NPN):** NPN refers to nitrogen in a feed sample that is not in the form of protein but can be used by the microbial population in the rumen to synthesize amino acids and proteins. E.g. of NPN are urea and ammonia.

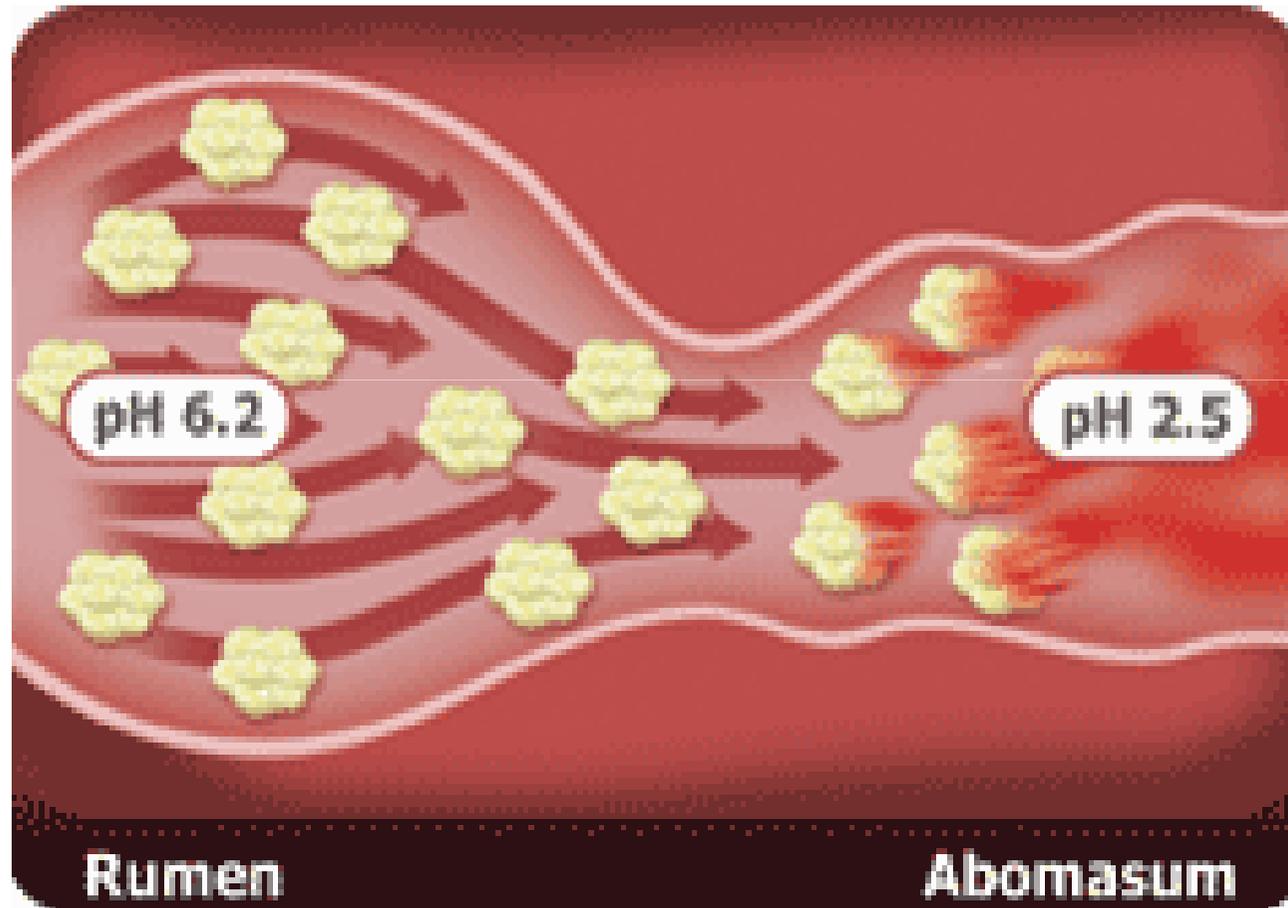
•**Rumen degradable protein (RDP):** Rumen degradable protein is defined as that portion of dietary protein that can be **degraded in the rumen**, the largest of the multi-compartmental stomach, by microorganisms (both bacteria and protozoa) that use protein to manufacture high quality microbial cell proteins, also known as microbial crude protein.

Normal path of Digestion in Ruminants (Ruminant stomach)

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Passage of By-Pass Nutrients



- Nutrient Requirements:** Nutrient requirement refers to the **minimum amounts of nutrients** (energy, protein, fat, minerals and vitamins) necessary to meet an animal's real needs for maintenance, growth, reproduction, lactation or work (but does not include a safety margin in ration formulation).
- Ruminants:** Ruminants are a class of animals that have **multiple organs** working together to accomplish digestion. The digestive tract consists of *reticulum*, *rumen*, *omasum* and *abomasum* (acid-pepsin digestion similar to a monogastric).
- Rumen:** The rumen is the foregut (or fore stomach) of ruminant animals such as cattle, sheep and goats. The rumen is a large, hollow muscular organ that is the site of most of the fibre digestion that occurs in ruminant animals. This digestion is largely performed by microorganisms (bacteria, protozoa and fungi) that inhabit the rumen.
- Ruminal Microbes:** Ruminal microbes include the whole community of microorganisms present in the rumen of ruminant animals. They accomplish the digestion or fermentation of feed. An estimated 150 billion microorganisms per teaspoon are present in the contents of the rumen. This microbial community consists of bacteria, protozoa and fungi.
- Mono-gastric animals:** Mono-gastric animals have a **simple or single-chambered** stomach. Mono-gastric animal utilizes an acid-pepsin digestion to extract nutrients from ingested feed or food.

•**Total Digestible Nutrients (TDN):** TDN is a **sum** of the digestible fibre, protein, lipid, and carbohydrate components of a feedstuff or diet. TDN is directly related to digestible energy and is often calculated based on ADF. TDN is a measure of the energy value in a feedstuff.

•**Total Mixed Ration (TMR):** TMR is a **homogenous mixture** of mechanically mixed ration ingredients that typically combine **roughages (forages) and concentrates** such as grains to optimize animal performance. TMRs are commonly used in large dairy or beef feedlot operations.

•**Biological value (BV):** Biological value is a **measure of the proportion of absorbed protein** from a food which becomes incorporated into the proteins of organism's body. It captures how readily digested protein can be used in protein synthesis in cells of the organism. Proteins are the major source of nitrogen in food.

•**Vitamins:** Vitamins are an organic compound and a vital nutrient that an organism requires in limited amounts because animals cannot synthesize the vitamins in sufficient quantities, and it must be obtained through diet.

•**Digestibility:** The proportion of a foodstuff absorbed from digestive tract into bloodstream, normally 90–95%. It is measured as the **difference between** intake and faecal output, with allowance being made for that part of faeces that is not derived from undigested food residues. Digestibility measured in this way is referred to as ‘**true digestibility**’ as distinct from approximate measure, ‘**apparent digestibility**’ which is simply the difference between intake and output.

•**Dry Matter Digestibility (DMD):** DMD is the portion of the **dry matter** in a feed that is **digested** by animals at a specified level of feed intake. There is **no direct laboratory method for measuring DMD**. It is often estimated by measuring *in vitro* or *in situ* digestibility. Both of these analyses are rather expensive and laborious.

•***In-Vitro* Dry Matter Digestibility (IVDMD):** *In-vitro* digestibility of a feed is determined by incubating a ground feed sample with rumen fluid in a beaker or **test tube** for 24 to 48 hours, followed either by addition of acid and pepsin and further incubation for 24 hours or by boiling in neutral detergent fibre solution.

•***In-Situ* Digestibility:** *In situ* digestibility is determined by incubating a ground forage sample in a porous nylon bag placed **within rumen** via a fistula.

Importance of Animal Nutrition

Current Scenario of Animal Husbandry in India

Fig. 1: Graphical presentation of Indian Livestock Population (numbers in millions)

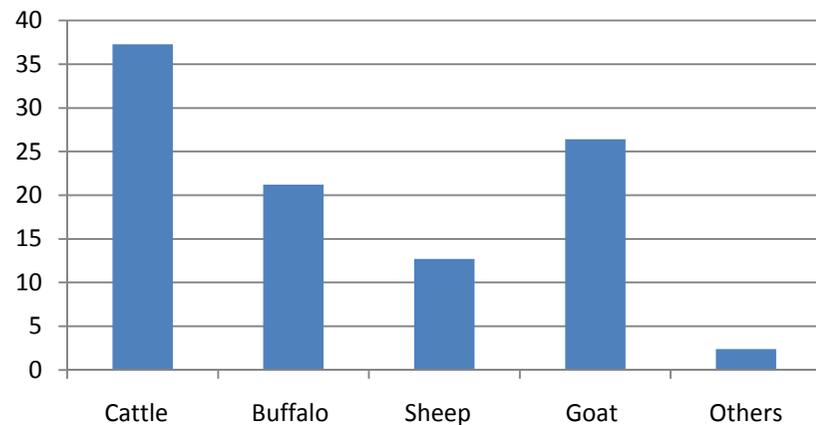
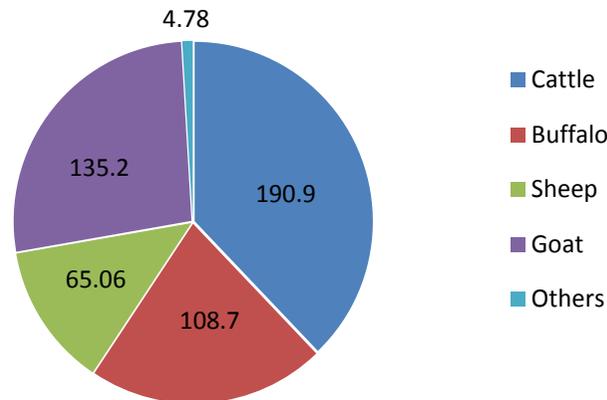


Fig. 2: In 19th Livestock Census, 37.28% were Cattle, 21.23% Buffaloes, 26.40% Goats, 12.71% Sheep & 2.38% other Animals

- **Cattle:** 2nd position in world (16.30% of total world population of cattle present in India)
- **Buffalo:** 3rd position in world (57% of total world population of buffaloes present in India)
- **Sheep:** 3rd position in world
- **Goat :** 2nd position in world
- **Poultry:** India 3rd in egg production & 5th in poultry meat production .Overall 5th position in world.

Feeds and Fodders in India (MMT)

Feed Type	Availability	Need	Deficient	% Deficient
Green Fodder	400	1097	696	63
Dry Fodder	466	609	193	23
Concentrates	75	131	56	42

Feeds and Fodders in MH (MT)

Feed Type	Availability	Need	Deficient	% Deficient
Green Fodder	472	1214	742	61
Dry Fodder	320	486	166	34
Concentrates	80	126	56	46

Major Challenges

The livestock sector in India faces the following major challenges;

•**Shortage of Feed and Fodder:** While the livestock population is increasing, the **gap between** the requirement and availability of feed and fodder is increasing primarily due to decreasing area under fodder cultivation and reduced availability of crop residues as fodder. There is **continuous shrinkage** of common property resources leading to over grazing in the existing grasslands. It is imperative to arrange sufficient good quality feed and fodder for efficient utilization of genetic potential of the various livestock species and for sustainable improvement in productivity.

•**Low Productivity:** Although India is a major producer of livestock products the average **productivity of livestock is lower compared to world average**. Inadequate availability of feed and fodders, insufficient coverage through artificial insemination, low conception rates, non-availability of quality males for breeding, poor management practices, high mortality and morbidity losses due to diseases, inadequate marketing infrastructure & unorganized marketing are other major concerns.

•**Livestock Health:** A large number of **infectious and metabolic diseases prevalent** in Indian livestock have serious implication for animal productivity, export potential and safety/quality of livestock products and many of these diseases have **zoonotic implications**. The current efforts of prevention and control of livestock diseases needs to be strengthened. There is a **shortage of veterinary and para-veterinary manpower** and facilities including mechanisms for diagnosis, treatment, tracking and prevention of the diseases.

•**Livestock and Environment:** Climate change and global warming may have serious implications to the livestock sector. These may be manifested in the form of **heat stress**, loss of animal habitat especially in coastal areas, **scarcity of quality feed** and fodder, and changes in **epidemiological pattern of vector borne diseases**, etc., ultimately leading to reduction in production and therefore, economic losses. Mitigating the impact of climate change, calls for critical appraisal of the situation on continuous basis and advance planning.

•**Knowledge Gap:** Most of the **livestock producers being small and marginal farmers**, their capacity to mobilize resources required to absorb the **latest technologies developed** by research institutions are limited. **Absence of effective extension machinery** for this purpose compounds the problem. Lack of access to institutional finance is a major constraint in attracting investment required for improving productivity by adopting latest technology.

•**Inadequate Infrastructure for Marketing, Processing and Value Addition:** The livestock sector is handicapped due to **inadequate marketing and processing infrastructure** as a result of which the primary producers do **not get remunerative prices most of the times**. Although various initiatives for dairy development have resulted in vibrant dairy cooperatives in many states, but still large number of dairy farmers are not covered by cooperatives. The **dairy cooperatives handle only about 8% of milk production**. Still major share of marketable surplus of milk and other livestock products are not handled by organized processing industry, resulting in reduced price realization by farmers and post production losses and wastages.

THANK YOU