

**COURSE
GUIDE**

**ANP 510
LIVESTOCK ECONOMICS
(2 UNITS)**

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Introduction

Livestock economics is a two-credit unit course. Livestock economics is an aspect of Agricultural economics that deals with how producers, consumers, and societies use scarce resources in the production, marketing, and consumption of animal and products. Livestock is the domesticated animals raised in an agricultural setting to produce labor and commodities such as meat, eggs, milk, fur, leather, and wool. The livestock species play very important economic and socio-cultural roles for the wellbeing of rural households, such as food supply, source of income, asset saving, source of employment, soil fertility, livelihoods, transport, agricultural traction, agricultural diversification and sustainable agricultural

Livestock economics requires thorough understanding of the:

- a) The place of livestock in the Nigerian economy, theory of Consumer's behaviour, retailing and wholesaling;
- b) Agricultural production functions;
- c) Application of economic theory and quantitative analysis which including capital Investment and depreciation of capital;
- d) Economics of animal feeds and feeding;
- e) Principles of aggregate demand and supply in livestock trade;
- f) Management of livestock enterprises and
- g) Input / return relationship in livestock production
- h) Livestock feed economics.

Course Aim

Livestock economics is designed to provide you with the knowledge of the importance of animal in providing income, employment, food, farm energy, manure, fuel, transport and a major source of government revenue. It also enlighten students on the different types consumer behaviour, economics of feeds feeding and input / return relationship in livestock production. Highlight micro and macro-economics in animal production,

agricultural production functions including data collection and analysis, marketing theory in relation to livestock production, application of economic theory and quantitative analysis. Capital investment and depreciation of capital; the economics of egg, meat and milk production and Livestock feed economics.

Course Objectives

On successful completion of the course, you should be able to:

- Explain the concept livestock products, multifunctionality of animal and its relevance to Nigerian economy
- Explain the factors militating against successful animal production
- Enumerate the principles of consumption, consumption pattern and factor affecting consumption.
- Mention the different utility analysis and their approaches
- Describe micro and macro economics of animal production
- Discuss the various economic theory
- Highlight different types of capital investment available to investors and the depreciation of Capital
- Discuss the marketing theory in relation to livestock production
- Describe the economics of animal feeds and feeding.
- Explain the principles of demand and supply
- Enumerate the input / return relationship in livestock production.

Working through this Course

You are expected to study and understand the content of this course. Each unit must be properly studied for good comprehension of the contents. By the end of each unit, you are expected to answer the questions therein and submit as appropriate when directed by the administration of the University. These questions are like continuous assessment. You are expected to sit for an examination on completion of the course. The course duration shall take about 17 weeks of learning. Therefore, you must be able to organize your time to achieve this successfully. Tutorial session will be available and it is advisable for you to

attend in order to be able to assess and compared yourself with your peers and clarify any area that you do not properly understand.

The Course Material

Major components of the course material are:

- The Course Guide
- Study Units
- The References/Further Reading, that will be provided at the end of each unit are necessary supplements to the course material.

Module 1: Livestock Product Consumers and Consumption Pattern

Unit 1: The Place of Livestock in the Nigerian Economy

Unit 2 Consumer and Consumption Pattern of Livestock Product

Unit 3 Theory of Consumer's Behaviour

Unit 4 Retailing and Wholesaling

Module 2: Agricultural Production Functions

Unit 1 Principle of Microeconomics and Macroeconomics

Unit 2 Production Function in Agriculture

Unit 3 Costs of Production

Unit 4 Marketing Theory in Relation to Livestock Production

Module 3: Economic Theory and Livestock Feed Economics

Unit 1 Application of Economic Theory and Quantitative Analysis

Unit 2 Nutrition in Livestock

Unit 3 Feeds and Feeding

Assignment File: The assignment file will be made available in this file. You will find all the details of the work you must undertake and graded online. The marks you obtain for these assignments will count towards the final mark you will obtain for this course. Assignments will normally attract 30% of the final grade, while the final examination attracts 70%.

Three assignments are administered (10 each) to make up to over 30% marks of the assignment. As a precaution, you are advised to keep a copy of each assignment you submit if it is not computer based. You are advised to be very systematic in following the instruction as it pertains to your course of study.

Final Examination and Grading: The final examination of the course (ANP 510: Livestock Economics) will have five questions for you to answer any four in 2 hours. Total marks earned will be over 70%, while the tutor or computer marked assignments (TMA or CMA) will be over 30% as earlier stated. Examination questions can come from any part of the course.

You may find it useful to review all TMAs/CMAs and Students' Assessment Exercises before the final examination

Working Through this Course: For you to be will taught, you ought to read through all the study units, and some of the references and other materials. In each unit under each module, there are Students' Assessment Exercises which you should attempt before checking the correct answers at the end of the unit. TMAs/CMAs must be submitted for marking and grading before the final examination, to test your understanding and mastery of the course.

Tutor-Marked Assignments (TMAs) or Computer-Marked Assignments (CMAs):

There are Tutor-Marked Assignments or Computer-Marked Assignments in this course. You are advised to do and submit three TMAs/CMAs. The completed TMAs /CMAs will be graded to form 30% of your final examination, which is 70%, both add up to 100%.

Below are some points worth noting:

1. Read the course guide thoroughly;
2. Organize a study schedule;
3. Do everything you can to stick to your study schedule.
4. Review the objectives of every unit and make sure you have achieved the objectives. Any further explanation can be received through your facilitator or in your students' study cycle.

5. After going through the units, review the course and prepare yourself for the final examination.

Final Advise: Studying in any Open and Distant Learning (ODL) mode involves self-study and discipline. Manage your time well. Take advantage of any facilitation or study cycle to ask any questions on units you do not understand. Proceed unit by unit through the course, pacing your studies as necessary so that the whole exercise will be easy for you.

Best of Luck.

Module 1: Livestock Product Consumers and Consumption Pattern

Unit 1: The Place of Livestock in the Nigerian Economy

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1. Introduction

Livestock produce about 30% of the agricultural gross domestic product (AGDP) in the developing world, and about 40% of the global GDP. Growing populations has raised the demand for easily cooked nutritious food, and rising incomes, which allow people to express their food preferences, the demand for livestock products is the fastest growing agricultural market, especially for the products in which smallholders can be competitive.

2.0 Objectives

At the end of this unit you will be able to have an overview if livestock products, the prospects of Livestock Industry in Nigeria, factors militating against successful animal production and the multi-functionality of livestock in Nigeria.

3.1 Overview of Livestock products

Livestock are domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labour. Livestock are generally raised for profit. Raising animals (animal husbandry) is a component of modern agriculture. It has been practiced in many cultures since the transition to farming from hunter-gather lifestyles.

Livestock production in Nigeria was dominated by nomadic pastoralism long before the advent of the British Colonial Administration. It accounts for one third of Nigeria's agricultural GDP, providing income, employment, food, farm energy, manure, fuel and transport. They are also a major source of government revenue. It has been argued that, livestock, especially ruminants, are the most efficient user of uncultivated land and contribute evidently to crop production. Efficient crop-livestock integration systems have the tendency of allowing nutrients to be recycled more effectively on the farm thereby enhancing crops' yield. In such a system livestock can be fed on crop residues, like straw, fruits and grains, as well as other products that would have otherwise been disposed of. Traditional livestock production is varied and complex in nature. It has evolved over centuries of adaptation under prevailing conditions of harsh climate and severe disease challenge and now represents an excellent adaptation to uncertain environmental conditions. It promotes the most efficient possible use of non-arable land, and can also contribute substantially to crop production.

Traditional livestock production in Nigeria is varied and complex. Livestock, especially ruminants, are the most efficient users of uncultivated land and can contribute substantially to crop production. The majority of households in both the savanna and the sub-humid zones of Africa own some livestock, be it cattle, sheep and/or goats, in addition to poultry. These animals contribute substantially to the quality of the human diet as well as to the household economy.

Among all the livestock that makes up the farm animals in Nigeria, ruminants, comprising sheep, goats and cattle, constitute the farm animals largely reared by farm families in the country's agricultural system. Nigeria has population of 34.5million goats, 22.1million sheep and 13.9million cattle. The larger proportion of these animals' population are however largely concentrated in the northern region of the country than the southern region. Specifically about 90 percent of the country's cattle population and 70 percent of the sheep and goat populations are concentrated in northern region of the country.

Nigerian livestock population estimates

Species	Number
Chickens	82 400 000
Goats	34 500 000
Sheep	22 100000
Cattle	13 900 000
Donkeys	900 000
Horses	200 000
Camels	90 000
Other poultry*	31 900 000
Pigs	3 500 000
Dogs	4 500 000
Cats	3 300 000
Rabbits	1 700 000
Guinea pigs	500 000
Giant rats	60 000

Source: Animal Genetic Resources, 2018

3.2 Prospects of Livestock Industry in Nigeria

Livestock production has indeed contributed immensely to the protein need of humankind, as it is claimed to contribute too, to the socioeconomic growth of Nigerian state particularly, through its commercial farming with modern technique, and it is expected to enhance development in a way that will guaranteed food sufficiency. Over the years, animal production has been an avenue for wealth and job creation, hundred of thousands of youths within the Nigerian state have been engaged in one form of production or the other within this agricultural subsector.

With the growing population of the Nigerian state, animal production is also expected to grow in this magnitude so as to meet the needs of the nation, where there will be availability of meat, milk, egg, for human consumption as well as manure for crop

production. In the area of job creation, a good number of Nigerians have been employed in this agricultural subsector. Some directly involved in rearing of cattle, cow, goats, sheeps. Others are in piggery, poultry etc. A good number of them majored in meat and animal skin production, milk production, those in poultry farming produced both meat and eggs. The diversification of Nigerian economy by Nigerian government away from oil particularly, to agriculture has been a welcome development as many are encouraged to take to mechanized farming with modern technology approach.

A good number of Nigerian have been taken off the street into agriculture farming particularly, in the area of animal production with mouth-watering grants and loans to take off with the business.

So livestock Industry has been one of the fastest growing labour employers in Nigeria. Being a major source of protein, livestock production has contributed in keeping Nigerians well and healthy, even as it contributed consistently to the advancement of food for all policy.

In animal production plants are used for animal food, and these are the same animals whose faeces are used as manure in crop production hence, the money spent by Nigerian government on fertilizer is drastically reduced. This is one among other economic important of animal production. Most of the shoes, belts we wore are made out of the animal production. So you can now imagine the impact livestock Industry has made in the nation, economically and socially.

In spite of the contribution it has made socioeconomically to the growth of the Nigerian state, the industry however, is challenged with some issues that are begging for attention. Much of what we enjoyed today as a result of animal production, are really produced by way of traditional methods, that is, small scale method, as farmers are not buoyant enough in terms of Finance, and the modern technology to go into commercial or large scale production are not there.

Though some of the food taken, for example, by cattle are natural, for instance, grass, not

every part of the country has this endowment and so, to go into say, cattle production, where there is non of this natural endowment, then you perhaps need a lot of money to go into cattle business.

Many Nigerian who are into animal production lack the requisite knowledge of animal husbandry. With little grants and loans they get from the government, they do not have what it takes, the modern know-how to go about the business in commercial dimension, they are not investing in relevant literature or a body of knowledge that can direct or instruct them on how to go about animal husbandry.

In view of the Nigerian economic reality, coupled with the growing population of this country, there is need for sufficient food production as the population keeps increasing on daily basis.

No country can be successful unless it can feeds its citizens and keep them healthy. Animal production is promising, if only the government will channel resources into this subsector, and as well encourage commercial or large scale production so as to meet the demand for food in this country.

However, livestock Industry has indeed contributed immensely to the government policy of food for all, there are some challenges facing the industry, and the way forward is far the government to pay close attention to this sector of the economy since it has reiterated its readiness to diversify Nigerian economy, it is glaring that agriculture will command a lot of attention in this regard hence, the government should encourage the youths the more in agriculture business by way of inducement, by that, I mean creating attractive conditions such as training the youths on how to go on commercial production.

They should be updated with modern technique on how to run the business, if need be, they can go for training outside the country. And I believe there is need for technology transfer since agriculture is the only promising sector that will boost the nation's economic status, given the current economic reality in the nation. A new scheme should be introduced, where the government will support the teeming youths with financial assistance for them to be able to run their business of animal production.

Animal husbandry contributed to well over 65 percent of the nation's economic growth. The federal government should launch a scheme that empowers states to embark on animal production such that is peculiar to the individual state, because all the states cannot produce the same animal, because climate and location differs.

Disease control must be of interest to animal producers, because if one is infected, then all is in danger. Government should take this as important by making sure that all the necessary vaccine that will help control animal disease are available to the farmers and at affordable prices.

3.2.1 The Economic Importance of Livestock

The economic importance of livestock includes the following;

- **Food Nutrition:** Meat, milk and eggs provide more than protein. They also provide essential micronutrients that are less available in plant-based foods. This makes livestock-derived foods highly valued in poor households subsisting almost wholly on high-carbohydrate starchy foods, and particularly valuable for infants in their first 1,000 days of life, from conception to 2 years old.
- **Livelihood:** One billion people are involved in livestock value chains globally, with more than half of these dependent on livestock for their livelihoods. Most livestock-dependent people live in developing countries and farm or herd cattle and other ruminants. Globally, livestock contribute an average of 40% to agricultural GDP, with this percentage rising fast in developing countries.
- **Health:** Livestock enhance human health in developing countries by providing nourishing foods, which are the foundation of good health and help the body protect itself against, and recover from, disease. In addition, farm animals give people viable ways to make a living, which allow them to make better dietary and health choices and to pay for good medical care.
- **Environment:** Livestock production helps make optimal use of all the planet's biomass, exploiting its full ecological potential and supporting a circular, regenerative food production system where nothing is wasted. While livestock production

inherently produces greenhouse gases, there are major opportunities to mitigate such emissions.

3.2.2 Category of livestock includes;

- i. Cattle
- ii. Sheep
- iii. Goat
- iv. Pig
- v. Rabbit
- vi. Snail
- vii. Grass cutter
- viii. Birds (poultry)

3.2.3 The Importance of Keeping Livestock

1. Large quantity but low density of nutrients in natural and agricultural ecosystems collected by livestock and converted into small quantity of high nutrient density human food
2. In addition livestock provide non-food commodities (fibres, feathers, hides, skins, horn, bones, manure), services (transport, riding, leisure activities) and subsistence needs or/and generate income.
3. Furthermore livestock have socio-economic functions and socio-cultural and religious significance.
4. Livestock assist mobilizing 14 of cropping systems by value adding, internal expansion, mobilizing production reserves, enhancing soil fertility, nutrient recycling and energy recovery.□
5. Livestock provide 40 to 60 % of the agricultural GDP worldwide and contribute to risk reduction, market integration, savings function, off-farm income, social coherence and cultural and religious concerns

3.3 Factors Militating Against Successful Animal Production

Nigeria is threatened with the problem of food insecurity and poverty because of fast growing population. Unfortunately, an average Nigerian still consumes far less animal protein than his counterpart in the developed world because the animal

production industry is still in its infancy due to hydra-headed problems and the per capita income is low leading to a consumption of less than 9grams of animal protein per capita per day as compared to over 50 grams per capita per day in North America and Europe (Boland et al.2013).

Nigeria animal production is facing numerous challenges with certain factors militating against successful animal production. These factors are as follows:

- i. Capital: Capital is crucial factors of production needed to set up an animal production and processing farm and capital is needed to sustain productivity. Financial inadequacies have led to slow growing animal industries or moribund ones or even destroyed animal production industries. According to McKay 2012, low income earners who dominate the animal industry are not able to cope with the demands of the industry especially when production is not at its optimum level To worsen matters loan facilities are hardly available and where they are available there are lots of bottle-necks and constraints to accessing such loans.
- ii. High cost of animal feeds : Nutritious animal feeds are essential for full development and productivity of animals. Animal feeds are not readily available and where they are they are not easily affordable for an average farmer. Since farmers go into animal production for profit they need to obtain feed at a price where they do not only break-even: but also make reasonable profit. Perhaps the livestock industry of ruminants does not feel the impact as much as the poultry industry which is mostly intensive in nature requiring constant supply of feeds for maximum productivity unlike the livestock which can still be fed on pastures and forage or allowed to scavenge for food. Due to the high cost of feeds various research alternatives have been sought for other means of providing animal feeds to ameliorate the effects of cost of feed such as the use of activated sludges (Vriens et al.1989).
- iii. Animal diseases: Livestock diseases remain a veritable threat to the animal production industry. Animal products are constantly under threat by diseases that affect livestock and hence reduce productivity (MacRae et al.2005). Endemic animal diseases such as Helminthosis, Contagious Bovine Pleuropneumonia

(CBPP), brucellosis, mastitis, peste des petits ruminants (PPR), and many others have devastating impacts upon the animal industry leading to losses in hundreds of millions of dollars every year in developing economies like Nigeria (Bamaiyi 2012, Bhat et al.2012). Brucellosis alone in sheep and goats of Borno and Yobe states of Nigeria is estimated to cost the economy USD 3.2 million annually (Brisibe et al.1996).

- iv. Access to veterinary services Vaccines and drugs: Most animal production activities are located in rural areas or remote areas inaccessible to proper veterinary services and many that are accessible find the high cost of veterinary services prohibitive. Hence they resort to easily available quacks that wreak havoc on the animal industry by using expired vaccines, fake drugs and wrong prescriptions for treating diseases. Sub-standard and all manner of low quality drugs and vaccines are in the market now and can easily be purchased and used by practically almost everyone (Babalobi 2005, Olugasa et al.2013). In order to have a viable and good animal production system in the country the government should subsidize veterinary services to farmers.
- v. Level of education of farmers: Farmers generally have a low level of education or are even illiterates making it difficult for them to employ modern animal production techniques where traditional techniques have failed or yielded less profit. Adebayo and Adeola (2005) opined that farmers with higher educational level achieved higher productivity in their farms enterprise. Therefore, farms managed by educated entrepreneurs will perform better than those managed by illiterates.
- vi. The Role of the Government: Government polices are expected to drive the development and sustainable availability of animal products. Unfortunately, failed policies limits the progress of the animal industry. Banning of importation of goods not readily available in the country in an attempt to help home grown industries but without providing viable alternatives leads to shortage and skyrocketing high prices of animal products.

- vii. Urbanization : Rapid urbanization in many developing countries like Nigeria comes at a high price to animal productivity due to neglect of animal farming as a result of mass rural-urban drift for better standards of living and yet increased demand for animal products is the order of the day (Devendra 2007). According to Van der Zijpp (1999), urbanization is usually associated with higher income which increases the purchasing power of individuals leading to higher demands for better quality food which entails a good amount of animal protein in the food unlike the normal rural food which has less animal protein and more carbohydrate and fats. Urbanisation also leads to constraints of space due to overcrowding arising from population explosion in the cities (Alirol et al.2011, Lancet 2011). This implies that there will be less opportunity for animal production as emphasis shifts to rapid industrialization. Nigerian cities like Lagos consume a lot of meat mainly brought from some northern parts of the country like Borno state which accounts for about a quarter of all ruminant livestock population in the
- viii. Market and storage facilities : Sustainability of animal products is dependent on Market for animal products. The reality is animal production market is poorly organized and often farmers lose instead of making profit because most animal products are perishable goods that expire within a short period of time. China according to Zhou et al. (2012) has over the years rapidly developed its animal production industry leading to a meat industry revolution with international processing and storage facilities good enough for local consumption of a large population and export. This is a contrast to the situation in Nigeria with the largest population in Africa and significant animal population but the market and storage facilities are still mostly primitive. To encourage maximum animal productivity there should be provision for storage of animal products in deep freezers and other storage facilities that are now been used with technological advancement. Employing modern methods of meat preservation will help Nigeria to grow its animal production to be able to take part in international trade and better the economy of the nation.

- ix. Inadequate Extension services: Extension services are crucial in promoting good agricultural and farming practices among our animal industry stakeholders. The livestock industry can produce more than it is doing currently if the farmers are well enlightened on certain aspects of production. A good number of Nigerian Universities and other institutions offer courses on Agricultural extension services but the number of graduates each year that end up in the actual profession of Agricultural extension are still grossly inadequate compared with the population involved in farming and the locations of those they are supposed to service. Extension workers provide technical advice to farmers on techniques for maximum productivity and advise on market related matters with the ultimate aim of ensuring the farmers succeed in their chosen vocation and contribute meaningfully to the economy of the nation (Davis 2008). Well trained extension service workers could be deployed to help train farmers in remote locations and get answers to their questions. This training could be strategically positioned at farmers who command a lot of market and followership who will in turn influence other farmers. Unfortunately in Nigeria the number of qualified agricultural extension workers is grossly inadequate to make meaningful impact on the economy of a nation with a large population like Nigeria. In some remote areas such extension services are lacking completely and farmers are left to use their traditional knowledge to improve animal productivity. One of the greatest challenges of extension services in Nigeria in spite of the intervention of a world bank assisted project is the ability to secure the commitment of government and mobilizing local funds to sustain the service (Omotayo et al.2001).
- x. Inadequate manpower: Skilled labour in the animal production industry in Nigeria for example in some quarters one man does the work of many people leading to inefficiency in productivity. This is a point for major concern because of the potentials of a nation of over 170 million people (Population 2012). If more people are encouraged to go into animal production like in China (Zhou et al.2012) Nigeria will have adequate manpower involved in animal production. There is inadequate labour supply in the country and many times farmers have to hire temporary workers or forfeit it at the detriment of their farms due to costs(Ude and Salau 1987). It is gratifying to note that women like their men counterparts are

actively involved in animal production in Nigeria (Adekanye 1984, Porter 1995). But in spite of all these the manpower is still inadequate for the industry and for sustainable animal production.

- xi. Transportation: Transportation is critical to the success of animal industry. According to Gujba et al. (2013), movement of animal products from production to consumption points requires good transport networks are either not existing or in very bad shape in the Nigeria. Many of the methods used in Nigeria for transporting ruminants from the north to the south of the country go against standard animal welfare procedures for the safety and welfare of the animals. This is the animals are under undue stress as they are overcrowded in trailers for mass transport making them sustained traumatic injuries and stress that affects their health and productivity. There is a need to improve on these transport systems for maximum animal production because good transport is essential for food security
- xii. Inadequate basic infrastructure: Generally, there is a lack of proper mechanized animal farming using modern infrastructure such as;
 - 1) Improved milking machines that could reduce the incidence of diseases like mastitis
 - 2) Good animal houses to help productivity of the animals by focusing on intensive farming instead of allowing small ruminants for example, to roam about scavenging for food and the large ruminants invading crop farms in the community and destroying harvests meant for human consumption-an issue which has often been a source of communal conflicts.
 - 3) Perennial problem of electricity supply in Nigeria which is a major setback for the livestock industry. It means meat has to be prepared for consumption immediately after slaughter or additional costs of utilizing generating plants to store the meat will be incurred.
 - 4) Water supply is also inadequate even though it is very essential to have water always for maximum animal productivity.
- xiii. Climatic and environmental factors: Certain climatic factors are natural and some are man-made due to human activities but affect animal production. Desert encroachment is a major environmental problem in the northern part of Nigeria. Deforestation as a result of human activities diminished the potential animal's role in

providing renewable energy. Desert encroaches in the northern part of the country, hence, nomadic Fulani are forced to keep migrating southwards in search of pasture for their cattle and expose their animals to diseases of the rainforest such as Trypanosomosis which will affect productivity of the animals.. Some natural disasters like flood affect agricultural produce and animal production.

- xiv. Attitude to animal production: People's attitude to animal husbandry and production is very poor. Some young people in Nigeria think animal production is only for the elderly or sometimes retired government staff but youths are known to do very well in animal production when they diligently go into it.

3.4 Multi-functionality of livestock

Farm animals continue to play several central roles in the livelihoods of the people in developing countries, ranging from providing households with high-quality foods, good nutrition and regular incomes to providing labourers with jobs, community members with social status and farmers and herders with ways to sustain food production. Food and nutrition In order to increase livestock's contribution to the livelihoods of developing communities requires improved understanding of livestock's multiple and complex roles. The contribution of food from animal origin to the nutritional status of the world population is well documented (Ndlovu, 2010):

Beyond the important role that livestock play in the provision of food and nutrition in people's diets, they also have important social functions. They raise the social status of owners and contribute to gender balance by affording women and children the opportunity to own livestock, especially small stock (Waters-Bayer and Letty, 2010). In marginal areas with harsh environments, livestock provide a means of reducing the risks associated with crop failure and a diversification strategy for resource poor small scale farmers and their communities (Vandamme et al., 2010).

4.0 Summary

Livestock play multiple roles in the livelihoods of people in developing communities, especially the poor. They provide food and nutrition, work, economic and social status, and ensure environmental sustainability. With the livestock sector experiencing rapid change – mainly driven by the rapidly changing livestock production systems, demographics, environmental impacts, technologies, policies and institutions – this “multifunctionality of livestock” becomes an even more complex issue, intertwined with other research and development challenges.

5.0 The diverse roles of livestock in developing and emerging countries create opportunities to meet nutrition, income, livelihood and ecosystem needs while mitigating livestock-related threats to human and environmental health. But these opportunities must be managed to add to the positive aspects livestock provide while mitigating the negatives. Population growth, urbanisation, and most importantly, increasing income have resulted in a rapid increase in demand for livestock products, which is likely to continue well into the future. This growth of the livestock sector presents both enormous opportunities and challenges. Major measures suggested to solve these problems militating against animal production are provision of credit facilities, capacity building, creation of livestock markets, offering guaranteed prices and the formation of Farmer Based Organizations (FBOs). In conclusion, a vibrant animal research enterprise will be central to an effective response to potential threats to animal agriculture to ensure global food security.

6.0 Tutor Marked Assignment

- 1) What do you consider to be the factors militating against successful animal production in developing economy?
- 2) Highlight various strategies for enhancing multifunctionality of livestock.
- 3) Discuss the factors responsible for increase in demand for livestock products.

7.0 References / Further Readings

Lawal-Adebowale O.A. (2012). Dynamics of Ruminant Livestock Management in the Context of the Nigerian Agricultural System <https://www.intechopen.com/books/livestock-production/dynamics-of-ruminant-livestock-management-in-the-context-of-the-nigerian-agricultural-system>

Food and Agriculture Organization of the United Nations, “The livestock sector accepts the challenge of the UN Agenda 2030”, 23 June 2016, <http://www.livestockdialogue.org/events/events/multi-stakeholder-meetings/panama-20-23-june-2016/en/>; Food and Agriculture Organization of the United Nations, *World Livestock: Transforming the livestock sector through the Sustainable Development Goals*, 2018, <http://www.fao.org/3/CA1201EN/ca1201en.pdf>.

Boland, M. J., Rae, A. N., Vereijken, J. M., Meuwissen, M. P. M., Fischer, A. R. H., van Boekel, M., ..., & Hendriks, W. H. (2013). The future supply of animal-derived protein for human consumption. *Trends in Food Science & Technology*, 29(1), 62–73. <http://dx.doi.org/10.1016/j.tifs.2012.07.002>.

Unit 2 Consumer and Consumption Pattern of Livestock Product

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1.0 Introduction

Consumer behaviour is the study of individuals, groups, or organizations and all the activities associated with the purchase, use and disposal of goods and services, including the consumer's emotional, mental and behavioural responses that precede or follow these activities. While Consumption can be defined in different ways, but it is best described as the final purchase of goods and services by individuals. The purchase of a new pair of shoes, a hamburger at the fast food restaurant or services, like getting your house cleaned, are all examples of consumption. It is also often referred to as consumer spending.

Consumer behaviour is an inter-disciplinary social science that blends elements from psychology, sociology, social anthropology, anthropology, ethnography, marketing and economics, especially behavioural economics. It examines how emotions, attitudes and preferences affect buying behaviour. Characteristics of individual consumers such as demographics, personality lifestyles and behavioural variables such as usage rates, usage occasion, loyalty, brand advocacy, willingness to provide referrals, in an attempt to understand people's wants and consumption are all investigated in formal studies of consumer behaviour. The study of consumer behaviour also investigates the influences, on the consumer, from groups such as family, friends, sports, reference groups, and society in general.

The study of consumer behaviour is concerned with all aspects of purchasing behaviour – from pre-purchase activities through to post-purchase consumption, evaluation and disposal activities. It is also concerned with all persons involved, either directly or indirectly, in purchasing decisions and consumption activities including brand-influencers and opinion leaders. Research has shown that consumer behaviour is difficult to predict, even for experts in the field. However, new research methods such as ethnography and consumer neuroscience are shedding new light on how consumers make decisions.

2.0 Objectives

At the end of this unit you will be able to you will be able to define consumers and their consumption patterns, highlight factors affecting consumption. You will also be able to enumerate the principles of consumption.

3.1 The concept of Consumer and Consumption

Consumers are becoming increasingly interested in how their food is produced. Producers (or processors, retailers, etc.) use these labels to increase (1) consumer awareness of a particular product feature (say, organic) and (2) willingness to pay for the food product, assuming the featured label is of value to consumers.

Today's grocery store shoppers are interested in a multitude of food product attributes, including not only at- tributes of the food itself, like low-fat or low-calorie, but also attributes surrounding the production processes employed to produce the product. Consumers are increasingly interested in whether food products, and especially meat and milk products, were produced in an environ- mentally—and socially—responsible manner. Livestock products, in particular, evoke consumer sentiment regarding the treatment of livestock and welfare of animals used to produce meat and milk products (frewer *et al.*, 2005). Consumers are considering production process attributes when selecting food products, such as environmental impacts, food safety implications, animal welfare impacts, and social implications of production methods.

Consumer confidence regarding the meat and milk products they purchase may depend on a number of factors, including the specific meat or milk product in question, the species of livestock animal employed in the production of that good, which production process attribute was verified, and the source of any available verification information.

The theory of demand begins with the examination of the behavior of the consumer since the market demand is assumed to be the sum total of the demands of individual consumers.

The consumer is assumed to be rational. Given his income and the market prices of the

various commodities, he plans the spending of his income so as to attain the highest possible satisfaction or utility. This is the axiom of utility maximization. In the static theory, it is assumed that the consumer has full knowledge of all the available commodities, their prices and income. To attain this objective, the consumer must be able to compare the utility (satisfaction) of the various 'baskets of foods' which he can buy with his income.

These are two basic approaches to the problem of comparison of utilities, the cardinalist theory and the ordinalist theory. The cardinalist school postulated that utility is measurable perhaps in monetary units, by the amount of money the consumer is willing to sacrifice for another unit of a commodity. Others suggested the measurement of utility in subjective units, called units. The ordinalist school postulated that utility is not measurable, but is an ordinal magnitude. The consumer need not know in specific units the ability of various commodities to make his choice. It suffices for him to be able to rank the various 'baskets of foods' according to the satisfaction that each bundle gives him. He must be able to determine his order of preference among the different bundles of foods or livestock products. Seven methods of animal production that can influence consumer's consumption pattern are:

- i. Product is certified organic.
- ii. Animals were humanely raised.
- iii. Animals were grass-fed (or raised on a vegetarian diet).
- iv. Animals were not administered growth hormones.
- v. Animals were not administered antibiotics.
- vi. Animals were raised in a free-range (or cage-free) environment.
- vii. Genetically modified organisms were not used in the production of this product (Non-GMO).

3.2 Factors Affecting Consumption

So what else do economists believe affects consumption and your decision to purchase products and services, besides your real income?

- i. Prices - If prices are higher, then a person's total level of consumption will be lower, because consuming will use up a higher percentage of a person's income.
- ii. Taxes - As taxes on goods and services (sales taxes) rise, people may not be able to afford as much as they used to and, as a result, will consume less. The income tax rates you pay also affect your ability and decision to consume. Higher tax rates lead to less disposable income, which is money you have left over for spending and savings after you pay taxes.
- iii. Saving - People generally have two things they can do with their money. They can save or they can spend. The more money people save, the less they have to consume in the short-run.
- iv. Consumer confidence - If people are worried about the economy or their own future income, they may delay making purchases in order to provide some safety and extra cash for future expenses. They will save or delay their consumption until they feel better about what lies ahead.

3.3 Four Principles of Consumption

When analysing buying behaviour, a consideration of four principles of consumption is useful: harmonious consumption, diminishing utility, variety, and satiety

- i.** Harmonious consumption: This is the principle of consumption referring to the tendency to purchase combinations of things. An example of harmonious consumption is the matching of cow meat and accompany packaging accessories
- ii.** Diminishing utility: Diminishing utility is the principle holding that as more of a given product is consumed, per-unit satisfaction of the product declines.
- iii.** Variety: This is the principle of consumption referring to the desire to accumulate different kinds of goods.
- iv.** Satiety: This is the principle of consumption concerning the desire to obtain an unlimited amount of goods and services.

These principles almost always are involved, in one way or another, in purchasing decisions. Consumers who recognize the influence of these four principles on their buying decisions will be better able to control their buying habits and, therefore, able to make better use of the money.

3.3 Consumption Pattern

The economic notions of consumption patterns refer to expenditure patterns of income groups across or within categories of products, such as food, clothing, and discretionary items. Sociocultural and political extensions of the consumption pattern idea probe the class, cultural, and symbolic dimensions of organization of consumption.

Consumption is distinct from consumption expenditure, which is the purchase of goods and services for use by households. Consumption differs from consumption expenditure primarily because durable goods, such as automobiles, generate an expenditure mainly in the period when they are purchased, but they generate “consumption services” (for example, an automobile provides transportation services) until they are replaced or scrapped.

Neoclassical (mainstream) economists generally consider consumption to be the final purpose of economic activity, and thus the level of consumption per person is viewed as a central measure of an economy’s productive success.

The study of consumption behaviour plays a central role in both macroeconomics and microeconomics. Macroeconomists are interested in aggregate consumption for two distinct reasons. First, aggregate consumption determines aggregate saving, because saving is defined as the portion of income that is not consumed. Because aggregate saving feeds through the financial system to create the national supply of capital, it follows that aggregate consumption and saving behaviour has a powerful influence on an economy’s long-term productive capacity. Second, since consumption expenditure accounts for most of national output, understanding the dynamics of aggregate consumption expenditure is essential to understanding macroeconomic fluctuations and the business cycle.

Micro-economists have studied consumption behaviour for many different reasons, using consumption data to measure poverty, to examine households’ preparedness for retirement, or to test theories of competition in retail industries. A rich variety of household-level data sources allows economists to examine household spending behaviour in minute detail, and micro-economists have also utilized these data to

examine interactions between consumption and other microeconomic behaviour such as job seeking or educational attainment

4.0 Conclusion

The economic notions of consumption patterns refer to expenditure patterns of income groups across or within categories of products, such as food, clothing, and discretionary items. The four components of gross domestic product are personal consumption, business investment, government spending, and net exports. That tells you what a country is good at producing. GDP is the country's total economic output for each year.

5.0 Summary

A consumer profile is a way of describing a consumer categorically so that they can be grouped for marketing and advertising purposes. By target advertising to a specific market segment, companies and marketers can find more success in selling a particular product and increase profits. Consumer behavior can be explained as all social, psychological and physical behavior of consumers as they become aware of evaluate, purchase, consume and tell others about the products and services. Characteristics of consumer behavior are: Consumer behavior is the part of human behavior. This cannot be separated.

6.0 Tutor Marked Assignment

- i. Explain in details what is economic notions of consumption patterns
- ii. Define the terms consumers and their consumption patterns
- iii. Highlight factors affecting consumption.
- iv. Enumerate the principles of consumption.

7.0 References / Further Readings

Gujarati DN Basic Econometrics: 2nd ed. McGraw-Hill Book Company, New York 1988; 431-466.

Keynes JM Book III: The Propensity to Consume in: The General Theory of Employment, Interest and Money. Marxists.org edition, London: Macmillan Cambridge University Press 2002 (Chaps 8, 9, 10).

Deaton, Angus (1992). Understanding Consumption. Oxford University Press. ISBN 978-0-19-828824-4. [https://en.wikipedia.org/wiki/Consumption_\(economics\)](https://en.wikipedia.org/wiki/Consumption_(economics))

Unit 3 Theory of Consumer's Behaviour

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1.0 Introduction

Theory of consumer behavior in Economics describes how consumers allocate incomes among different goods and services to maximize their utility. According to this law, an equal additional unit of a good is consumed, everything else remaining constant, satisfaction will increase, but at a diminishing rate.

Consumer behavior involves more than just how a person buys a products or services. In today's world of competitive offerings, diversity of consumer preferences, and proliferation of brands, consumer behavior has become extremely important for marketing decisions.

Consumer behavior emerged as an independent field of research within marketing nearly

sixty years ago. In recent years, study of consumer behavior has emerged as a specialty of growing concern to marketing scholars. Knowledge of consumer behavior can provide useful input to marketing strategies like segmentation, target market selection and positioning.

In many ways, consumer behavior is a subtle phenomenon. The reasons for their behavior are not always clear. Actions of consumers are impulsive thus sometimes difficult to predict, and sometimes even hard to explain.

In the present unit, an attempt is made to look at the basics of consumer behavior, in broad terms. Six important models of consumer behavior are emphasized. All these models in this unit stand as the base for the study of consumer behavior in their respective fields. Major factors influencing consumer behavior, economic (Utility, Want, and need) and non-economic aspects (environmental factors and individual factors) are highlighted in section four.

2. Objectives

At the end of this unit you will be able to explain the meaning and concept of utility analysis, consumer behavior, the various approaches and describe the laws of utility analysis. You will also be able to discuss major theories of consumer behavior.

3.1 Concept of Consumer Behavior

It is believed that consumers make their purchases on the basis of small number of selective chosen pieces of information. Markets resolve every activity around the ultimate consumers and focuses on:

- > Who buy the products?
- > How do they buy the product?
- > Where do they buy them?
- > How often do they buy them?
- > When do they buy them?
- > Why do they buy them?
- > How often do they use them?

The decision process helps the marketers to decide the target consumers and also the consumers need satisfying products. The ultimate target and the primary force of all marketers is the consumer. No matter who they are: urban or rural residents, male or female, young or old, rich or poor, educated or uneducated, believer or non-believer. As a consumer, individual encompasses many different behaviors such as collecting, nurturing, cleaning, preparing, displaying, storing, wearing, sharing, evaluating, and serving etc.

An organization's marketing activity look forward to satisfy consumer needs and wants at a profit. Consumers play an important role in building local, national, and international economic conditions. Every person has, is and will continue to be a consumer of some product or the other. Because of this, the study of consumer behavior will be of interest not only to marketers but also to economists. An understanding of consumer behavior will help the economists to shape overall infrastructure of the industry, suitable for the future development. For a layman, the study will help to become a better consumer. Thus, the study will be enabling to grasp a gainful insight into the internal and external factors influencing the consumption related behavior of individuals.

To have a wide and clear view of the behavioral aspect, meaning of consumer, customer and buyer are bifurcated and their meaning are as follows:

1. Customer - Individual who is the ultimate user of the goods/services and purchases the same from particular organization or shop. A customer is not always a consumer thus; all the buyers or consumers are not buyers.
2. Buyer - One who purchases the product is called the buyer. Buyer may not be the ultimate user.
3. Consumer - The end user of goods/services is known as consumer. The consumer may or may not be the buyer or customer. Latent purchase behavior is referred here.

As time changes, the consuming entities being used by consumer has been divided into personal consumer and organizational consumer. Personal consumer is the ultimate or the end user of the goods/services. Here the purchase activity is made with little or no influence of others. Organizational consumer purchases the commodity either for profit

or for the non-profit activities, which are further used in the production processes. Products purchased by organizational buyer are secondary goods, which are further used for production process; here direct consumption does not take place.

Assael (1992)³² has discussed the concept of consumer behavior with the help of a simple model. First and the foremost criterion to start the model is the consumer decision- marketing making process. He studied the consumer decision on purchasing a brand, through evaluating the product information, with the other available alternatives in the market. To come up with the decision making process, three factors influence the same, namely, individual consumer, environmental influences, and applications of consumer behavior to marketing strategies. Thus, the purchase of the product is affected by consumers' needs, attitude towards alternatives, characteristics of the products/services, lifestyle, personality and many more. Besides these, individual factors such as social class, culture, sub-culture also play an effective role. Before influencing the consumer, marketing opportunities should be evaluated by the marketer. This will help to target the exact consumer with the appropriate goods/services.

Once the consumer has made a decision i.e. post-purchase evaluation, consumer response stage is reached. As per the experience, a consumer can change their pattern of consumption and may or may not buy the product. Consumption experience will directly influence whether the consumer will buy the same brand ever again in the future. Thus, marketing research is required at every stage of consumer response, by the marketer and the importance of analyzing consumer behavior can be judged with the same process.

The model of consumer behavior provides a basis for developing marketing strategies beside the information necessary for the same. The only limitation with the consumer behavior model is that the model will vary among individuals in the same market and also that all purchase decisions are not equally complex.

Wilkie, W.L. (1990) has studied seven basic characteristics of consumer behavior. They are motivational behavior, activities, process, timing, complexity, roles, influencing factors, and the people. One of the priority keys to study consumer behavior is

motivation, as consumer behavior is always requisite. It aims to achieve a particular goal. Consumer behavior includes many activities. Understanding such activities provides a useful basis for developing marketing strategies and the process can be referred to as selecting, purchasing, and using the product. Timing refers to when the decision takes place and how long the entire process takes. At the same point complexity refers to the number of activities involved in a decision making process. Combination of roles a consumer can play includes influencer, purchaser and the user. Influence is the natural occurrence in the consumer world. It can be external or internal. Culture, sub-culture, lifestyle, and family are some of the universal influencing factors. External influence sources vary with the time duration. Consumer behavior differs from one to another. As a result, market segmentation stands as one of the basic strategy for producers.

As said by Adam Smith (1776), consumption is the final purpose of all the production. The interest of the producer is to promote their goods or services to the consumer. In the present commercial system, the consumption is the ultimate end point and the production relies heavily on it. Consumer behavior reflects the totality of the decisions i.e. whether, what, why, how, when, where, how much/often/long about the consumption, acquisition, usage and disposition of an offering, product, service, time, and ideas by the decision making units including information gatherer, influencer, decider, purchaser, or user over time i.e. for hours, days, weeks, months, and years.

Consumer behavior studies the characteristics of individual consumers such as demographics, psychographics, and behavioral variables. In an attempt to understand the consumer activities, one has to study the people's wants. As consumer behavior has become an integral part of strategic market planning, detail research of the area by marketers is of priority. Next section discusses the important models of consumer behavior, helps in understanding and studying the marketing strategies in trend, in the market environment.

3.2 Models of Consumer Behavior

Major theories of consumer behavior irrespective of the field of study are discussed in this unit. Six important models of consumer behavior are emphasized here namely:

1. Microeconomic model
2. Learning model
3. Psychoanalytic model
4. Nicosia Model
5. Engel-Blackwell-Minard (EBM) model
6. Howard and Sheth model.

These models can be further clubbed as traditional models, behavioral models, and experimental models. Study of these models helps in the development of new theories, understanding complex relationships, and also they provide the framework for research work and discussions. Such models will also help in understanding the buying as well as the consumption behavior of the consumers.

3.2.1 Microeconomic Model

Microeconomics is the study of the actions of consumers and producers in specific markets for goods and services. Micro economists concentrate on explaining what consumers would purchase and in what quantities these purchases would be made.

Theory of consumer behavior in Economics describes how consumers allocate incomes among different goods and services to maximize their utility. Here consumer behavior is best understood in three distinct steps - consumer preferences, budget constraints, and consumer choices. Theory of consumer behavior is surrounded with the fence of assumptions and the primary among these are:

- Consumers' wants and needs are unlimited and therefore cannot be fully satisfied.
- Consumers' limited purchasing power (budget) makes them to allocate the same in a way that maximize satisfaction of their wants and needs.
- Consumers' preferences are consistent over time and they are developed independently.
- Consumers have perfect knowledge i.e. they know exactly how much

satisfaction they can gain from the consumption of a particular product.

- The consumers follow the law of Diminishing Marginal Utility (DMU).

According to this law, an equal additional unit of a good is consumed, everything else remaining constant, satisfaction will increase, but at a diminishing rate. Thus, *ceteris paribus*, each additional unit of a good consumed will yield less extra satisfaction than the previous unit consumed.

1. Price is the single decisive factor to measure the sacrifice involved in obtaining a product.
2. Consumers are perfectly rational i.e. with their subjective preferences; they will always act in a planned manner to maximize their satisfaction.

With these assumptions, economists believed that perfectly rational consumers will always purchase the goods that provide the highest ratio of additional benefit to cost. The maximization of utility is considered to be the only drive of the model. Thus economics relies on the fundamental premise that people tend to choose those goods/services they value most highly. For any given commodity, benefit/cost ratio can be expressed as ratio of Marginal Utility (MU) to price (P), (MU/P). MU is the extra satisfaction a consumer gets from consuming an additional unit of particular goods/services. Therefore, to achieve this situation for any number of goods, consumers would seek the following optimal consumer portfolio.

$$\frac{MU_1}{P_1} = \frac{MU_2}{P_2} = \frac{MU_3}{P_3} = \dots = \frac{MU_n}{P_n}$$

Here, MU_i is the extra satisfaction derived from consuming one additional unit of a good, every thing else remaining constant. Whereas, P_i shows the price of a product purchased. Key for selecting the best combination of goods/services lies in comprise of P and MU, regardless of the amount of a consumer's purchase or size of portfolio. The highest level of utility will be achieved only if, the last unit of purchasing power spent and MU per unit spent on each goods/services are equal. The set of all bundles that are affordable with given P_s , are also called as the opportunity set. If any one products ratio is greater than the others, the consumer can achieve greater satisfaction per rupee from this combination and will immediately purchase more of this blend, provided there is an adequate budget.

The consumer will continue purchasing the affordable set until the products declining MTU reduces its P ratio and a position equal to all other ratios is achieved. Additional purchasing of this combination will then be clogged. The preference-ordering (here the consumer ranks all possible consumption sets in order of preferences) scheme will then be followed

To have the best possible combinations, the consumer, with the help of an indifference curve, can analyze all the available sets. Here, all the sets for which consumer is indifferent are compared in one go. The bundle that lies above the indifference curve, are all preferred whereas those that lie below it are rejected. Thus, an indifference map is used as a summary of the preference ordering.. The best affordable bundle occurs at a point of tangency between an indifference curve and the budget constraint.

Microeconomic model is based on highly unrealistic assumptions. Consumers frequently endeavor for acceptable and not maximum levels of satisfaction. The purchase of one good may reduce the MU of another good, causing a shift in the optimal portfolio. They lack perfect knowledge regarding products and they often influence each other's preferences. Also, they appear to use many variables in addition to price, to access a products cost and may frequently use P as a measure of product quality as well as cost. Pre and post purchase behavior of consumers are not taken into consideration in the model. They also do not appear to be perfectly rational in all their purchase decisions at all the time.

3.3.2 Pavlovian Learning Model

Learning is the knowledge of skill gained through study or being taught. Learning involves a change in behavior as a result of acquired knowledge and such change is based on some form of practice or experience. Thus, learning has two aspects: behavior and experience. Learning is a relatively permanent change in behavior, as a result of an experience. It is a continuous process and gets modified as a result of exposure to new information and experience. Consumer behavior is often based on how much learning has taken place by which individual acquire purchase and consumption knowledge and experience, which is applied to future behavior.

Ivan Pavlov, the Russian psychologist, studied the learning model as classical

conditioning: natural response to something as a result of repeated exposure to it. Thus, classical conditioning is a specific procedure that creates a learning environment, but other learning processes may operate simultaneously with the procedure. He conducted an experiment on a dog to prove the repetitive association between stimulus (effect of existing, that which excites or arouses energy) and response (an answer given, a reply or retort feeling).

The connection between food and salivation to hungry dog is not taught but is just a secondary indubitable reaction. Pavlov rang the bell with giving food to the dogs. After an adequate number of repetitions, the dog learned the connection between bell and food. When they heard the bell in future, even without food they salivated.

Classical conditioning was formerly viewed as being a reflective action; however, according to new thinking now, it is viewed as cognitive association learning.¹⁰

Contiguity and repetition of the process are the two important factors for learning to occur, through the associative process. Consumers can be conditioned to develop positive impression and images of brands through the associative process. The more the frequency of exposure to brand, the stronger association between consumer and brand will develop. Basic concepts of consumer behavior as per classical conditioning are repetition, stimulus generalization, and stimulus discrimination.

Many experts do not completely agree with this theory as it explains learning but is unable to explain the total consumer behavior. Consumers are considered as passive beings, whose response is based on the reward, after using the product. In general, market offers the product to satisfy the needs but to use every product is not possible.

3.3.3 Freudian Model of Psychoanalytic Motivation

According to Schiffman and Kanuk (2004)ⁿ, personality is the inner psychological individuality, which resolves and reflects the person's response to the environment. Distinctive properties of one's personality includes: individuals' preferences and differences, reflected most stably and quite consistently in personality. Along with the other factors individuals' moods, values, motives, and habitual methods of responding to

situation are also considered while studying personality.

Sigmund Freud, an Australian Physician and pioneer psychoanalyst, is considered as the father of psychoanalytic theory. He proposed that every individual's personality is the product of three forces: id, ego, and super ego.

1. The id is the source of strong inborn drives and urges. It operates on the pleasure principle; meaning acts to avoid tension and seeks pleasure. Thus unconscious mind is called the id.
2. Ego represents the conscious mind. It is composed of perceptions, thoughts, memories, and feelings. The ego gives the personality a sense of identity and continuity. It comes into being because of the limitations of the id, in dealing with the real world. It is said to be the executive of the personality. It operates on reality principle and serves as the organized focal point for effective action in the environment. It varies from one individual to another, as it is an internal drive and conscious.
3. Super ego constitutes the moral part of the individuals' psychic structure, through internalizing the values of the society. It influences the individual to strive for perfection. It acts to control basic strivings of the id, which could interrupt the social system and influences the ego. Ego is to pursue goals that match the morality dictated by society and culture.

Freud's model has biological forces (represented by id), societal forces (the super ego), and human consciousness (the ego) in its foundation. Individuals' personality development is the relation between these three factors. Influence of human motivation and needs affects these three factors.

Marketers to create brand image, through psychoanalytic theory have to satisfy the Freud's model inputs. Appeal to fantasy (wish, fulfillment, fantasy, aggression, and escape from life's pleasure) is one of the results of the application of the theory.

3.2.4 Nicosia Model

Nicosia model is the first consumer behavior model, emphasizing on the compound decision-making process rather than the act of purchase. Francesco Nicosia, an analyst of

consumer motivation and behavior process has developed this model in 1966. He has developed flow chart format, similar to the computer programming steps. As a result, none of the variables are dependent or independent but they are inputs to the next stage.

Basic assumption of the model is: consumers are seeking to fulfill specific goals and there is no previous interaction between the consumer and the firm.

Consumers neither have positive nor negative opinion about the firm. The process of communication is being represented, where the firm takes the initiative to communicate with consumer, in one or the other way, firm trying to make their further existence in market by the consumer response. Results of the consumer response will make the model ongoing. The model has four major elements:

1. The firms' communication and consumers psychological characteristics.
2. Consumers' behavior of search and evaluation of available choice.
3. Consumers' provoked act of purchase.
4. Consumers' storage or use of the product.

The mode has been evolved on the basis of funnel approach, where the consumer moves from general to particular product knowledge. Model shows that decision-making process is an important act rather than the purchase of the product and therefore firm has to influence the decision making process of the consumer, rather than only selling the product.

The field of limitations surrounds the model. The important one is only considering few elements of consumer behavior and excluding all others. There are numerous factors internal to the consumers, which are not taken care of. Secondly, without the proper previous interaction process by the firm, the decision-making process of consumer will never take place, due to competitive market structure. Nicosia model of consumer behavior was pioneering in its influence, on how others would attempt to understand consumer behavior.

3.3.5 Engel-Blackwell-Minard model

The original model of Engel-Kollat and Blackwell was developed in 1968, had gone

through the numerous revisions. Most recently Minard has contributed to model in conjunction with Engel and Blackwell.

Engel-Blackwell-Minard model (EBM) is the result of the input of five activities of consumer decision-making process.

1. Problem solving.
2. Information search.
3. Alternative evaluation.
4. Purchase.
5. Outcome.

On the basis of consumers' decision-making process, the model has four sections, namely:

- i. Information output.
- ii. Information processing.
- iii. Decision process.
- iv. Variables influencing decision process.

Two different modes of operations: EPS and LPS of consumers are studied here. EPS includes high level of both, involvement and risk. Here at any level consumer can quit or can even purchase a product. Satisfaction is the basic ingredient for future purchase of the product. LPS behavior by consumer does not represent the loyal consumers and they may not purchase the product even once. Repurchase of the product by LPS consumers is out of the present model syllabus. Both EPS and LPS model of consumers will result in four section of the model but the involvement level varies.

The model is flexible and it focuses on the level of consumer involvement. EBM includes number of stages and the processes, which consumers goes through before purchasing a product and thus accepted as an important model of consumer behavior. But some of the influencing factors are indistinguishable from others and also alternative evaluation and search for information process is somewhat synthetic.

The information search from internal and external sources (marketing and non-marketing factors), are analyzed in the second section of information processing through exposure, attention, comprehension, acceptance, and retention.

Short-term memory of consumers is emphasized in further processing of information. If the results are positive, of all the five decision-making activities taking place along with the environmental influences, individual differences adds to the purchase of product.

3.3.6 Howard and Sheth model

Howard and Sheth model has learning theory at its roots and it studies the purchase behavior of the consumer, over a period of time. The model makers are emphasizing both the industrial purchases and the ultimate consumers, by using the term buyer. Unified theory, useful for understanding a great variety of behaviors is developed here. Three important levels of decision-making process are depicted, to rationalize brand choice behavior of buyer under the event of incomplete information and limited abilities.

- i. EPS is the preliminary stage of the decision-making process. Here the buyer has little information about brands and has not yet molded the criteria to purchase in a structured way.
- ii. LPS is the secondary stage of a decision-making process. Here the consumers are still in a dilemma about which brand will serve their purpose in the best manner. Here EPS (Choice criteria) are well defined.
- iii. Routinised response behavior is the final stage of decision-making process i.e. purchase of a brand takes place here, after very little evaluation of alternatives. Though strong opinion for a brand exists in consumers mind. Four major components namely input variables; output variables, hypothetical constructs, and exogenous variables are involved here, resulting in buyers move from extensive to routinised problem solving behavior
- iv. Significance and symbolic stimuli beside social stimuli are the major ingredients of input variables. Significant stimuli are the authentic elements of the brand while, the producer generates symbolic stimuli.
- v. Apparent response of the buyer, as a result of the input stimuli is the outcome of attention, comprehension, attitude, intention, and purchase behavior
- vi. Hypothetical constructs - number of dominant variables is categorized here as perceptual and learning constructs, which deals with the buyers' formation of concepts. Perceptual concepts describe sensitivity to information, perceptual

favoritism, and search for informative. While learning constructs are defined as motive (specific goals impelling action), brand potential of the evoked set (perception of the ability of brand to satisfy buyers motives), decision mediator (buyers mental rules according to there motive), predisposition (fondness towards brand among the evoked set mentioned as an attitude towards them), inhibitors (environmental forces), and above all satisfaction.

vii. Exogenous variables are not well defined in the model. They are external to the buyer but their list runs long.

The model defines the variables influencing consumers and details how they interact with each other. But complex nature of representation made the model comprehends, due to large number of variables and complicated relationship among them.

3.4 Factors Influencing Consumer Behavior

Consumer market consists of all the individuals and households who buy or acquire goods and services for personal consumption. Studying important influencing factors will further help in learning the consumer behavior effectively. These factors can further be studied from the point of economic, non-economic, and individual aspects. Economic aspects included here are utility, wants and needs whereas; non-economic aspects includes social class, culture, and group influence. Individual factors include learning and motivation.

The consumer's are quiet unpredictable, and their complex nature makes the study and understanding peremptory. The environmental elements influence consumer behavior up to a large extent. Major factors along with there pros and cons are studied here, with the effect they makes on the behavior of an individual. Most of the non-economic factors are uncontrollable and the marketers had to accept the facts, the way they come. However, they have to be considered while studying consumer behavior. Individual factors vary from consumer to consumer. A brief discussion of these factors follows.

3.4. 1 The Meaning and Concept of Utility Analysis

The term utility in Economics is used to denote that quality in a good or service by virtue of which our wants are satisfied. In, other words utility is defined as the want satisfying

power of a commodity. Utility is the quality in commodities that makes individuals want to buy them and the quality of a good to satisfy a want.

Utility has the following main features:

1. Utility is Subjective: Utility is subjective because it deals with the mental satisfaction of a man. A commodity may have different utility for different persons. Cigarette has utility for a smoker but for a person who does not smoke, cigarette has no utility. Utility, therefore, is subjective. □
2. Utility is Relative: Utility of a good never remains the same. It varies with time and place. Fan has utility in the summer but not during the winter season. □
3. Utility and usefulness: A commodity having utility need not be useful. Cigarette and liquor are harmful to health, but if they satisfy the want of an addict then they have utility for him. □
4. Utility and Morality: Utility is independent of morality. Use of liquor or opium may not be proper from the moral point of views. But as these intoxicants satisfy wants of the drunkards and opium eaters, they have utility for them. □

The theory of consumer's behaviour seeks to explain the determination of consumer's equilibrium. Consumer's equilibrium refers to a situation when a consumer gets maximum satisfaction out of his given resources. A consumer spends his money income on different goods and services in such a manner as to derive maximum satisfaction. Once a consumer attains equilibrium position, he would not like to deviate from it. Economic theory has approached the problem of determination of consumer's equilibrium in two different ways such as cardinal utility analysis and ordinal utility analysis.

Utility can be studied as cardinal utility and ordinal utility.

- 1) Cardinal utility: the magnitude of utility differences is treated as an ethically or behaviorally significant quantity. Here the assignment of values of some absolutes takes place.
- 2) Ordinal utility: A measure of consumer satisfaction expressed in terms of ranking

of preferred combinations of commodities.

Neo-classical Economics has largely retreated from using cardinal utility function as the basic objective of economic analysis. Cardinal utility functions are unique. Ordinal utility functions are equivalent upto monotone transformations, while cardinal utilities are equivalent upto positive linear transformations.

Marginal utility is the additional satisfaction, or the amount of utility, gained from each extra unit of consumption. It is the extra satisfaction gained by a consumer from a small increment in the consumption of goods/services. Although total utility usually increases as more of a good is consumed, marginal utility usually decreases with each additional increase in the consumption of a good. This decrease demonstrates the law of DMU. As there is a certain threshold of satisfaction, the consumer will no longer receive the same pleasure from consumption once that threshold is crossed. In other words, total utility will increase at a slower pace as an individual increases the quantity consumed. Such a theory explains why a price rise causes consumers to cut demand of goods/services.

The Cardinal Approach to the theory of consumer behaviour is based upon the concept of utility. It assumes that utility is capable of measurement. It can be added, subtracted, multiplied, and so on.

There are three concepts of utility:

(1) Initial Utility: The utility derived from the first unit of a commodity is called initial utility. Utility derived from the first piece of bread is called initial utility. Thus, initial utility, is the utility obtained from the consumption of the first unit of a commodity. It is always positive. □

(2) Total Utility: Total utility is the sum of utility derived from different units of a commodity consumed by a household. □ According to Leftwitch, Total utility refers to the entire amount of □ satisfaction obtained from consuming various quantities of a commodity. Supposing a consumer four units of apple. If the consumer gets 10 utils from the consumption of first apple, 8 utils from second, 6 utils from third, and 4 utils from fourth apple, then the total utility will be $10+8+6+4 = 28$. Accordingly, total utility can be

calculated as : □

$TU = MU_1 + MU_2 + MU_3 + \text{_____} + MU_n$ or □ Here TU = Total utility and $MU_1, MU_2, MU_3, + \text{_____} MU_n =$

Marginal Utility derived from first, second, third _____ and nth unit.

(3) Marginal Utility: Marginal Utility is the utility derived from the additional unit of a commodity consumed. The change that takes place in the total utility by the consumption of an additional unit of a commodity is called marginal utility.

According to Chapman, Marginal utility is the addition made to total utility by consuming one more unit of commodity. Supposing a consumer gets 10 utils from the consumption of one mango and 18 utils from two mangoes, then. the marginal utility of second .mango will be $18-10=8$ utils.

Marginal utility can be measured with the help of the following formula

$$MU_{nth} = TU_n - TU_{n-1}$$

Here MU_{nth} = Marginal utility of nth unit, □ TU_n = Total utility of nth units, □ TU_{n-1} = Total utility of n-i units, □ Marginal utility can be (i) positive, (ii) zero, or (iii) negative.

(i) *Positive Marginal Utility*: If by consuming additional units of a commodity, total utility goes on increasing, marginal utility will be positive. $TU = EMU$

(ii) *Zero Marginal Utility*: If the consumption of an additional unit of a commodity causes no change in total utility, marginal utility will be zero. □

(iii) *Negative Marginal Utility*: If the consumption of an additional unit of a commodity causes fall in total utility, the marginal utility will be negative.

□ Relationship between total utility and Marginal Utility: □

The relationship between total utility and marginal utility may be better □ understood with the help of a utility schedule and a diagram as shown below in **Table No. I**

No. of Units Consumed	Total Utility	Marginal Utility
0	0	-
1	10	10
2	18	18
3	24	6
4	26	2
5	26	0
6	24	-2
7	21	-3

The relationship between total utility and marginal utility can be explained with the help of the above table and diagram based thereon.

1. Total utility, initially, increases with the consumption of successive units of a commodity. Ultimately, it begins to fall. □
2. Marginal Utility continuously diminishes. □
3. As long as marginal utility is more than zero or positive, total utility increases, total utility is maximum when marginal utility is zero. It falls when marginal utility is negative. □
4. When marginal utility is zero or total utility is maximum, a point of saturation is obtained. □

3. 4. 2 Laws of Utility Analysis

Utility analysis consists of two important laws

1. Law of Diminishing Marginal Utility. □
2. Law of Equi-Marginal Utility. □

1. Law of Diminishing Marginal Utility:

Law of Diminishing Marginal Utility is an important law of utility analysis. This law is related to the satisfaction of human wants. All of us experience this law in our daily life. If you are set to buy, say, shirts at any given time, then as the number of shirts with you goes on increasing, the marginal utility from each successive shirt will go on decreasing. It is the reality of a man's life which is referred to in economics as law of Diminishing Marginal Utility. This law is also known as Gossens First Law.

According to Chapman, The more we have of a thing, the less we want additional increments of it or the more we want not to have additional increments of it.

According to Marshall, The additional benefit which a person derives from a given stock of a thing diminishes with every increase in the stock that he already has.

According to Samuelson, As the amount consumed of a good increases, the marginal utility of the goods tends to decrease.

In short, the law of Diminishing Marginal Utility states that, other things being equal, when we go on consuming additional units of a commodity, the marginal utility from each successive unit of that commodity goes on diminishing.

Assumptions:

Every law in subject to clause other things being equal □ This refers to the assumption on which a law is based. It applies in this case as well. Main assumptions of this law are as follows:

1. Utility can be measured in cardinal number system such as 1,2,3 _____ etc.
2. There is no change in income of the consumer.
3. Marginal utility of money remains constant.
4. Suitable quantity of the commodity is consumed.
5. There is continuous consumption of the commodity.
6. Marginal Utility of every commodity is independent.
7. Every unit of the commodity being used is of same quality and size.
8. There is no change in the tastes, character, fashion, and habits of the consumer.
9. There is no change in the price of the commodity and its substitutes.

Explanation of the Law

Table No. 2: The Law of Diminishing Marginal Utility

No. of Breads	Marginal Utility
1	8
2	6
3	4
4	2
5	0 point of satiety
6	- 2

It is clear from the above Table that when the consumer consumes first unit of bread, he get marginal utility equal to 8. Marginal utility from the consumption of second, third and fourth bread is 6, 4 and 2 respectively. He gets zero marginal utility from the consumption of fifth bread. This is known as point of satiety for the consumer. After that he gets negative utility i.e. -2 from the consumption of sixth unit of bread. Thus, the table shows that as the consumer goes on consuming more and more units of bread, marginal utility goes on diminishing.

Pricing Decision:

A retailer's price policy is a crucial positioning factor and must be decided in relation to its target market, its product and service assortments and its competition. This involved the decisions regarding the price lilies to be earned and overall markdown or sale policies:

Promotion Decision:

Retailers use the promotional tools - advertising, personal selling, sales promotion and public relations to reach. Customers Personal selling requires careful training of sales people in how to greet customers, meet their needs and handle their complaints.

3.4.3 Wants and Needs

In economics, a want is something desired, necessary. It is distinct from the need. Need is the psychological feature that arouse an action towards a goal. The reason for the action, is giving purpose and direction to the consumer behavior. Consumers have ultimate wants. One cannot have everything they want and therefore have to look for the best available alternative.

- Need: Without which consumer cannot work further.
- Want: Desire/like to have.

Thus need is a necessity but want is a luxury

3.4.3 Social Class

Social class refers to the group having a number of people, who have more or less equal positions in the society, which is achieved rather than ascribed, with same opportunity existing for upward or downward movement to other classes. Many a times, social class is also helpful in defining:

- 1) Social stratification: division of members of society into a degree of various status or classes. As a result, members of each class have relatively the same status and that of other classes have either more or less.
- 2) Social status: the amount of status (social position) individuals of particular class has in comparison with members of other social classes.
- 3) Social comparison theory: comparison of ones own material possessions with those owned by others, in order to determine their relative social standing.
- 4) The demographic/socio-economic variables: some important factors like family income, occupational status, and educational attainment used by marketing practitioner to measure social class.

Basic guidelines, to be followed by the marketers before using social class as a variable to segment the market includes:

- 1) Social class may not always be a relevant fact to be taken into consideration i.e., segmentation criteria such as age and culture is sometimes more appropriate.
- 2) Cost involved in segmenting the consumers on the basis of social class will be much more in relation to the benefit from such segmentation for undifferentiated product market.
- 3) Segmenting market on the basis of social class, when used with additional variables like life cycle stages etc. is more effective than using social class as only bases for segmenting market.

The basic characteristics of social classes are as follows:

- 1) Social classes represent status.
- 2) Social classes are multidimensional.
- 3) Social classes are hierarchical.
- 4) Social classes restrict behavior.

- 5) Social classes are relatively homogeneous.
- 6) Social classes are continuous rather than concrete.

Three status factors that are used frequently by scholars for estimating social class are: relative wealth (amount of economic assets), power (effect of personal choice or influence over others), and prestige (degree of recognition received from others).

Social factors influences, how individual think, feel and behave; relative to their physical, social and marketing environments. There are certain symbolic identifications which are considered as a status symbol, on the basis of which status is being accorded to an individual including: insignia, titles and designations, pay and perquisites, physical facilities etc.

The number of separate social classes can be used while studying the consumer behavior on such basis like the attitude and behavioral pattern of the consumer. Variations in the number and types of social class categories can vary from two to nine categories. The most frequently used division is of five categories including: lower, lower-middle, middle, upper-middle, and upper class or lower, working-class, lower-middle, upper-middle, and upper class. The other important distribution of the social class is of three categories considering lower, middle, and upper class or blue collar, grey collar, and white collar.

Difficulty in measuring social class structure is their being no specific criteria. Wide range of techniques, which believes to give fair approximate results, is being used. Broad categories include: subjective measures, reputation measures, and objective measures. Within these measures, few important variables are: occupation, income, education, possession, personal performance and interactions. The researchers to study differences in clothing habits, leisure and recreational activities, saving and spending, credit habits, shopping, fashion products etc are using social class identification.

3.4.4 Culture

Culture is the moral power of the consumers through their norms and values, established by the society, in which they live. Culture not only influences the behavior of an individual but also reflects the same. It is a mirror of both values and possessions of its

members. Some values are relatively resistant to change whereas; the others do change gradually and continuously. It can be studied as a broadest parameter of a society and can rightly be called as the personality of the society.

Study of psychology explains why consumers behave in a particular manner whereas; the study of culture explains how they behave. Culture consists of traditional ideas, particularly the values attached to these ideas. It includes both abstract elements (values, attitudes, ideas etc.) and material elements (those objects that are valued by a large group of people in meeting their various needs). Combination of both the elements characterizes the large group of people.

Consumers' perception is influenced mainly by the culture, which in turn affects the preference and purchase. Marketing mix, an important element for marketers, is effective as long as it is relevant to a given culture. Although people hardly ever notice their own culture, thus it is adaptive, dynamic and patterned.

Basic Characteristics of culture includes

- 1) Culture is a learned response.
- 2) Culture includes inculcated values.
- 3) Culture is a social phenomenon, adaptive to the needs of the society.
- 4) Culture is a gratifying response.
- 5) Culture is invented.
- 6) Culture satisfies needs.
- 7) Culture is subjective and dynamic.

The major characteristics of culture show that the behavioral culture and the same will help the marketing manager to cope with the rational aspects of consumer behavior. As culture constitutes a group (society) behavior, more than an individual way of thinking and behaving.

The multifaceted nature of culture can be measured by applying either one or more of the following techniques:

1. Projective test.
2. Attitude measurement test.
3. Depth interviews and group discussion.

4. Observation.

5. Content analysis.

Subculture serves three important functions to individual: group identification, group of networks and institutions, and a frame of reference. Analysis of subculture can be done at various stages based on demographic or socio cultural variables. It can be based on religion, region, language, age, and gender etc. In Indian context, the diversity of subculture is based not only on the above mentioned variables but also on caste, sub-caste system and rural urban basis.

All consumers are members of not only one but more than one subcultural segment. Thus, marketers should strive to study the multiple subcultural memberships and should interact to influence target consumers. With a proper segmentation of a market and fine tune of marketing strategies, marketers can meet the specific needs, motivations, perceptions and lifestyles shared by the people of same subcultural group.

Subculture can be taken into consideration by dividing the market on the following subcultural basis:

1. Geographic subculture
2. Age subculture
3. Ethnic subculture
4. Gender subculture
5. Income subculture
6. Nationality subculture
7. Religion subculture.

To understand the effect of cultural differences and similarities on consumer values, one has to study social class. But there are no boundaries specifying separate social classes and there is no agreement as to where one social class ends and another begins. Individuals tend to associate much more with one another than they do with members of other classes. As a result, class relates differently to consumption on the basis of cultural context.

3.4.5 Group influence

A reference group is one whose presumed perspectives or values are being used by an individual, on the basis of their current behavior.

Thus, a group is not any random collection of people. Each group has a unique ideology, and distinct features from another. An individual at a point of reference, so as to arrive at the judgment, preferences and beliefs, is using Reference group. Selection of a group or reference group mainly reflects the type of influence one has to consider before being a part of the same. Both positive and negative effect on consumers can be analyzed with the help of the reference group.

As mentioned above, group helps in arriving at a firm conclusion of whether to possess a goods/services or not. Group formation helps in interpersonal attraction with the other members of the same group. It also serves as a means of need satisfaction by acting as a vehicle of socialization' Basic means to which group formation helps is to arrive at a decision making and getting the work done in a satisfactory manner.

All the comments and theories on consumer behavior, from the experts stress on group formation and its importance. The benefits, which an individual have, as group member includes:

1. Greater sum total of knowledge and information.
2. Greater number of approaches to the problem.
3. Participation increases acceptance.
4. Better comprehension of the problem and solution.
5. Group acts as a motivator.

Instead of above mentioned merits, there are also certain disadvantages of group formation. The important ones to be considered are

1. Solution mindedness
2. Compromised results
3. Untimely decisions
4. Conflicts
5. Diffusion of responsibility
6. High coordination cost in time and money

After considering the pros and cons of group formation consumer can decide whether to be a part of a particular group or not, as each and every consumer is directly or indirectly, a part of one or the other group.

Several types of reference groups and their key distinguishing characteristics are

highlighted in Table 2.1. There are five different categories in which reference groups can be studied. All the consumers are a part of one or the other group at a point of time. Irrespective of the market environment, consumers follows these groups.

Table 2. Different Reference Groups and Their Distinctive Features

Types of Reference Group	Key Distinction and Characteristics
Formal/informal	Formal reference groups have a clear specified structure where as informal groups do not
Primary/secondary	Primary reference group involve direct fact to face interactions secondary groups do not
Membership	People become formal members of membership reference group
Aspirational	People aspire to join or emulate aspirational reference group
Dissociative	People seek to avoid or reject dissociative reference group

Source: Kotler, P., 1997.

3.4.6 Learning

When people act they learn. Thus, learning is the acquisition of new process, occurring as a result of experience or practice. An individual's behavior and nature can be determined through learning. Learning is the knowledge got to study.¹⁸ Learning process changes the individual's behavior, opinion, and attitude, to observe and understand. It can result in either positive or negative movement of the same.

A major determinant on which learning of an individual depends is the method of learning, characteristics of learning material, and the learner. The learners need not to have the .direct experience; they can also learn by observing events that affects others.

Important elements involved in the learning process are: change in behavior, experience or practice. One has to consider learning as a permanent change in behavior, which varies from the capacity of one individual to another. Essential components for learning are includes: motivation, cue, response, and reinforcement.

- i. Motivation - A stimulus activity which occurs due to a stronger need for a goods/services. The preliminary stage, which makes consumer involve in the product, is motive. To make the awareness about the product appearance in the market and involving consumers to enquire the same is the basic motive. Here, the consumer and the product are brought together.
- ii. Cues - Cues are minor or weak stimuli but provide direction to the motives. Almost everyday numerous cues are suggested to the consumers through advertisements, display, prices, and packages etc. Cues serve to help consumers purchase certain brand by making awareness about the same. Cues used by producer vary not only from market to market but from consumer to consumer also.
- iii. Response - Response is the result or outcome of cues and stimuli. It can be physical or mental in nature, depending upon the learning. The response of the consumer depends on the previous learning experience. Every cue has a response and all may not be positive. Only the positive response results in purchase of the product.
- iv. Reinforcement - To make the consumer purchase the product, is the main motive of the producer but this motive does not stop at a one-time purchase. Reinforcement leads to the purchase and consumption of the same product again and again.

Learning reflects the effects of experience. One of the current marketing consumer behaviors is: none of the firm is engaged in overall measurement of what consumer learns.¹⁹ Learning is the development of new behavioral pattern, which may become way of life.

3.4.7 Motivation

Most basic and driving force, which propel individual into an action is Motivation; some unfulfilled needs, wants, or desires a person feels i.e. the state of deprivation as a result of

tension in mind. Every individual tries to reduce this tension by looking for an incentive, which can satisfy his or her needs. As human wants are unlimited, after getting a single want satisfied at a time, the very next moment new want or desire arises. Thus, the process to search for the means is an ongoing process. Means and ways to the process vary not only from person to person but within the environment. The essence of every marketing program is the human or the consumer needs. Products and services offered in the market are to match the unfulfilled needs and motives of consumers.

Psychologists can better study the behavior and the driving force. The milestone work of A.H. Maslows was first presented in 1972. The need theory of Maslow shows the hierarchy levels in five stages in the form of pyramid.

Mostly internal stimuli gets satisfied first then only the ways and means to think of status or prestige would come in mind. These sets of needs are repetitive in nature and thus make the basic platform for an individual to stand in society. The next level of need emerge with a motive of safety and security. The driving force is concerned with security, certainty, and stability rather than only physical safety. The third level is the social needs constituting love, affection, acceptance, and belongingness etc. One can understand the importance of social needs as people have strong attachment with their families where love and affection is the linking factor. Next stage includes social or ego needs, including reputation, prestige, status, self-esteem, success etc. Here the ways and means of satisfactory level varies from blue collar to white-collar personnel. The highest point of pyramid suggests self-actualization need fulfillment.

The important forthright statement about consumer behavior is that, as soon as one want or desire is satisfied, the other arises and the same is a continuous process. Also a satisfy need is no more a driving force, only unsatisfied need is capable to motivate individual. The major problem with need hierarchy theory is, it is not at all possible to measure accurately how satisfied ones need is before the next higher level need becomes active.

4.0 Conclusion

The interdisciplinary richness of the field of consumer behavior is studied in the present chapter. Here the fundamentals for critical thinking in the area of consumer behavior are emphasized. Communication technology has enabled consumers to become more aware

of things and hence, more options are available in the market. This has made the marketers to undertake a broader view on individual consumption behavior.

5.0 Summary

Basic models of consumer behavior will always be the same, irrespective of the market environment and growth. Individual behavior can be analyzed and studied but the collective behavior of the consumers should be considered with the basic guidelines, as specified in the present chapter.

In the light of various theories presented in this chapter, the questionnaire is prepared to examine consumer behavior.

6.0 Tutor Marked Assignment

- i. What are the advantage and disadvantages of group formation
- ii. State the basic characteristics of culture
- iii. Mention the Law of Diminishing Marginal Utility and their Assumptions
- iv. State the three concepts of utility with their main features
 - v. Enumerate the factors influencing consumer behavior
 - vi. Define the concept of consumer behavior
 - vii. Discuss the models of consumer behavior
 - viii. Enumerate the different reference groups and their distinctive features

7.0 References / Further Readings

Dr.M M Varma, R K Aggarwal, “Consumer Behaviour”, King Books, Delhi.

eprints.bournemouth.ac.uk/.../Consumer_Behaviour_Theory_Approaches_and_Models
www.dsi.

[https://nscpolteksby.ac.id/ebook/files/Ebook/Business%20Administration/Consumer%20Behaviour%20and%20Advertising%20Management%20\(2006\)/21.%20Chapter%2020%20-%20Models%20of%20Consumer%20Behaviour.pdf](https://nscpolteksby.ac.id/ebook/files/Ebook/Business%20Administration/Consumer%20Behaviour%20and%20Advertising%20Management%20(2006)/21.%20Chapter%2020%20-%20Models%20of%20Consumer%20Behaviour.pdf)

Leon G.Schiffman, Leslie lazar Kanuk (2002), “Consumer behavior”, Sixth edition, Prentice Hall of India private limited, New Delhi.

Leon G.Schiffman, Leslie Lazar Kanuk (2008), "Consumer behavior", Ninth edition, Prentice Hall of India private limited, New Delhi.

Managementation.com/4-types-of-consumer-buying-behavior

Philip Kotler, Gary Armstrong (1999), "Principles of Marketing", Eighth edition, Prentice Hall of India private limited, New Delhi.

unive.it/~marek/files/05%20-%20consumer.pdf

Unit 4 Retailing and Wholesaling

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3.1 The Concept of Retailing and Wholesaling

Retailing the activities involved in the selling of goods to ultimate consumers for personal or household consumption. Retail involves the sale of merchandise from a single point of purchase directly to a customer who intends to use that product.

Present scenario of retailing is that retailers margins are very low. They are able to survive on low margins due to remarkable capacity for thrift. In many traditional shops the family provides much of the labour. He performs several functions distribution, finance and risk taking. When there is keen competition, retailers tend to undercut each other. They compensate themselves by taking higher margins on other products, or by

increasing the turnover. The main characteristics or features of retailing can be highlighted as follows:

- i. Small quantities: Retailers buy and sell goods in small quantity.
- ii. Sell to ultimate consumers: Retailers sell goods to ultimate final consumers.
- iii. Varieties of goods: A retailer can sell various necessary goods to consumers.
- iv. Personal contact: A retailer establishes direct and personal contact with customers.
- v. Shop display: Retailers decorate and display goods to attract customers.
- vi. Last link: Retailers work as the last link of distribution channel.

Wholesaling is the sale, and all activities directly related to the sale, of goods and services, to business and other organizations for (1) resale (2) use in producing other goods and services or (3) operating an organization.

Wholesalers buy mostly from producers and sell mostly to retailers, industrial consumers and other wholesalers.

3.2 Nature and Importance of Wholesaling

Here we will focus on firms engaged primarily in wholesaling. Retailers may also be occasionally be involved in wholesale transaction.

Manufacturers small or big cannot establish their own direct link with retailers or customers. It is not cost effective to them. At the other end of the distribution channel, most retailers and final users buy in small quantities and have only a limited knowledge of the market and source of supply. Thus there is gap, a wholesaling middleman can fill this gap by providing services of value to manufacturers and or to the retailers. Wholesaling brings to the total distribution system the economies of skill, scale and transactions.

Wholesaling skills are efficiently concentrated in a relatively few hands. This saves the duplication of effort that would occur if many producers had to perform wholesaling function themselves.

Economics of Scale are there because of the specialization of who leasing function that

might otherwise require several small departments run by producing firms. Wholesalers typical can perform wholesaling functions more efficiently than most manufacturers can.

3.3 Function and Types of wholesalers

3.3 .1 Function of wholesalers

Wholesalers perform number of functions. They facilitate the task of producer and retailer by performing one or more of the following channel functions:

- 1) **Selling and promoting:** Wholesalers' sales force help manufacturers reach many small customers at low cost. The wholesalers have more contacts and are often more trusted by the buyer than the distant manufacturer.
- 2) **Buying and assorting:** Wholesalers can select items and build assortments needed by their customers, thereby saving the consumers much work.
- 3) **Warehousing:** Wholesalers hold inventories, thereby reducing the inventory costs and risks of suppliers and customers.
- 4) **Transportation:** Wholesalers can provide quicker delivery to buyers because they are closer than the producers.
- 5) **Financing:** Wholesalers finance their customers by giving credit and they finance their suppliers by ordering early and paying bills in time.
- 6) **Risk bearing:** Wholesalers absorb risk of the manufacturers by taking title and bearing the cost of theft damage, spoilage and obsolescence.
- 7) **Market information:** Wholesalers give information to suppliers and customers about competitors new product and price developments.
- 8) **Management services and advice:** Wholesalers often help retailers train their sale clerks, improve store layouts and displays and setup accounting and inventory control systems.

3.3. 2 Types of wholesalers

Wholesalers can be broadly divided into three broad categories Merchant wholesaler, Agent wholesaling middleman and Manufacturers' Sales facility.

Types of wholesaling institutions:

Merchant Wholesaling including

Merchant Wholesaling including	Agent Wholesalers middleman including	Manufacturers facilities including	Sales
Full Service	Manufacturers agents	Branches	
Truck Jobber	Brokers Offices	Offices	
Drop Shippers			

Merchant Wholesalers: A merchant wholesaler is independently owned business that takes title to the merchandise it handles. Merchant wholesalers include Full service, Truck jobbers, Drop Shippers.

- 1) **Full service wholesalers:** Full service wholesalers provide a full set of services, such as carrying stock, using a sales force, offering credit, making deliveries and providing management assistance. They are either wholesale merchants or industrial distributors. Wholesale merchants sell mostly to retailers and provide a full range of services. Industrial distributors are merchant wholesalers that sell to producers rather than to retailers.
- 2) **Truck Jobbers:** They perform a selling and delivery function. They carry a limited line of goods (such as milk, bread or snack food) that they sell for cash as they make their rounds of supermarkets, small groceries, hospitals etc.
- 3) **Drop Shippers:** They operate in bulk industries such as coal and heavy equipment. They do not carry inventory or handle the product. Once an order is received, they find a producer who ships the goods directly to the customer.
- 4) **Agent wholesaling middleman:** It is an independent firm that engaged primarily in wholesaling by actively negotiating the sale or purchase of products or behalf of other firms but that does not take title to the products being distributed.

- 5) **Manufacturers Agents:** Agents represent buyers a seller on a more permanent basis. Manufacturers agents represent two or more manufacturers of related lilies. They have a formal agreement with each manufacturer covering prices, territories, order handling procedures, delivery and warranties and commission rates. They know each manufacturer's product line and use their wide contact to sell the products.
- 6) **Brokers:** A broker brings buyer and sellers together and assists in negotiations. The parties hiring them pay brokerage. They do not carry inventory, get involved in financing or assume risk. Examples are: Food brokers, real estate brokers, insurance brokers and security brokers.

Naira (N)	M.U. of Cows	M.U. of Goats
1	10	8
2	8	6
3	6	4
4	4	2
5	2	1

It is clear from the Table that if the consumer, spends N3 on Cows and N.2 on Goats, the marginal utility lie gets from the last naira on both becomes equal i.e. 6. In this way he gets maximum satisfaction. The total utility from both the commodities will be $10+8+6+8+6 = 38$, which is maximum. In case the consumer spends his income in any other manner, he will act lesser total utility.

In this diagram units of money are shown on ox-axis and marginal utility on oy-axis. It indicates that if the income of the consumer is N 5.00, he will spend N3.00 on cows and N 2.00 on goats, because third spent on cows and second naira spent on cow yield him equal marginal utility i.e. 8 utils. By distributing his income on cow and goat in this

manner, the consumer gets total utility of 38 utils. It will be the maximum total utility derived by the consumer out of his expenditure of N5.00. So by spending his income in this manner the consumer will get maximum satisfaction.

If the, consumer spends his income on cow and goats in any other manner, his total utility will be less than the maximum.

It is evident from the above figure that by spending one rupee less on apples the loss will be equal to ABCD and by spending one naira more on bananas the gain will be equal to EFGH. It is clear that $(ABCD) < (EFGH)$, hence loss is more than gain.

The importance of the law of equi-marginal utility can be explained as follows:

1. Consumption: If a consumer spends his income, as suggested by this law, on different commodities in such a way that the last unit of money spent on them yields him equal marginal utility, he will be getting maximum satisfaction out of his income. □
2. Production: Every producer aims at earnings maximum profit. To achieve this objective he must utilize different factors of production in such a way that the marginal productivity of each factor is equal. □
3. Exchange: Acting upon the law of equi-marginal utility, every person will go on substituting goods giving more utility for the ones giving less utility, till the marginal utility of all becomes equal. Exchange will stop at that point. □
4. Distribution: It refers to the distribution of national income among the factors of production, i.e. land, labour, capital, etc. Distribution is done in such a way that in the long-run every factor gets its share out of national income according to its marginal productivity. □
5. Public Finance: At the time of levying taxes, finance minister takes the help of this law. He levies taxes in such a manner that the marginal sacrifice of each taxpayer is equal. Then only it will have the least burden on all tax-payers. To achieve this objective, a finance minister may substitute one tax for the other. □

This law has been subjected to the following criticism.

- i. Cardinal measurement of utility is not possible: Measurement of utility is not possible. How can a consumer say that he would get 10 utils of utility from first apple and 8 utils, of utility from the second. Unless marginal utility is estimated, application of the law will remain dubious.
- ii. Consumers are not fully rational: The assumption that consumers are fully rational is not correct. Some consumers are idle by nature, and so to satisfy their habits and customs, they sometimes buy goods yielding less utility. Consequently, they do not get maximum satisfaction. □
- iii. Shortage of Goods: If goods giving more utility are not available in the market, the consumer will have to consume goods yielding less utility. □
- iv. Ignorance of the consumer: Consumer is ignorant about many things concerning consumption. Many a times, he is ignorant about the right price of the goods. He is ignorant about the less expensive substitutes that may be way available in the market. He is also ignorant about the different uses of goods. On account of this ignorance, the consumer fails to spend his income in a manner that may yield him maximum satisfaction. □
- v. Influence of Fashion, Customs and Habits: Actual expenditure of every consumer is influenced by fashion, customs, and habits. Under their influence, many a times the consumer buys more of such goods which give less utility. □ Consequently, he buys less of those goods which give more utility. Hence he fails to spend his income according to this law. □
- vi. Constant Income and Price: An important assumption of the law is that the income of the consumer and the price of the goods should remain constant. Income of the consumer is limited, as such he cannot increase his satisfaction beyond a particular limit. Likewise, prices being constant, he will get only as much of satisfaction as the amount of goods that he can buy with limited income. He cannot extend his satisfaction beyond this limit. □
- vii. Change in the Marginal Utility of Money: The assumption that marginal utility of money remains constant is also unrealistic. In actual □ life, marginal utility of money may increase or decrease. Due to increase in the marginal utility of money, a consumer will have to rearrange his expenditure on different goods.

- viii. Complementary Goods: The law does not apply to complementary goods. It is so because complementary goods are used in a fixed proportion. By using less of one commodity, use of the other cannot be increased.

4.0 Conclusion

Retailing the activities involved in the selling of goods to ultimate consumers for personal or household consumption. Retail involves the sale of merchandise from a single point of purchase directly to a customer who intends to use that product. Wholesaling skills are efficiently concentrated in a relatively few hands. This saves the duplication of effort that would occur if many producers had to perform wholesaling function themselves.

5.0 Tutor Marked Assignment

- i. Define the nature and importance of wholesaling
- ii. Explain concept of retailing and wholesaling function of wholesalers
- iii. Write short notes on the following broad divided of wholesalers: Merchant wholesaler, Agent wholesaling middleman and Manufacturers' Sales facility.
- iv. State precisely the importance of the law of equi-marginal utility?

6.0 References / Further Readings

Ackerberg, Daniel, C Lanier Benkard, Steven Berry, and Ariel Pakes, "Econometric tools for analyzing market outcomes," *Handbook of econometrics*, 2007, 6, 4171–4276.

Akerman, Anders, "A theory on the role of wholesalers in international trade based on economies of scope," *Research Papers in Economics*, 2010, 1.

Frewer, I. J., A. Kole, S. A. A Van de Kroon, and C. de lauwere. "Consumer Attitudes Towards the Development of Animal-friendly Husbandry Systems. *Journal of Agricultural and Environmental Ethics* 18(2005):345-67.

<https://marketinglord.blogspot.com/2012/06/meaning-and-features-of-retailing.html>

Yiridoe, Emmanuel K., Samuel Bonti-Ankomah, and Ralph C. Martin. 2005. "Comparison of Consumer Perceptions and Preference Toward Organic versus

Module 2: Agricultural Production Functions

Unit 1 Principle of Microeconomics and Macroeconomics

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1.0 Introduction

2.0 Objectives

3.0 Main Content

3.1 Basic Concept of Economics in Animal Production

3.2 Microeconomics in Animal Production

3.3 Macroeconomics in Animal Production

4.0 Conclusion

5.0 Summary

6.0 Tutor Marked Assignment

7.0 References / Further Readings

1.0 Introduction

An agricultural production function expresses the relationship between the physical volume of output and the various inputs employed. In economics, a production function relates physical output of a production process to physical inputs or factors of production. It is a mathematical function that relates the maximum amount of output that can be obtained from a given number of inputs – generally capital and labor.

In simple words, production function refers to the functional relationship between the quantity of a good produced (output) and factors of production (inputs). “The production function is purely a technical relation which connects factor inputs and output. Though the number and variety of the different resources businesses require is limitless, economists divide the factors of production into three basic categories: land, labor, and capital. Land refers to all of the natural resources that businesses need to make and distribute goods and services.

2.0 Objective

At the end of this unit you should be able to explain the basic concept of economics in animal production, micro and macro economics in animal production.

3.1 Basic Concept of Economics in Animal Production

Economics is concerned with the well-being of *all* people, including those with jobs and those without jobs, as well as those with high incomes and those with low incomes. Economics acknowledges that production of useful goods like animal products and services. It probes questions like how to tell when big businesses or big labor unions are operating in a way that benefits society as a whole and when they are operating in a way that benefits their owners or members at the expense of others. It looks at how government spending, taxes, and regulations affect decisions about production and consumption.

Economics covers two parts: Microeconomics focuses on the actions of individual agents within the economy, like households, workers, and businesses; Macroeconomics looks at the economy as a whole. Microeconomics and macroeconomics are not separate subjects, but rather complementary perspectives on the overall subject of the economy.

In economics, the micro decisions of individual businesses are influenced by whether the macroeconomy is healthy; for example, firms will be more likely to hire workers if the overall economy is growing. In turn, the performance of the macroeconomy ultimately depends on the microeconomic decisions made by individual households and businesses.

3.2 Microeconomics in Animal Production

What determines how households and individuals spend their budgets? What combination of goods and services will best fit their needs and wants, given the budget they have to spend? How do people decide whether to work, and if so, whether to work full time or part time? How do people decide how much to save for the future, or whether they should borrow to spend beyond their current means?

What determines the products, and how many of each, a firm will produce and sell? What determines what prices a firm will charge? What determines how a firm will produce its

products? What determines how many workers it will hire? How will a firm finance its business? When will a firm decide to expand, downsize, or even close? In the microeconomic part of this book, we will learn about the theory of consumer behavior and the theory of the firm.

What determines the level of economic activity in a society? In other words, what determines how many goods and services a nation actually produces? What determines how many jobs are available in an economy? What determines a nation's standard of living? What causes the economy to speed up or slow down? What causes firms to hire more workers or to lay workers off? Finally, what causes the economy to grow over the long term?

3.3 Macroeconomics in Animal Production

An economy's macroeconomic health can be defined by a number of goals: growth in the standard of living, low unemployment, and low inflation, to name the most important. How can macroeconomic policy be used to pursue these goals? Monetary policy, which involves policies that affect bank lending, interest rates, and financial capital markets, is conducted by a nation's central bank..

Macro-economics: Macro-economics is concerned with aggregate and averages of the entire economy, such as national income, aggregate output, total employment, total consumption, saving and investment, aggregate demand, aggregate supply general land of prices, etc. we study how these aggregate and averages of the economy as a whole are determined and what causes fluctuation in them. Macroeconomic deals also with how an economy grows. It analyses the chief determinants of the economic development and the various stages and processes of economic growth. The macro-approach is useful in several ways, namely:

- i. It is helpful in understanding the functioning of a complicated economic system.
- ii. It gives a bird's eye view of the economic world.
- iii. It is of the utmost significance for the formulation of useful economic policies for the nation.
- iv. It also occupies an important place in economic theory in its pursuit of the solution of urgent economic problems.

Thus, we are able to study the economy in its dynamic aspect. Limitations of macroeconomics:

Macro-analysis has limitations of its own.

- 1) Individual is ignored altogether; it is the individual welfare which is the main aim of economics.
- 2) It overlooks individual differences. E.g. general price level may be stable, but the prices of food grains may have gone spelling ruin to the poor. Thus, according to the views of the economist today, the subject matter of economics includes.
- 3) Price theory (or micro-economics) Income and employment theory (or macro-economics) and Growth theory

Hence, broadly speaking, economics may be described as a study of the economic system under which men work and live. It deals with decisions regarding the commodities to be produced and services to be rendered in the economy, how to produce them most economically, distribute them properly and to provide for the growth of the economy.

4.0 Conclusion

Microeconomics and macroeconomics are two different perspectives on the economy. The microeconomic perspective focuses on parts of the economy: individuals, firms, and industries. The macroeconomic perspective looks at the economy as a whole, focusing on goals like growth in the standard of living, unemployment, and inflation. Macroeconomics has two types of policies for pursuing these goals: monetary policy and fiscal policy.

5.0 Summary

Microeconomics is also called as Price Theory. Price theory explains the composition, or allocation, of total production- why more of some things is produced than of others. When we speak of or the micro approach, what we mean is that it is some small part or component of the whole economy that we are analysing. Thus, micro

economic theory studies the economic behaviour of individual decision - making units such as consumers, resource owners and business firms. Macro - economics is called Income Theory. Income theory explains the level of total production and why the level rises and falls. Macro - economics is concerned with aggregates and averages of the entire economy, such as national income, aggregate output, total employment, total consumption savings and investment, aggregate demand aggregate supply general level of prices, etc., It studies the behaviour of economic system as a whole or all the decision making unit combined together.

6.0 Tutor Marked Assignment

1. Explain briefly the economics in animal production:
2. What is the difference between microeconomics and macroeconomics?
3. Enumerate the usefulness and limitation of macro and microeconomics

7.0 References / Further Readings

<https://opentextbc.ca/principlesofeconomics/chapter/1-2-microeconomics-and-macroeconomics/>

Payne, W.J.A. (1990). *An Introduction to Animal Husbandry in the Tropics*. Fourth Edition. Longman Scientific & Technical (Publ.)

Sankhayan, P.L. (1988), *Introduction to the Economics of Agricultural Production*, Prentice Hall of India Private Limited, New Delhi-110 001.

Unit 2 Production Function in Agriculture

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
 - 3.1 The Concept of Production
 - 3.2 Production Function

- 3.3 Three Stages of Productions
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor Marked Assignment
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1.0 Introduction

The production function refers to the relationship between the input of factor services and the output of the resultant product. The production function is based on the idea that the amount of output in a production process depends upon the amount of inputs used in the process. It is the mathematical representation of relationship between physical inputs and physical outputs of an organization. There are different types of production functions that can be classified according to the degree of substitution of one input by the other. In this unit, you shall be exposed to the definition of production and what production function is. Factors of production shall be discussed and their important in production process and the decisions a producer must make in production process.

2.0 Objective

At the end of this study session, you should be able to:

- i. Define production.
- ii. Explain a production function
- iii. Prove a single and two variable production function
- iv. Mention the factors of production.
- v. Examine the decision maker's tools of analyzing decision variables

3.1 The Concept of Production

Commodities that are demanded are produced and supplied by transforming some other goods and services (called inputs) into them (output or product). Production is therefore the process involved in transforming a number of inputs into a product. In terms of satisfaction derived, production can be termed creation of utility. Inputs are also called resources or factors of production. However, the use of these terms is not permanent because what is a product to one person may be an input to another person. For example,

a farmer may produce maize using land, labour, capital (hoes and cutlasses) and his managerial skill as factors of production. On the other hand, a poultry farmer sees the maize as one of the inputs in producing eggs or chicken as outputs. A positive relationship exists among these inputs and the output such that the greater availability of any of these factors will lead to a greater potential for producing output. In addition, all factors are assumed to be essential for production to take place. The functional relationship $f(x)$ represents a certain level of technology and know-how, that presently exists, for conversion these input such that any technological improvements can also lead to the production of greater levels of output. For instance, egg production process requires at least two inputs, feeds and pullets in addition to other fixed input like water, housing etc .in every case, production can only take place with at least two inputs. Examples of products production components are stated below:

Product			
Goods		Services	
Primary	Secondary	Direct	Indirect
Agricultural products	Manufacturing	Teacher	Communication
Minerals		Doctor	
Forest Products		Army, Police	Insurance
		Civil Service	Information
			Banking etc.

Fig. 1: Production Components

3.2 Production Function

The technical relationship between factors of production (inputs) and product is known as production function. It relates the quantity of a product produced to the quantity of inputs used, i.e. they are used to determine how much of an output to produce as well as how much of the various inputs to use. A production function can be described using graphical, tabular and algebraic methods. A production function for a particular good or service is often written as follows: $X_1 = f(L,K,M,R)$ Where:

X_1 = is the quantity produced of a particular good or services and

L = represents the quantity and ability of labour input available to the production process.

K = represents capital input, machinery, transportation equipment, and other types of intermediate goods.

M = represents land, natural resources and raw material inputs for production and

R = represents entrepreneurship, organization and risk-taking or

$Q = f(X_1, X_2, X_3, \dots X_n)$ where;

Q = Output

$X_1 \dots X_n$ = inputs

The production function can be studied under two situations i.e. short term and long term.

Under the short run production function, it is assumed that at least one input is fixed and hence there are three possibilities.

- i. When only one product is produced and one output is variable. This is known as one factor, one product relationship. It determines the most profitable amount of input to use.
- ii. When one product is produced but two inputs are variable factors i.e. two factor-one product (factor-factor) relationship. It determines the best combination of inputs to use.
- iii. When one variable factor is used to produce two products, i.e., one factor-two products (product-product), relationship. It determines right combination of various products.
- iv. When many products are produced using as many variable inputs as possible. This is the most realistic especially in Nigeria but the most difficult to compute and analyze. Its analysis is only possible by use of linear programming.

However much of a commodity a business firm produces, it endeavors to produce it as cheaply as possible. Taking the quality of the product and the prices of the productive factors as given, which is the usual situation, the firm's task is to determine the cheapest combination of **factors of production** that can produce the desired output. This task is best understood in terms of what is called the **production function**, *i.e.*, an equation that expresses the relationship between the quantities of factors employed and the amount of product obtained. It states the amount of product that can be obtained from each and every combination of factors. This relationship can be written mathematically as:

$$y = f(x_1, x_2, \dots, x_n; k_1, k_2, \dots, k_m).$$

Here, y denotes the quantity of output. The firm is presumed to use n variable factors of **production**; that is, factors like hourly paid production workers and raw materials, the quantities of which can be increased or decreased. In the formula the quantity of the first variable factor is denoted by x_1 and so on. The firm is also presumed to use m fixed factors, or factors like fixed machinery, salaried staff, etc., the quantities of which cannot be varied readily or habitually. The available quantity of the first fixed factor is indicated in the formula by k_1 and so on. The entire formula expresses the amount of output that results when specified quantities of factors are employed. It must be noted that though the quantities of the factors determine the quantity of output, the reverse is not true, and as a general rule there will be many combinations of productive factors that could be used to produce the same output. Finding the cheapest of these is the problem of cost minimization.

3.2 1 Single Variable Production Function

The production function for a single variable input and output is specified as

$Q = f(X_1, X_2, \dots, X_n)$ 1 Here, X_1 is variable input, X_2, \dots, X_n are fixed inputs and Q is output

Average product of X_1 is defined as:

Marginal product of X_1 input

$MP_1 = dQ/dX_1$ 3

Elasticity of X_1 input $E_1 = dQ/dX_1 \cdot X_1$ 4

$$Q = X_1 \frac{dQ}{dX_1} = dQ = Q \frac{dX_1}{X_1}$$

$$\text{Elasticity of production (Ep)} = MP_1/AP_1 \dots\dots\dots 5$$

Example: Let us assume the estimated production function with a single variable input as:

$$Q = 20 + 150 X - 1.2 X^2 + e \dots\dots\dots 6$$

Equation 6 is called a quadratic production function or second degree polynomial function. With single variable input using equations 1, 2 and 4, we can derive MP_1 and AP_1

Elasticity of X_1 input

Elasticity of production (Ep)

$$Q = 20 + 150 X - 1.2 X^2$$

$$AP_1 = Q / X_1$$

$$= 20/X_1 + 150 - 1.2 X_1$$

$$MP_1 = dQ/dX_1 = 0 + 150 - 2.4 X_1$$

$$= 150 - 2.4 X_1 \dots\dots\dots 7$$

$$Ep = 150 - 2.4 X_1 / 20/X_1 + 150 - 1.2 X_1 = MP_1/AP_1$$

Taking derivative of MP_1 (second derivative)

$$d^2Q/dX_1^2 = 2.4$$

3.2.2 Two Variable Production Function

The estimated production with two variables X_1 and X_2 is given as:

$$Q = 21.27 + 10.3 X_1 + 4.3 X_2 - 0.32 X_1^2 - 0.44 X_2^2 + 0.13 X_1 X_2 \dots\dots\dots 9$$

This is second degree polynomial response function with two variables

MP_1 and MP_2 are estimated for the given equation (9)

$$MP_1 = \delta Q / \delta X_1 = 0 + 10.3 - 0.64 X_1 + 0.13 X_2 \dots\dots\dots 10$$

$$MP_2 = \delta Q / \delta X_2 = 0 + 4.3 - 0.88 X_2 + 0.13 X_1 \dots\dots\dots 11$$

To get the maximum profit, MP_1 and MP_2 should be equated with their respective price ratios

$$10.3 - 0.64 X_1 + 0.13 X_2 = P_1/P_2 \dots\dots\dots 12$$

$$4.3 + 0.13 X_1 - 0.88 X_2 = P_2/P_q \dots\dots\dots 13$$

Assume the price ratios for equations (12) and (13) and solve them simultaneously to get optimal level of X_1 and X_2

P_1/P_q is assumed as 0.5

P_2/P_q is assumed as 1.20

To solve for the values of X_2 , multiply equation (12) by 0.13 and equation (13) by 0.64

$$1.34 + 0.08 X_1 + 0.02 X_2 = 0.07 \dots\dots\dots 13$$

$$2.75 - 0.08 X_1 - 0.56 X_2 \quad 4.09 \quad 0.54 X_2 = 0.07 \dots\dots\dots 14$$

$$4.09 \quad 0.54 X_2 = 0.84$$

$$- 0.54 X_2 = 0 \quad -4.09 + 0.84$$

$$X_2 = 6.02$$

Substituting $X_2 = 6.02$ in equation (12) we get

$$X_1 = 17.38$$

$$X_1^* = 17.38 \quad X_2 = 6.02$$

Here X_1^* and X_2^* are optimal levels of inputs

Substitute $X_1^* = 17.38$ and $X_2^* = 5.03$ in equation (9) to find out the optimal level of Q

$$Q^* = 127.1$$

Here X_1^* and X_2^* are the economic optimal levels of inputs and give maximum profit at that level. The unconstrained profit function equation (9) is specified as

$$= P_q Q - (P_1 X_1 + P_2 X_2) \dots\dots\dots 15$$

$P_1 = N6$ per unit of X_1 input

$P_q = N12$ per unit of output

$P_2 = N14.4$ per unit of X_2 input

$$X_1^* = N17.38$$

$$X_2^* = N6.02$$

$Q = 127.1$ units of output

Substituting the above values in equation (16), we get the amount of profit

$$\text{Profit} = N1,334.23$$

a. Three Stages of Productions

In a law of variable proportion, the three levels of production are TP, MP and AP as described below;

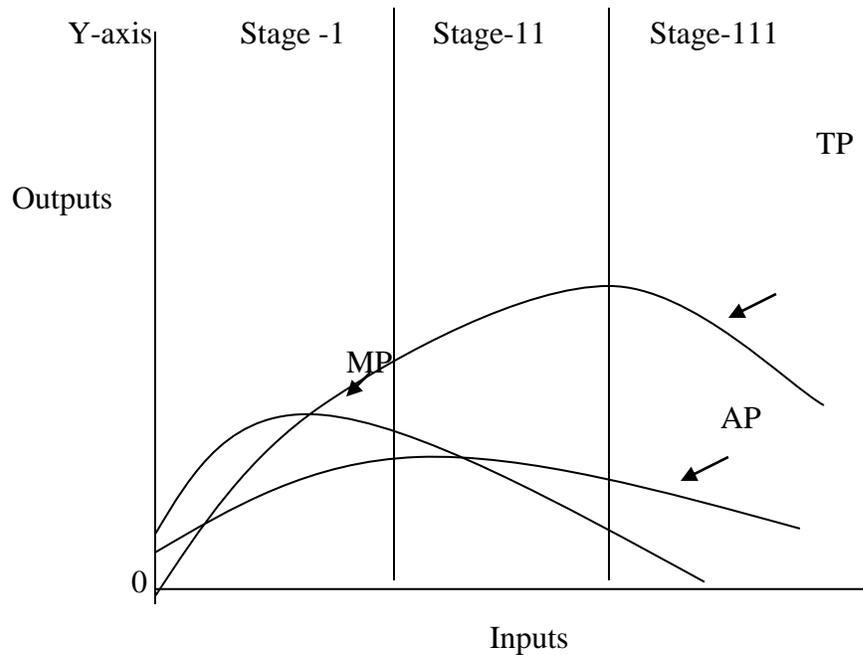
1. Total Product (TP): Total Product can be obtained from given quantities of inputs
2. Marginal Product (MP): Marginal product is net addition to the total product, when one more unit of production is used in production process.
3. Average Product (AP): Average product is the ratio of total product to the total factor input

Total Product

$$AP = \frac{\text{Total Product}}{\text{Total Factor Input}}$$

i.e

Units of inputs	TP	MP	AP
1	2	2-0 = 2	2
2	5	5-2 = 3	2.5
3	8	8-5 = 3	2.7
4	12	12-8 = 4	3
5	13	13-12 = 1	2.6
6	19	19-13 = 6	3.2



X-axis

Law of Variable Proportions or Three Stages of Production

The relationships of TP, MP and AP can be expressed as;

1. When the output is increasing, marginal product is positive.
2. When the total product is maximum, marginal product is zero.
3. When the total product is decreasing, marginal product is negative.
4. When the total product is increasing at increasing rate, the marginal product is increasing; and
5. When the total product is increasing at decreasing rate, the marginal product is decreasing but positive.

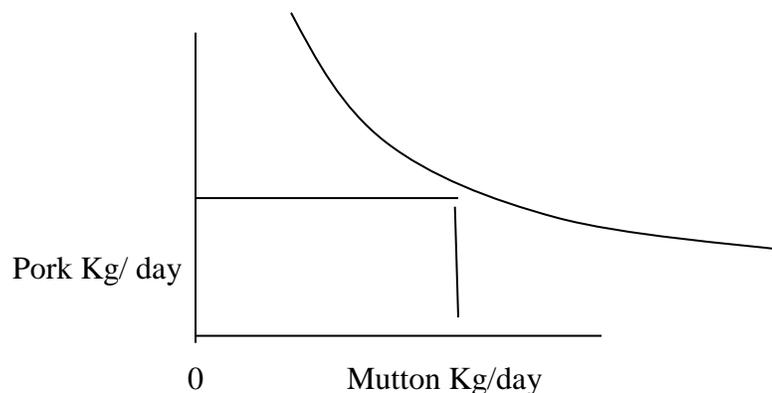
In conclusion, the Stage-11 is found most profitable, feasible or economical, because it lies between two maximum points as TP and AP.

- i. **Factor-Factor Relationship.** Output (Product) is related to two or more variable production inputs (factors) given a set of fixed inputs.

Let us consider a situation where only two inputs are used in production and the production function can be written as;

$$Y = f(X_1, X_2, X_3, \dots, X_n)$$

Where Y is wheat output, while X_1 and X_2 are quantities of seeds and fertilizers. It is to be noted that these inputs are required to apply on farm in variable quantities, with the other inputs which are kept constant at a fixed level. Our concern is that what would happen to output when the quantities of inputs X_1 , X_2 are increased or decreased. Besides the effect on output, what would happen to substitution of one variable factor for another by changing the quantities of these inputs. Thus we would be focusing on the substitution between inputs X_1 , X_2 in any agriculture production process. The farmers could choose various combinations of the factors of production within the limitations of his investment capacity. The economical feasible level of output can be obtained from different combinations of given level of inputs is called Iso-Product Curve or Iso-Quant Curve as shown in Figure No.3. Such curve represents different efficient combinations of X_1 and X_2 that are capable of producing a given level of output. Farmers are always interested in finding out the least cost or cheapest method to produce a given level of output.

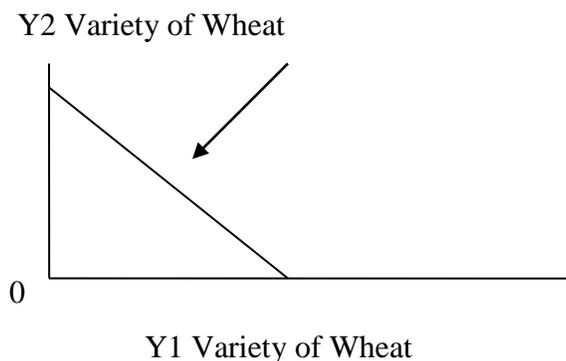


An Isoquant Curve

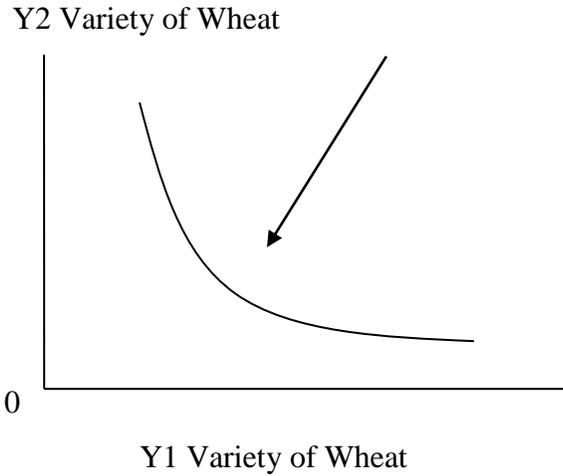
- ii. **Product - Product Relationship.** The relative quantity of two or more outputs (Products) is related to a fixed quantity of inputs (factors).

Product-product relationship is concerned with the allocation of a fixed resource set between competing enterprises. The farmer has to take great care in selecting the most appropriate product or product mix to maximize his profit from the given resource set. The relationship between products can be categorized as competitive, supplementary, and complimentary or joints products. To explain these categories we can make use of production possibility curve, which represents various possible combinations of two products that can be produced with fixed level of inputs as shown in Figure No.4. The slope of the production possibility curve denotes the rate at which one product substitutes for another.

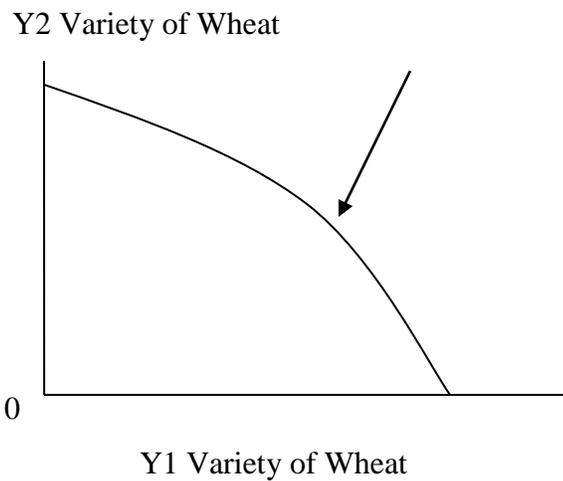
Competitive Products: Two products are competitive in the use of given resources if an increase in the output of one product involves a reduction in the output of the other product. The marginal rate of product substitution, which indicates the quantity of one product that must be given up, when the output of other product is increased by one unit, is negative. Marginal rate of product substitution can be denoted as $\Delta Y_2 / \Delta Y_1$. It indicates the number of units of Y_2 which must be given up when an additional unit of Y_1 is to be produced. If the two products are competitive, the marginal rate of product substitution $\Delta Y_2 / \Delta Y_1$ is negative. The nature of product relationship depends on the nature of production function for each independent product. These could be 1) The constant rate of substitution 2) Decreasing rate of substitution c) Increasing rate of substitution.



Production Possibility Curve showing constant rate of product substitution



Production Possibility Curve showing decreasing rate of product substitution

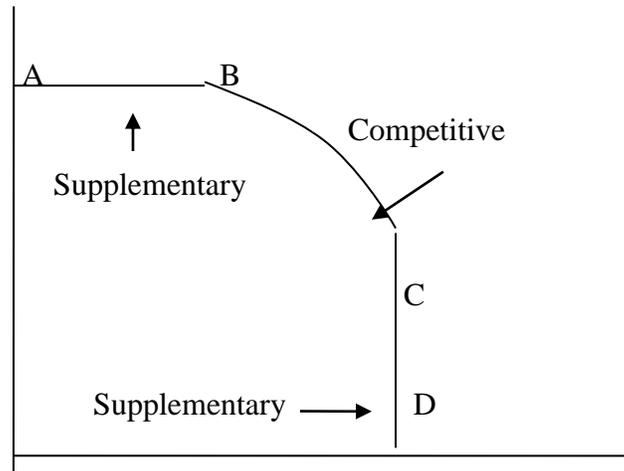


Production Possibility Curve showing increasing rate of product substitution

Supplementary Products: Two products are supplementary when an increase in output of one product, holding the resources constant in quantity, has no effect on the level of output of the second product. In other words, with the same resources, the output of one product can be increased with either a gain nor a sacrifice in the other product. Supplementary products use the idle resources. On small farms keeping a few milk animals or poultry birds may be supplementary to the fodder

enterprises because permanent labour is used these products without reducing the productivity of fodder products as shown in Figure No.7

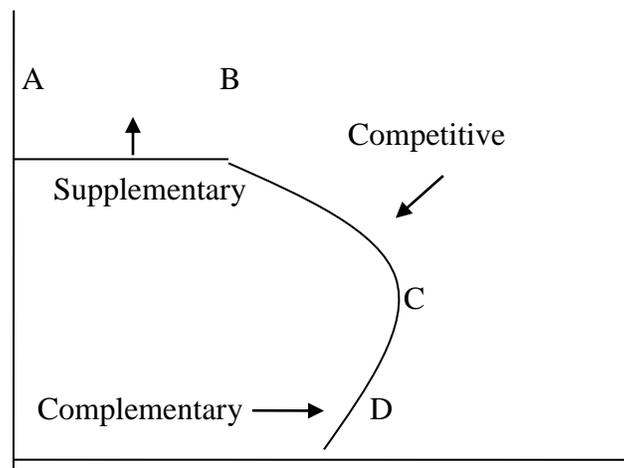
Y2



Supplementary Relationship

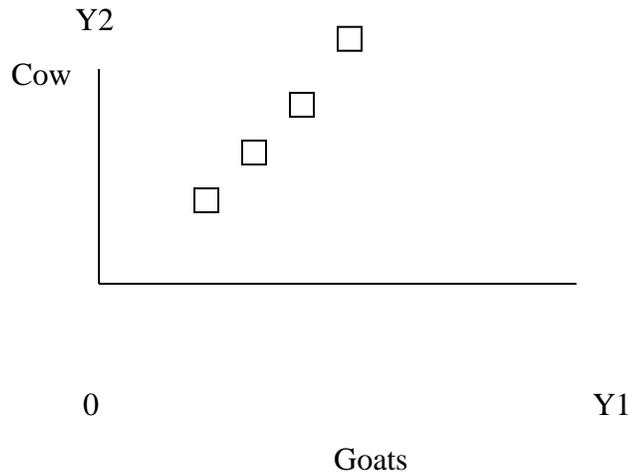
Complementary Products: Two products are complimentary when increase in output of one product, using the fixed resources, also increases the output of the second product. In other words shift of resources from one product to a second product will increase rather than decrease the output of first as shown in Figure No.8. Leguminous crops increases the fertility status of soil, which is beneficial for production of wheat on a piece of land, termed as complementary products.

Y2



Complementary Relationship

Joint Products: These products are obtained in fixed proportions. If a given quantity of one product is produced, the quantity of other products is fixed by nature. Joint products are produced through a single production function and for the purpose of analysis they may be treated as single product. The combinations of products are represented in Figure No.9.



Joint Products

4.0 Conclusion

The production function refers to the relationship between the input of factor services and the output of the resultant product. The production function is based on the idea that the amount of output in a production process depends upon the amount of inputs used in the process. It is the mathematical representation of relationship between physical inputs and physical outputs of an organization. There are different types of production functions that can be classified according to the degree of substitution of one input by the other.

5.0 Summary

Production is the functional area responsible for turning inputs into finished outputs through a series of production processes. The Production Manager is responsible for making sure that raw materials are provided and made into finished goods effectively. The Concept of Production, the different production function and the three stages of productions is well explained in this unit

6.0 Tutor Marked Assignment

1. Define production.
2. Explain a production function
3. Prove a Single Variable Production Function and Two Variable Production Function
6. Mention the factors of production.

7.0 References / Further Readings

Doll, John P. and Orazem. F. (1984), *Production Economics: Theory with Application*, John Wiley and Sons, New York.

Modern Economic Theory by K.K. Dewett

Principles of Economics by K.P.M. Sundram and M. C. Vaish

Unit 3 Costs of Production

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- 7.0 References / Further Readings

1.0 Introduction

In economics, the cost-of-production theory of value is the theory that the price of an object or condition is determined by the sum of the cost of the resources that went into making it. There are a number of different types of costs of production that you should be aware of: fixed costs, variable costs, total cost, average cost, and marginal cost.

2.0 Objectives

At the end of this unit, you should be able to state the element of cost of production and differentiate between explicit and implicit costs is crucial to understanding the difference between accounting profits and economic profits.

3.1 Element of Cost of production

Costs of production are total sum of money required for the production of a specific quantity of output. Following elements are included in the cost of production;

1. Rent of land.
2. Wages of labour.
3. Interest on capital.
4. Wear and tear of the machinery and building.

5. Advertisement charges.
6. Insurance charges.
7. Payment of taxes.

The costs of production from the point of view of individual firm is divided into two parts; Explicit Costs and Implicit Costs:

1. **Explicit Costs:** Explicit cost represents all such expenditure which are incurred by an entrepreneur to pay for the hired services of factors of production and in buying goods and services directly. The explicit costs include wages and salary payments, expenses on the purchase of raw materials, light, fuel, advertisements, transportation, taxes and depreciation charges. In short, all the items of expenses appearing on the debit side of trading account of a firm represent explicit costs. Explicit cost is also called accounting costs.
2. **Implicit Costs:** The implicit costs are imputed value of the entrepreneur's own resources and services. Implicit costs can be defined as expenses that an entrepreneur does not have to pay out of his own pocket but are costs to the firm because they represent an opportunity cost. Implicit costs thus are the alternative costs of the self-owned and self-employed resources of a firm. **Other Costs of Production:**
3. **Real Costs:** Real costs are the pains and inconveniences experienced by the labour to produce a commodity.
4. **Opportunity Costs:** It is amount of income or yield that could have been earned by investing in the next best alternative. The costs foregone opportunity to take advantage of next best alternative.

The difference between explicit and implicit costs is crucial to understanding the difference between accounting profits and economic profits. **Accounting profits** are the firm's total revenues from sales of its output, minus the firm's explicit costs. **Economic profits** are total revenues minus explicit and implicit costs. Alternatively stated, economic profits are accounting profits minus implicit costs. Thus, the difference between economic profits and accounting profits is that economic profits include the firm's implicit costs and accounting profits do not.

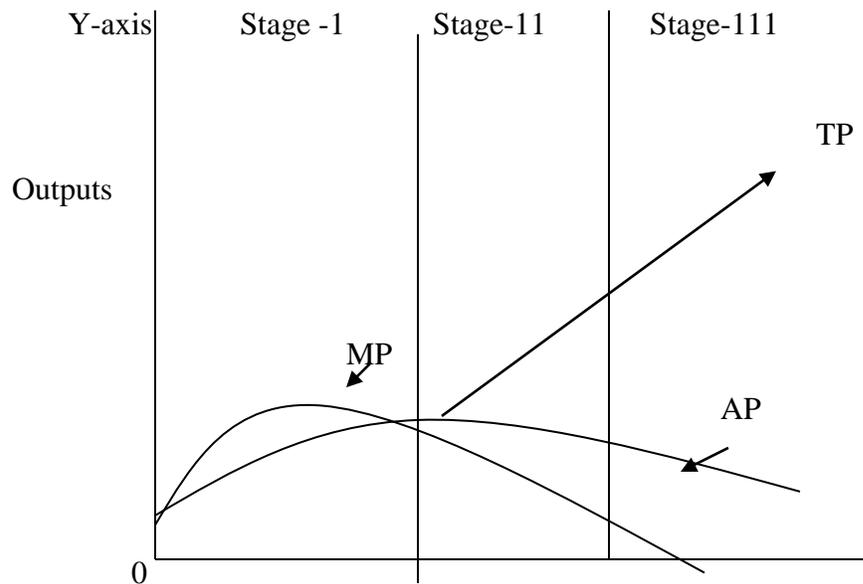
A firm is said to make **normal profits** when its economic profits are *zero*.

Total Cost (TC): Total cost is the sum of all its variable and fixed costs.

Marginal Cost (MC): Marginal cost is the per unit change in total cost that results from a change in total product.

Average Cost (AC): Average cost is the ratio of total cost to the total quantity of output.

$$\text{AC} = \frac{\text{Total Cost}}{\text{Quantity}}$$



Fixed and variable costs. In the short run, some of the input factors the firm uses in production are fixed. The cost of these fixed factors are the firm's **fixed costs**. The firm's fixed costs do not vary with increases in the firm's output.

The firm also employs a number of variable factors of production. The cost of these variable factors of production are the firm's **variable costs**. In order to increase output, the firm must increase the number of variable factors of production that it employs. Therefore, as firm output increases, the firm's variable costs must also increase.

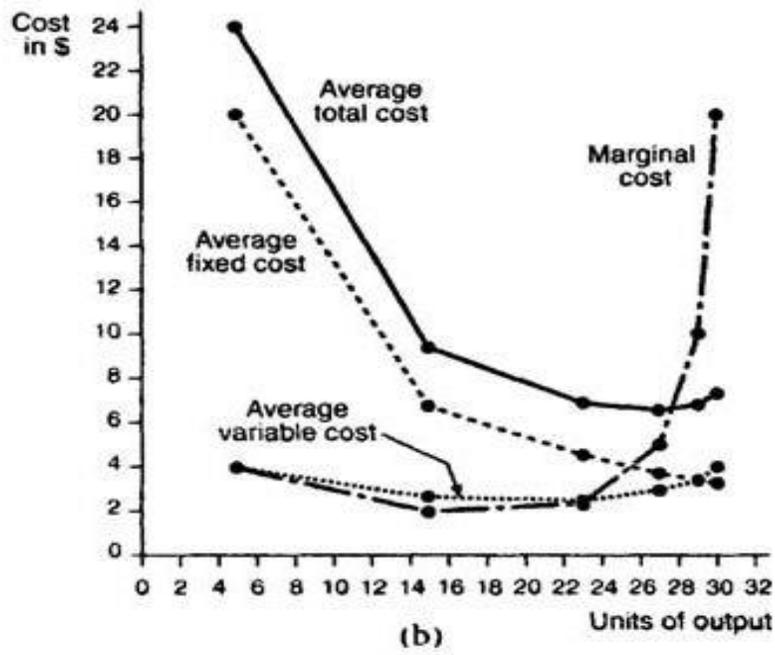
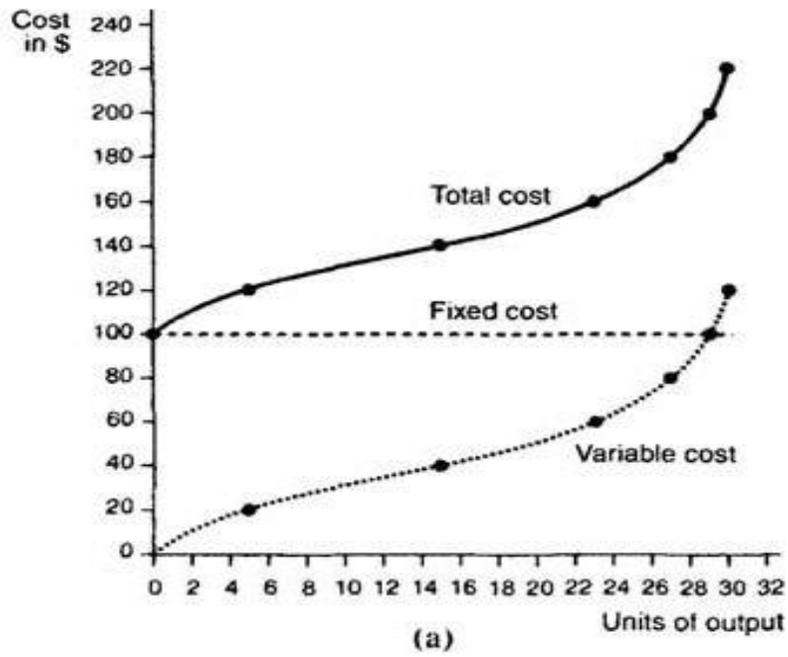


Figure 1
Cost Curves

3.2 Scale of Production

The Law of Return to Scale explains that when inputs are increased by the same proportion, keeping in view their ratio fixed, the scale of production is expanded. The effect on output like laws of returns has three distinct stages;

1. **Increasing Return to Scale:** If inputs of a production process are increased by 100% and it leads to an increase in production by more than 100%, then the production function is said to be increasing return to scale.
2. **Decreasing Return to Scale:** If inputs of a production process are increased by 100%, leads to an increase in production by less than 100%, then the production function is said to be decreasing return to scale.
3. **Constant Return to Scale:** If inputs of a production process are increased by 100% and output increases exactly by 100%, then the production function of the firm is said to be constant return to scale.

Assumptions of Law of Return to Scale: The main assumptions of law are as;

1. There are only two inputs, labour and capital which are variable.
2. Firms produce output with no change in technology.
3. There is perfect competition in the market.
4. The output is measured in quantities.

3.3 Factors affecting costs of production

- i. **Wage costs.** For labour intensive industry (service sector/production of dairy products) a small change in wage costs has a big impact on the overall costs of firms.
- ii. **Labour productivity.** New technology which improves output per worker enables the firm to cut back on employing workers, leading to lower costs.
- iii. **Exchange rate.** A rise in the exchange rate makes imports cheaper. If the firm needs to import raw materials, an appreciation can reduce the cost of production (though exports will be less competitive)
- iv. **Raw materials.** A rise in the cost of raw materials will increase the cost of firms. Nearly all firms will be affected by higher oil prices – which increase the cost of transport.

- v. Tax. Higher national insurance (tax on workers) raises costs.
- vi. Bureaucracy and administration. Firms which have to fill in paperwork and complicated tax returns will have higher costs. This could be significant for firms who export but have to pass through administrative hurdles (non-tariff barriers)
- vii. Transport costs
- viii. Interest rates. Firms who borrowed to invest will be affected by an increase in interest rates – which raises the cost of loan repayments.

4.0 Conclusion

The cost-of-production theory of value is the theory that the price of an object or condition is determined by the sum of the cost of the resources that went into making it. The different types of costs of production that exist are fixed costs, variable costs, total cost, average cost, and marginal cost.

5.0 Summary

Production costs are those, which must be received by resource owners in order to assume that they will continue to supply them in a particular time of production. The relationship between outputs and the variable inputs when all inputs or factors are increased in the same proportion. It is all of the payments or expenditures necessary to obtain the factors of production of land, labor, capital and management required to produce a commodity. It represents money costs, which we want to incur in order to acquire the factors of production

6.0 Tutor Marked Assignment

1. State the element of cost of production
2. Write short note on: Fixed cost, Variable cost, Average Cost Marginal Cost and scale of production
3. What the factors affecting costs of production
4. Enumerate the assumptions of law of return to Scale

7.0 References / Further Readings

https://economicsconcepts.com/concept_of_cost_of_production.htm

Stickney, C. P., R. L. Weil, and S. Davidson. 1991. Financial accounting . Sixth edition. Harcourt Brace Jovanovich, New York, NY.

Unit 4 Marketing Theory in Relation to Livestock Production

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
 - 3.1 Livestock Marketing
 - 3.2 Functions and Elements Marketing
 - 3.3 Market Types and Marketing
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- 5.0 Summary
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1.0 Introduction

Marketing is defined as the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large. Marketing is the study and management of exchange relationships. Marketing is the business process of creating relationships with and satisfying customers. With its focus on the customer, marketing is one of the premier components of business management. It provides the mechanism whereby producers exchange their livestock products for cash. The cash is used for acquiring goods and services which they do not produce themselves, in order to satisfy a variety of needs ranging from food items, clothing, medication and schooling to the purchase of breeding stocks and other production inputs and supplies. Both inputs and outputs fluctuate over time.

It involves two components: Direct marketing involves buyers who purchase livestock directly from a farmer rather than through an intermediate market or party. While direct marketing situations involve the movement of livestock with the service of an intermediary. The intermediary expects to receive a commission or percentage in exchange for his or her efforts to facilitate the sale.

2.0 Objectives

At the end of this unit, you should be able to define the concept of livestock marketing, elements of price theory used in explaining market prices, the attributes for types of livestock markets, factors influencing livestock marketing system, different types of market types, the elements and functions of marketing

3.1 Livestock Marketing

Marketing is an important aspect of any livestock system. It provides the mechanism whereby producers exchange their livestock and livestock products for cash. The cash is used for acquiring goods and services which they do not produce themselves, in order to satisfy a variety of needs ranging from food items, clothing, medication and schooling to the purchase of breeding stock and other production inputs and supplies.

Marketing includes all business activities involved in the flow of goods and services from producers to consumers. For a consumer or producer, the objectives of marketing are to maximize benefits from the available resources and to expand marketing operations to increase wealth. From a societal (public) viewpoint, the major objectives of marketing are to:

- i. Assist in the efficient allocation of resources
- ii. Create wealth and promote economic growth
- ii. Improve income distribution among different sectors of the economy
- iii. Maintain stability of supply and demand for marketed goods

The main characteristics of livestock marketing are:

- i. Marketing begins at the level of individual farmers.
- ii. Producers are widely dispersed.
- iii. Agricultural and livestock commodities are perishable and seasonal in supply.

iv. Institutional supports are limited.

Marketing and trade allow specialization of activities. This leads to enhanced resource-use efficiency and economic growth. With economic development, the tasks and activities of marketing further increase, creating employment and other avenues for development. Some important fundamentals to market development are:

- i. Proper linkages between rural areas and urban centers of consumption
- ii. A conducive (beneficial) policy institutional environment for marketers to operate effectively and for markets to expand beyond the basic need levels of consumers and producers
- iii. A dynamic relationship between supply and demand.
- iv. The marketing system and its structure influence the determination of a commodity's market price.

The six main elements of price theory used to explain market prices are:

1. Perfect competition
2. Imperfect competition
3. Horizontal and vertical combination of markets
4. Separation of markets
5. Product differentiation
6. Seasonal and cyclic variations.

Marketing functions

Exchange functions	Physical functions	Facilitating functions
Buying	Assembling	Financing and risk-bearing
Selling	Transport and handling	Market information
Pricing	Storage	Demand and supply creation
	Processing and packaging	Market research
	Grading	

3.2 Functions and Elements Marketing

Marketing is sometimes thought of as simply the process of buying and selling. Its tasks are much more extensive than this simple description. For a marketing system to be

operative and effective, there are three general types of functions which it must provide. Marketing system functions are broadly categorised as: exchange functions, physical functions and facilitating functions.

1. **Exchange functions** are what are commonly thought of as marketing. They involve finding a buyer or a seller, negotiating price and transferring ownership (but not necessarily physical transfer). These functions take place at the "market" - that is, the physical meeting point for buyers and sellers at the point of production or other means of communication. At this point, formal or informal property rights are important to ensure the reliable transfer of ownership and to guarantee legality (e.g. that animals on sale were not stolen and will not be reclaimed)
2. **Physical functions** enable the actual flow of commodities through space and time from producer to consumer and their transformation to a form desirable to the consumer. Assembling or concentrating the product at convenient points allows its economical transport (i.e. getting enough animals together to transport cheaply). Storage allows the commodity to be held until peak season demand, thereby stabilizing supply. Processing transforms the commodity into the products desired by the consumers. Grading and standardization allow the consumer to be more confident of the characteristics of the good being purchased.
3. **Facilitating Functions** - Financing and risk-bearing are two important facilitating functions. The owner of goods at any marketing stage must sacrifice the opportunity to use the working capital needed to buy those goods elsewhere. There is an implicit cost in the risk of losing all or part of that capital through theft, spoilage, mortality or changing market conditions. Without the willingness to provide the capital and to bear these costs, no stage of the market chain could function. Other facilitating functions enable producers to respond to consumer needs and thus provide goods in the locations, quantity and form desired.

Four elements of Marketing

- a. Product type
- b. Participants
- c. Physical infrastructure
- d. Policy institutional environment.

Functions of the middlemen in the market are carried out by four types of enterprises, namely:

- a. Locally-based private enterprises
- b. Co-operatives
- c. Marketing boards and other state enterprises
- d. Transnational companies

3.3 Market Types and Marketing

- i. **Auction (also sales barn, commodity auction):** Livestock are received and sold to buyers on an auction basis with bidding and selling open to the public. Auctions may be owned privately by individuals, partnerships, corporations or cooperative associations.
- ii. **Cash or Spot Market:** The market for the actual, physical commodity of each livestock class. Price quotations may come from terminal, auction, electronic or direct market.
- iii. **Electronic Marketing:** A system of trading through use of computer processing, storage, retrieval, and transmission of market information. Trading is organized and centralized through a single point so the market is accessible to buyers and sellers at locations distant it. The product is merchandized on description rather than visual appraisal.
- iv. **Future Market:** Market in which contracts are bought and sold under formal and regulated conditions. The seller agrees to deliver and a buyer agrees to accept a specified commodity at a future time. Terms of the contract specify the commodity being traded, price, quantity, quality, place and time of delivery.
- v. **Tel-O-Auctions:** An interlocking system of telephone conference call setups where bidders in different geographic areas can bid on livestock as described over the voice system. Sorting and grading must be very precise because buyers are bidding on description only.
- vi. **Terminal-public Market:** Also called public stockyards, central public markets or terminal markets. Livestock is consigned to commission firms for selling; two or more commission firms must operate such a market. A stockyard company

owns and maintains the physical facilities. Individuals, partnerships, corporations or cooperative associations operate as commission agencies on terminal public markets. A market where livestock are bought and sold.

Factors that influence the livestock marketing system

- a) Government policy through fiscal, regulatory and development intervention affects the volume, flow and prices of livestock in the marketing system.
- b) Favourable fiscal policies that encourage livestock production and reduce costs to producers increase the supply of livestock, e.g. subsidies, and price stabilization policies
- c) Taxes and levies of all kinds tend to restrict the volume supplied.
- d) The control of epidemic diseases, the proper development of range areas and the development of trek routes and livestock market facilities tend to increase the volume supplied and reduce marketing costs.
- e) In general government monopolistic tendencies and the fixing of artificially low prices stifle market supply and demand.

Attributes for Types of Livestock Markets

Type of Market	Main Sellers	Main buyers	Purpose of purchase
Primary collection markets	Producers	Other producers	For stock replacement or fattening
		Local butchers	Slaughter
		Traders	Collection for resale in larger regional markets
Secondary distribution markets	Traders	Local butchers	Slaughter
		Traders	For resale in terminal markets
Terminal markets	Traders	Local slaughter house	Slaughter
		Traders	Export

Ariza Nino et al, 1980

Steps to Livestock Marketing Success

1. Estimate costs

The first step involves accurately estimating costs of production and cash flow needs. This step is listed first because of its importance. While it can be done at any time, it is best to do this step as early as possible.

By estimating both production costs and cash flow requirements, you can decide what type of animal to produce and when it will have to be sold to meet payment schedules. These estimates, along with price forecasts, should be used to determine how the animal will be marketed.

By knowing past production costs and future price forecasts, you can also determine when to retain female stock for expansion or to cull more heavily. Production cost estimates and breakeven calculations are critical in setting a series of target prices that should be watched for in the changing market.

2. Gather market information, including market outlook

Following market trends and projected livestock prices aids you in deciding what to produce in order to bring the greatest returns. For example, deciding whether to sell weaned calves, yearlings or slaughter cattle depends upon the market outlook for each of these animals. In some cases you will watch the United States market for export opportunities, so a decision could be made to finish animals to a weight preferred by American buyers.

3. Know your product

The quality and type of livestock for sale must be known before you can seriously evaluate the different pricing and delivery alternatives. By knowing what you have for sale, you can contact interested buyers and, if there are premiums in the market for livestock with specific characteristics, you can then capitalize on them.

Knowing your product also involves presenting it favourably. Sorting animals into lots of similar size and weight will make them more attractive to buyers. Selling clean and healthy animals assures buyers that they are paying for a quality product.

4. Set several target prices

Set target prices by knowing production costs and what the market is paying or is expected to pay. The level and timing of these targets should be set based on outlook information, cost of production figures and cash flow needs rather than expected profit

levels. The advantage of setting several target prices rather than just one price is that it gives you flexibility to respond to changing market trends. Staying in touch with the market is crucial when trying to achieve a target price.

5. Evaluate pricing and delivery alternatives

Evaluate all available alternatives for pricing and delivering livestock. Each alternative has specific features that may make it more suitable than another.

When pricing livestock, there are several choices available. A forward contract offers you the opportunity to lock in a price for the livestock ahead of an expected sale date. Other livestock pricing alternatives include open bids at auction markets, producer or breed association sales, video auctions, electronic auctions, direct sales to packers, sales to livestock order buyers or using the futures or options market for a hedging strategy. As a pricing alternative is considered, keep the target prices in mind.

For each of the market delivery alternatives, there are associated pricing methods to consider. For example, a pricing method may determine whether an animal is sold live or rail graded, and whether it is sold with a pencil shrink or not. All pricing agreements will have a direct influence on the final returns.

When evaluating marketing alternatives, keep in mind how the animals will be delivered to the buyer and if this delivery method will influence the settlement price. Transportation considerations include both the costs of the trucking and the costs of lost quality or weight of the animals. These factors should be kept in mind as you decide how and where to have the livestock priced.

Pricing and delivery decisions are typically made together when selling. The pricing decision will sometimes dictate what the delivery method will be. However, both pricing and delivery methods can be negotiated when reaching a settlement price with a buyer. By knowing production costs, cash flow needs and current market conditions, you can determine if the price being negotiated is suitable for your needs and is a reasonable price for current conditions.

6. Stick to your plan

A livestock marketing plan involves all the steps listed above. By executing these steps, you will have a thorough understanding of how your business is functioning. Have confidence to stick to your plan as you follow the market.

7. Evaluate your plan

All plans must be evaluated to determine what worked and what can be improved upon. By looking back on livestock sales and how the returns matched the needs of the business, you will continue to learn about what factors influence the operation. This learning process will provide opportunity for future growth

4.0 Conclusion

Marketing is an overall management process of identifying, anticipating and satisfying customers' demands, for a profit. Marketing involves identifying customers and their needs, knowing what you can produce profitably, and using feedback to refine production and services. Livestock marketing refers to the integrated process to produce, promote and price a commodity. There is a difference between marketing and selling livestock and there are steps involved in the marketing processes

5.0 Summary

A market system is any systematic process enabling many market players to bid and ask: helping bidders and sellers interact and make deals. It is not just the price mechanism but the entire system of regulation, qualification, credentials, reputations and clearing that surrounds that mechanism and makes it operate in a social context. Steps to livestock marketing success, attributes for types of livestock markets and factors that influence the livestock marketing system were discussed. Types, elements, functions, marketing and price theory was discussed in this unit.

6.0 Tutor Marked Assignment

1. Enumerate the steps to livestock marketing success
2. Highlight the attributes for types of livestock markets
3. What are the factors influencing livestock marketing system in Nigeria
4. State the different types of market types
5. List and discuss the elements and functions of marketing
6. Briefly discuss price theory

7.0 References / Further Readings

Doll, John P. and Orazem. F. (1984), Production Economics: Theory with Application, John Wiley and Sons, New York.

Modern Economic Theory by K.K. Dewett

Module 3: Economic Theory and Livestock Feed Economics

Unit 1 Application of Economic Theory and Quantitative Analysis

CONTENTS

1.0 Introduction

2.0 Objectives

3.0 Main Content

3.1 The Concept of Economic theory

3.2 Capital Investments

3.3 Depreciation of Capital

3.4 Application of Economic Theory in Animal Production

4.0 Conclusion

5.0 Summary

6.0 Tutor Marked Assignment

7.0 References / Further Readings

1.0 Introduction

Economic theories try to explain economic phenomena, to interpret why and how the economy behaves and what is the best to solution - how to influence or to solve these economic phenomena.

2.0 Objectives

At the end of this unit you should be able to explain the concept of economic theory, state the fundamentals problems economic theories. You also be able to understand the theories of investment, concept of capital investment and depreciation of capital

3.0 Main Content

3.1 The Concept of Economics theory

Economic theory deals with the law and principles that govern the functioning of an economy and it various parts. An economy exists because of two basic facts. Firstly

human wants for goods and services are unlimited and secondly productive resources with which to produce goods and services are scarce.

In other words, we have the problem of allocating scarce resource so as to achieve the greatest possible satisfaction of wants. This is the economic problem. It is also called economizing problem. The economic problem arises from the two basic inter related facts:

- i. Man's unlimited desire for the goods in the aggregate, and
- ii. The limited capital, natural and human resource available to a society for the production of goods in aggregate.

There has been a lot of controversy among economist about the true content of economic theory or its subject matter. The subject matter of economics or economic theory has been variously defined:

- i. According to Adam Smith economics enquires into the nature and causes of the wealth of nations.
- ii. According to Ricardo, economist studies, " how the produce of the earth is distributed." That is, economics deals with the distribution of income and wealth.
- iii. According to Marshall, economics is a study of mankind in the ordinary business of life and it examines that part of individual and social action which is connected with material requisites of well being.
- iv. According to Pigou, economics studies that part of social welfare which can be brought directly or indirectly into relationship with the measuring rod of money.
- v. Professor Lionel Robbins defines economics as a study of the allocation of scarce resources among competing ends or uses.

Each definition of economics given above is incomplete and inadequate since they do not indicate the true scope and subject matter of economics. The following are the main questions which have been raised by the economists from time to time. It is worth remembering that all these fundamental questions arise because of the basic problem of scarcity confronting an economy.

- i. According all of the available productive resources being fully utilized by the economy, or are some of them lying unemployed and unutilized?

- ii. What goods are produced and in what quantities by the productive resources which are employed?
- iii. How are the different goods produced that is what production method are employed for the production of various goods?
- iv. How is the total output of goods and services distributed among the member of the society?
- v. Are the productive resources being used efficiently?
- vi. Is the economy's productive capacity increasing, declining or remaining static overtime?

The six questions listed above have been the concern of economic theory from time to time. All of them arise from the fundamental problem of scarcity.

3.1.1 Meaning and definitions of economics

In our opinion, it is very essential for a student to have some definitions in mind as a working basis. Besides, the discussion leading to a definition is very useful in giving a clear understanding of the subject. The following are some of the definitions put forward from time to time.

Early Definitions: Science of Wealth

In the 18th century, Adam Smith, The Father of Classical Economics defined economics in his well known book "Wealth of Nations" as "An Enquiry into the Nature and Causes of the Wealth of Nations". So, according to Adam Smith, economics was concerned with an enquiry in the nature and causes of wealth of nations. Thereby economists called economics, the Science of Wealth. According to French economist J. B. Says, economics is the science which treats of wealth. The American economist F.A. Walker says that economics is that body of knowledge which relates to wealth.

Prof. Walker defines economic as the body of knowledge which relates to wealth.

Thus, in these definitions a key position was assigned to wealth in the study of economics. Adam Smith and his associates treat economics as nothing more than a "Science of Wealth." Thus in these definitions a key position was assigned to wealth in the study of economics. Marshallian Definition: Science of Material Welfare

"Economics is a study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of well being - Marshall

Thus, Dr Marshall defined economics as the study of man's action in the ordinary business of life; it enquires how he gets his income and how he uses it. Thus, it is on the one hand a study of wealth, and on the other hand, which is more important; a part of the study of man. "Economics is the study of the general methods by which men cooperate to meet their material needs. - Beveridge According to these economists, the aim of economics is to study human activities which are conducive to human welfare in its material aspect.

Robbins' Definition: Science of Scarcity or Science of Choice

Prof L. Robbins put forth his definition in 1932 in his famous book." The Nature and Significance of Economic Science" He defined economics as "The Science which studies human behavior as a relationship between ends and scarce mean which have alternative uses. This definition mean:

- Our wants are unlimited.
- Means to satisfy these wants are strictly limited.
- Hence a man has to make choice.

In other words, economics is a study of the allocation of scarce means capable of alternative uses, among competing ends for the attainment of a maximum result in the achievement of these ends.

Modern Definition:

It is now considered that economics is much more than merely a theory of value or of resource allocation. The credit for bringing about a revolution in economic thinking goes to the Lord J.M. Keynes. According to him, economics studies how the levels of income and employment in a community are determined. Thus, in Keynesian term, economics is defined as the study of the administration of scarce resources and of the determinants of income and employment. In Benham's words, economics is a study of the factors affecting the size, distribution and stability of a country's national income.

Thus, a study of economic growth and of economic stability forms an integral and important part of the study of economics. A good and adequate definition of economics must cover them.

3.1.2 Major economic problems:

In view of the scarcity of means at our disposal and the multiplicity of ends we seek to achieve, the economic problem lies in making the best possible use of our resources so as to get the maximum satisfaction in the case of consumer and maximum output or profit for a producer. Economic problem consists in making decision regarding the ends to be pursued and goods to be produced and the means to be used for achievements of certain ends. From the definition of economic problem we can derive the following fundamentals problems which an economy has to tackle.

- i. **What to produce:** The first major decision relates to the quantity and the range of goods to be produced since the resources are limited we must choose between different alternative collections of goods and services that may be produced. It also implies the allocation of resources between the different types of goods e.g. consumer goods and capital goods.
- ii. **How to produce:** Having the decided quantity and type of goods to be produced we must next determine the techniques of production to be used e.g. labour intensive and capital intensive.
- iii. **For whom to produce:** This means how the national product is to be distributed, i.e. who should get how much. This is the problem of the sharing of the national product.
- iv. **Are the resources economically used? :** This is the problem of economic efficiency or welfare maximization. There is to be no waste or misuse of resources since they are limited.
- v. **Problem of full employment:** Fullest possible use must be made of the available resources. In other words, an economy must endeavor to achieve full employment not only of labour but of all its resources.
- vi. **Problem of growth:** Another problem for an economy is to make sure that it keeps on expanding or developing so that it maintains conditions of stability. It is not to

be static. Its productive capacity must continue to increase. If it is an under-developed economy. It must accelerate its process of growth.

3.2 Capital Investment

Capital investment refers to funds invested in a firm or enterprise for the purpose of furthering its business objectives. Capital investment may also refer to a firm's acquisition of capital assets or fixed assets such as manufacturing plants and machinery that is expected to be productive over many years.

Capital investment is a component of asset strategy development and as already described, occurs in the context of a corporate planning environment that aims to translate government policy settings into agency service delivery strategies. It describes the acquisition of a new building asset, or the material improvement of an existing (building) asset that produces an increase in service capacity, quality, or useful life of that asset.

3.2.1 Types of investments

Investment expenditures play a key role in many theories of the business cycle, including Keynes's theory. Macroeconomic theorists have agreed on a basic framework that models the investment strategy of a profit-maximizing firm. However, empirical evidence has failed to provide substantial support for this model, which has been a source of frustration for those involved in investment modeling. There are four main investment types, or asset classes, that you can choose from, each with distinct characteristics, risks and benefits.

- i. Growth investments.
- ii. Shares.
- iii. Property.
- iv. Defensive investments.
- v. Cash investments include everyday bank accounts, high interest savings accounts and term deposits.
- vi. Fixed interest.

3.2.2. Types of investment risk

Investment risks are of various types. These includes:

- i. Market risk. The risk of investments declining in value because of economic developments or other events that affect the entire market.
- ii. Liquidity risk.
- iii. Concentration risk.
- iv. Credit risk.
- v. Reinvestment risk.
- vi. Inflation risk.
- vii. Horizon risk. .
- viii. Longevity risk

3.2.3 Theories of investment

The theories of investment are:

- i. The Accelerator Theory of Investment
- ii. The Internal Funds Theory of Investment
- iii. The Neoclassical Theory of Investment.

The accelerator theory of investment, in its simplest form, is based upon the notion that a particular amount of capital stock is necessary to produce a given output. For example, a capital stock of N400 Billion may be required to produce N100 billion of output. This implies a fixed relationship between the capital stock and output.

Thus, $X = K_t / Y_t$

where x is the ratio of K_t , the economy's capital stock in time period t , to Y_t , its output in time period t . The relationship may also be written as

$$K_t = xY_t \dots(i)$$

If X is constant, the same relationship held in the previous period; hence

$$K_{t-1} = xY_{t-1}$$

By subtracting equation (ii) from equation (i), we obtain

$$K_t - K_{t-1} = xY_t - xY_{t-1} = x(Y_t - Y_{t-1}) \dots(ii)$$

Since net investment equals the difference between the capital stock in time period t and the capital stock in time period $t - 1$, net investment equals x multiplied by the change in output from time period $t - 1$ to time period t .

By definition, net investment equals gross investment minus capital consumption allowances or depreciation. If I_t represents gross investment in time period t and D_t represents depreciation in time period t , net investment in time period t equals $I_t - D_t$ and $I_t - D_t = x (Y_t - Y_{t-1}) = x \Delta Y$.

Consequently, net investment equals x , the accelerator coefficient, multiplied by the change in output. Since x is assumed constant, investment is a function of changes in output. If output increases, net investment is positive. If output increases more rapidly, new investment increases.

From an economic standpoint, the reasoning is straightforward. According to the theory, a particular amount of capital is necessary to produce a given level of output. For example, suppose N400 billion worth of capital is necessary to produce N100 billion worth of output. This implies that x , the ratio of the economy's capital stock to its output, equals 4.

If aggregate demand is N100 billion and the capital stock is N400 billion, output is N100 billion. So long as aggregate demand remains at the N100 billion level, net investment will be zero, since there is no incentive for firms to add to their productive capacity. Gross investment, however, will be positive, since firms must replace plant and equipment that is deteriorating.

Suppose aggregate demand increases to N105 billion. If output is to increase to the N105 billion level, the economy's capital stock must increase to the N420 billion level. This follows from the assumption of a fixed ratio, x , between capital stock and output. Consequently, for production to increase to the N105 billion level, net investments must equal N20 billion, the amount necessary to increase the capital stock to the N420 billion level.

Since x equals 4 and the change in output equals N5 billion, this amount, N20 billion, may be obtained directly by multiplying x , the accelerator coefficient, by the change in output. Had the increase in output been greater, (net) investment would have been larger, which implies that (net) investment is positively related to changes in output.

In this crude form, the accelerator theory of investment is open to a number of criticisms. First, the theory explains net but not gross investment. For many purposes, including the determination of the level of aggregate demand, gross investment is the relevant concept. Second, the theory assumes that a discrepancy between the desired and actual capital stocks is eliminated within a single period. If industries producing capital goods are already operating at full capacity, it may not be possible to eliminate the discrepancy within a single period. In fact, even if the industries are operating at less than full capacity it may be more economical to eliminate the discrepancy gradually.

Third, since the theory assumes no excess capacity, we would not expect it to be valid in recessions, since they are characterized by excess capacity. Based on the theory, net investment is positive when output increases. But if excess capacity exists, we would expect little or no net investment to occur, since net investment is made in order to increase productive capacity. Fourth, the accelerator theory of investment, or acceleration principle, assumes a fixed ratio between capital and output. This assumption is occasionally justified, but most firms can substitute labor for capital, at least within a limited range. As a consequence, firms must take into consideration other factors, such as the interest rate.

Fifth, even if there is a fixed ratio between capital and output and no excess capacity, firms will invest in new plant and equipment in response to an increase in aggregate demand only if demand is expected to remain at the new, higher level. In other words, if managers expect the increase in demand to be temporary, they may maintain their present levels of output and raise prices (or let their orders pile up) instead of increasing their productive capacity and output through investment in new plant and equipment.

Finally, if and when an expansion of productive capacity appears warranted, the expansion may not be exactly that needed to meet the current increase in demand, but one sufficient to meet the increase in demand over a number of years in the future.

Piecemeal expansion of facilities in response to short-run increases in demand may be uneconomical or, depending upon the industry, even technologically impossible. A steel firm cannot, for example, add half a blast furnace. In view of these and other criticisms of the accelerator theory of investment, it is not surprising that early attempts to verify the theory were unsuccessful.

Over the years, more flexible versions of the accelerator theory of investment have been developed. Unlike the version of the accelerator theory just presented, the more flexible versions assume a discrepancy between the desired and actual capital stocks which is eliminated over a number of periods rather than in a single period. Moreover, it is assumed that the desired capital stock, K^* , is determined by long-run considerations. As a consequence

$$K_t - K_{t-1} = \lambda (K_t^* - K_{t-1}) \quad (0 < \lambda < 1),$$

where K_t is the actual capital stock in time period t , K_{t-1} is the actual capital stock in time period $t-1$, K_t^* is the desired capital stock, and λ is a constant between 0 and 1. The equation suggests that the actual change in the capital stock from time period $t-1$ to time period t equals a fraction of the difference between the desired capital stock in time period t and the actual capital stock in time period $t-1$. If λ were equal to 1, as assumed in the initial statement of the accelerator theory, the actual capital stock in time period t equals the desired capital stock.

Since the change in the capital stock from time period $t-1$ to time period t equals net investment, $I_t - D_t$ we have

$$I_t - D_t = K_t - K_{t-1} = \lambda (K_t^* - K_{t-1}).$$

Consequently, net investment equals λ multiplied by the difference between the desired capital stock in time period t and the actual capital stock in time period $t-1$. The relationship, therefore, is in terms of net investment.

To account for gross investment, it is common to assume that replacement investment is proportional to the actual capital stock. Thus, we assume that replacement investment in time period t , D_t equals a constant δ multiplied by the capital stock at the end of time

period $t-1$, K_{t-1} , or

$$D_t = \delta K_{t-1} \quad (0 < \delta < 1).$$

For example, if δ equals 0.05, then 5 percent of the economy's capital stock at the beginning of time period t wears out or is destroyed during the period.

Since net investment, $I_t - D_t$, equals $\lambda (K_t^* - K_{t-1})$, we have, upon substitution,

$$I_t - \delta K_{t-1} = \lambda (K_t^* - K_{t-1}).$$

or

$$I_t = \lambda (K_t^* - K_{t-1}) + \delta K_{t-1}, \quad \dots(iii)$$

where I_t represents gross investment, K_t^* the desired capital stock, and K_t , the actual capital stock in time period t . Thus, gross investment is a function of the desired and actual capital stocks.

Finally, according to the accelerator model, the desired capital stock is determined by output. Yet, rather than specifying that the desired capital stock is proportional to a single level of output, the desired capital stock is commonly specified as a function of both current and past output levels. Consequently, the desired capital stock is determined by long-run considerations.

In contrast to the crude accelerator theory, much empirical evidence exists in support of the flexible versions of the accelerator theory.

3.2.4 The Internal Funds Theory of Investment

Under the internal funds theory of investment, the desired capital stock and, hence, investment depends on the level of profits. Several different explanations have been offered. Jan Tinbergen, for example, has argued that realized profits accurately reflect expected profits. Since investment presumably depends on expected profits, investment is positively related to realized profits. Alternatively, it has been argued that managers have a decided preference for financing investment internally. Firms may obtain funds for investment purposes from a variety of sources:

- i. Retained earnings,
- ii. Depreciation expense (funds set aside as plant and equipment depreciate),
- iii. Various types of borrowing, including sale of bonds,
- iv. The sale of stock.

Retained earnings and depreciation expense are sources of funds internal to the firm; the other sources are external to the firm. Borrowing commits a firm to a series of fixed payments. Should a recession occur, the firm may be unable to meet its commitments, forcing it to borrow or sell stock on unfavorable terms or even forcing it into bankruptcy. Consequently, firms may be reluctant to borrow except under very favourable circumstances.

Similarly, firms may be reluctant to raise funds by issuing new stock. Management, for example, is often concerned about its earnings record on a per share basis. Since an increase in the number of shares outstanding tends to reduce earnings on a per share basis, management may be unwilling to finance investment by selling stock unless the earnings from the project clearly offset the effect of the increase in shares outstanding.

Similarly, management may fear loss of control with the sale of additional stock. For these and other reasons, proponents of the internal funds theory of investment argue that firms strongly prefer to finance investment internally and that the increased availability of internal funds through higher profits generates additional investment. Thus, according to the internal funds theory, investment is determined by profits.

In contrast, investment, according to the accelerator theory, is determined by output. Since the two theories differ with regard to the determinants of investment, they also differ with regard to policy. Suppose policy makers wish to implement programs designed to increase investment.

According to the internal funds theory, policies designed to increase profits directly are likely to be the most effective. These policies include reductions in the corporate income tax rate, allowing firms to depreciate plant and equipment more rapidly, thereby reducing their taxable income, and allowing investment tax credits, a device to reduce firms' tax liabilities. On the other hand, increases in government purchases or reductions in personal income tax rates will have no direct effect on profits, hence no direct effect on investment. To the extent that output increases in response to increases in government

purchases or tax cuts, profits increase. Consequently, there will be an indirect effect on investment.

In contrast, under the accelerator theory of investment, policies designed to influence investment directly under the internal funds theory will be ineffective. For example, a reduction in the corporate tax rate will have little or no effect on investment because, under the accelerator theory, investment depends on output, not the availability of internal funds. On the other hand, increases in government purchases or reductions in personal income tax rates will be successful in stimulating investment through their impact on aggregate demand, hence, output.

Before turning to the neoclassical theory, we should note in fairness to the proponents of the internal funds theory that they recognize the importance of the relationship between investment and output, especially in the long run. At the same time, they maintain that internal funds are an important determinant of investment, particularly during recessions.

3.2.5 The Neoclassical Theory of Investment

The theoretical basis for the neoclassical theory of investment is the neoclassical theory of the optimal accumulation of capital. Since the theory is both long and highly mathematical, we shall not attempt to outline it. Instead, we shall briefly examine its principal results and policy implications.

According to the neoclassical theory, the desired capital stock is determined by output and the price of capital services relative to the price of output. The price of capital services depends, in turn, on the price of capital goods, the interest rate, and the tax treatment of business income. As a consequence, changes in output or the price of capital services relative to the price of output alter the desired capital stock, hence, investment.

As in the case of the accelerator theory, output is a determinant of the desired capital stock. Thus, increases in government purchases or reductions in personal income tax rates stimulate investment through their impact on aggregate demand, hence, output. As in the case of the internal funds theory, the tax treatment of business income is important.

According to the neoclassical theory, however, business taxation is important because of its effect on the price of capital services, not because of its effect on the availability of internal funds. Even so, policies designed to alter the tax treatment of business income affect the desired capital stock and, therefore, investment. In contrast to both the accelerator and internal funds theories, the interest rate is a determinant of the desired capital stock. Thus, monetary policy, through its effect on the interest rate, is capable of altering the desired capital stock and investment. This was not the case in regard to the accelerator and internal funds theories.

3.3 Depreciation of Capital

Livestock held primarily for sale by for-profit farmers must be included in inventory. However, livestock held for draft, breeding, or dairy purposes can either be included in inventory or depreciated as the farmer chooses. Both options have advantages and disadvantages, so the decision is ultimately based on whether farmers prefer a current benefit or future benefit.

If farmers choose to depreciate the livestock, they will receive a current depreciation deduction. However, this will decrease the farmer's basis in the livestock and therefore increase any gain when the livestock is sold. Also, any future gain on a sale up to the amount of depreciation taken will be taxed at ordinary rates. If, on the other hand, farmers choose to inventory the livestock, they will forego the current depreciation deduction but any future capital gain will be taxed at the lower and more preferable capital gain rates. Farmers should consider this decision and its impacts carefully, because once a method is chosen, it cannot be changed unless authorized by the Commissioner.

Depreciation Methods

If farmers decide to depreciate their livestock, depreciation will begin when the livestock is mature (i.e., can be worked, milked, or bred). Most farm business assets are depreciated using the Modified Accelerated Cost Recovery System (MACRS) which

consists of two depreciation systems: the General Depreciation System (GDS) and the Alternative Depreciation System (ADS).

Generally, GDS must be used unless ADS is required by law or elected. The recovery period for cattle, goats, and sheep under the GDS method is five years, while the recovery period for hogs is three years. These recovery periods remain the same under the ADS method except for cattle, which increases to a seven-year recovery period. For 3-, 5-, 7-, or 10-year property placed in service before 2018, farmers were required to use the 150% declining balance method over the GDS recovery period (discussed above) unless election was made to use the straight line method. For property placed in service after 2017, these types of property are by default depreciated using the 200% declining balance method.

All purchased livestock are considered to be tangible personal property and are therefore eligible for a depreciation deduction under Section 179. Those with a recovery period of 20 years or less are also eligible for a bonus depreciation allowance. For qualified property acquired prior to September 28, 2017, and placed in service in 2018, there is a bonus depreciation allowance of 40% provided that the original use of the property begins with you. For qualified property acquired after September 27, 2017, the bonus depreciation allowance is 100% and the property can be either new or certain used property. It is important to note that farmers can deduct the costs of raising livestock during the years in which the animals are being raised. If these costs are deducted, the basis of the livestock is zero and, therefore, these costs cannot be depreciated.

Inventory Methods

If a lower tax rate on a future capital gain is preferred by farmers, they should choose to inventory their livestock. There are two inventory methods available. The simplest method is called the farm-price method. This method provides for the valuation of inventories at market price less direct cost of disposition. The other inventory method available is the unit-livestock-price method. To determine the valuation under this method, livestock are classified into groups with respect to age and kind. Then, a price

for each class is established, taking into account the normal cost of raising those animals. Farmers using the unit-livestock-price method must reevaluate unit prices each year and adjust either upward or downward to reflect changes in the costs of raising livestock.

Treatment and Calculation of Gain on Sale

Sales of livestock are reported on Form 4797, Sales of Business Property. Calculation of the gain depends on whether the animals were raised by the farmer or purchased. The gain on sale of livestock raised by the farmer is calculated as the difference between the selling expenses and the gross sales price, assuming the basis is zero because the costs of raising the livestock were deducted during the years in which the animal was being raised. The gain on sale of livestock purchased by the farmer is calculated by subtracting the adjusted basis and selling expenses from the gross sales price.

There are many different methods available to account for livestock, and it is important that farmers be knowledgeable of their options. The decision of whether to depreciate or inventory their livestock must be made at the beginning of the farming operation and cannot be changed without permission of the Commissioner. These various options make it imperative that farmers utilize the tax planning services a tax professional can provide.

4.0 Conclusion

The policy implications of the various economic theories of investment differ. It is important therefore to determine which theory best explains investment behaviour. Much of the disagreement arises because the various empirical studies have employed different sets of data. Consequently, several economists have tried to test the various theories or models of investment using a common set of data.

5.0 Summary

Economics is a study of the allocation of scarce means capable of alternative uses, among competing ends for the attainment of a maximum result in the achievement of these ends. All economic theories used to explain specific situations or problems in the economy of

some of its models. These models of economic systems try to explain the situation and solve it using approaches that are typical of the economic theory (eg. Keynesian theory subdued stimulate the economy through government money).

6.0 Tutor Marked Assignment

1. Define the concept of economic theory?
2. Discuss capital investments and depreciation of capital in relation to livestock production
3. What is the application of economic theory in animal production
4. Enumerate four main investment types, or asset classes in livestock production

7.0 References / Further Readings

<https://www.lbmc.com/blog/livestock-depreciate-inventory-sell/>

Unit 2 Nutrition in Livestock

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main Content
 - 3.1 Nutrition in Livestock Production
 - 3.2 Major Livestock Nutrients
- 4.0 Conclusion
- 5.0 Summary
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1.0 Introduction

Livestock nutrition is primarily concerned with six different food groups, all of which serve a specific purpose in maintaining livestock health, weight, and product viability: Carbohydrates are composed of carbon, hydrogen, and oxygen and provide energy to animals. Proper nutrition is vital for your good health and proper function, it is just as vital for the health and function of agricultural animals. Nutrition is important for a variety of reasons. Animals need the proper nutrition for growth and maintenance, and to

provide energy for work and vital functions. The essential nutrients required by grazing animals are water, energy, protein, minerals, and vitamins. These nutrients are needed to maintain body weight, growth, reproduction, lactation, and health. There are other factors that affect nutritional requirements.

There are two main types of nutrients, macronutrients and micronutrients. The three main categories of macronutrients include carbohydrate, protein, and fat. The two types of micronutrients are vitamins and minerals, and these are extra molecules that cells need to make energy.

2.0 Objectives

At the end of this unit you will be able to state the different components nutrient of livestock, enumerate the functions of each nutrients, explain the factors affecting water intake of animals and the quality and type of nutrients required for livestock production.

3.1 Nutrition in Livestock

The food needs of people from developing countries are not different from those of the developed world. There are six groups of nutrients. Nutrient is the name given to the different components of feed/food that are useful to the body. Most foods contain several kinds of nutrients but no one food has all that the body needs. Nutrients are any food constituents or groups of food constituents of the same general chemical composition that aid in the support of life. This implies that nutrients in feed/food are responsible for preserving life. Nutrients are components of food, which have a function in providing energy, starting and controlling various processes, providing materials for growth, reproduction, storage, repairs and protection. They are:

1. Water - for control of body processes. Sources of water are portable water, tropical fruits and leaf vegetables. 65-70% - of body weight of animal at birth 40-50% - of body weight at slaughter 90-95% - of blood, 80% of egg
2. Carbohydrates – sources of calories or energy e.g. Yam, maize, sorghum, wheat, breadfruit, cassava, sugar, plants, body building.
3. Proteins – used for protection, growth, tissue maintenance and repair. May also be used to provide energy e.g. meat, insects, soyabean meal, eggs, fish meal, groundnut

cake, cowpea, milk.

4. Fats – a source of energy and protection e.g. palm oil, coconut oil, groundnut oil, melon seeds, fish oil, butter, margarine.
5. Minerals – regulates body processes, can be used for growth and replacement of tissue e.g. fruits and salt, leaf vegetable.
6. Vitamins – regulate body processes, used as co-factors e.g. tropical leaf vegetables, fruits, root vegetables, carrot.

3.1.1 WATER

Water is an important constituent of all forms of life. Its wide distribution within feeds and feedstuffs coupled with its effect on feed quality makes the study of water a significant part of animal nutrition. Moisture refers to the absolute amount of water present in a feed while water activity has to do with the form in which the water exists in the feed such as free or chemically bound water. Moisture is the amount of water present in a feed as component, relative to all the other solid constituents such as proteins, carbohydrates, oils and non-water liquids. Most water in foods is called **free water**. Free water is lightly entrapped and therefore easily pressed from feed matter/feed; the water can be seen and felt. Free water acts as a dispersing agent and solvent and can be removed by drying foods. **Adsorbed water or structural water** is a second type of water, which associates in layers via intermolecular hydrogen bonds around hydrophilic food molecules

Bound water sometimes called the water of hydration is a third form of water in feed or food. It exists in a tight chemically bound situation, such as within a crystalline structure via water-ions or water-dipole interactions. Bound water does not exhibit the typical properties of water such as freezing at 0°C or solvent.

Water Activity – is a measure of the availability of water molecules to enter into microbial, enzymatic or chemical reactions. This availability determines the shelf-life of feed/food. The bound water is inversely related to water activity, as the percentage of bound water in a food increases, the water activity decreases. At any given food/feed moisture, water activity will increase with an increase in temperature.

SOURCES OF WATER

The main sources of water are potable water

- Metabolic water – is produced by metabolic processes in tissues mainly by the oxidation of nutrients, oxidation of 1g of CHO yields 0.6g of H₂O, 1g of fat yields 1.1g of H₂O and 1g of protein yields 0.4g of H₂O, metabolic H₂O is about 5-10% of the total water intake.
- Portable water – (stream, borehole, rain, river, bottled water, well, lake)
- Tropical feeds and fruits – oranges, water melon and Leafy vegetables – water leaf

3.1.2 FACTORS AFFECTING WATER INTAKE OF ANIMALS

- i. Type of diet – silage, hay high mineral salt content of feed, H₂O intake
- ii. Purpose (and physiological status) of the animal – lactating cow, dry cow (lactating, dry .
- iii. Type of digestive tract – ruminant, non-ruminant
- iv. Type of urinary system – mammals, birds, sweat excretion reptiles, birds, fish, sheep and goat
- v. Environmental condition – temperature and relative humidity

Approximate water consumption of mature animals:

- (i) Swine – 5.68-11.36 litres/head/day
- (ii) Sheep – 3.79-11.36 litres/head/day
- (iii) Cattle – 37.85-53.0 litres/head/day
- (iv) Horses – 37.85-53.0 litres/head/day
- (v) Poultry – 2 parts water for each
- (vi) 1 part dry feed
- (vii) Rabbits – <3 liter/head/day

3.1.3 EFFECT/SIGNIFICANCE/FUNCTION/USES OF WATER

Water neither produces energy or heat, yet it is about 75-95% of proportion of the body.

Water has an inverse relationship with fat. The higher the amount of water, less fat will be found in that region of the body and vice versa. Water is found in all body cells and water is the most abundant of all the nutrients, it is the cheapest and reduces with age.

Water can be lost from the body through urine, faeces evaporation, sweat and skin

(referred to as insensitive losses).

- In respiration and gaseous exchange water helps in moistening the alveoli in the lungs.
- Water has high specific heat and by this property it disperses heat fast
- It regulates body temperature through sweat and consequently cools the body. There always results loss of mineral salts through sweat, hence animal drinks more water to replace that which is lost through sweat.
- Water intake helps to prevent constipation in animals and man.
- Water is responsible for movement of minerals across cells and it helps to remove metabolic wastes from the body.
- Essential for mixing of drugs for man and farm animals
- Water supports chemical reactions like digestion, absorption, excretion and maintains shape of cells.
- Water lubricates and cushions joints and organs in the body e.g. synovial fluid, cerebrospinal fluid.

The quality and type of feed determine the water content of feeds. However, amount of water in a feed affects the following:

- a) The nutritive value of silage for example, because the dry matter content of the feed is affected by the amount of water present in the feed.
- b) High water content (>15%) lowers nutritive value at storage and moulds may occur.
- c) Spontaneous combustion may occur at 12% or lower water content and it destroys the nutritive value of feeds.
- d) High water content wastes money because farmer may end up paying for water i.e. mere bulk storage.
- e) Water makes silage making easy where 90% water content is fairly tolerated, at times, however water may be added to mature forage crops to ease packing which is done to exclude air. Water affects silage preservation, excess water content of silage may cause loss of mineral through seepage into the surrounding soil of silage pit.
- f) Water prevents dustiness of prepared feed/feedstuff but animals get little value when fed feeds of high water content. The of the animals wears down

(emanciates) depleting the body reserves of fat. This emanciation, will reduce the profit margin of farmers who will have to incur extra costs on feeds to restore normal growth of the animals. Excessive intake of water by animals reduces voluntary feed intake to about 30% which reduces animal's efficiency of feed utilization. Water dilutes concentration of energy in feeds hence feeds should be supplied to animals on dry matter basis.

- g) Water is a constituent of saliva (serous/mucus fluid), synovial fluid of joint caps, blood and its cell components, tears from tear glands which help to initial and clean eyes, digestive juices, amniotic fluid which supports fetuses against pressures.
- h) Water ensures sensitivity or irritability by maintaining electrolyte level (i.e. acid-base balance) of the body.
- i) Water helps in the absorption and transportation nutrients and hormones in the blood, which ensures coordination of body activities and processes.
- j) Water is the habitat of important animals plants e.g. fish, snails, cray fish and prawn and water leaf
- k) Water of high quality is particularly important for the canning of foods and production of carbonated beverages and beer.
- l) Water acts as an important vehicle for heat transfer in foods during food processing and in food preparation.
- m) Water as an ingredient. Water is given to farm animals and can be incorporated as component of processed foods.
- n) Water act as a plasticizer – especially in low moisture and frozen foods. A plasticizer is a substance that when added to a food system, makes it softer.

WATER LOSSES: Water is lost from the body constantly

- i. In the respired air by evaporation
- ii. From the skin via sweat and
- iii. Periodically by excretion in urine or faeces.

Faecal water losses are considerably higher in ruminants than other animals. In diarrhea large losses of H₂O occur with the faeces.

WATER QUALITY

Water is ubiquitous, the presence of water like that of air is taken for granted. Yet water is a most remarkable liquid, having properties which make it uniquely the support of life. Most rural people in some countries of the tropics depend on rivers, lakes, springs and shallow wells for their water supply. The purity of such water depends on the geological source and local surroundings. In some communities portable water is a luxury commodity and not within the reach of the inhabitants.

Potable water is free from harmful bacteria and chemical impurities. It is clear and bright, colourless, tasteless, odourless and contains no suspended matter or turbidity. In addition it should have an attractive appearance and be pleasant to drink.

Certain chemical substances have maximum allowable concentrations in drinking water while excess is detrimental to health.

Contamination by sewage or human excrement and by animal pollution poses the greatest danger associated with drinking water in most developing countries in the tropics. The organisms most commonly used as indicator of water pollution are *E. coli* and the coliform group as a whole. Standards for drinking water have been published by the WHO for European countries and international use.

3.2 Major Livestock Nutrients

3.2.1 Carbohydrates

Carbohydrates are any of a large group of organic compounds occurring in foods and living tissues and including sugars, starch, and cellulose. They contain hydrogen and oxygen in the same ratio as water (2:1) and typically can be broken down to release energy in the animal body. Carbohydrates accounts for a large portion of animal's daily food supply, they are made up of C, H, O with an empirical formula $C_n(H_2O)_n$. Other characteristics are:

- i. Includes sugars, starch and cellulose
- ii. Very little occurs as such in animal body
- iii. Form largest (3/4) of plant dry weight
- iv. Formed by photosynthesis in plants
- v. Digested into crude fibre (cellulose, hemicelluloses, lignin) which are poor digested

- and nitrogen free extract (soluble sugars and starches) which are readily digested
- vi. Stored in animal body by converting its fats
 - vii. Functions mainly as energy supply, heat production and building stones for other nutrients.
 - viii. The major function of carbohydrate in metabolism is as a fuel to be oxidized and provide energy for other metabolic processes.
 - ix. Carbohydrate is utilized by cells mainly in the form of glucose.

The 3 principal monosaccharides resulting from the digestive processes are glucose, fructose and galactose. Fructose may result from high intake of sucrose while galactose is of major significance when lactose is the principal carbohydrate in the diet (lactation), however, fructose and galactose are readily converted to glucose by the liver.

The intermediary metabolisms of carbohydrate in the mammalian organisms are as follows:

- i. Glycolysis – oxidation of glucose or glycogen to pyruvate and lactate by the Embden – Meyerhof pathway
- ii. Glycogenesis – The synthesis of glycogen from glucose
- iii. Glycogenolysis – the breakdown of glycogen to glucose in liver and to pyruvate and lactate are main products in muscle
- iv. Oxidation of pyruvate to Acetyl – COA – this is a necessary step prior to the entrance of the products of glycolysis into the citric acid cycle, which is the final common pathway for the oxidation of carbohydrate, fat and protein
- v. Gluconeogenesis – formation of glucose or glycogen from non carbohydrate sources mainly in the citric acid cycle and glycolysis. Substrate for gluconeogenesis are glucogenic amino acids, lactate, glycerol and in the ruminant propionate.
- vi. Hexose Monophosphate Shunt (pentose phosphate pathway) – is an alternative pathway to the Embden-Meyerhof pathway for the oxidation of glucose.

CLASSIFICATION

Carbohydrates are the ultimate source of most of our food – we eat starch-containing grain or tubers or feed it to animals to be converted into meat and fat which we then eat.

A carbohydrate that cannot be hydrolysed to simpler compounds is a Monosaccharide.

A carbohydrate that can be hydrolysed to two monosaccharide molecules is a Disaccharide.

A carbohydrate that can be hydrolysed to many monosaccharide molecules is called a Polysaccharide.

Sweet carbohydrates – contained in large quantities in many foods – confectioneries, soft drinks, cakes because of the sweet taste e.g. refined sugar which supplies only energy. Excess consumption cause dental decay especially in children. Others are fructose in fruit, honey, lactose in milk and malt.

Non-sweet carbohydrates – not sweet at all e.g. starch, it is the bulk in our food as in yams, bread, beans and cereals. Contains other valuable nutrients.

The main types of food/feed carbohydrates, their monosaccharide composition and their most common sources are listed below:

Type	Composition	Sources
Polysaccharides		
Starch, dextrins	D-glucose	Cereals, roots, tubers, plantains
Cellulose	D-glucose	Cereals, fruits, vegetables
Glycogen	D-glucose	Liver, animal tissue, sweet corn
Hemicelluloses	L-Arabinose, D-xylose	Cereals, fruits, vegetables
Gums	L-Rhamnose, D-galactose, mannose, glucose, glucuronic	Cereals, legumes, nuts, seaweeds
Pentosan	L-Arabinose, D-xylose	Fruits, vegetables
Oligosaccharides		
Raffinose, Stachyose	D-gal, D-glu,	Legume seeds, cereals
Maltooligosaccharides	D-Glu	Starch syrups, malt
Disaccharides		
Sucrose	D-glu, D-fru	Sugarcane fruits, vegetables

Maltose	D-glu	Starch syrups, malt, honey
Lactose	D-gal, D-glu	Milk, dairy products

3.2.2 PROTEINS

Protein is important in feeding farm animals and human beings, because it is the nutrient found in highest concentration (after water) in organic and muscle tissues.

The young, growing animal has the highest requirements for protein when expressed as a percentage of the diet. In addition, productive functions such as gestation and lactation greatly increase the protein requirement because of the needs of the foetus during gestation and for milk protein production during lactation.

Protein is one of the critical nutrient particularly for young rapidly growing animals and for high producing mature animals such as dairy cows and fish. Optimal use of protein is a must in any practical feeding system, since protein supplements are much more expensive than energy, fibrous and fat feedstuffs and wasteful usage increase the cost of production in almost all instances.

If we are short of fat in our diet, then carbohydrates and proteins can be converted into body fat. If we are short of carbohydrate in the diets, fats and proteins can be converted into energy, but if we are short of protein in the diet, carbohydrates and fats cannot be used to build up our bodies or repair the wear and tear that takes place.

It is therefore essential that an adequate quantity and quality of protein is supplied by our feed/food.

Protein quality is a measure of the ability of protein supplement/feedstuffs to supply needed amino acids in the diet when ingested (plant and animal origins).

For practical purposes, protein quality refers to the amount and ratio of essential amino acids in a protein source. The amino acids contained may either be essential amino acids, which are those amino acids that are required for the functioning of the body but cannot be synthesized in the body, hence, they have to be supplied in the diet (indispensable).

The non-essential amino acids are those amino acids that are necessary for the functioning of the body but can be synthesized within the body (dispensable). Therefore, a good quality protein is that which contains a high proportion of the essential amino acids.

The term biological value is used to express protein quality and it is dependent on the relative quantities of the essential amino acids present. For all practical purposes, egg has a biological value of 100 and considered a standard good quality protein, however, cereals like maize/corn have low biological value of 40 as it lacks the amino acid lysine.

A total of 23 primary amino acids are required by the body. Ten (10) amino acids essentials are Histidine, Arginine, Lysine, Leucine, Phenylalanine, Valine, Tryptophan, Threonine, Isoleucine, Methionine. The 12 non-essential amino acids are – Glu, Gln, Asp, Asn, Pro, Hyp, Cystine, Cysteine, Tyr, Ely, Ala, Ser.

Proteins are complex polymer of amino acids, found in all cells, involved in most of the vital chemical reactions of plant and animals metabolism. It is the specific sequence of amino acids and the manner in which the amino acids strands are connected to each other than determines the physical and chemical properties of each individual protein and its biological functions.

For ruminant animals, the need for a nitrogen source which can be partially degraded in the rumen to ammonia and most likely for some of the essential amino acids such as methionine or for some peptides. However, high producing ruminant animals also bypass some ingested proteins into the intestine without it being broken down in the rumen. Hence, it is probable that protein quality is more important under these circumstances than for animal producing at low levels and consuming much less feed.

TYPES OF PROTEIN BASED ON ORIGIN

There are two main types of proteins –

- i. Proteins from animal origin
- ii. Proteins from plant origin

(1) Proteins from animal origin

These are proteins of animal origin characterized by a better quality protein than vegetable proteins. They have high biological value meaning high profile of essential amino acids. They are called “complete” protein. They are costly (high price), not affected by seasonal variations, available all year round. Lack of or limited

Anti-nutritional factors. Require little or no processing before incorporation in human or animal feed/food. Included in small quantities in animal feeds. Chemical composition is relatively standardized. Crude protein greater than 65% CP. Examples include fish meal,

meat meal, blood meal, egg, milk or dairy products, feather meal, chicken offal meal, maggot meal, termite meal, grasshopper meal, frog/toad meal.

(2) Plant Proteins (PP)

These are proteins of plant origin, often termed “incomplete” proteins. Characterized by low biological value (BV) compared to animal proteins meaning lower profile of essential amino acids. PP is included in higher percentages in animal feed, percentage constituent crude protein of PP is between 20-45% CP. Its use is affected by seasonal availability. Not available all year round. It contains antinutritional factors especially in the raw state, proximate composition or chemical composition is not standardized i.e. variable. However the price of PP compared to animal proteins is very low. PP requires a lot of processing before incorporation in animal feed. Deficient in one or more essential amino acids and the quality is lower compared to animal proteins.

Examples include – soybean meal, groundnut cake, cottonseed cake, sunflower cake, palm kernel cake, rapeseed meal, jack bean, pigeon pea meal, castor seed meal.

FUNCTIONS OF PROTEINS

Proteins are highly complex nitrogenous organic compounds occurring naturally in all living matter and forming an essential part of animal feed requirements.

They are very important for many cellular functions as follows:

- Proteins are the chief structural units of protoplasm
- Proteins in diets serve as primary source of amino acids the building block of cellular proteins
- The biological catalysts known as enzymes are proteins
- Some of the hormones, the regulators of chemical reactions are proteins or peptides
- Antibodies are complex proteins
- Protein play an important role in the transport of water, inorganic ions, organic compounds and oxygen
- They can contribute through functional properties of proteins, in foods by contributing to colour, flavor, odour, foam formation e.g. maillard and browning reactions.

3.2.3 FATS

Fats are essential components of all cells. The distinction between an oil and a fat is simply that at a normal temperature oils are liquid and fats are solid. A molecule of fat consists of glycerol, a trihydroxylic alcohol, esterified with three open chain fatty acids.

1 Glycerol + 3 fatty acids ----- fat + 3 H₂O

Fats supply essential fatty acids needed for adequate nutrition and normal health. They are mainly included as energy sources as they furnish 9.3 calories per gram compared to 4.1 calories per gram from carbohydrate. Fats are found in foods of animal and vegetable origin, we have “visible” fat such as butter, palm oil, groundnut oil and fat in pork, but fat can also be “invisible” like the fat contained in egg yolk, fish, oil seeds.

Functions

- a. Supply energy, a concentrated energy source
- b. Fats act as carriers for vitamins A, D, K
- c. Fats are important for maintenance of the skin and coat
- d. Steroids hormones and cholesterol are also fats
- e. Insulation of organs and storage of fat soluble vitamins
- f. Improves palatability
- g. Reduce dustiness of feed especially cassava and sweet potato based diets
- h. Protection and insulation

The common dietary fat is the triglyceride composed of both saturated, monosaturated and polyunsaturated fatty acids. Levels of up to 20% are acceptable in the diets, however, large levels may reduce feed intake and other essential nutrients thereby resulting in reduced growth.

There are four (4) essential fatty acids dietarily – Oleic, Linolenic, Linoleic and Arachidonic. Deficiency of these fatty acids leads to defective growth, dry hair, scaly skin and susceptibility to infections. These essential fatty acids are found in soyabean oil and groundnut oil. Another problem with fat inclusion is the problem of RANCIDITY.

Lipids are classified into:

- (a) Simple (Neutral) lipids
- (1) Fats and oils (2) Waxes

(b) Compound lipids

(1) Phospholipids (phosphatides) e.g. Lecithins, Cephalins, Sphingomyelins

(2) Glycolipids e.g. cerebrosides, sialic acid, gangliosine

(c) Derived lipids

(1) Sterols (2) Bile acids

Food may contain any or all of these substances, but those of greatest concern are the fats or glycerides and phospholipids.

3.2.4 VITAMINS

Vitamins are a group of complex organic compounds which are generally required in the diet in rather small amounts for normal growth and maintenance of health. In contrast to other nutrients, vitamins are not used for structural or energy requirements or as raw materials for synthesizing other compounds.

In the tropics, the lush vegetation is full of fruits, leafy vegetables, insects and meat animal that provides source of all vitamins. A varied balanced diet will supply all the necessary vitamins however, in complete absence of a vitamin, clinical conditions known as deficiency diseases develop with fatal consequences. Animals obtain vitamins through feed they consume, additional supplements of salt lick, microbial synthesis or through maternal transfer .

Vitamins are of two types – FAT SOLUBLE and WATER SOLUBLE, as shown below:

Names	Function(s)	Deficiency Symptom(s)	Source(s)
Vitamin A (Retinol)	Normal vision Epithelium formation	Night blindness Keratinisation Retard growth	Provitamins in green leafy vegetables Milk, fat, liver, carrot
Vitamin D (Cholicalciferol)	Absorption of minerals Ca, P and phosphatase levels Bone formation Efficiency of feed utilization Reproduction	Rickets Irregular teeth	Dry forage Fish oils

Vitamin E (Tocopherol)	Normal reproduction and lactation Antioxidant	Low fertility	Egg yolk, germ oils, oils from oilseeds
Vitamin K (Phylloquine)	Formation of prothrombin	Failure of blood to clot	Green leafy material, liver Eggs, fish me

Names	Function(s)	Deficiency Symptom(s)	Source(s)
Thiamine (B1)	Carbohydrate metabolism	Beriberi Anorexia, paralysis, convulsions, impaired gastric secretions	Yeast, cereals Plant proteins
Riboflavin (B2)	Electron transport system;Energy metabolism	Watery eyes “blood shot” Fatty liver;Low hatchability egg	Yeast, green leaves Milk products
Niacin	Electron transport chain	“Black tongue” Pellagra Nervous symptoms	Yeast, distillers soluble, rice Wheat bran
Pyridoxine (B6)	Amino acid metabolism	Improper heart function Microcytic anaemia Convulsion	Yeast, cereals Animal tissue
Panthenic acid	Carbohydrate Lipid metabolism	Intestinal disturbances Convulsions	Yeast, liver

Cobalamine (B12)	Amino acid synthesis Protein and nucleic acid synthesis	General weakness	Animal tissue
Folic acid	Transfer of single carbon units Synthesis of choline & N2-bases	Anaemia	Groundnuts Liver, leafy vegetables
Biotin	Fatty acid synthesis Carbohydrate metabolism	General weakness	Yeast, distillers soluble, liver
Choline	Formation of acetyl-choline	Fatty livers	Plant protein, wheat Animal tissue
Vitamin C	Formation of tissues Wound healing	Bleeding and swollen gums Scurvy	Fruits and vegetables Liver Green peas

3.2.5 MINERALS

The total mineral content of plants or animals is called ash. These are inorganic elements useful to the body in many ways. Like proteins, we cannot make minerals in our body; hence, minerals must be supplied by our feed/food as they are widely distributed in the average diets. They yield no energy but have important roles to play in many activities in the body.

They can be classified as major minerals required in large quantities in the diet these include – Ca, P, Na, Cl and those required in minute quantities called trace/micro minerals e.g. Fe, Cu, Co, K, Mg, I, Zn, Mg, Mo, F, Se and S as shown below

Names	Function(s)	Deficiency Symptom(s)	Source(s)
Calcium	Ossification of bones and teeth; Muscle tone Coagulation of blood Selective cell permeability	Rickets Osteomalacia Enlarged parathyroid	Bones; Milk; Animal products

Phosphorus	Ossification of bones and teeth; Fat and CHO metabolism; Fat and CHO metabolism	Rickets Osteomalacia Retarded growth	Animal products Plant material
Sodium	Osmotic regulation and water balance; Nerve and muscle action	Muscular cramps General weakness Vascular collapse	Common salt Animal products
Chlorine	Maintains osmotic concentrations Transport of CO ₂ Solubility of proteins Activates salivary amylases	Alkalosis Hyperexcitability	Animal products Common salts
Potassium	Osmotic regulation Enzyme reactions Electrolyte and H ₂ O balance; Nerve and muscle action	Slow growth Muscular weakness Herpetrophy of the adrenals	Most ingredients
Magnesium	Ossification of bone and teeth; Enzyme activator Decrease tissue irritability	Nervousness Twitching	Oilseed meals Cereals Bones
Sulphur	Component of some amino acids and vitamin Component of cartilage	Reduced moth, cyt, thiamine synthesis	Most ingredients
Iodine	Thyroxine synthesis	Goitre Stillborn births Cretinisms	Sea food Iodized salts
Iron	Component of Hb and Myoglobin Component of cytochrome and Xanthine oxidase	Anaemia Reduced growth Difficult breathing	Meat; Green vegetables

Copper	Increase iron absorption Formation of erythrocytes Component of enzymes	Anaemia De-pigmentation Impaired bone formation Impaired reproduction	Plant materials
Cobalt	Synthesis of Vit. B12 Activator of peptidases	Emaciation Macrocytic anaemia	Plant materials
Manganese	Bone formation Functioning of reproductive system	Defective ovulation Testicular degeneration	Grains and roughage
Zinc	Co-factor of enzymes Bone and feathers RNA synthesis	Lesions on epithelium Atrophy of male reproductive organs	Animal products
Selenium	Component of enzyme Glutathione peroxidase	Degeneration of pancreas Muscular dystrophy	Feed ingredients
Fluorine	Prevent dental caries	Enamel density reduction	Drinking water

4.0 Conclusion

Nutrients are compounds in foods essential to life and health, providing us with energy, the building blocks for repair and growth and substances necessary to regulate chemical processes. There are six major nutrients: Carbohydrates (CHO), Lipids (fats), Proteins, Vitamins, Minerals, Water.

5.0 Summary

There are two main types of nutrients, macronutrients and micronutrients. The three main categories of macronutrients include carbohydrate, protein, and fat. The two types of micronutrients are vitamins and minerals, and these are extra molecules that cells need to make energy. Nutrients are the substances found in food which drive biological activity,

and are essential for the human body. They are categorized as proteins, fats, carbohydrates (sugars, dietary fiber), vitamins, and minerals, and perform the following vital functions.

6.0 Tutor Marked Assignment

1. State explicitly the function, deficiency symptoms and sources of calcium, phosphorus, sodium, chlorine, potassium, magnesium, sulphur, iodine, iron, copper, cobalt and manganese.
2. State explicitly the function, deficiency symptoms and sources of five (5) fat soluble and water soluble fat.
3. Write short notes on functions of Carbohydrates, Proteins and Fats
4. In a tabular form, state the main types of food/feed carbohydrates, their monosaccharide composition and their most common sources.

7.0 References / Further Readings

<http://gohardanehco.com/wp-content/uploads/2014/02/Animal-Nutrition.pdf>

Van Soest P J 1994 *Nutritional Ecology of the Ruminant*, 2nd edn, Ithaca, NY, Comstock.

Garton G A 1969 Lipid metabolism of farm animals. In: Cuthbertson D P (ed.) *Nutrition of Animals of Agricultural Importance*, Oxford, Pergamon Press.

Harwood J L 1997 Plant lipid metabolism. In: Dey P M and Harborne J (eds) *Plant Biochemistry*, London, Academic Press.

Palmquist D L 1988 The feeding value of fats. In: Ørskov E R (ed.) *World Animal Science*, Amsterdam, Elsevier.

Devlin T M (ed.) 2002 *Textbook of Biochemistry with Clinical Correlations*, 5th edn, New York, Wiley-Liss.

Unit 3 Feeds and Feeding

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1.0 Introduction

Feed, also called animal feed, food grown or developed for livestock and poultry. Modern feeds are produced by carefully selecting and blending ingredients to provide highly nutritional diets that both maintain the health of the animals and increase the quality of such end products as meat, milk, or eggs. Both feed and fed share a common definition, but they indicate different tenses. Therefore, they are not interchangeable. Feed is the base form of the verb, and relates to giving someone or something food. Fed is the past form of feed, and can also be short for federal reserve or federal official. Overall, the proper balance of protein, energy, vitamins and all nutritionally important minerals in diets is needed to make a successful nutrition program that is both productive and economical.

2.0 Objectives

At the end of this unit you will be able enumerate animal protein sources and their limitations, define Fat in livestock feeds and list 6 general groups of fats, classify foods and feeding stuffs and highlight energy sources of livestock feeds.

3.0 Main Content

3.1 The Concept of Feeds

Feed is a material, which after ingestion by the animal is capable of being digested, absorbed and utilized to satisfy metabolic needs i.e. being transformed into body elements of the animal. The compounds of a feed that are capable of being transformed into body elements are known as nutrients.

The metabolic needs include:

- i. Maintenance – supply of energy for physiological processes whether new tissue or products are formed.
- ii. Growth – this is a building process of the body. Growth may be defined as correlated increase in mass of body indefinite intervals of time in a way characteristics of the animal specie. There are two types of growth – Hyperplasia which is the increase in number of cells. Hypertrophy – which refers to increase in size of cells.
- iii. Growth of hair and feathers
- iv. For work – muscle action. Energy is needed for work
- v. For reproduction – including egg production in poultry
- vi. For fattening – specialized production activities
- vii. Milk production – Lactation in milk producing animals, man, pigs, rabbits and pigeons
- viii. For synthesis of specialized products – synthesis of enzymes, hormones, haemoglobins
- ix. Catalysis – in stimulating and regulating body activities e.g. vitamins, hormones and enzymes
- x. Sleeping, breathing are important activities requiring good nutrition.

All feeds may be divided into two classes namely: roughages and concentrates. Roughages are feeds, which are high in fiber and low in total digestible nutrients and include such common feeds as alfalfa, grass hay, corn fodder, sorghum fodder, silage, straw, etc. Concentrates are feeds which are high in total digestible nutrients, and low in fiber. They include such feeds as barley and the other grains, cottonseed meal, soybean meal, wheat bran, etc. Roughages are further divided into

carbohydrate roughages and protein roughages. Carbohydrate roughages include wild hay, timothy hay, corn fodder, silage, sorghum fodder, etc. Protein roughages include alfalfa hay, clover hay, soybean hay, etc.

The concentrates are divided in the same way. Protein concentrates include soybeans, soybean meal, cottonseed meal, wheat bran, flax seed, linseed meal, shorts, middlings, tankage, meat meal, fish meal and dry beans. Carbohydrates include corn, wheat, oats, barley, dried beet pulp.

3.1.1 Carbohydrate, Fats and Proteins

Most people categories cats carbohydrates and proteins are the essential nutrients in a ration. This is only partly true since minerals, vitamins, water and air are just as essential. fats and carbohydrates are the energy foods and in the process of digestion are broken down into simple forms which can be utilized by the animal's body in producing milk, work, fat, etc. The carbohydrates include the sugars, starches and similar materials in the plant. The fat is the natural fat in the plants and is utilized the same as the carbohydrates.

Protein can also be used as a source of energy but primarily it is used for growth and repair of the body. Because it is necessary for growth, young animals require more protein in comparison to their body weight than older animals do. Proteins from different sources vary greatly in value to the animal. Proteins are composed of amino acids. There are 22 of these acids, but a particular protein may not contain all of them. The numbers which are present in a protein and the proportion in which they are present gives the protein its individuality. Because proteins differ in the number and proportion of amino acids, they are not all of the same quality or value to the animal. In many of the proteins the amino acids are not in the proportion in which they are needed by the animal body. for this reason, better results may be obtained when an animal receives its proteins from two or more sources. This happens any time an animal receives more than one feed.

An animal being fattened on corn, barley, dried beet pulp and alfalfa hay would be receiving its protein from four sources. These proteins all dovetail together and give better results than if they came from only one source. This is especially true if the

protein source is from the grains and dried beet pulp since these proteins are of very poor quality. The carbohydrates can be stored in the body in the form of fat for future use. This is not true of the proteins. There is no storage of protein in the body. This makes it necessary to provide the animals with the amount of protein needed each day. If more is given than is needed, waste results.

3.1.2 Minerals and Vitamins

Minerals: Farm animals are more likely to suffer from a lack of phosphorus or calcium than from any of the other minerals except common salt. Pregnant animals, in certain sections, may also suffer from a lack of iodine. Money spent for minerals other than these is generally wasted. Common salt which is sodium chloride should be kept before all animals at all times. Salt must be in a form that it can be utilized by them. Much of the rock salt which is on the market is so hard that it is difficult for animals to get a sufficient amount of it. Loose salt is likely the best form in which to feed it.

A lack of phosphorus is shown by the tendency of animals to chew bones, sticks or by the licking of dirt. The animal seems to have a depraved appetite and will try to chew most anything. This craving can be satisfied by supplying some feed high in phosphorus. Bonemeal with 30 percent salt is a good source of phosphorus. Also, rock phosphate which has been deflorinated is satisfactory. Both of these products are cheap. Calcium will be lacking where the roughage is largely of a carbohydrate nature such as wild hay, sorghum or corn fodder or stover. This can be most easily supplied by ground lime-stone. Unslacked lime and water-slaeked lime should not be used because of their caustic nature.

Iodine may be necessary for pregnant animals in certain sections where the soil is deficient in this mineral. Iodine deficiency is evidenced by pigs being born hairless or by calves being born with an enlarged thyroid gland or goiter. A sow needs about 2 grains of potassium iodine per week, a cow about 5 grains, a ewe .35 grain, and a mare 15 grains per week. Iodine needs to be fed only during the latter half of the pregnancy period and only on farms where evidence of an iodine deficiency has occurred. There is no object in giving iodine to any but

pregnant animals. The stockman should view with suspicion those brands of mineral mixtures for which extravagant claims are made.

Vitamins: Vitamin A—Vitamins are absolutely necessary for all animal life. No doubt farm animals suffer more from a lack of vitamin A than they do from a lack of any of the other vitamins. Many hogs suffer from a lack of vitamin D when they are confined in dark quarters and do not have access to sunshine. All of the grains, except yellow corn, are a very poor source of vitamin A. Yellow corn is a fair-to-good source of vitamin A

Vitamin D—A lack of vitamin D produces bones which are soft, legs which are bent and crooked, and retarded growth. Vitamin D is stored in the liver. It is possible to accumulate a reserve that will fulfill all requirements for several weeks or months, even if all sources of vitamin D are cut off. Vitamin D is called the sunshine vitamin since animals exposed to sunshine usually need no further source of the vitamin. Sun-cured roughages are a good source of this vitamin.

There are a number of other important vitamins, but they are probably of little practical importance to the average live-stock raiser or feeder. Experience shows that good feeding practices furnish adequate amounts of all the recognized vitamins that are required by the larger animals. For various reasons, however, there are times when the feed supply is limited and it is difficult to follow approved practices. The vitamin most likely to be deficient in the feed, under those circumstances, is vitamin A and is the only one likely to be deficient in the rations of cattle, hogs, sheep, and horses. A liberal supply of fresh forage is the most practical method of preventing this type of deficiency.

3.2 Nutrient Requirements

Nutrient requirements deal with the adequacy of the feed to the needs of the farm animals. Adequate nutrition seems to be the most important environmental factor that influences the ability of the animal to attain their genetic potential for growth, reproduction, longevity and respond to stimuli.

There are at least 40 specific nutrients (chemical elements) that need to be present in the diet to support life, growth and optimum reproduction. These consist of 13 important

amino acids, 13 vitamins, 13 essential minerals and 1 fatty acid known as linoleic acid.

- i. Amino acids – Arg, Cystine, Gly, Hist, Ile, Lys, Met, Phe, Thr, Tryp, Tyr, Val
- ii. Minerals – Ca, P, Mg, Na, K, Cl, Mn, Zn, I, Cu, Fe, Co, Se
- iii. Vitamins – A, D, E, K, Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridocine, Biotin, Choline, Folic acid, B₁₂
- iv. Fatty acid – Linoleic acid

The essence of nutrition is to define the nutrients required by the animal to perform at a certain level, identify a suitable source of those nutrients and match these two in a diet formulation to obtain a balanced diet.

The requirement for any nutrient may be defined as the amount of that nutrient which must be supplied in the diet to meet the needs of the normal healthy animal given an otherwise completely adequate diet in an environment compatible with good health.

Summarily, nutrient requirement is the amount of a given nutrient required by the animal to maximize performance e.g. a specified rate of growth or a stated level of production.

The nutrient requirements of farm animals are documented and published by National Research Council (NRC), USA, Agricultural Research Council (ARC), UK, Nutrient Requirements Table, Aduku (1993), Nutrient Requirements of Poultry by Fetuga (1984); Nutrient Requirements Table by Olomu (1995).

3.2.1 Factors Affecting Nutrient Requirements

Certain factors affect the levels of nutrients required for optimum performance of farm animals. These includes –

- 1) Texture of feed – feed particle size affects nutrient requirement. Coarse feed may not be consumed sufficiently by very young animals. Pelleting of a bulky diet will increase the nutrient density per unit volume thus increasing nutrient consumption.
- 2) Energy content of the diet – the largest single dietary need of animals is for energy. Energy is required for all processes of life. This energy is bound in molecules of carbohydrate, fat, protein and alcohol. Birds tend to satisfy their energy requirements first hence the energy content of the diet tends to influence the intake of other essential nutrients. Efficient utilization of proteins is dependent on the amount of energy available, hence, the concept Protein: Energy ratio in farm

animal nutrition.

- 3) Environmental condition – Temperature, climatic conditions have marked effect on energy requirement and hence on feed intake and other nutrients. Animals tend to eat less in warm/hot than in cold environments – rainy/harmattan. Temperature also influences the requirement for (vitamins).
- 4) Age – nutrient requirements change with age of the animals. Age relates to growth and increased metabolic activities.
- 5) Sex – boars, bucks (male farm animals) require more energy and nutrients than, sows, does (female animals).
- 6) Physiological/Productive state – rate of growth, egg production, amount of milk produced, pregnancy lactation can affect the nutrient requirements of farm animals. Mature cockerel will have low requirement for amino acids (nutrients) than the laying hen producing eggs
- 7) Physical activity – active farm animal require more energy and nutrients than inactive/less active animal e.g. Athletes and non- athletes.
- 8) Size of the animal and breed – large animals and people need more feed and hence nutrients than smaller animals. Breed effect is important e.g. light breed and heavy breed, fish (genetical) vs. rabbit.
- 9) Effect of health status – this can affect the requirement for nutrients. Diseased condition or ill-health, absence or presence of internal parasites. Animals recovering from illness need more energy and nutrients than healthy animals e.g. diarrhea and H₂O.
- 10) Balance between nutrients – the balance between amino acids, dietary protein levels versus individual amino acids, this may affect the metabolic utilization of individual nutrients and hence their requirements.
- 11) System of management – in poultry and pigs, floor or cage rearing, intensive or extensive management system can affect requirements for specific nutrients.
- 12) Presence of antinutritional factors – availability of nutrients from various feedstuffs may be affected by certain substance (anti-metabolites) e.g. phytase, oxalate may render ions of Zn, Mn and Ca completely unavailable to the animal.
- 13) Destruction or loss of nutrients in feed/feedstuffs – improper processing e.g.

overheating of a feedstuff may result in denaturation of protein or the browning reaction of Maillard's reaction.

- 14) Stress – stresses occur in every day life and these may affect nutrient requirements e.g. hot weather and vitamin C supplementation in feed or water.
- 15) Competition for absorption due to nutrient imbalances and competition for active transport of nutrients. Metabolites may react with the epsilon amino groups of lysine thereby decreasing protein value of diet.

3.2.2 Nutrient/Chemical Composition Of Feedstuffs

This refers to the chemical constituents of feedstuffs. It depicts the amount of nutrients present in a feed ingredients/feedstuffs which confers specificity on the feed ingredients.

This composition indicates is a pointer on the usefulness and for what purpose the feedstuff can be incorporated or used in the nutrition/feeding of farm animals. Most importantly, nutrient composition assists in the classification of the different feedstuffs.

The nutrient/chemical composition of feedstuff is affected by

1. Processing method
2. Season/climatic conditions
3. Age/growth stage in forages
4. Presence of antinutritional factors
5. Storage

The **Balanced Ration**: A balanced ration is a ration which furnishes to the animal the several nutrients—protein, carbohydrates and fats—in such proportion as will properly nourish the animal for 24 hours. A balanced ration does not mean anything unless the characteristics and composition of the feeds to be used and the requirements of the animals to be fed are understood by the feeder. Theoretically, a balanced ration can be made of feathers and saw- dust, but both substances are entirely indigestible to animals.

3.3 Feeds and Feeding of Different Classes of Livestock

The term 'food' is usually used in relation to human diets while the term 'feed' is used in relation to farm animals. However, foods and foodstuffs are sometimes used for both farm animals and human beings to describe foods or and feed ingredients are the sources of nutrients in the diet.

The expression 'concentrate feeds' is used to describe those foodstuffs that contain less

than 15% water.

Succulent foods are those that contain 70% or more of water. Succulent foods can be classified into 2 broad groups

(a) Roots and Tubers

(b) Green fodders

Classification of foods and Feeding stuffs

Foods and feeding stuffs can be broadly categorized into 5 as follows:

1. Energy sources
2. Protein sources
3. Mineral Supplements
4. Vitamin supplements
5. Feed additives or non - nutritive additives

3.3.1 Energy Sources

This consists those foods, grains and feed ingredients that contain less than 20% of protein in dry state. Examples are cereals and some of their by-products, starchy roots, fats and oils, sugars and syrups.

Starchy Roots and Tuber

Starchy roots (i.e. tubers and roots crops) most widely cultivated in tropical and sub-tropical part of the world are cassava, yams, cocoyam's and sweet potatoes in that order roots are also eaten in small quantities in some tropical countries. In temperate countries, the most widely cultivated root crop is irish potato. irish potato are also grown in some tropical areas.

Starchy roots contain large quantities of starch and so are high in energy per hectare than most cereal. They are however, generally low in protein (1 – 4%) minerals and vitamins. Starchy roots forms the major part of the diet of man in many party of the world. They are sometimes used in feeding of farm animals e.g. cassava and its products like gari, cassava flour or fermented cassava meal may be used to replace a large pro-portion or all of the grains in poultry and pig diets. In using cassava, care must be taken to balance the diets for protein and amino acids, especially methionine.

Starch and root crops are relatively easy to grow with high yield even on poor soils. They contain large quantities of starch and so are good energy source. They produce more

energy per hectare than most cereals but are generally low in protein (1- 4%), minerals and vitamins. Starchy roots form the major part of the diets of man in many parts of the world. They are sometimes used in the feeding of farm animals.

Cassava

It is a very popular tropical plants use in feeding man and all classes of livestock. There are two main types. These are the varieties like types *manihot utilisima* or *manihot esculentus* and the sweet types *manihot palmate*.

It is easy to propagate from stem cutting and is one of the most productive root crops in the tropical areas. Its yield is between 10 and 20 tons per hectare. It is available all the year round. Cassava contains between 50 and 70 % water. It is low in protein (1 – 3 %), oil, ash and crude fibre (up to 5% CP can be obtained from some of the new variety). The protein content of cassava tuber is deficient in lysine, methionine, tryptophan, tyrosine and phenylalanine but high in arginine. It is low in minerals and most vitamins but it is high in energy content.

The peels of cassava are richer in protein, oil and ash than the peeled portion. On a dry basis, cassava leaves have protein content that range between 14 and 69% DM. It is fair in lysine content marginal in tryptophan and isoleucine but deficient in methionine.

Cassava is able to serve as substitute to maize in livestock feeds at levels between 5 and 50 %, well processed cassava leaves and peels are widely fed to cattle, sheep and goats.

Limitations

Both the bitter and sweet varieties contain cyanide. The content of cyanide in fresh tuber of bitter varieties contain less than 100mg/kg. The peels contain 3 – 10 times more cyanide than edible portion. Levels of cyanide less than 50mg/kg are considered harmless, 50 – 80mg/kg slightly poisonous, 80 – 100mg/kg toxic and above 100mg/kg fatal.

Symptoms of eating raw or improperly processed cassava in man include feeding of sickness nausea a, vomit by abdominal distention respiratory difficulty and collapse. Over a long period of consumption, raw cassava may caused goitre, deformed and mental defective cretinism, ataxia, neuropathy with mental retardation. Detoxification of cyanide is required.

Cyanide is detoxified into thiocyanide and thus involves the use of sulphur. Some of these sulphur are obtained from sulphur containing amino acid. Cyanide also interfere with thyroid gland and therefore interfere with iodine metabolism.

However, much of the cyanide is removed during processing of cassava. The processing method include cooking, frying, boiling, washing, grating, soaking, fermentation and sun drying and long period of storage. Properly processed cassava products are virtually free of HCN. High levels of cassava in feed make the feed to become dusty, hence molasses and oil may be added to reduce the level of dustiness.

The leaves and peels of cassava are widely fed to cattle, sheep and goats, although with fatal consequences sometimes.

Yam

It is mainly cultivated for human consumption. There are different species of yam. The most popular ones are:

1. Water yam
2. Aerial yam
3. Yellow yam
4. Tritollate yam
5. Chinese yam
6. White yam

Dioscorea alata *Dioscorea bulbifera* *Dioscorea cayeneusis* *Dioscorea dumetorium*
Dioscorea esculenta *Dioscorea rotundata*

Yam is high in water content, high in soluble carbohydrate, low in cp (1-4%), low in fibre and fair in ash. The protein content is low in lysine, methionine, tryptophan but contain fair amount of valin, arginine and isoleucine. It also contains fair amount of B. Complex and minerals. Yam peels are valuable as livestock feed especially in ruminant animals.

Limitation

The major set back in the use of yam as livestock feed is the content of its major antinutritional factor (alkaloid) which can reduce the level of intake with time. It also have an itching effect on the palate. Some varieties contain tannin up to 0.4% and

saponin. Most of these antinutritional factors are destroyed during cooking and drying.

Coco Yam

Cocoyam can be fed to livestock. However cocoyam should be cooked before being fed to livestock particularly pigs since the acid (Ca – oxalate) or saptoxin contained in the corn is irritating to the digestive tract and may even be poisonous. The pods and leaves of cocoyam are valuable feed for ruminants (cattle sheep and goats).

Cocoyam are edible aroids. There are two major species and they are

1. The yaro cocoyam, *colocasia esculenta* (koko funfun) and
2. The yannia cocoyam, *xanthosoma sagitt, folium* (koko pupa)

Cocoyam produces cormes, a form of underground stem. The big central corm is surrounded by smaller ones called cormels. The cormels are the commonly used as human food. Cocoyams are fair high in water and carbohydrate contents. The starch of coco yam contains predominantly amylase and small amount of amylopectin. It is low in fat (less than 0.5%) and protein content. Proteins of cocoyam have fair amount of the essential amino acids but are low in lysine and hutidine. The peels are richer in oils than the inner content tuber. The leaves have higher nutrient content than the corms.

Limitations

-Cocoyam can be fed to livestock. However, cocoyam should be cooked before fed to livestock especially pig. The peels and leaves of cocoyam are valuable feed for ruminants (cattle goats and sheep)

-Cocoyam contain some toxic factor. Cocoyams are irritating to the body because of the presence of calcium oxalate in them. However, when boiled or roasted, the irritation disappears.

-The corms of cocoyam contain a gastrogenic substance.

Sweet Potato

It is cultivated in both tropical and temperate areas. There are varieties. The varieties are colour yellow or red.

Fresh potatoes contain 70-80% of water. It is low in crude fibre, fat and protein.

However, the protein content have high biological value and it is rich in essential amino acid. On dry basis over 90% of sweet potatoes tuber is made up of carbohydrate. The CHO is highly digestible when cooked but low when raw. Much of the starch in sweet potatoes is converted to maltose during cooking (i.e. heat, enzymatic hydrolysis and starch) and this is responsible for the sweet taste in cooked sweet potatoes.

Potato tuber is rich in carotene (especially yellow varieties), ascorbic acid (especially yellow varieties) and B-vitamin. However, storage and cooking reduce the content of vitamins. It has fair amount of ash and minerals e.g. phosphorus, calcium sodium, chloride and potassium. Its leaves are rich in protein, minerals and vitamins.

Sweet potatoes are good for all classes of live stocks. The leaves and vines of potato are useful feed for ruminants.

Sweet potato has been used in diets of pigs and can be used in poultry diets along with suitable protein supplements. The leaves and vines of potato are useful feed items for cattle. Cooked Irish potato can be used effectively in the diets of pigs.

Other energy supplier feedstuffs include

- i. Confectionary products
- ii. Bakery wastes
- iii. Cull fruits and vegetables
- iv. Snack food waste
- v. Kitchen/cafeteria/canteen waste

Sugars And Syrups

SUGARS: sugars are cheap and easily digested forms of energy.

Sugars are obtained from sugar cane and sugar beet. After extraction, the crude sugar is refined and made into cubes (crystalline sugar).

Raw sugar, obtained from chewing the cane directly, contain small amounts of protein, minerals and vitamins refined sugars are however essentially carbohydrates and lack every other nutrients.

All white sugars i.e. crystalline table sugar cube sugar, icing are practically 100% sucrose and are free of any toxic factors. Brown sugar is less highly refined sucrose and contains traces of other sugars, minerals and colouring matter.

Syrups: Syrups are highly concentrated solutions in which the sugar unable to crystallize out because of the presence of small quantities of other substances. Some syrups, such as molasses and golden syrup are by-products of the manufacture of crystallize cane sugar. There syrups contain some ants of protein (0.3%), Ca (0.03%) and Fe (1.5 mg/100g). They are devoid of any other ingredients.

Molasses: Molasses are mainly by products of the manufacture of sugar from either sugar cane or sugar beets. Their sugar content is about 50-60% and water content is between 22% (beet molasses) and 27% (cane molasses)

Beet molasses is higher in C.P (7-11%) then cane molasses (3-4%). Molasses have a mineral content of 8-10% composed mainly of Na and K salts. The Ca and P content are 0.10 and 0.02% respectively (for beet molasses) and 0.8 and 0.8% (for can molasses). The thiamine and riboflavin contents are each 0.05 mg/100g while the means content is about 1.5 mg/100g. The Fe content is between 0.01 and 0.02%

The use of molasses in poultry diets is limited by its laxative effects when used at high levels. Any level above 5% is laxative. Molasses may be used to prevent dustiness in mixed feeds and in the treatment of poultry blue comb diseases because of its sugar content. Molasses can be used at a rate of 3-5% in the diet of sows to help prevent constipation enhance feed intake. It is also used to ensile forage during silage production for ruminant animals. The difficulties in obtaining the product limit the use of molasses in animal diets.

Molasses is increasingly being used by human beings. It is sometimes used in place of honey.

Honey: Honey is made by bees. Most honeys glucose and fructose known as the invert sugars. Honey also contains some protein (0.4%), minute traces of Ca (0.005%), and small amounts of Fe (0.4 mg/100g) thiamine 0.05 mg/100g, riboflavin 0.05 mg/100g and niacin 0.2 mg/100g. Honey is an attractive, pleasant and sweet food.

Jams: Jams are prepared by boiling fresh fruit, or a pulp preserved with sulphur-di-oxide (sulphite pulp), with sugar. Depending on the antinutritional factors present in the raw materials, pectin may or may not be added. Jam is a general name for all such products.

Marmalade is synonymous to Jam in some parts of the world. In other parts, notably is a

name used specifically for jams made from citrus fruits.

Most jams contain about 65-70% sugar, 0.5% protein. It also has Ca (0.02 – 0.04%), iron (1.2 mg), Vitamin A (2-10 mg/100g) and Vitamin C 10-45 mg/100g. Jams are pleasant, attractive and sweet foods.

Cereals

Cereals are mostly used in the tropical countries are maize, rice and guinea corn and to a less extent millet and wheat.

In temperate or dry climate, wheat, barley, oat and rye may be available for use in the diets of farm animals and human beings. Cereals are high in starches that are readily digested by animals. They are relatively low in protein content. Cereal energy constitute below 45 - 70% of the energy in poultry, swine and rabbit diets. Cereals contain fair amount of Ca, P and Fe, although the absorption of these minerals. Whole cereals contain useful amounts of B vitamins although most of these B vitamins are lost in the milling process to which the grains are subjected in the preparation of various foods from them.

They are however totally devoid of vitamin B₁₂ and ascorbic acid. Vitamin A activity in cereals is low except for yellow maize cereals are also deficient in the amino acid such as lysine and tryptophan.

Maize (*Zea mays*)

It is grown extensively in the country for human food as well as livestock feed. It is used for all classes of livestock.

Essentially maize supply energy which is as high as 14.2 MJ/kg. It is low in protein (8-10%) depend on the variety. Its protein content is low in lysine and tryptophan. The fat content is about 4% and high in linoleic acid an essential fatty acid (about 50%) yellow maize contain Xanthophyll which gives yellow colouration to the shank, skin, egg yolk of birds and carcass of pig fed diet containing yellow maize.

Yellow maize contains carotenoids which have pro vitamin A activity 100 – 800 mg/100g. white maize is low in xanthophylls and lacking in vitamin A activity.

Green leaves, palm oil or synthetic colourant can be added to white maize. Niacin in maize is in bound form and is not easily available. However, treatment with home water

makes the niacin more available. Maize is used up to 60% in livestock feed. It is sometimes difficult to do 100% replacement of maize.

Sorghum (Guinea Corn) *Sorghum guiness*

It is widely grown in several parts of the world. In Nigeria, it is grown in the Northern part. Sorghum can be grown successfully on poorer soils and in drier conditions than maize. Its energy content is comparable to that from maize up to 13.79MJ/kg. Its protein content is slightly higher than that of maize. It contains low levels of xanthophylls, linoleic acid, lysine, methionine, tryptophan and fibre. It is also low in calcium but high in phosphorus. It is used to substitute maize to a reasonable extent in livestock feeding. It is also used in human food in various forms especially in the Northern part of the country.

The use of sorghum in livestock feeding is limited by its content of tannin. Although low tannin sorghum has been bred to improved its utilization in poultry. Tannins are a group of compounds that bind proteins, thus impairing protein digestion. Tannins also reduces palatability.

Guinea corn leaves are used as feed for ruminant animals. However, it must be noted that young sorghum contains cyanogenic. The glycoside occurs in the germinated plant and its contents increases as the plant matures and disappears completely when grain appears glycoside hydrolysis yield hydrocyanic acid (HCN).

Rice (*Oryza sativa*)

Rice is grown locally but principally as human food, though it is useful in livestock feeding. By products obtainable from rice includes rice husk, rice bran, broken rice, rice polishing and rice mill by products.

Rice bran consists of the pericarp or bran layer and germ. The fat and linoleic acid contents of rice bran are relatively high. The protein content is between 12 and 13%.

Rice polishing is obtained in the operation of brushing the grain to polish the rice. The protein content and linoleic content of rice polishing are higher than those of maize. The crude fibre content is low (4.1%). Its energy value is higher than rice bran.

Rice mill by-products consist of rice husk, rice bran, rice polishing and broken rice

grains. Its CF may be higher than 32%. Its CP is low and fat content 5 – 6 %. Its high CF and its low ME values discourage its use in poultry and swine diets.

Cereal grain By-products

Cereals grain by-products are obtained during the processing of grains into food and drinks for human. The by-products are used mostly for feeding livestock. Some are now processed into human foods e.g oat bran breakfast cereals. Examples of cereal by-products include: Wheat Bran, Wheat Shorts, Wheat middling, Wheat mill run, Rice Bran, Rice Polishings, Rice mill by – products, maize Gluten meal, Maize gluten feed, Maize Distillers Dried grains, Hominy feed, Brewer's dried grains, Sorghum distillers grain, Breweries dried yeast, Torula dried yeast

□

Dried Bakery products □

1. **Wheat Bran:** wheat bran consists of the coarse, outer covering of the wheat in the usual process of commercial milling of wheat. Although of low energy value, wheat bran is useful when low calorie diets are required. It is also cheap. The crude fibre level is above 9.5%
2. **Wheat Shorts:** Wheat shorts consist of fine particles of wheat bran, wheat germs. Wheat flour and the offal from the tail of the mill, in the usual process of milling wheat. Because of the endosperm fraction, wheat shorts contain more energy and less crude fibre than wheat bran. It has not more than 7% Crude fibre.
3. **Wheat Middling:** wheat middling are essentially similar to wheat shorts except for the differences in crude fibre content. Wheat middling consist of fine particles of wheat bran, wheat shorts wheat germ, wheat flour and some of the offal from the tail of the mill. Has not more than 9.5% crude fibre
4. **Wheat mill Run:** This consists of coarse wheat bran, fine particles of wheat bran, wheat flour and the offal from the tail of the mill. The chemical content of wheat mill run are similar to those to those of wheat shorts. Not more than 9.5% crude fibre. Wheat mill run and the other wheat by-products are ingredients that can be used but in restricted amount in poultry and swine diets.
5. **Rice bran:** Rice bran is the by-product of the milling of rice to produce edible rice.

Rice bran consists of the pericarp or bran layer and germ of the rice, along with small quantities of hull fragments, and some chipped, broken rice and perhaps CaCO_3 as is unavoidable in the rice milling process but which should usually not exceed 5%. The fat and linoleic acid contents of rice bran are relatively high. The protein content is below 12 – 13%. The oil from rice bran is used largely in human diets. Rice bran is relatively high. The protein content is below 12 – 13%. The oil from rice bran is used largely in human diets. Rice bran can be used successfully to replace some part of the grain portion of some poultry and swine diets. As much as possible, rice bran should be avoided in the diets of younger poultry and pigs.

6. Rice Polishing: this is a by – products of rice obtained in the milling operation of brushing the grain to polish the rice. The protein content and linoleic acid content of rice polishing are higher than those of maize. The product is characterized by relatively low crude fibre content 4.1%. Its energy value is higher than rice bran.
7. There are no special limitations to the use of rice polishing in poultry and swine diets. It is however not as available as rice bran.
8. Rice mill by – product: this consist of rice hulls, rice polishing, and broken rice grains. Rice mill by-product is in actual fact the total offal obtained in the milling of rice. Its crude fibre content should normally not exceed 32%. Its protein content is low, with fat content of 5.6%.
Maize gluten meal: Maize gluten meal is the dried residue from maize after the removal of the larger part of the starch and germ, and the separation of the bran by the process employed in the wet milling manufacture of corn starch or syrup or by enzymatic treatment of the endosperm it may contain fermented corn extractive and/or maize germ meal. The energy amino acid contents of maize gluten meal are much higher than those of maize gluten feed. Like maize the maize by-products are deficient in lysine and tryptophan.
9. Maize Gluten feed: This is that part of the commercial shelled maize that remains after extraction of the larger portion of the starch, gluten and germ by the processes employed in the wet milling manufacture of maize starch or syrup it may or may not contain fermented Maize extractives and or maize. Contain about 21 – 23% crude protein and 9 -10% crude fibre.
Maize Distillers Dried Grains: These are derived

from the fermentation industry particularly the alcohol industry. There are 2 types of maize distillers dried grains, with soluble and maize distiller's dried grains, both containing 27% Crude protein. The crude fibre (12%) is high and energy value relatively. Generally the distillers dried Grains and the distiller dried soluble are by-products obtained after removal of ethyl alcohol by distillation from the yeast fermentation of grains and the distillers dried soluble are by products obtained after removal of ethyl alcohol by distillation from the yeast fermentation of a grain or grain mixture.

10. Homing feed: this is a mixture of maize bran, maize germ and part of the starchy portion of the maize grain as produced in the manufacture. There have at least 5% Crude fat (ether extract). The fat of homing feed is high in lionoleic acid (3.2%) and the energy content is fairly high.
11. Brewers dried grains: this is the dried extracted residue of barley alone or in mixture with other cereal grain or grain products resulting from manufacture of beer and may contain pulverized dried spent hops in an amount not exceeding 3% evenly distributed. Because of its low energy content and high fiber content (over 18%). BDG is more suitable as cattle feed. It is also used extensively in swine production. Other cereal by products includes sorghum distillers grain, brewers dried yeast, torula dried yeast and dried bakery by product.

3.3.2 Fats And Oils

The term fat general, referred to a group of food or feed ingredients including animal fats, vegetable oils and related compounds. Technically, fats refer to those that are

- Solid at room temperature e.g butter, fallow and land while oil is the term used to describe fats that exist as liquid at room temperature e.g. groundnut oil, corn oil etc.
- Fats and oils are concentrated sources of linoleic acid and linolenic acid (two essential fatty acids). Fats and oils may be a source of fat soluble vitamins. Most vegetable oils contain significant amounts of vitamin E. Red palm oil is a rich source of beta carotene and hence a good source of vitamin A. corn oil contain small ants of carotene. Fish liver oils, milk fat (and thus butter and milk) and animal fats generally contain vitamins A, and D. Most vegetable oils do not contain vitamins A and D.

Fat commonly included in livestock feeds (for poultry and pigs) can be divided into 6 general groups

- i. **Animal fats:-** these are rendered fats from beef or pork by- products.
- ii. **Blended feed grains animal fats:** these may include mixtures of beef, tallow, pork lard, poultry grease and possibly restaurant grease
- iii. **Poultry fat or grease:** This is rendered fat from poultry offal.
- iv. **Vegetable oil:** these are oils derived from vegetable materials e.g groundnut, soybean, palm nut etc.
- v. **Blended animal and vegetable fats:** these may include proportions of animal and plant fats
- vi. **Soap stocks:** This is also used in the manufacture of soap: these contain products not wanted in oil meant for human consumption including free fatty acids.

The use fats and oils in poultry and pig diets would depend on their price and availability relative to other energy source. Fats should be used in diets where higher energy levels are required such as those for broiler chickens and turkey poultry, weaning pigs, fast growing market hogs and lactating sows. It is not economical to add any fat at levels above 5% in poultry and swine diets. It is however possible to use levels between 5-8% if prices are favourable. Animal tallow and restaurant greases are the most used animal fat. All fat supplements used in animal diet should contain an anti oxidant to prevent rancidity. Contain raw oil seeds such as groundnut and soybean may deteriorate under certain circumstances. It is wise to use artificial antioxidants to preserve butylated hydroxyl toluence (BHT), butylated hydroxyl anisole (BHA), ethoxyquin, propyl galate and octylgallate.

3.3.3 Animal Protein Source

It is made from dried ground, whole fish, or fish cuts, offals with or without oil extraction. There are various brands of fish meal but the commonest are those with high oil including herring, menhaden, salmon and low white fish.

Fish Meal

It is a very common animal protein feed ingredient in use. It is a by- product of fish industry. It is usually made from whole fish. However, fish offals of high quality could

also be used. Local fish meal is lower in its protein content than the imported fish meal. Crude protein content of fish meal may vary from 55 and 77% depending on the fish type use and extent of oil extraction. Calcium (3-6%) and phosphorus (1.5 – 3%) contents and micro mineral are in high content are high (i.e 3-6% and 1.5 – 3%) respectively.

Fish meal is low in fat soluble vitamin because they are extracted along with the oil. It is however, high in vitamin B complex vitamins especially vitamin B₁₂. Its biological value is very high and usually varies from 60-80%. It is a good source of sulphur amino acid i.e methionine is about 1.8%. Its lysine content is about 4.5%. Fish meal must be properly stored because of its residual oil causing rancidity.

Limitation of fishmeal

1. It is usually used at a level between 0 – 5% for economic reasons.
2. High levels of inclusion may make animal go off feed.
3. Fish meal flavor may also be imparted to the carcass at higher level of inclusion.
4. Fish meal must be properly stored because of its residual oil.

Blood Meal

It is a slaughter's house by products. It is prepared from fresh and clean animal blood free of all extraneous materials such as stomach content, hair and urine. The water in the blood is usually removed by parboiling. It is parboiled or mechanically dewatered the resulted semi solid blood mass is rapidly dried and ground to obtain meal.

It is high in protein (80-88%). It is an excellent source of lysine if properly prepared. It is also rich in leucine but is low in isoleucine, ash calcium and phosphorous. It can partly replace fish meal in starter diets for broiler chicks and turkey but can replace all the fish meal in broiler finisher.

Limitation

1. Badly processed blood meal may expose animal to the attack of salmonella organisms create problems of flies.
2. Its amino acid content is not well balanced. It is low in sulphur containing amino acids. Its biological value is low (i.e about 19%).
3. It is not usually utilize beyond 5% level. Higher levels make animal go off feed.
4. Over heating reduces lysine availability of protein is less digestible.

Meat and Bone Meal

It is the rendered product from animal (especially mammal) tissues including bone. It excludes blood hair, hoof horn, hide trimmings, manure, stomach and rumen content.

It contains about 50% CP and it is high in fat and ash. The protein quality is variable depending on the quality of meat and amount of extraneous material. It is a good source of lysine, calcium and phosphorous but it is deficient in methionine, cystine and tryptophan.

Limitations

- Excessive processing temperature may reduce lysine availability.
- Too high levels of inclusion may result in undesirably high levels of calcium and phosphorous.

Meat and Bone Meal Tankage

It is similar to meat and bone meal except that it may contain blood or blood meal.

Meat Meal (Meat Scrap)

It is the rendered products from animal (especially mammal) tissue. It excludes bone, blood, hair, hoof, horn, hide trimmings, manure stomach and rumen content. It is similar to meat and bone meal except that it is low by calcium and phosphorous unit than 4.4%, it is classified as meat and bone meal.

It is used at about 7-10 % dietary inclusion level. Meat meal is virtually non existent in Nigerian as virtually all parts of the animals are consumed

Meat Meal Tankage

It is similar to meat meal except that it contains blood or blood meal.

Poultry By-Product Meal

It consists of the ground, dried, rendered parts of the carcass of slaughtered poultry such as heads, feet offals, undeveloped eggs and intestine. Feathers are not included.

It is an excellent source of protein (i.e 55% CP). It is rich in lysine tryptophan, calcium and phosphorous. The level of inclusion is as discussed for meat and bone meal.

Feather And Hair Meals

Feathers and hairs are not digestible commercially available feather and hair meals are often referred to as hydrolyzed feather and hair meal. This is obtained by pressure

streaming un-decomposed clean feathers from slaughtered poultry. Excessive heat may destroy cysteine and lysine. They are about 75% digestible.

Hydrolysed feather meal is high in cystine and threonine but deficient in lysine, methionine, histidine and tryptophan.

Dried Poultry Manure

It is dried poultry excreta. Its chemical contents may vary depending on the source and age of the birds from which manure is obtained. The protein content is between 25 and 29%, fat content 1.5 – 2.5% and fibre 14 – 20%. Lysine content 0.3 – 0.5%, methionine 0.10 and 0.15%. Dried poultry manure is used in ruminant and monogastric animal feeding.

Miscellaneous Sources Of Protein

Leaf Protein

Plant protein contains fair amounts of protein. The protein can be concentrated by crushing and disintegrating the leaves or by precipitating protein concentrate from the leaf juice with the aid of heat or acid. The concentrate so formed may contain up to 60% protein.

Single Cell Protein refers to bacteria, yeast, fungi and algae are microorganisms. Biomass containing up to 50% or more can be produced from each of these microorganisms are termed single cell protein. (SCP).

Hatching waste: It is a mixture of egg shells, infertile and unhatched eggs called chicken that are cooked, dried and ground prior to use.

Insect Meals

They include larva of insects, whole insects and earthworm. They can replace plant protein or parts of the fish used in the diet.

Milk and milk by product: they include skimmed milk, condensed butter milk, dried whole milk. They are excellent source of protein but are usually too expensive to be included in the feed.

Processing Of Feeds

There are several ways of processing feed stuffs. This can be classified into dry and wet

processing or cold and hot processing.

Cold Processing Methods

GRINDING: The particles may be finely, moderately or coarsely ground. However, fine ground may lead to wind loss, tends to form ball in the GIT when mixed with saliva, reduces palatability in cattle, and reduces digestibility and absorption due to faster rate of passage in GIT. May cause ulcer in pig, feed bloat in cattle. Moderately ground is good for pig and poultry. Grinding of grains for cattle may probably not necessary but sorghum has to be crushed coarsely because its waxy coats may prevent digestions. Fine ground grains for dairy cattle will result in low butter, fats and milk.

Rollermill Grinding

Rollermills act on grain by compressing it between two corrugated rolls that can be screwed together to produce smaller and smaller particles. Rollermills are not used with roughages.

Hammermills

A hammermill processes feed with the aid of rotating metal bars (hammers) that blow the ground product through a metal screen. The size of the product is controlled by changing the screen size. These mills will grind anything from coarse roughage to any type of grain. The products size will vary from particles similar to cracked grain to a fine powder.

Soaked Grain

Grain is soaked for 12-24 hours. The soaking, sometimes with heat, softens the grain which swells during the process making a palatable product that should be rolled before using in finishing rations.

Reconstitution

It is similar to soaking and involves adding water to mature dry grain to raise the moisture content to 25-30. It is stored in oxygen, limiting silo for 14-21days prior to feeding. This procedure works well with sorghum.

High Moisture Grain

Grain is harvested at a high moisture content of (25-35%) and stored in a silo or treated with chemical to avoid spoilage. It may be ground before ensiling or ground or rolled before feeding. This is an important method when

weather conditions do not allow sun drying.

Acid Preservation Of High Moisture Grains

Thorough mixing of 1.1.5% propionic acid, mixture of acetic propionic acids or formic and propionic acids into high moisture (20- 30%) whole corn or other cereal grains retards molding and spoilage.

Hot Processign Methods

Most of these methods are associated with high cost and maintenance problem of equipment.

Steam Rolling

The steaming is accomplished by passing steam through a tower above the roller mill. The grains are subjected to steam for only a short time (3-5minutes) prior to rolling. Most results had only little or no improvement on animal performance as compared to dry rolling but use of steam does allow production of larger particles and fewer fines.

Steam Flaking

Grain is subjected to high moisture steam for a sufficient time to raise the water content to 18-20%, and the grain then rolled to produce a flat flake. This process is beneficial in term of weight gain efficiency.

Pelleting

Pelleting is accomplished by grinding the feed and then forcing it through a thick die. Feedstuffs are usually but not always steamed to some extent prior to pelleting. Pellets can be made in different diameters, lengths and hardnesses and are commercially available. It is good for pig and poultry.

Advantages

1. It reduces dustiness
2. It reduces loss in the fine particles ingredients during transportation.
3. It reduces feed wastage particularly in fish, pig, poultry
4. Bulking reduction
5. It increases the utilization of fibrous feed component of the ration
6. Partial cooking of starch results in making it more susceptible to enzymatic action and improves digestibility of starch

Disadvantages

1. It increases cost of production
2. Improper pelleting procedure may cause feed spoilage
3. Ration high in fat are not good in pelleting

Roasting

Maize is usually the target. The maize is passed through a roaster. The moisture constant will be reduced to about 5% but the bulkiness is increased by 15%.

Results of livestock feeding trials with roasted maize used for pigs consistently shown an improvement in the rate of gain to about 8- 12% and improvement in feed efficiency to about 9-10%.

Cooking

It is usually done for two reasons:

1. To destroy the antinutritional factors in feed stuffs
2. To increase the utilization of starch granules present.

Protein Quality and Evaluation of Feed Stuff

Biological Efficiency of a Dietary Protein: It depends not only on the balance of available amino acids but also in the nitrogen and energy intake nutrient digestibility, the species and physiological stage of the animals.

The biological efficiency is also affected by the presence or absence of bacteria or fungi toxins. The rancidity of the associated fat, the content of vitamins, minerals and other essential nutrients that accompany it in a diet is also affected. Effect of physiological status of animals on protein utilization; Animal in a growing phase are able to utilize protein better than adult animals. Pregnancy and lactation also improve protein utilization while infection, emotion and injury reduce the utilization efficiency of protein.

Methods of Evaluation of Protein Quality

Protein Efficiency Ratio (Per): It expresses numerically the growth promoting value of protein. It involves using weight of protein intake in a test diet to divide the weight gain by animal on the test diet. It is assumed that the primary function of a dietary protein is to furnish a mixture of amino acid in a proper pattern for the synthesis of tissue protein.

PER have a high correlation ($r = 0.736$) with biological value. However, despite its long

history and wide usage, PER may not be a very good assay procedure based on the following facts;

1. The results are influenced by the level of protein consumed
2. No allowance is made for the quantity of protein used for maintenance
3. Gain in body weight does not necessarily correspond to gain protein

Net Protein Retention (Npr): Some improvements can be made to some of the shortcomings of PER by including a group of animals consuming a non protein diet (basal diet). NPR weight gain on a test diet - weight loss on a basal diet protein intake on a test diet The basal diet is made up of a purified diet and it contains no any other nutrient than a principal one.

Biological Value (Bv): It is the percentage of nitrogen absorbed from the GI tract which is available for productive body functions.

$$BV = \frac{N \text{ intake} - \text{faecal nitrogen} - \text{urinary N}}{N \text{ intake} - \text{faecal N}} \times 100$$

The Thomas Mitchell method of determining BV takes the metabolic and endogenous N losses into account

$$BV =$$

$$\frac{DNI - FN - MFN - UN - EN}{DNI - (FN - MFN) - (UN - EN)}$$

$$= \frac{DNI - FN - MFN - UN - EN}{DNI - (FN - MFN) - (UN - EN)}$$

Dietary Nitrogen Intake Faecal Nitrogen

Metabolic Faecal Nitrogen Urinary Nitrogen Endogenous Nitrogen

Net Protein Utilization (Npu): It measures efficiency of growth by comparing body nitrogen resulting from animals fed a test protein with that of animal fed protein free diets for the same length of time. There are two methods for this;

1. The carcass analysis technique: The nitrogen content of the animals on test diet and those of protein free diets are obtained and the formula below is applied; $NPU = \frac{\text{carcass N on test diet} - \text{carcass N on ... diet}}{\text{Total N intake on test diet}}$. It is only suitable for small animals like rat.
2. Nitrogen depletion method: Animals are fed on protein free diet for a period of time

sufficient to deplete the labile protein reserve. Animals are then placed on test diets and the response of the animals is measured. It is good for growing animals e.g. chicken and piglet.

Advantages

- i. Homogeneity and sensitivity
- ii. Linear response even at high protein intake
- iii. Ease of execution
- iv. Rapid response

4.0 Conclusion

Nutrient requirements deal with the adequacy of the feed to the needs of the farm animals. Adequate nutrition seems to be the most important environmental factor that influences the ability of the animal to attain their genetic potential for growth, reproduction, longevity and respond to stimuli.

5.0 Summary

Good nutrition is an important part of leading a healthy lifestyle. Combined with physical activity, your diet can help you to reach and maintain a healthy weight, reduce your risk of chronic diseases (like heart disease and cancer), and promote your overall health. Dieting, regulating one's food intake for the purpose of improving one's physical condition, especially for the purpose of reducing obesity, or what is conceived to be excess body fat.

6.0 Tutor Marked Assignment

1. Write short notes on the following: Net Protein Utilization (Npu): Net Protein Retention (Npr): Protein Efficiency Ratio Protein Quality and Evaluation of Feed Stuffs
2. Highlight the advantages and disadvantages of pelleting
3. Briefly explain the following animal protein sources and highlight their limitations:
 - i. Blood Meal
 - ii. Fish Meal
 - iii. Meat and Bone Meal
4. Define Fat in livestock feeds and list 6 general groups of fats Classification of foods

and Feeding stuffs

5. Write short notes on the following energy sources:
 - i. Dried Bakery products □
 - ii. Cereal grain By-products Rice (*Oryza sativa*)
 - iii. Sorghum (Guinea Corn) Sorghum guiness
 - iv. Maize (*Zea mays*)
 - v. Cereals
 - vi. Sugars And Syrups
 - vii. Sweet Potato
 - viii. Coco Yam Cassava

7.0 References / Further Readings

Church, D.E. (1991). *Livestock Feeds and Feeding*. Third Edition. New York, USA: Prentice Hall (Publ).

<https://athenaeum.libs.uga.edu/bitstream/handle/10724/12196/B1367.pdf?sequence=1>

https://mountainscholar.org/bitstream/handle/10217/81194/Ceres_S41Z22no384a.pdf?sequence=1

Kellems, R.O., and D.C. Church. 2002. *Livestock feeds & feeding*. 5th ed. Prentice-Hall. Upper Saddle River, NJ.

Pond, W.G., D.C. Church, and K.R. Pond. 1995. *Basic animal nutrition and feeding*. 4th ed. John Wiley and Sons. New York, NY.