COURSE GUIDE

ANP 202
PRINCIPLES OF ANIMAL PRODUCTION

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INTRODUCTION

This course guide provides a synopsis of the teaching schedules into which all study units in this course material are categorised. The Principles of Animal Production as laid out in this course guide are fundamental bases for acquiring knowledge, skills and techniques for animal production management and improvement that are needed to translate a livestock enterprise for higher productivity and profitability. Thus, understanding the guiding principles in animal production is akin to "holding the bull by the horns" which will afford a producer to tune his production activities for best results within the limits imposed by the environment and genetic make-up of the animal. This course; Principles of Animal Production (ANP 201) is an introductory course offered in the second year of B.Sc. Agric degree programme. It is a two-credit unit course consisting of 13 study units presently scheduled in the subsequent section.

Each unit entails activities expected to be covered in one week of study. Learners are requested to schedule their study programme to accommodate Tutor-Marked assignments, references and weekly tutorials provided by facilitators. Regular attendance to the schedule of work and classes is encouraged for up-mobile learners.

WHAT YOU WILL LEARN IN THIS COURSE?

Your expectations to acquire knowledge on principles of Animal Production have been carefully itemised in form of course guide and study units in this course material. The foregoing course overview briefly introduces you to changes in behaviour and ability you are likely to acquire with respect to practical knowledge and its applications to animal production for the benefit of mankind. The focus and purpose of the course are laid out in the course aim and objective to enable your mind concentrate on specific goals to be achieved as well as stimulate your interest in developing appropriate vision for overcoming constraints and improving livestock production in your environment. Thus, the study units are serialised to bring forth understanding of the subject matter from basic concepts, roles, constraints and strategies to specific techniques of livestock management as they relate to individual livestock specie in the tropical environment and under the systems the tropical environment has imposed.

COURSE AIMS

The course aims at providing an understanding of the established facts underlying the management and operation of livestock production with a view to inculcating appropriate technical skills in students to enable them increase production, improve productivity and cope with challenges arising there from.

COURSE OBJECTIVES

Specific objectives are set from the foregoing in a pattern such that at the end of the course, students (or readers) should be able to:

- Appreciate historical and current advances in the development of animal production; the roles of animal production and its relationship with other life sciences.
- Recognise the overwhelming influences of the production environment and genetic constitution over improvements in productive performance, system of livestock production, development of natural adaptation and acclimatisation features in animal breeds.
- Identify physical and production traits of indigenous breeds of livestock and some exotic breeds.
- Employ basic principles and techniques of animal breeding while using criteria from production records, physical evaluation and livestock judgments.
- Apply principles and tools of animal management for the husbandry of various classes and types of livestock namely cattle, sheep and goats, pigs, poultry, and rabbits.

STUDY UNITS

The thirteen study units contained in the course are as follows:

MODULE 1

Unit 1	An Overview of Animal Production: Concepts, Roles, Constraints and Strategies
Unit 2	Effects of the Tropical Environment on Animal Production
Unit 3	Adaptation and Acclimatisation as Means of Coping with Environmental Stress
Unit 4	Systems of Livestock Production
Unit 5	Principles and Techniques in Livestock Breeding

MODULE 2

MODULE 3

The first unit provides an overview of animal production. It also introduces learners to the concepts and the evolution of the traditional techniques of livestock production to modern scientific techniques with vast linkages with other life sciences. The growth in the skills of managing livestock has led to modernisation and automation of various techniques that forecloses gap between demand and supply of animal products, such that livelihood, employment, food and other socio-economic roles of this subject matter are fulfilled. However, problems and constraints are still emerging but knowledge based solutions are being deployed in form of new strategies.

Study units 2, 3 and 4 describe peculiar influence of the tropical environment on animal performance and perhaps, survival. This peculiarity imposes enabling environment for major constraints to animal productivity, demanding that learners must be guided to appreciate and assist animals to ameliorate or overcome through the application of appropriate biological and environmental principles. One of such means of overcoming environmental constraints is to organise animal production into different systems that suit specific condition, socio-economic ability of the producers and other considerations central to the entire production activities or processes.

Units 5 and 6 illustrate the principles of animal breeding and their application in selecting replacement stock for tropical farm animals. Genetic (inherited) factors are the second set of variables (to those of environment) that control the features, traits, performance and other productive abilities of an animal and its generations to come. Breeding and other management skills are means for drawing from large pool of genetic resources reserved in animal to the fore of productivity and profitability. In fact it may be assumed that if learners imbibe the principle of animal breeding one half of this course and its objectives would have been achieved.

The general principles of management for cattle, sheep, goat, pig and poultry including pullets and broiler and rabbits are provided in study units 7, 8, 9, 10, 11 and 12 respectively. The units map out the precepts for undertaking practical activities in animal production by the general principles of management of various livestock species. Unit 13 is an extended summary of management tips for livestock production not restricted to particular animal species but to the farm enterprise.

Unit Structure

Each study unit is presented in the following table of content that forms the unit structure.

1. Introduction
2. Objectives
3. Main Content
4. Conclusion
5. Summary
6. Tutor-Marked Assignment
7. References/Further Reading

TUTOR-MARKED ASSIGNMENT

Tutor-marked assignments (TMAs) account for 30per cent of your total course work. At least four TMAs are given in each study unit, three of which you expected to answer and submit for grading by Facilitator/Assessor. The assignments would be returned to you for your review. This course material and suggested reading and references will assist learners to complete their assignments and prepared for examination. Learners are however strongly warned against copying in verbatim their responses on assignment or memorising from the course content. You are required to undertake independent reading of relevant materials, extract useful points. The totality of your comprehension of the subject matter from the study unit, references and other relevant material should broaden your mind to address problems and give professionals insights and practical skills to the subject of animal production at a degree level.

Appropriate time schedule for assignments and examination have been provided, ensure that you adhere strictly to the schedule. In any circumstance that you are unable to meet time schedule for assignment, timely arrangement of work at a new date should be made with you facilitator.

ASSESSMENT

The overall evaluation of students consist of two phases – one phase consist of continuous assessment i.e. the Tutor-Marked Assignments (TMAs) and the other consist of the Final Written Examination, covering all areas of the course which will scheduled at your study centre. The work you submit to your tutor for assessment (TMAs) will account for 30 per cent of your total course work at the end of the course you will need to sit for a final or end of course examination of about 2-3 hours duration. This examination will account for 70 per cent of your total course work.
The TMA as a matter of compulsion must be submitted to your tutor within the stipulated period for assessment. It is important to revise self-assessment exercises, TMAs and Tutor's comments in preparation for your examinations.

FINAL EXAMINATION AND GRADING

The final examination at the end of this course will hold for 2-3 hours and it will be graded on a score of 70 per cent of total course work. The examination questions will reflect understanding of the subject matter or topics discussed in this course material. Application of the principles of animal production to solve farm condition problems commonly experienced by farmers will be expected. As much as possible the entire course content will be covered in the assessment, sound grasp of every discussion on the main content through reading formalisation with reference materials may be very helpful to you. A revision of TMAs and comments of facilitators prior to the examination is strongly advisable.

COURSE MARKING SCHEME

Assessment	**Marks Obtainable**
1. Tutor-Marked Assignments: 1-4 No.	Select best 3 at 10% each = 30% of course work.
2. End of Course Examination	= 70% of Course Work
	Total = 100% Course Work

TUTORS AND TUTORIALS

Tutorials covering a total of 16 hours have been slated to assist you in assimilating this course. Information regarding the dates, time and location of the tutorial will be conveyed to you as well as the name and phone contact of your facilitator. The facilitator to whom you are assigned will expect that you forward your assignments by post at least two working days prior to the deadline for submission. The facilitators have been instructed to mark record and also comment on your assignments and later return them for your revision. It is important to establish contact with your facilitator as soon as you are assigned to him/her for one or more of the following reasons:

- If you do not have clear understanding of the study, reference material or assignment given.
- If you have difficulties with marking or grading of the TMAs or self-test.

Attendance at tutorials is extremely desirable as it affords face-to-face contact between the learners and the facilitator. Active participation at tutorial would assist the facilitator to know the point of intervention to help your understanding.

Tutor-marked assignment presented at the end of each is a set of exercises for learners to attempt and return to the facilitators for assessment and grading as part of continuous assessment. Facilitators are requested to return marked assignments to their students to determine their performance and makes necessary adjustment where needed.

SUMMARY

Principles of Animal Production as a course aims at offering the learner the basic concepts and the principles underlying the techniques and methods for raising farm animals for improved productivity and profitability. On completion of this course, learners would have been sufficiently equipped with knowledge on concepts of the subject, interrelationship between traditional scientific methods of producing livestock, roles, constraints and strategies associated with animal production, the overbearing influence of the tropical environment, systems of animal management, breeding and genetics and the application to replacement stock, general principles of management to livestock species commonly found in Nigeria and management tips for animal farm enterprise. In addition, learners will be able to answer such question as:

- Explain briefly the concept of animal production.
- Identify important roles and constraints to livestock production in Nigeria.
- Enumerate direct effects of tropical climate on animal production and discuss their management implications.
- Pinpoint rationale for restriction on importation of European cattle breed into Nigeria.
- List and discuss the various modes of energy transfer.

- Describe the influence of heat stress on five specific animal performance traits.
- List and describe systems of livestock production you are familiar with under the traditional system.
- Identify and describe factors affecting system of livestock production in Nigeria.

At the end of this course the basic principles of animal production would have been sufficiently revealed to you to enable you acquire further instructions for your professional growth and development. I wish you the best in your learning and as you grow through the noble profession of Animal Production for your personal good and Nigeria at large.

MAIN COURSE

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MODULE 1

UNIT 1 AN OVERVIEW OF ANIMAL PRODUCTION: CONCEPTS, ROLES, CONSTRAINTS AND STRATEGIES

CONTENTS

1.0 INTRODUCTION

In this unit, students will be introduced to the concept of animal production and its relationship with other branches of agriculture and science. You will discover application of scientific principles as compared to traditional methods of production and their influence on current level of animal productivity. You will learn a brief historical development of animal production. You will also recognise and appreciate the various roles of livestock production and the problems challenging it in Nigeria. Students will be guided to discuss advances in farm animal production as means of proffering solutions to the present constraints.

2.0 OBJECTIVES

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

- explain the concept of animal production and your preference for application of scientific techniques rather than traditional techniques in animal production
- identify the important roles and constraints in livestock production in Nigeria
- suggest solutions to the constraints and chart way for advancing production of livestock particularly in Nigeria.

3.0 MAIN CONTENT

3.1 Concept of Animal Production

Animal production is an aspect of agricultural production. Agriculture is simply defined as the art and science of crop, animal and fibre production for human consumption. As a branch of agriculture, animal production deals with production of domesticated animals other than pets and game animals.

As a subject matter it has roots in the natural sciences not only by the application of basic principles of science but also in theoretical foundations. Thus, animal production relates in certain aspects to zoology, pathology, genetics, microbiology, botany, biochemistry, chemistry, physics, statistics, mathematical and pharmaceutical sciences.

Since animal production forms a central theme in the provision of essential human needs, the evolution of its practices over time has benefited from skills and knowledge acquired through cultural and scientific techniques. Both traditional and scientific skills have served useful purposes in the development and advancement of animal production. While the traditional technique often evolves slowly over several decades; conservative; limited to a locality or group of people and possibly extended by ancestral linkage; the scientific techniques has proven to be more versatile, and considered as a better alternative approach. It is more dependable in conveying knowledge and skills from an individual or from one place to another. Science-based skills much more than cultural skills are indeed more sustainable and profitable for individual farmers and nations applying them in their production activities or systems. Far beyond meeting social, economic, nutritional and profitability targets application of scientific principles in animal production has sustained productivity to barely satisfy the present level of world demands for animal products.

Under the traditional practice and knowledge system, taboos, custom and beliefs are associated with production, processing and consumption of livestock and livestock products. The Hindus religious sect of India, for example, forbids the slaughter of cattle and consumption of beef. Similarly in Nigeria, the Fulani cattle owners derive social dignity in terms of number or heads of cattle owned by an individual rather than the productivity of the herd.

In addition, same herders are traditionally bound to a specific coat colour or breed of animals inherited from their ancestors and may not permit introduction of a different coat colour or breed even if the latter offers superior desirable traits. Acceptance of certain beneficial technologies for adoption has suffered from rigid adherence to certain traditional beliefs or practices notwithstanding the potential advantages they hold. The use of artificial insemination as a cheaper means of cross-breeding exotic (foreign) bulls with the local breeds of cows for instance was resisted and rejected by local herdsmen because they considered it un-natural to inseminate animals by artificial method and processes.

In some instances, the traditional skills have been of tremendous to support to the production and healthcare of animals especially in areas remote from access to orthodox drugs and healthcare services. The use of herbs and bark of trees for disease treatment or to lessen reproductive difficulties has been shown to be effective. Indigenous knowledge has in recent time become an interesting subject of research study. However, limitations of extending the practice for wider adoption, ascertaining the quantity of active ingredient, determining the application rate or preserving such materials have constituted a major constraint, besides the slow rate of their discoveries.

The application of scientific principles and skills on the other hand has surpassed these limitations, and has greatly improved production and productivity of livestock with the aid of scientific principles; careful study of anatomy and physiology of the body systems of various livestock species; formulation of different feed and nutrient requirements for varying production purposes or targets have been determined, and are in use. On these principles diets are formulated and applied in accordance with body requirements of the class and specie of the animal.

In animal breeding, genetic studies have made provisions for crossing two or more breeds of animal with near predictable characteristics of the offspring, obtain higher hybrid vigour or determine how much of the character is heritable. Closely related to this is the artificial insemination technology which evolved from the accumulation of scientific knowledge on reproductive physiology and anatomy of animals. It is possible to collect and extend genetic material from a productive and proven male animal to artificially inseminate several other female animals far away from the environment of the bull or its generation. New advances in biotechnology application in animal production suggest production of several offspring's from artificial initiation of stem cell division into many units, each of which is capable to grow into individual animal. Several applications of scientific principles have evolved into skills and technologies with tremendous impact on improving animal production system, productivity and profitability. One beauty of the application of science is the ease with which it can be extended over a wide geographical area, its potency to solve the problem being targeted and the assurance to bring results if the procedures are carefully followed as well as the fast rate of generating new discoveries.

3.2 Brief History of Animal Production

Animal production perhaps began about 10,000 years ago, when man started domesticating animals from the wild for his immediate and continual needs. Man's efforts in this regard deviated from killing and destruction of animals especially for their products. In man's renewed attitude, captured animals were tendered through proper feeding, breeding and application of other management practices, which have led to favourable adaptation and multiplication within the confine of human environment. As man further realised the potentials of farm animals as sources of food, fibre, and income, greater attention and efforts began to evolve to improve production and productivity.

Outstanding performance of measurable and quality characteristics started to manifest for identification and consideration for possible multiplication through selection, breeding and upgrading. Since then new advances began to unfold especially in the Western countries. The advances brought alongside; provision of proper housing, feeding selection and breeding methods resulting in the automation of various aspects of animal production and processing at the present time. The improvement in livestock production in the Western nations far outstrip the level of development in the sub-Saharan Africa, where over 90% of ruminant animals are still in the hands of peasants who use traditional production methods. Applications of modern production methods in Nigeria are largely restricted to institutional farms and a few commercial farms.

3.3 Roles of Animal Production in Nigeria

The importance of animal production to the Nigerian economy derives largely from its provision of animal protein foodstuff, employment, industrial raw materials and foreign exchange earnings, and extends to several socio-cultural roles among different societies.

The recognised role of animal production in the nutrition of Nigerians particularly as source of animal protein stems from the common knowledge that 35 per cent of the nation's meat supply comes alone from sheep and goats not to mention supplies from cattle, swine and poultry. Failures to meet demand for the animal protein have resulted in continual importation of animal products with or without official permission. Optimum animal protein intake, without exaggeration, is required for optimum physical and mental development of every individual. The Food and Agriculture Organisation (FAO, 1985) of the United Nations recommended a minimum of about 56g of protein intake per person per day to be consistent with good living. About 50 per cent (or 28g) of this should come from such animal protein sources as meat, milk, eggs and fish. The British Medical Association recommended a higher minimum intake of 68g per person per day. Most Nigerians consume less than 10g of protein per person per day out of which only about 3.2g is animal protein compared to the recommended daily intake of 28g. The expected role of animal production is to fill the wide gap of about 25g of daily animal protein intake per person in Nigeria (Dafwang, 2006).

Engagement in farm animal production activities provides gainful employment and means of livelihood to a large cross section of Nigerians as herdsmen, butchers, livestock specialists, manufacturers and suppliers of feeds, drugs and other production inputs, marketers and traders in the diverse animal products produced regularly and on daily basis. In certain part of Nigeria, animal production activities offer an alternative full employment during the dry season when other agricultural production activities are reduced or non-existent. The alternative means of employment at off season enables the people concerned to earn a living while discouraging tendency to engage in vice habits.

The provision of primary industrial raw materials of animal origin is a major consideration for undertaking production of animals in most countries. Nigeria is known for export of the famous 'Morocco leather' obtained from the skin of Red Sokoto breed of goats in addition to the hides and skins from other livestock. Milk and eggs produced in large quantities in the developed nations form raw materials for large and long chain of assorted industrial firms upon which the economies of the countries depend. The economy of Holland is largely dependent on dairying activities, so also are nations of Australia and New Zealand whose revenues are derived substantially from live animals, beef and other meat products.

Export of industrial raw materials of animal source naturally translates into huge foreign exchange earnings for the exporting countries. As a result, nations aspiring to earn large foreign revenue make specific plans to develop their livestock industries for optimum productivity. The potentials of the Nigerian livestock industry to develop in order to satisfy domestic demands and earn huge foreign exchange within the sub-Saharan African and West African regions are clearly indicated in the impressive contributions of the subsector to the economy. These important roles and benefits from a well organised livestock production system are yet to be tapped to the fullest in Nigeria.

However, one role of animal production that seems to have been exploited perhaps to its maximum is the use of livestock production to meet socio-cultural obligations in marriages and festivals, where animals are used for sacrifices and as symbols of social status in the communities concerned. These cultural obligations are of tremendous social values to a large section of producers in Nigeria. There is a great task ahead to re-orientate and modify these values into the primary objectives of animal production which entail provision of animal protein food needed for growth development, gainful employment and improved livelihood. There is also an urgent need for repositioning the industry to earn foreign exchange for the nation as well as produce raw materials for industrial growth.

3.4 Problems Confronting Livestock Production

A number of constraints confront the Nigerian livestock industry and impedes its growth and development. Some of the most limiting factors are listed and discussed as follow:

(1) **Nutrition and Feed Supplies:** The provision of feed that is adequate both in quality and quantity and accessible to animals all year round is the most outstanding problem of livestock production in Nigeria. The natural range resources that form the primary source of nutrients have been observed to rapidly increase in nutritive value at the onset of rains and decline shortly thereafter. The state of poor nutritive feed quality often last longer during the year than the period of forage abundance and high nutritive quality. Supplementation with crop residues from cropped farmlands scarcely meets the requirements for animal growth. The unavailability of grazing feedstuff in the year round is aggravated by the widespread bushfire and imbalance between the stocking rate and carrying capacity of the range. The consequence of overstocking is simply high incidence of erosion and a reduction in the carrying capacity of vast land area with potential for high cattle production as in the Jos and Mambilla Plateaux, Sahel and Sudan ecological zones. In event of acute shortage of range resources during the dry season and extending for a period of 2 years as in 1972-1974 considerable losses in live weight and number of stock usually result. The cyclical occurrence of feed deficit year in and year out impairs animal growth rate and reproductive performance while instigating movement of stock from one place to another with its numerous attendant problems including high susceptibility of animals to diseases and pest attack and often fatal clash between herders and farmers.

(2) **Inadequate Breeding Programme:** Adoption of haphazard breeding programme in which indigenous cows are crossbred with bulls by natural or artificial insemination at one time and massive importation of exotic breeds into Nigeria at another, have failed to make any tangible impact. The consequence of this is the proliferation of local breeds of cattle in their numbers not responding to improvement in quantitative traits. It is still not clear as to what means to categorise local breeds of cattle as dairy or beef type. They all exhibit dual or triple-purpose traits, with productivity far below the average expected. The reproductive performance of the cows which is an important consideration in breeding is hampered by long calving interval that is rooted in poor management and inadequate feeding. Worst still, Nigeria has no breeding policy programme for her livestock.

(3) **Disease and Pest Infestation:** Due to tropical nature of the Nigerian environment, a number of important epizootic diseases of livestock easily thrive. In cattle, for example; rinderpest, contagious pleuropneumonia (CBPP), dermatophilosis foot and mouth disease, anaplasmosis, babesiosis and trypanosomiasis. These diseases are so virulent that they limit production, increase morbidity and cause widespread death of cattle. Recently, Nigeria was officially declared free of rinderpest infection. However, other diseases of less epizootic nature are assuming increasing significance e.g. mastitis, brucellosis, dermatophilosis, heartwater etc. Together these reduce productivity of the national herd even if they are less virulent. Although much progress has been made in the diagnosis and control of some of these diseases, the increasing populations of vector-pests that transmit the diseases constitute a major hazard and threat to farm animal production in Nigeria. Infestation of tsetse fly alone for example, covers 75 per cent or 600,000 to 700,000 km^2 of the entire country (FMA and GRNC, 1981) rendering areas with valuable feed resource nearly inhabitable for cattle. Other pests of significant economic importance are enteric and helmintic parasites of coccidian emeria, flukes, roundworm and hookworms as well as ectoparasites like ticks, mange, mites and lice. They cause diarrhoea, loss of appetite, slow growth rate, unthrithfulness, damages to skin and most often debilitating mortality among stock leading to grave economic losses.

(4) **Land Ownership and Usage:** Land tenure remains a major obstacle to livestock development, for herders have no secured individual accesses or rights to land. Communities and individuals who crop the land often lay claim to ownership of the land. A concession to carry out agricultural activities is merely given to settled pastoralists rather permanent land tenureship. Little or no opportunity is available for pastoralists to invest and develop the land for a full return of benefits and expansion.

(5) **Low Investment Potential:** The slow rate of growth of the livestock industry in Nigeria denotes a long gestation period for investment to mature. This is contrary to quick return on investment desired by financial institutions like banks and investment houses. Livestock projects are scarcely attractive unlike services and trades that have tendency to return borrowed funds and interest more quickly due to longer period of growth required and the high uncertainty it is associated. Collaterals and guarantee of substantial value are not easily available for livestock producers to secure sufficient loans to improve production even in few instances where financial institution may be willing to do so.

(6) **Institutional Problems:** Lack of genuine institutional support and political will to muster required efforts to improve livestock production cannot be divested from problems confronting the industry. In countries of India, Netherlands, Australia, New Zealand etc, deliberate action-packed programmes are outlined and implemented with very strong extension component that enables experts work in collaboration with native producers to find solutions to the problems of production. In Nigeria such plan programmes are tested within a limited area and frustrated by undue rivalry and competition for position, profession or financial benefits as well as poor implementation strategy. Policies are written and are never implemented before abrupt changes are introduced. As a result, Nigeria has as many policies as the number of commissions set up to assess part or all the teething problems militating against the growth of the livestock industry. As if the poor attitude on the part of government is insufficient, the greater undoing comes from producers who are largely uneducated, conservative and highly mobile. Meaningful extension outreach can rarely accommodate producers who harbor hatred, suspicion or reject and are nonchalant towards innovations put in place for adoption.

3.5 Strategies for Advancing Animal Production in Nigeria

Some strategies for purposeful development of the livestock industry in Nigeria are suggested as follows:

(1) Change in value and attitude of livestock producers from the present consideration for number of stock as status symbol to more important objectives of higher productivity and socio-economic benefits that are business oriented.
(2) Careful selection of local breeding stock from breed and individual records.
(3) National upgrading and breeding programmes involving exotic and local breeds, thereby mass producing the heterozygous offspring for production purposes.
(4) Careful exploration of various farming systems to ensure availability of feedstuff throughout the year and intensification agricultural production system.
(5) Feed quality improvement through deliberate supplementation and range exploitation to meet daily requirements for various nutrients.
(6) Exploitation of the biological abilities of the stock to derive maximally from the available feedstuff.
(7) Establishment of a responsive and resilient animal health system that is capable of quick intervention, continuous and effective management of animal diseases and their predisposing agents and conditions.

4.0 CONCLUSION

Animal production both in concept and practice is rooted in scientific principles upon which it has made substantial growth and development. The traditional methods of production, though still persistent and possibly played some roles in the past, are gradually fading out. The significance of livestock production is daily increasing with greater implications for human survival, economic and social advancement in the face of challenging constraints that need pro-active efforts to resolve.

5.0 SUMMARY

Animal production is defined as an aspect of agriculture which in itself is the science and art of producing crop, animal and fibre products for human use. Just as in wider agricultural activities, animal production depends on art (or traditional) and scientific principles in practice and theory. Current level of progress has indicated that scientific applications tend to be more amenable to meet present and future targets for animal products. The demand and usefulness of animal products for human health and survival economic and industrial growth as well as provision of other social services are ever increasing. Yet, challenges and constraints limiting Nigeria and other developing nations in fulfilling these demands for animal products are manifest. Perhaps, solutions lie in developing strategies around value and attitudinal orientation of the majority of producers, selection and upgrading of genetic pool for various desirable traits, and exploitation of the farming systems and feed resources for greater animal productivity while curtailing incidence of animal pests and diseases through a virile animal health management system.

6.0 TUTOR-MARKED ASSIGNMENT

1. Briefly explain the concept of animal production
2. Itemise rationales for your preference for the application of scientific principles rather than traditional techniques in animal production.
3. Identify important roles and constraints to livestock production in Nigeria.

7.0 REFERENCES/FURTHER READING

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UNIT 2 EFFECTS OF THE TROPICAL ENVIRONMENT ON ANIMAL PRODUCTION

CONTENTS

1.0 INTRODUCTION

This unit introduces students to the overwhelming influence of the environment; specifically the tropical climate, altitude and soil fertility, on animal production. As you progress further in this study you will discover far-reaching effects of the climatic elements directly on the system of animal production, body physiology and animal behaviour, feed supply and quality, proliferation of pests and parasites as well as preservation of animal products. Students will also be exposed to the moderating influence of altitude and soil on the overall activities of animal production.

2.0 OBJECTIVES

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

- identify the geographic limits of the tropical environment and its peculiarities
- explain the direct effects of three climatic elements on animal production and productivity in the tropics
- discuss the indirect effects of the tropical climate on animal production
- describe effects of altitude and soil fertility on animal production system.

3.0 MAIN CONTENT

3.1 The Tropical Environment and its Moderating Factors

The tropical region lies between the latitudes (tropics) of Cancer and Capricorn in the north and south of the Equator. By its geographical location, the region is expected to be uniformly hot all year round, but this is not so. A number of environmental factors moderate the hotness of the region such that several micro-climates (mini pockets of climatic conditions) are created in certain places by factors such as distance away from the equator (the degree of latitude), altitude (height above sea level), soils and contours vegetation, ocean currents, wind, rainfall and distribution of land and water. Differences between one micro-climate and another are noticeable by variation in such climatic elements as temperature, rainfall and to a lesser extent, humidity are the climatic elements of greatest influences in moderating conditions in a micro-climate. Similarly, they also cause major effects on animal physiology, behaviour and productivity through their individual or separate effects but, more often, by their combinations with other environmental factors. The influence of climate on animal production (including animal body functions, behaviours and productive abilities) may be direct or indirect. In either way, systems of animal husbandry or management are also affected. Direct influence of climate on animal production and husbandry has to do with such influence on the animal itself, while indirect influence is on the animal's environment each of these shall be examined closely.

3.2 Direct Effect of Climate

It must be noted from the onset that responses of individual animal to certain climatic condition vary between individual animals of the same breed.

Temperature
All domestic animals are homeotherms or warm blooded. In other words, they maintain their body temperature within a range most suitable for optimal biological activity. The body temperature range is relatively constant and is higher than the environmental temperature. The ambient temperature on the other hand varies with changes in the climatic elements at a particular time. The animal body temperature ranges within certain limits defined as the 'comfort zone' is a temperature range within which no demands are made on the temperature regulating mechanism. For a typical tropical breed of cattle, the 'comfort zone' range from 10 to 27 while a tropical temperate cattle has between -1 and 16. If there is a change in ambient temperature beyond either the upper or lower limit, the body mechanism for

regulating animal body temperature is triggered to action to enable the body remain or return to normal. However, thermo regulative mechanism may begin to fail, resulting in abrupt rise in rectal temperature, decline feed intake, an increase in water intake, a decrease in productive process such as growth and milk/egg production and perhaps a loss in body weight. Sometime the composition of milk produced may be affected. This partly explains the deterioration of highly productive cattle imported from temperate area to the tropics.

Other behavioural and physiological responses of animal to excessive high temperature or heat load include sweating, panting, wallowing in mud or pool of water, reduction in physical exercise and mating activities. Let us examine a few of these effects of temperature on animal conducts.

Effect of Temperature on Grazing Activity

(a) **The Effect of High Air Temperature on Cattle is Reflected in their Grazing Behaviour;** Studies have shown that length of day time grazing is related to the ambient temperature, and reduction in heat load improves grazing behaviour. Herders in semi-arid and arid area have adopted the act of grazing at night to improve both intake and length of grazing in hot seasons. Fast growing broiler birds are often fed in the night and sprinkled with droplets of water in the day as means of alleviating heat load to improve feed intake and overall production.

(b) **Effect of Temperature on Growth and other Productive Performance:** High ambient temperature depress appetite and reduce feed intake and grazing time which may also diminish production as measured by growth, milk yield and milk solids production. Experimental evidence has shown that there is a partial correlation with growth rate when body weight is constant. However, under good management conditions where feeding and management are adequate, high ambient temperatures do not appreciably affect growth rates. Temperate type sheep in the tropics of Australia that are exposed to high air temperature often have a low lambing percentage and give birth to small weak lambs that have a high post-natal mortality. Lambs born in early summer and reared through hot summer are usually smaller at birth than lambs born in the cool months of early dry season. In poultry light breeds and young chicks are more resistant to heat than heavy breeds and adult birds. High temperatures predispose laying birds to abrupt decline in egg production.

(c) **Effect of Temperature on Milk Yield and Composition:** Studies have indicated the effect of temperature on milk yield, butter fat and solids – not – fat. All these are depressed by high temperature, but usually by indirect effect of temperature on changes in feeding. As much as between 44 per cent and 55 per cent differences in milk yield and butter fat production were noticed between twin heifer reared under sound tropical and temperature management conditions. With increasing air temperatures appetite is depressed, food intake lowered, and heat production reduced. The exact mechanism of temperature effect on milk and milk composition is not known. Either the high temperature directly affects appetite, thus decreasing feed intake productivity and heat production or the need to reduce heat production forces down appetite and hence lower feed intake. The direct effect of temperature is further appreciated in a study that defines optimum temperature (^{0}C) for milk production as 21-27 in Jersey and Holstein 29-32 in Brown Swiss and higher in tropical breeds of cattle. Similarly, milk constituents namely; butter fat, chloride, lactose and total nitrogen are affected when temperature rises above 27-30.

(d) **Effect of Temperature on Reproduction:** Air temperatures do not seem to affect reproductive cycle of cows, but bull fertility is markedly influenced. High testicular temperatures adversely affect spermatogenesis and hormonal system. Seminal degeneration and temporary infertility have been reported in Merino sheep exposed to temperature above 33^{0}C over a length of time. Both sizes of egg and thickness of its shell decline when laying fowls are exposed to high temperatures. Egg productivity decline has been experienced in poultry farms in Nigeria. However, incubation and brooding are favoured under high temperature.

Humidity

As stated earlier, it is difficult to separate or single out the effect of temperature, precipitation and humidity on animal production. Evaporation is one of the important channels of heat loss. It depends on ambient air temperature, the amount of available moisture in the atmosphere (humidity), area of evaporating surface and the degree of air movement. The amount of available moisture partly affects the rate of evaporative heat loss from the skin and respiratory system of an animal. High humidity adds to the heat load of the animal by depressing evaporative heat loss with declining effect on feed intake and productivity as demonstrated under temperature effects.

Solar Radiation

The quantity of solar radiation received in tropical region differs profoundly from the temperate. For tropical breeds of animal, solar radiation effects are scarcely noticeable because of their skin and eye that are pigmented. When temperate breeds are exposed suddenly to solar radiation of the tropics they suffer from sun burns or skin cancers, epithelioma (eye infection from solar radiation) and other photosensitive disorders. Solar radiation correlates with air temperature and thus partly contributes to the ambient temperature which is a principal climatic element affecting animal production. Management systems adopted in the tropics are a means for minimising adverse effects of solar radiation such as grazing in the night, clipping of excessive hair, grazing under shades in the day time etc. Solar radiation may contribute or may even create a more severe heat stress.

3.3 Indirect Effects of Climate

Effects of the climatic environment on animal production, biotic agents, nutrition including the influence on animal feed supply and quality may be regarded as indirect effect that does not bear on immediate conduct of the animal but on its environment.

Effect on Feed Supply: Climate affects the quantity and quality of feed available to the animal. Temperature, precipitation, daylight and humidity limit plant growth and affect feed quality more drastically than other climatic factors. In humid and sub humid areas where there is sufficient rains, plant exhibit seasonal growth, hence seasonal availability of forage. In the dry season when plant experience slow growth or complete growth seizure, available grazing stuff declines and animals lack enough to eat. In the arid and semi-arid zone lack of sufficient grazing material results in seasonal movement in search of forage feed in the wetter areas. The pattern of distribution of rainfall in which tropical region experience torrential rainfall in a short duration also partly explain rapid growth of plants within a short while followed by fast decline in biomass and other nutritional qualities. Nutritional quality of feed has to do with proportion of constituent nutrients, availability and balance of these nutrients in the ratio needed by the animals. Feed quality is most influenced by the climatic factors as precipitation and humidity. Rapid growth of plants results in production of high fibrous content of the forage feed as quality deteriorates with age. Tropical forage compared with that of temperate matures quicker, such that at same age the fiber content is higher; and digestible protein and total digestible nutrients lower. Thus stocks in the tropics usually have to digest more fibrous feeds and this may add to their heat load.

Studies have indicated the extreme sensitivity of cattle to heat stress. It is noted that the balance of acetate available for purposes other than heat production is increased as environmental temperature increases. Ruminants in hot climate are more sensitive to imbalances of protein-energy, which results in an increased heat production. High temperatures and high humidity provide favourable breeding environment for internal and external parasites, fungi and disease vectors. There is high incidence of internal parasites in the humid tropics and in the wet season. In arid areas, and in dry season, the incidence of insect pests and external parasites remain a major health threat. As much as the vegetation-type influences the incidence of insect pests/vectors of disease, so much is climate indirectly affects animal production. Incidence of tsetse fly infestation and distribution between the humid and sub humid area explains the interaction between the climate and vegetation and their influence on an animal production. Heat / humidity stress may have all or some of the following effects:

- Increases the requirement for protein by the animal
- Decreases the efficiency with which metabolisable energy is utilised
- Heat stressed animals must reduce feed intake
- An unbalanced diet which leads to excessive metabolic heat production will compound the effects of heat stress due to climatic condition.

Tropical climate favours the rapid deterioration and increases the cost of handling animal products. In arid or humid climates of the tropics, substantial quantity of animal products have been lost to putrefying organisms which multiply rapidly under such conditions to cause deterioration, spoilage and 'food poisoning' of enormous economic value. This indirectly affects animal production in terms of high cost of generating electricity and provision of refrigeration on the farm to reduce wastage of valuable animal products.

3.4 Effects of Altitude and Soil Condition on Animal Production

Altitude refers to height of a place over and above relative to the sea level which is usually measured in metres. Three plateaux in Nigeria exhibit micro-climatic conditions that differ slightly from the general tropical environment in terms of relatively lower ambient temperature, temperate vegetation and sometimes precipitation. This distinct condition confers on the Obudu Hill, Jos and Mambilla Plateau temperate like micro-environment on these places located within the tropical Nigerian climate. As such, production of cattle and other livestock may take the semblance of the temperate system of animal production. Some of the environmental stress conditions earlier enumerated may be unnoticed or moderated in the elevated places. Physiological responses of animals supported by favourable micro-climatic condition tend to stimulate improved animal performance in terms of intake and metabolism of nutrients, growth and reproductive activities. Federal and state governments, organizations and wealthy individual scramble to establish livestock farms on Obudu Hill, Jos and Mambilla Plateau as well as other unique environments in Nigeria to take special advantage of the modified climate in such places for improved animal production and tourism. The emerging growth in dairy production in Kenya is partly attributed to high productivity of dairy cattle located on high altitudes and highlands of the country. The geographical principle of “the higher the relative altitude of given place, the cooler it becomes” is characteristic of the micro-climatic phenomenon experienced in most tropical highlands, which has led to improved animal productivity.

The effect of soil condition on animal production is more or less indirect. The nutrient composition in food and forage, and possibly water depends on the soil content of micro and macronutrients. Relative balance of the required nutrients available for growth, production and reproductive performance in the body system of farm animal derive primarily from soil fertility and retention of nutrients in crops and forage which the animal consume. Palatability of certain forage feeds has been ascribed to the fertility of the soil. Forage and crop residue upon which tropical livestock survive are known to deteriorate rapidly in nitrogen and biomass contents, and lack in P, Ca and Na partly as a result of soil fertility factors, and these impact seriously on tropical livestock productivity. A few soil borne bacterial diseases such as anthrax and blackleg in contaminated sites may constitute a major problem on animal health.

3.5 Effect of Tropical Climate on Animal Parasites, Vectors and Diseases

In the vast tropical regions characterised by marked dry seasons and periodic droughts, climate is often the most prominent factor influencing animal health. It determines seasonal loss of body conditions, production and periodic starvations in years or times with exceptionally poor rains. Apart from this, the tropical climate stimulates proliferation of infectious and parasitic diseases through recurring provision of a favourable environment for development, growth and spread of such diseases and their agents. The resulting problems they cause livestock vary between various climatic regions, systems of management and between breeds or populations of animals.

Climatic differences between regions have profound effects. It is obvious that worm eggs survive far better in humid climates than in the deserts, although surprisingly favourable conditions may occur locally around water points in a dry area. In Africa, tsetse flies thrive in warmer lower regions, while the tick vector of East Coast fewer prefers cooler, higher areas of greater altitude. As a general rule, animal populations tend to be adapted to the local diseases in the area in which they lived many generations, especially as they are kept under traditional, extensive management. Problems tend to crop up or increase, when they are kept in crowded conditions, favourable to intensive disease transmission and to concentrations of helminthes, eggs, coccidia and ectoparasites.

Major climatic effect on animal diseases and parasites arise when European cattle are introduced into the tropics. Quite apart from the tropical climatic stress that further compound the poor health condition, exotic breeds such as dermatophilosis, theileriosis, trypanosomiasis, babesiosis, cocodiosis, tick infestation and a host of other diseases than are populations of local cattle in the areas in which such diseases are endemic. It is thus clear that co-evolution of host and parasite tend to result in natural selection of greater resistance on the part of the host. Quite often it is not so much a matter of breeds or species, but more of populations locally selected by natural disease pressure.

Worm infestations are less spectacular than acute bacterial, viral or protozoan diseases, and their harmful effects, loss of production or sub-optimal performances, are often underestimated. Acute rise in the degree of worm infestation during the rainy season in the tropics has been reported. The use of existing knowledge on the epidemiology and immunology combined with use of drugs have assisted a great deal to limit infestations to levels where they are harmless or nearly so. Eradication is hardly possible due to major part of the worm population occurring in the environment in form of eggs and larvae.

Ectoparasites infestations apparently take over from the internal parasites as rainfall diminishes into the dry season. Ectoparasites inflict irritation, wounds and abscesses by their biting habit on the host. Thus resulting in painful bites, restlessness, reduced production performance, damages to hides, loss of blood, teat and part of the udder, causing considerable economic waste. The conditions further predispose animals to various parasitic and disease attack. Beside climatic conditions that permit the prevalence and proliferation of the ectoparasites, alternative hosts, especially wild beasts and domestic animals, harbor different stages of the biological cycle of the parasites. Certain pocket of micro-environments also provides suitable places for breeding of the ectoparasites, making eradication much more cumbersome where such programme exists.

4.0 CONCLUSION

Virtually all production aspects of animal agriculture are affected or influenced by the unique tropical climate. It is very clear that the climate impinges directly on the biological functions of the body system, animal behaviour and production performance through such overbearing and moderating influence of temperature, humidity, solar radiation, and indirectly on feed supply, parasites and diseases, storage and handling of animal products. Progress in animal production has for age long being dependant on adjusting production system to suit the influence of the climate or changing the body physiological functions and behaviour to fix-up with climatic dictates. These fundamental factors underlie the various systems of production, systems of housing, feeding, reproduction and the overall management practices that are often adopted, modified or imposed.

5.0 SUMMARY

The review has indicated the divergent effects of the tropical climate on the production system, animal behaviour, productivity, feed production, and animal healthcare with implications for management practices required to reduce negative or enhance positive influence of the climate. The knowledge of the production environment in the tropic are tools for management practices in animal production. Students need to pay great attention in undertaking theoretical and practical course in the subject area.

6.0 TUTOR-MARKED ASSIGNMENT

1. Enumerate direct effects of tropical climate on animal production and discuss their management implications.
2. Of what significance are the indirect effects of the climate on animal productivity in Nigeria, giving specific examples?
3. Pinpoint rationales for restriction on importation of European cattle breeds into Nigeria, citing associated climatic, environmental health risks and their implications.

7.0 REFERENCES/FURTHER READING

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UNIT 3 CONCEPT OF ADAPTATION AND ACCLIMATISATION

CONTENTS

1.0 INTRODUCTION

This unit introduces students to some basic concepts in understanding animal adaptation and acclimatisation to its environment. Students will be in position to explain adaptive means by which animals cope with their physical environment. One component defined by a few concepts is the environmental energy balance, energy distribution and transfer. In different environments and energy many times, the energy distribution produces stress against which animals gradually build mechanism to reduce and improve productivity. The effects of these on animal productivity are important for students to appreciate just as it is worthwhile to understand the various mechanisms of the animal body against heat or cold stress.

2.0 OBJECTIVES

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

- explain the concepts of adaptation and acclimatisation
- identify various means by which animals cope with their environments
- describe the concept of environmental energy balance, distribution and transfer which often result in heat or cold stress
- discuss the effect of environmental stress on animal productivity and mechanism of body defence against stress.

3.0 MAIN CONTENT

3.1 Some Concepts of Adaptation and Acclimatisation

Due to the super-imposing influence of the environment on the survival, behavior, character (expressed as performance, productivity and responses) of farm animals, great consideration is often given to modifying the environment by livestock owner to ensure its suitability. Equally of primary importance is the need for adaptation and acclimatisation of the hereditary and physical features of the animal itself to the predominating environment if stock must survive under favourable and harsh environment conditions. Adaptation and acclimatisation of the animal to the environmental conditions form the basis for any modification or adjustment required on the part of farmer to apply into the management system for survival and improved productivity of the stock. In other words, an animal must first and foremost undergo natural selection for survivals in an environed before improve growth, reproduction, and other productive traits can be contemplated. By natural selection therefore, the genes favourable for survival in that environment interact, interrelate, associate and coordinate with the environment to ensure the survival of the animal.

This condition is known as adaptive norm which is an array of related genotype capable of adjusting to the demands of the environment. It embodies heterosis, adaptive polymorphism and homeostasis. From the genetic point in view, fitness is the ability to produce offspring which will survive and produce their likes. Thus, a biologically fit population is one that is capable of adapting to its environment in such a way that it can survive and reproduce. The fitness of animals includes more than their ability to survive but also to withstand the demands of future environment. These criteria of fitness or ability will depend on adaptation variability, stability and rate of environmental change. It is important to note that while domestication improves on all criteria of fitness, diseases negate and reduce fitness to almost nil. It may be deduced from the foregoing that living system not only respond to the environment but also control and regulate their reactions towards environmental effects. This is the concept of homeostasis.

Homeostasis

Homeostasis is the constancy of the internal environment of an animal and the mechanism by which such constancy is maintained. It involves regulation of many internal body variables as temperature, P^H, salt, water content, nutrient and chemical composition etc. mammals and birds that occupy the highest evolutionary scale, possess the greatest regulatory capacity and regulate the greatest number of internal factors with the best precision through a deployment of appropriate physiological adaptation and compensation.

Physiological Adaptation

Any change in the internal condition of an organism which favours its survival during changes in the environment is known as physiological adaptation. Physiological adaptation involves the possession of mechanisms and capacity that allow organism to adjust itself to other living organisms and to external physical environment. Physiological adaptation may manifest as acclimatisation, acclimation, habituation, learning and conditioning.

Acclimatisation: Acclimatisation refers to a long term adaptive physiological adjustment which results in an increased tolerance to continuous or repeated exposure to complex climatic conditions occurring under natural condition.

Acclimation: Acclimation refers to adaptive changes to a single climatic variable normally produces in an artificial environment e.g. increasing temperature in a climatic chamber.

Habituation: habituation is a gradual change which may lead to a loss of response as a result of repeated stimulation.

Learning: learning is the acquisition of a new response or a qualitative change of an existing response which may be inform of inhibition or increase of an existing response by a new stimulation.

Conditioning: Conditioning is the transfer of an existing response of new stimulus. Besides physiological adaptation, other forms of adaptations in organisms include biological and genetic adaptation.

Biological Adaptation

Biological adaptation involves the morphological, anatomical, physiological, biochemical and behavioural characteristic of the animal which promote welfare and favours survival in a specific environment.

Genetic Adaptation

Genetic adaptation refers to the heritable animal characteristics, which favour the survival of a population in a particular environment; such favourable characters are derived from evolutionary changes over many generations.

It is important to note that individual animal has limit to its ability to regulate its reaction according to genetic make-up. Animal has a defined range of environmental variation within it can live. This is referred to as Zone or Range of Tolerance, beyond which the animal will exhibit some resistance, suffer some damage, and eventually succeed. The Zone or Range of tolerance has upper and lower limits at either ends also known as Upper and Lower Incident Lethal levels at which death occurs.

The micro-climatic environment has the most profound influence on animal production, physiology and behavior. It is determined by such meteorological factors as: air temperature, air pressure, relative humidity of air, wind density and air density as well as radiation (defined as the heating and cooling of the atmospheric air). Man can modify his micro-climate by building houses, offices, travelling in cars, planes, ships, wearing clothes etc. animals on the other hand modify the micro-climate by burrowing or moving into or from these meteorological factors in search of warmth, cold or calm. The behavioural entrance or escape from inclement meteorological conditions is, however, limited in providing the required optimum body conditions at all times. The primary means by which animal control, or respond to variations in the meteorological factors, and thereby maintain its body conditions, is through the flow of energy or total energy exchange between the animal and environment.

Energy is the ability to do work. It is regarded biologically as the source of life and movement. All life process involves in one way or other the expenditure of energy through work. An animal cannot continuously gain or lose energy to the environment, otherwise it will die. Thus animal tolerates energy gains or losses from their immediate environment only within certain limits in the Zone or Range of Tolerance.

An animal exchanges its energy with its environment (micro-climate) through radiation, convention, condition, evaporation and metabolism. The pathways of energy flow are many and characterised by direct interaction between animal and its environment. In order to survive in a given environment over a long period of time, the energy gain of an animal must be equal to energy loss.

The energy balance of an animal is therefore expressed as:

Ra – Re $\pm$ Cv $\pm$ Cd $\pm$ Ev $\pm$ Mh = 0 (thermo-neutrality)

Where: Ra = Radiation absorbed
Re = Radiation emitted
Cv = Convection
Cd = Conduction
Ev = Evaporation
Mg = Metabolic heat

NB: The positive signs represent gain of energy and the negative signs depict loss of energy. After a long term, the total must add up to zero, but within a short period there can be loss or gain of energy while an animal is cooling down or warming up.

Modes of Energy Transfer

1. **Radiation**: Radiation is a form of energy transfer in wavelength by electromagnetic waves. Radiant energy is ubiquitous (i.e. found everywhere) and is emitted from all objects whenever the surface temperature of the object exceeds absolute zero. Energy loss by radiation is one of the primary sources of heat loss by animals. Objects at ambient temperature (23 – 25^0C) radiate mostly infrared rays at long wavelength and beyond. Objects at very high temperature e.g. the sun radiate shorter wavelength in the ultraviolet and blue region. The amount of energy radiated is proportional to the 4th power of the surface temperature in absolute degree i.e.

$E \alpha \, T^{04}$

$E = \delta \, T^{04}$

Where δ = Stetan – Boltzman Constant
E = Total energy radiated/M^2/S
T^0 = Temperature (Absolute) of surface radiation

Also,

$E = e \, \delta \, T^4$

Where e = Emissivity

Radiation in the natural environment is derived from 2 – main sources: high temperature of the sun (direct source) and the extended source which is the thermal radiation from the ground, trees clouds or atmosphere. An animal exposed to direct solar radiation, absorbs certain quantity of incident energy depending on the surface exposed, angle of surface and absorbance of the surface. The absorbance of the surface determines the greatest percentage of the incident radiation absorbed. An animal with a black body surface absorbs all the incident energy and its body temperature is much more affected by the quantity of radiation falling on its surface.

2. **Conduction**: When an object is in contact with another, molecular motion can be transferred from one object to another by a process of bombardment similar to diffusion activity. Such transfer of molecular motion is known as thermal conduction. Air for example, is a poor thermal conductor while water is a good one. Conduction however occurs only from regions of higher to region of lower temperature. It is only the heat that is transferred and not the material.

3. **Convection**: this is a special form of heat transfer by conduction. It occurs where the surrounding medium is fluid e.g. air or water. Upon increase in temperature air or water rises due to its decreasing density (becoming less dense) and the layer of fluid next to the warm object is replaced by another mass of cooler (more dense) fluid. The exchange of energy by convection is proportional to:

   a. Surface area
   b. Temperature differential between animal surface and free air beyond the boundary layer
   c. Convection coefficient
      $C \propto A (Ts – Tc)$
      $C = hcA (Ts – Tc)$

   Where hc = Coefficient of convection which depends on thermal conductivity and thickness of the boundary.

   A = Surface area

   Ts – Tc = Temperature differential between animal surface and free air beyond the boundary layer.

The Boundary Layer plays an important role in maintaining body temperature. The concept of Boundary Layer is given as: Just immediately to the surface of the animal is a bound layer of air which is more or less stationary and it is the transfer zone between the integument temperature (skin temperature) and temperature of the free air beyond the boundary layer. As it is already known heat is always transferred along the temperature gradient occur between the surface temperature of animal and air temperature of short distance away from the surface. The rate of heat conduction across the boundary layer is dependent on:

(1) the thickness of the layer
(2) the temperature differential between the skin and fluid
(3) the thermal conductivity of the fluid
(4) movement or stillness of air.

Transfer of energy across the boundary involves two methods: by molecular conduction across the boundary layer and into the free air and by mass movement of air. Natural convection occurs when there is no wind or free air while forced convection occurs when there is wind to transfer energy.

3.2 Adaptive Means of Coping with the Environment

Temporary acclimatisation has to do with adaptation to or tolerance to, a short duration of heat stress rather than to more moderate continuous heat stress. Temporary acclimatisation effect of the heat stress. The wide changes in heat stress between the day and night in three dry zones and between seasons of the year readily prepare animal to acclimatise and adapt easily.

Permanent acclimatisation to climate stress may be due to changes in the behavior of the animal or to changes in physiological relations that may or may not be inherited. Natural or artificial selection for morphological characteristics that assist the animal to acclimatised may be needed for permanent acclimatisation such changes in behavior of domestic livestock ought to form good management aims and indicators to facilitate the adaptation. Common adaptive behaviours to heat stress by tropical livestock include sluggish movement to reduce muscular heat production, raising of the wings among poultry to allow for air circulation and heat loss; tendency of livestock to graze at night and more often seek to stay under shade in the hot day; drinking of large volume of water; slow rate and reduced consumption of feed; pigs Walloons in water ponds or moist environment and often stretch themselves in lying position. Physiological adaptations to tropical environment on the other hand are several and, often, not easily observed. These include:

- decreasing the body metabolic rate and varying the body temperature
- varying coater turnover (loss) by concentration of waste products in urine to conserve body water

- recycling of urea in the saliva to conserve nitrogen in period when forage is lacking
- varying tolerance to salt concentration in drinking water
- decreasing certain hormonal activity, for example, the thyroid and adrenal hormones
- panting or reduction of body heat through the short and quick breath.

There are also morphological adaptations or characteristics that help to achieve environmental acclimatisation especially to temperate animal to tropical condition. These include:

- possession of large skin area in relation to live weight especially develop or large comb
- skin pigmentation, with short and light coloured hair to reduce heat and light radiation absorption
- tendency to have thin layer of subcutaneous fat deposit
- possession of long leg by Desert sheep or goats to cover long distance in search of feed and water.

Most adaptative features are derived from natural selection and they often form the basis for ultimate development of a new and more adapted breed or strain with minor manipulation by man, as the manager. Breeding of animal for higher productivity must recognise important adaptive traits that may help to achieve good performance. Similarly, importation of livestock from a distinct environment to another need to take into consideration adaptation to major climatic factors and disease and parasite criteria, feed situation, prices of inputs and products as well.

3.3 Concept of Energy Balance in the Physical Environment

Since mammals and avian that form bulk of farm animals are homeotherms and hence maintain a constant body temperature, they possess means for producing and losing heat during extreme cold or heat conditions respectively.

Hear Production: Animal produce heat when transforming chemical energy of food into work. Under normal circumstances a grazing animal while in the sun may gain heat directly or indirectly from solar radiation. The added solar heat and metabolic heat generated from food and muscular activities form the animal heat gain.

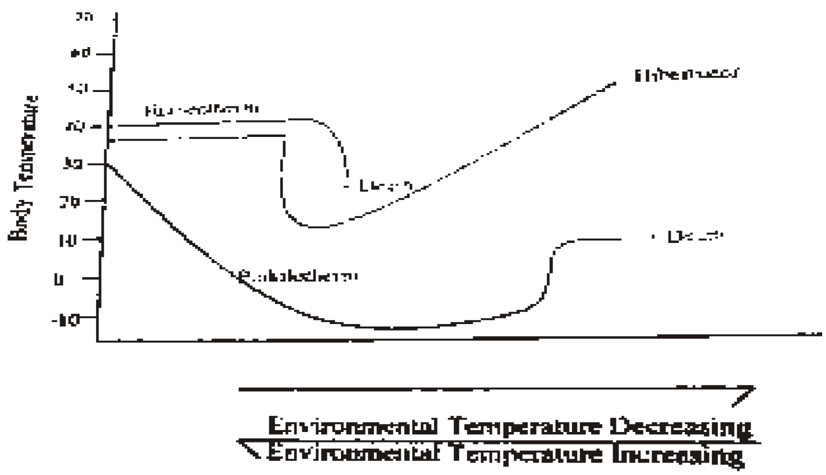
The heat gains in one animal vary from another as a result of:

(a) the intensity of heat production by different organs varies depending of the weight of the organ. On net weight basis, the brain generates heat faster than the muscular tissue due to higher density of the former
(b) the body size also affects heat requirement, for instance, smaller sized animals require a greater heat production per unit weight than larger sized animals if the same temperature is to be maintained. This is because the smaller the animal, the greater the surface area and the more the heat loss
(c) specific surface area which is the ratio of surface to volume determines heat loss. This is because with increasing body size, the surface to volume of the animal increases, and therefore the relative surface from which is dissipated increased. When heat production is better expressed per unit surface area, the effect of body size is largely eliminated. Heat production is better expressed in terms of body surface area.

Evaporation: Evaporative water loss occurs from the skin after it has been secreted by the sweat glands. Other areas of evaporative of water losses include respirative water loss and sweating. The two forms of water are two major processes used in temperature regulation in animals. The process of evaporation of water requires a large amount of energy and is therefore used to cool the body of animal. Evaporation occurs only when the air is not saturated already with water.

Metabolic and Chemical Heat Transfer

With increasing environmental temperature body temperature for homeotherm is constant while that for poikilotherm increases. Increasing ambient temperature for poikilotherms increases the metabolic rate and decreases with decreasing ambient temperature similar normal chemical reaction. However, with homeotherms, the metabolic rate decreases with increasing temperature and increases with decreasing temperature. Other chemical reactions like muscular activities, shivering and metabolic reaction of the liver are also involved e.g. liver apart from producing heat also releases glucose into circulation which is a basic requirement for chemical temperature regulation.



Factors Affecting Heat Production

Ingestion of food leads into increase in heat production which varies greatly with the type of nutrients ingested. Also in ruminants the rumen micro-organism constitutes an auxiliary source of heat (about 10 per cent) in addition to the animal's moral heat production. The foetuses as well as lactation add up to the amount of heat production by the dam. During severe cold or active physical exercise, the heat generation by muscular activities increases while the heat from abdominal organ decreases. In cattle and sheep, heat production is about 10 per cent greater in standing position than in lying position. In pregnant animal, foetus metabolism together with the acceleration of body processes of the dam result in an increment in the total heat production.

The presence of brown fat is another source of heat production. Brown fat is found in rodents but has been found in other animals including man. It is especially useful in homeotherms exposed to cold and hibernators. The brown adipose tissue is distributed around vital organs of the thorax, along sympathetic ganglia of the central nervous system, around the cervical and thoracic segment of the spinal cord to prevent loss of heat and excessive cold from inactivating the function of the vital organs. Both the metabolic and thermo-genic actions of the brown fat are by stimulation from sympathetic nervous system under cold condition.

Heat Loss: Heat loss from animal body is by two means:

(1) sensible heat loss i.e. through radiation, convection and conduction
(2) insensible heat loss which is through evaporation of water.

Heat loss by means of sensible heat loss offers little or no control for the animal to regulate unlike insensible heat loss in which animal exerts marked control. Heat transfer by sensible heat can be in either direction of loss or gain, while insensible heat transfer is only along one direction i.e. through loss from animal to the environment.

Heat transfer involves two forms of gradient:

- Inner gradient and out gradient. Inner gradient concerns with heat flows from the core of the body to the surface of the body.
- Outer gradient on the other hand refers to the heat that goes from the surface of the body to the environment. Heat transport along the inner gradient is affected by conduction across the tissues and by convection by the blood. Along the outer gradient, heat transport is by the following:

    1. Convection across the hair coat and boundary layer of still air surrounding the body
    2. Convection from the boundary layer of air to the fully moving air
    3. By radiation from the tips of the air across the boundary layer
    4. Evaporation across the hair coat and boundary layer.

3.4 Effect of Stress on Animal Productivity

Generally heat result in increase in the blood volume and a decline in red blood count. However, longtime heat stress at moderate level leads to haemo-concentration as a result of heat loss. Heat loss also creates an acid surplus due to formation of lactate, metabolic or respiratory acidiosis which may exhaust the bicarbonate buffer system of the blood resulting in a fall of P^H. The increase in blood volume also leads to a drop in total protein concentration. The decline in tyroxine secretion is accompanied by increase in ACTH (growth hormone) released and also induces the release of vasopressin from the posterior pituitary gland. Other effects of heat stress on specific productive parameters are discussed as follows:

1. **Effect of heat of reproductive Function**: In the male, heat stress impairs testicular function resulting in depressed spermatogenesis, lower testosterone function before leydig cells, delayed puberty, and decrease libido. There is also an increase in sperm abnormalities and impaired integrity of sertoli cells. Heating the testises to abnormally high temperature cause a complete cessation of spermatogenesis. There is also a decline in sperm mobility, sperm density and fluctuation in seminal P^H.

In female animals there is delayed puberty, reduced ovulation rate, increased incidence of silent heat. Short oestrous and prolonged oestrous cycle. Other effects are reduced conception rate, increased rate of embryonic mortality, increased litter abnormality, increased incidences of abortion and therefore depressed little size, low birth rate, poor growth rate and poor lactation.

2. **Effect of Light on Reproduction**: Certain animals are seasonal breeders while other breed throughout the year. Experiments have shown that exposing sheep to constant photoperiod reduces spermatogenesis and if the photoperiod is reduced to 13 hours daily there is increase in ovulation rate. Seasonal fluctuation in day length is an important factor affecting the length of breeding in some other parts of the world except the tropics. In ewes the constant photoperiod is not as efficient as reducing photoperiod in inducing oestrus.

3. **Effect of Climate on Egg Production**: It has been demonstrated that among all factors affecting egg production, temperature, humidity and light play a major role. An increase in temperature above 27^0 C, reduces the number of egg laid per year and egg shell thickness. If temperature is above 27^0C the shell thickness is reduced and the egg quality is reduced. Of all the parts produced, the egg yolk is the least susceptible to heat stress while the albumen is most susceptible to high relative humidity also lower egg production.

In birds, the control of sexual maturity depends largely on the pattern of photoperiod. Exposing bird to increasing day length is known to hasten sexual maturity while shorter day length delays sexual maturity. Increasing the day length also causes an increase in the number of egg laid per year.

However, beyond certain period of day length, increasing the photoperiod will make the bird photo-refractory i.e. resistant to photoperiod with cessation of reproductive.

3.5 Mechanism of Body Defence against Stress

Mechanism of Body Defence against Cold

The animal body can defend itself against cold by three means namely: storing or conserving heat, through insulation and by increasing heat production or a combination of all. Increasing the body insulation against cold is more economical considering energy expenditure involved.

Differences in species nurtured by adaptation have favoured economic ways of supporting higher body insulation to animals living in cold climates. The body insulation is in three classes:

1. **Peripheral Tissue**: This act by vasoconstriction of the coetaneous and sub-coetaneous to reduce the temperature gradient from the skin surface to the environment and also by the aid of subcutaneous fat.

2. **Hair Coat Insulation**: This depends entirely on trapped air which occupies over 95 per cent of volume of the air coat. The insulating capacity increases with thickness and air density of the air coat. For example, temperature and arctic species of animals tend to develop thick air coat while most tropical animal have thin air coat. There is also a non-linear fall of temperature along the hair coat, so that as the body size of animal decreases below certain level, the level of the hair coat decreases. However, wind and rain greatly reduce the efficiency of hair coat as insulating mechanism. But the impeding effect of wind diminishes with increasing hair coat density.

3. **Insulation of the Air**: This insulation is caused by the layer of air or boundary layer adhering to the surface of the hair coat in the hairy species and to surface of the body in non-hairy species. It varies from one specie to another and is almost independent of the body size. The insulating mechanisms of the boundary layer decreases with increasing air speed.

Mechanism of Body Defence against Heat

This can be effected by:

1. Behavioural means e.g. moving away from heat source, drinking more water, looking for shed or cold surface
2. Reduction in body insulation e.g. (a) vasodilatation to the ears, legs and tongues as more blood flows there to dissipate heat by taking advantage of hairlessness of the body parts. (b) Shedding of hair: If environmental temperature is equals to body temperature, vasodialation ceases to be very effective.
3. Increase in temperature loss: This occurs either from the skin or respiratory tract. The evaporation from skin is by sweating through sensible and insensible heat loss. Loss of heat energy

from respiratory tract is by panting as often noted in chicken or dog.

4. By lower rate of heat production if exposed to heat stress. The appetite drops and animal consume less feed. It also reduces its motor and thyroid activities. The thyroid gland regulates basal metabolism for homeotherm.
5. Increase in the reflectance of hair coat to solar radiation. Animal with lighter hair coat reflect more heat than those with darker coat colour. The relative importance of cutaneous and respiratory evaporation varies from specie to another. A sweating animal controls the amount of water while a panting animal controls the amount for larger proportion of total evaporation than European type of cattle. Also within a breed, heat tolerant animal have higher cutaneous and lower respiratory evaporation than heat intolerant counterpart.

4.0 CONCLUSION

Animals living in different ecologies of the world have for several decades and for every moment of the day developed means for coping with their environment as a matter of survival. Farm animals expectedly must go beyond survival to improve their productivity notwithstanding the degree of stress to contend with. Breeding or introduction of animal into an environment should recognise important adaptive traits and concepts that may help to achieve good performance. Consideration must be given to effects and adaptive mechanisms for different stress factor.

5.0 SUMMARY

The concept of fitness of farm animal extends from ability to survive now and withstand environmental demands in future, to ability to produce sufficiently to justify cost of domestication. Homeostasis, physiological, biological and genetic adaptations are concepts in understanding the means by which animal cope with their environment. The concept of energy balance forms the central pivot which tilts the environmental stress in different directions for animal to respond. Effective responses of animals to environmental stress often result in depressed productivity even in attempt to apply mechanisms to ward off the pervading stress condition. The responsibility of the producer is to understand these concepts in the management of the stock for survival and higher productivity by controlling the overbearing influence of the environment.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define and explain the following concepts.
   (a) Heterosis
   (b) Homeostasis
   (c) Habituation
   (d) Conditioning
   (e) Learning
2. List and discuss the various modes of energy transfer
3. Describe the influence of heat stress on five specific animal performance traits.

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UNIT 4 SYSTEMS OF LIVESTOCK PRODUCTION

CONTENTS

1.0 INTRODUCTION

All systems of livestock production are related to their environment. An understanding of why a system has developed with its particular local characteristics is essential to any study of livestock production or attempt to improve on it. Two broad systems of livestock production are found in the tropics – the traditional and modern production systems. Each has several subdivisions depending on the prevailing climatic condition and other factors; environment, farm system, legislation, level of urbanisation, degree of adaptation, carrying capacity of the grazing land.

2.0 OBJECTIVES

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

- identify and describe system of livestock production as well as their sub-systems
- enumerate factors responsible for the adoption of a particular system of production under different circumstances of time, season etc
- list specific advantages and disadvantages associated with pastoralism and ranching systems of cattle production
- recommend feedlot system as a strategy to meet sudden rise in demand of meat or live animals
- appraise integration of system of livestock production with other system agricultural production or practices.

3.0 MAIN CONTENT

3.1 Extensive System of Livestock Production

The traditional systems of livestock husbandry have evolved in response to climate and environmental factors. In the dry parts of the tropics, flocks or herd are large and often travel long distances. These are also known as extensive systems.

Under extensive production systems, livestock graze and browse large area of land that usually of a marginal nature, and unsuitable for other agricultural use. The distance herds or flock move daily to reach out for water, shelter at night and pastures dictates the degree sedentarisation or normadism. A sedentary system is one with fixed homestead and steady grazing area. A large proportion of tropical stock of mixed or individual species of cattle, sheep and goats may be grazed at same time. Within the extensive system two traditional subsystems are recognized, both of which have utilised marginal areas successfully for very long time. These are nomadism and transhumance. Nomadism was widespread until recently, when it is gradually transforming into sedentary and transhumance systems. Camps are fixed at different points along their route of movement depending upon the amount of water and pastures available in an area. Political boundaries are often ignored in the course of movement, which often pose legal constraints and other bottleneck. Transhumance is a common feature in the tropics involving movement and seasonal pastures as well as between different regional areas. Apart from wide cycle movement, altitude transhumance, also occurs between lowland areas and mountain top in response to temperature. Shuttling occur specially between very dry and wetter are to avoid pest infestation and in search of good quality and abundant forage and water as well which vary with change of seasons between north and south in the sub-Saharan Africa. The practice is also found in other parts of Africa, South East Asia, Near and Middle East, Mediterranean Europe and South America.

Several reasons other than a search for forage and water accessibility are given for transhumance practice that often take different modes. Animals from different families may be grouped together as one large flock or herd for transhumance expedition at a season, hired herder may be employed and mixed species could be involved. Goats are often move to pastures at higher altitudes than cattle because they are more agile and can better utilise sparse vegetation rather swampy in river or lake basins. The migratory movement is not an aimless wondering as erroneously misconstrued in the past, and number of reasons may be adduced, namely:

1. To find feed and water throughout the year for stock
2. To avoid flooding in wet areas
3. To permit cropping of homestead for food production
4. To avoid discuss and pest infestation known to be prevalent in a particular place
5. To afford full utilisation of grazing resources perhaps lying waste in the marginal land areas
6. To conserve and improve soil fertility for seasonal agricultural production, in which crop residues are consumed by livestock and in return they give manure.

The Fulani in West Africa are transhumant. Their permanent bases are in areas of seasonal crop production. In rainy season they move into tropical savanna and desert scrub. In the dry season they return to cultivated areas where their animal feed on crop residues; they may even extend further into the fringes of the forest zone. Herd and flock sizes may range from 50 – 300 heads per herder with a herd or flock composition of 55 per cent mature female, 25 per cent mature male and 25 per cent young female of sheep, cattle or goats.

3.2 Intensive System

The intensive system of livestock production refers to management practice where animals are confined and by implication are not allowed to forage or fend for themselves under similar practice; a fenced land area may be designated as grazing area or paddock, usually adjacent to animal pens. Often high cost resulting from labour costs, expensive feed or a large investment in one of the farm assets such as land, housing or animals, as such products are highly priced and optimum productivity is desirable to achieve success or economic viability. Housing facilities managed under hygienic condition are provided for the stock and appropriate medications and health management are offered as well. Of significant importance is the provision of good quality feed that is sufficiently balanced in the required nutrients and quantity for animals to perform optimally under confinement. Agro-industrial and farm wastes constitute bulk of feed material for intensively managed stock. Stall feeding is the method commonly adopted in this system.

Ranching System

The system is commonly found in lowland, Europe, where it was introduced by colonial settlers into Africa and Asia. Herds or flocks are kept in large sizes on an expense of land area surrounding by fence. Imported breeds or their crosses are stocked under ranches. Pasture as the main source of feed receives quality improvement in form of agronomic inputs, maintenance, conservation and control. As such, control or rotational grazing form part of daily management practices to ensure sufficient good quality forage throughout the year. Young ruminants are engaged in creep grazing to permit access to better and uncontaminated pasture than the older stock. It ensures sufficient time for the grazed portion to recover and to produce sufficient re-growth. Specific time for recovery of a pasture is strictly monitored to ensure production of non-fibrous but highly digestible forage. A rotational or spelling period of 7 weeks is usually allowed for vegetation recovery of a paddock to obtain good nutritional balance. However, a longer period of 10 weeks is required to control parasitic worm infestation in a paddock striking a balance between nutritional and veterinary requirements may be difficult, however, behoves the manager to reach out for appropriate compromise. Ranching system depends importantly on availability of god quality forage throughout the year for encamped stock. It is therefore recommended for areas with sufficient rainfall to support good growth of pasture grass.

Intensive Finishing (Feedlot Fattening)

Intensive finishing represents the final stage in meat-type production system for ruminant animals. Although it requires relatively expensive inputs, the high-valued products often derived more than compensate for the cost of production. The span of intensive finishing is usually limited to a period of 3 – 4 months for cropping a set of fatteners. Where large number of stock is to be kept together in a confinement, standard of management needs to be high. Finishing units are located in near towns and large urban centres where there is great demand for meat. The intensity of management of inputs reflects on the high quality of feedstuff offered and veterinary services administered, which to a large extent determine functionality and success of the system. Intensive finishing is usually programmed to target religious period when it becomes obligatory for adherents of Islamic faith to slaughter animals for sacrifice.

3.3 Semi-Intensive System

As may be observed in the foregoing, varieties of subsystems have been adopted to take advantage of low-cost of the extensive system and the high productivity of the intensive as circumstances may dictate under different operational environment. Many times, such adapted system takes the semblance of both the intensive and extensive system, forming a hybrid system between the two. Most improvement efforts on the traditional extensive system deliberately avoid high cost of the intensive system to adapt to semi-intensive system. Under such intensive system, a limited number of stocks, specially breeding female animal is confined only at night in an enclosure in which there is a shelter large enough for all animals. Grazing with the animal is done daily using a paid labourer in addition to concentrate feed, mineral salt block and clean water. Herd or flock has access to cultivated leguminous fodder and vaccination against common diseases of internal and external infections. Breeding is highly controlled.

The system is amenable to integration with other farming systems and may take different forms in terms of its operation under different production conditions. A few of subsystem management practices under semi-intensive systems are listed as follows:

- Shepherded grazing
- Grazing in fenced paddock
- Tethering
- Scavenging

3.4 Integrated Livestock Production System

A good number of production practices have evolved which entail integration of one system of livestock production with another agricultural practice. Most intensification practices of this nature are still on trial or at experimental stage, while a few cases are actually in practice. Livestock production intensification practices often arise from constraints of increasing pressure of urbanisation, complementarily between systems in terms of benefit or resource sharing, disposal of waste or manure, legislation etc.

An example of such intensification of livestock production is the age long practice of crop-livestock integration. In this system, crops are grown primarily or partly for feeding livestock and the latter is employed in land preparation and soil fertility improvement using the animal manure.

In urban areas, integration of poultry production with aquaculture fish farming has been reported. The poultry droppings are channeled into the fish pond to enrich and fertilize the pond to support growth of plankton on which fish feed. In places where ducks are kept as poultry, swimming in the pond also helps to aerate the water. Similar intensification practice has been suggested between small ruminant and pond fish production. In swamp rice growing area, introduction of fish into irrigated rice farm has been suggested.

In certain parts of Nigeria, crop residue (or leftover) of farm harvest are deliberately preserved for grazers to feed on, and encamp for a specified period to ensure sufficient dropping of manure for cereal production in the next growing season. The advantage of intensification is considerable and be enumerated.

4.0 CONCLUSION

Several systems of livestock production abound in the tropical area in response to the environment. The main traditional and modern systems with their subdivisions arose from climatic and seasonal effects, farming systems, carrying capacity etc. the advantages and problems of each system requires new modifications, adaptation and adoption depending on certain factors and capacity of the farmer.

5.0 SUMMARY

All systems of livestock production evolve from dictates of the environment where production activities take place. Systems are developed in response to the environment to create convenience for productive performance. There are two systems of animal common in the tropical Africa – the traditional and modern production systems each with several subdivisions. The attributes of extensive, intensive and semi-intensive systems continue to be attractive to the practitioners despite their challenges. The challenges also stimulate further search for new methods including integration method and various modifications under the influence of certain controlling factors.

6.0 TUTOR-MARKED ASSIGNMENT

1. List and describe systems of livestock production you are familiar with under the tradition system
2. Identify and list factors affecting the system of livestock production in Nigeria
3. Discuss advantage and disadvantage associated with pastoralism and ranching systems

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UNIT 5 PRINCIPLES AND TECHNIQUES IN LIVESTOCK BREEDING

CONTENTS

1.0 INTRODUCTION

The early part of this course focused on the effects of the tropical environment on animal production. In this unit, another important factor controlling performance of farm animal will be examined. Genetic factors relate to the influence heritable characters from parents and ancestors have on the performance ability of an animal. Genetic factors differ from environmental factor which do influence performance of animal arising from the external environment rather than from inherited. The two principal tools (genetic and environmental factors) are available for livestock owner to use for improving animal performance. For each to be used successfully, the other must be properly taken care of. If maximum improvement is to be derived from selection, animals should be reared in most favourable environment. This unit will offer basic principles and techniques used for animal breeding for all important performance traits.

2.0 OBJECTIVES

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

- explain the basic principles of animal breeding
- recognise heritable characters and methods for genetic improvement
- explain the procedures and use of artificial insemination for successful breeding improvement
- develop improvement programme
- identify inherited defects.

3.0 MAIN CONTENT

3.1 Methods of Genetic Improvement

The farmer has two main ways in which he can attempt to raise the performance of the animals. He can either improve their environment or try to change their genetic make-up in order to increase their genetic potential. The various traits or characteristics of a pig for example are genetically controlled and inherited through genes, which contain the basic hereditary material. These genes can be manipulated to achieve genetic improvement by either increasing the frequency of favorable genes or combinations of genes by selection, or by introducing new genes into the population by crossbreeding with other breeds or strains.

Selection for improvement

Genetic traits can be divided into simple traits governed by a single pair of genes, such as shape of the ears or coat colour, or complex traits, controlled by many genes, which include the performance traits such as growth rate, feed –conversion efficiency and carcass quality. With simple traits genes are normally dominant and recessive. If present in the heterozygote (i.e. a mixture of dominant and recessive genes), the dominant gene suppresses the expression of the recessive gene. Recessive traits will thus only appear when two recessive genes come together in the homozygous form this means that occurrence of a trait in a breeding programme can be predicted. As an example, if a recessive trait was desirable (e.g. prick ears) then only prick –eared animals would be used as parents. This pattern of inheritance was first discovered by an Austrian monk called Mendel, in his classic work with green peas, and is therefore known as Mendelian inheritance.

In the case of complex traits, the situation is entirely different. If we take growth rate as an example, within a given environment the individuals, who possess a greater frequency of genes favouring growth rate will exhibit superior growth rates compared to the rest of the population. Thus, if only animals with superior growth rates are selected as parents, this will increase the frequency of the favourable genes in the next generation. This may be illustrated in a population of pigs where selection is being considered according to growth rate, and only the animals growing faster than 750g/day would be used as parents.

The major factors which affect the efficiency and genetic progress in selection programme are as follows:

- **Definition of objectives**

  It is of paramount that selection objectives are clearly defined before a breeding programme is embarked upon, and that they are not subject to constant change. This is particularly important in tropical conditions, where traits such as adaptability, coat colour and ability to produce on low-quality diets may be more critical than growth rates or carcass characteristics. Priorities may be completely reversed, e. g. fat pigs are preferred to thin pigs in some situations, The number of traits in a breeding programme must be kept to a minimum, as the more traits are selected for simultaneously, the slower the progress for each trait.

- **Selection differential**

  This is a measure of the superiority of the selected parents over the mean of the population from which they are derived; the bigger the differential, the greater the genetic progress. Clearly, the larger the variation in a heritable trait in a population, that is the scope for a bigger selection differential, the faster the rate of genetic progression.

- **Heritability**

  Heritability is a measure of the proportion of the superiority of the parents above their contemporaries which on average is passed to the offspring. More precisely, the heritability indicates the proportion of the total phenotypic variance that is due to additive genetic effects. Conversely, a heritability of 100 per cent indicates that the trait is totally heritable whereby differences in environment between animals will not affect the phenotypic variation of such a trait. In general in the pig, reproductive traits tend to be of low heritability, growth traits of medium heritability and carcass traits of relatively high heritability. Genetic progress will always be greater when selecting for traits of higher heritability (Table 5.1).

TABLE 5.1: Some heritability estimates for important traits in the pig

	Heritability %
Number piglets born per little litter	
Litter-size at weaning	15
Daily weight	7
Daily weight gain	9
Feed-conversion efficiency	21-41
Dressing-out percentage	20-49
Mean backfat	26-40
Carcass length	43-74
	40-87

Generation Interval

This is defined as the average age of the parents when their offspring are born, and represent the time interval between generations. The shorter the generation interval, the more rapid the genetic progress, and if young boars are mated with gilts and replaced by selected progeny after one litter, the generation turnover can be as short as one year. Even in the normal situation where it is assumed that progeny born in first-to-fifth litters are equally likely to be chosen as replacements, pigs with an average generation interval of 2-2.5 years still have a great advantage over other domestic meat-producing species such as sheep (3-4 years) and cattle (4-5years).

Accuracy of measurement of units

The success of a selection programmed is entirely dependent, in the first instance on the accuracy of the records that are used. In this case important traits are easy to measure, e.g. live weight gain, but in others it is more difficult to be accurate, e.g. feed –conversion efficiencies and carcass measurements. Before embarking on a selection programme, it is essential to ascertain that the traits involved can be accurately measured.

Estimating the response to selection

Once the values for heritability (h2) and selection differential (SD) and generation interval (GI) have been determined, the genetic gain per year can be estimated.

3.2 Techniques and Processors for Testing Performance

Progeny-testing

As the boar has a relatively large influence on the characteristics which the next generation of a pig herd will inherit, testing systems have tended to concentrate on improvement of boars. Boar progeny-testing systems have been in operation throughout the world for a long time and are based on measuring the relative merit of a boar's progeny from several sows. This obviously gives a true indication of what a boar may be able to contribute towards the genetic improvement of a herd. However, in addition to being very expensive progeny-testing takes a long time in order to accumulate the data required to evaluate a boar, which makes him relatively old before his potential is known. This reduces his useful life. Consequently, as a routine system, progeny-testing has largely been superseded for traits of higher heritability by the performance test. Nevertheless progeny-testing is useful for assessing traits which do not lend themselves to performance-testing, e.g. sex-associated and slaughter traits.

Performance-Testing

The basis of a performance test is that an animal own performance taken as a measure of its genetic merit and with traits of high heritability used as a guide to how its progeny will perform. Thus the better individuals are selected from within group of contemporary animals that have been treated similarly. The value and accuracy of a performance test can always be checked by running a subsequent progeny test seeing if the result agrees with the merit order of the Performance test. Performance test can be carried out at central performance-test station, where the environment standard for all animals tested. If facilities are adequate, testing can be carried out on-farm for within-herd comparisons.

The traits and selection criteria which are used in a test will obviously vary between countries according to their relative importance. They will also vary between countries according to their relative importance they will also vary within that country depending on the use for which the pig is required. The criteria for selection of a boar which is to used for generating gilts for commercial breeding, for example, will be different from those of a boar which is to be used as a terminal sire for the production of slaughter stock. Nevertheless, various combinations of growth rate, feed-conversion efficiency and back-fat thickness are the traits which generally form the basis for selection.

Selection Methods

Selection methods also differ and the two mostly commonly used are independent culling levels and the selection index.

Independent Culling Levels

In this method, a level of performance is set for each trait, and if a pig fails to reach the desired standard in any trait it is automatically culled. It can be likened to an examination system where if you fail any subject, you have failed the total examination. A major weakness of this technique is that if a pig has outstanding qualities in some traits say growth rate and feed conversion efficiency, and just fails to reach the standard on conformation, it is culled. The genes for the outstanding traits are therefore lost. This method is the main system used for judging merit in pedigree breeding schemes.

The Selection Index

In the index method, the traits to be selected for are combined for one animal into a total score or index. Each trait is normally weighted according to its economic value and heritability, so that the highest – index animal should yield the highest financial return. These economic weightings in the index can be adjusted as economic circumstances change. The advantage of the index method is that exceptional performance in one trait can balance out a weakness in another and if two traits are correlated so that improvement in one leads to a simultaneous decline in another required trait this can be allowed for in the weighting.

3.3 Improvement Programmes

As an example of how testing and selection procedures can be integrated into a genetic improvement programme, the national pig improvement programme in Zimbabwe is described. This programme is based on a pyramidal structure A small number of registered nucleus breeders assessed to be the best herds genetically in the country, send their pigs to a central performance – test station. Approved boars and gilts pass out to multiplication herds, assessed to be the next rung down in terms of genetic merit, where their progeny is performance tested on the farm. Animals which pass this test are then available to commercial producers, thus ensuring a constant supply of quality replacement stock to commercial herds.

At the central test station, pigs are housed in pens of two and fed individually and their performance is measured from 35 tropical indigenous and an imported exotic breed. For this reason, the level of heterosis will always be highest in the first (f) cross, and decrease in subsequent crosses as the genetic differences decline. However, the overall economic gain which can be obtained from heterosis effects can be cumulative within a cross- breeding system. Thus for litter –size at weaning, for example, if the first cross dam gives a heterosis improvement of 11 per cent, and there is a further 6 per cent to be gained from her progeny's performance, the cumulative effect is 17 per cent, or more than one additional pig weaned per litter. There are a number of different cross – breeding strategic which can be used, all of which harness different amounts of heterosis.

Of these two breeding systems, crisscross system is probably the most appropriate for the small- scale producer in the tropics. If a third pure breed is available this can be extended to a triple crossing system using a sire selected from each of three breeds in rotation. Maximum heterosis is obtained when the genetic diversity, between the parent breeds is large, and there is therefore considerable potential for cross between exotic and indigenous tropical breeds. The best use of such crosses is likely to be in semi-intensive systems of production where the hardiness and foraging ability of the indigenous animal will be complemented by the growth and improved performance of the exotic. Large numbers of cross – bred, animals can be found on these systems. The two main problems are the maintenance of exotic boars for generating the cross –breed, as they often fail to survive due to disease and management hazards, and the lack of breeding control, resulting in indiscriminate interbreeding.

One possible solution under such condition is the use of institutionally managed boar –holding centre, such as those in some parts of northern Nigeria, where indigenous sows from small- scale farmers are kept to be mated with pure-bred exotic boars. Alternatively, private farmers with intensive production units could be encouraged to produce cross- bred progeny for sale to small scale farmers. Similar methods could be use for the generation of exotic x indigenous boars for use on indigenous sows in small –scale production systems.

The benefits of heterosis in female reproductive traits can also be utilised in boars. Cross- bred boars have been shown to have greater libido, larger testes and higher sperm counts than their pure- bred contemporaries, leading to more reliable breeding and improved conception rates. This enhanced reproductive fitness is obviously likely to be a major advantage in extensive and semi-intensive production systems in developing countries.

The harnessing of heterosis is maximised in the genetic improvement schemes run by the private breeding companies in the developed world. Each company maintains a network of super- nucleus and nucleus herds in which superior genes are concentrated. These herds are subjected to strong selection pressure with rigid and comprehensive testing of stock for important traits. Selected purebred stock from nucleus herds is then used to populate multiplier herds where improved lines and breed are crossed. The resultant first cross or hybrid gilts are sold to commercial producers.

3.4 Cross Breeding and Artificial Insemination

In the previous section, methods of pig improvement have been based on selection within breed. There is, however, another means by which the producer can attempt to genetically improve the performance. This involves cross- breeding which is the:

- exploitation of the phenomenon of heterosis, which occurs when two breeds, which are genetically different, are crossed. If the cross- bred individual shows an improvement in performance above the mean of both parents it is said to exhibit hybrid- vigour or the ability to combine in one or more individuals the desirable characteristics of two or more existing breeds.

The higher levels of heterosis tend to occur in traits which are of lower heritability, e.g. reproductive traits.

Artificial insemination

Artificial Insemination **(AI)** involves the collection of semen from a boar and then the introduction of semen into a sow or gilt at a later stage by means of a catheter. This contrasts with natural service where a boar mounts a sow and introduces his semen.

The major advantage of AI is that is allows for the wider use and distribution of boars of high genetic merit. The ejaculate from one boar can be extended to inseminate up to 25 sows. Recent advances in methods of boar semen storage make it possible for developing countries in the tropics to the very top genetic stock from developed countries (e. g. in the UK, only the top 5 per cent of boars performance-tested by the Meat and Livestock commission are eligible for entry to AI studs). This calibre of genetic material would not otherwise be available to developing countries.

Other benefits of AI are:

- It overcomes the need to purchase, house and feed a boar. This is particularly pertinent to the small-scale producer who cannot justify keeping a boar for a small number of sows, and who cannot afford a boar of good quality. The effective use of AI is especially relevant where small-scale producers are involved in group or co-operative pig development schemes, and their units can be serviced from a central boar-holding centre,
- It prevents the transmission of disease from farm to farm by the sale and purchase of boar and on-farm reproductive disease cannot be spread by boar-to-sow contact.
- It overcomes the practical problems of differences in size of males and females. On occasions, this problem can severely limit the use of boars of high caliber.
- It reduces the risk to stockmen of handling boars for natural service.

Techniques

a. Semen collection

Although various artificial vaginas and electro-ejaculators are available, they are not necessary for successful semen collection. Boars can easily be trained to mount a dummy sow device or an oestrous sow, and firm pressure on the penis by a gloved hand causes ejaculation to occur. The first low-sperm fraction can be collected through a filter funnel, which removes the gelatinous fraction, into a warmed (30^0C) bottle.

A drop of semen can be observed under a microscope to check its fertility characteristics and, if desired, the semen can then be diluted. A number of diluents and extenders are available, and the individual doses are normally stored in 50 ml plastic bottles for up to three days at 15^0-20^0c. the number of spermatozoa used under commercial conditions for one insemination normally varies from 1×10^9 to 3×10^9 .

b. Insemination

This involves the insertion of a rubber spiral catheter into the sow's vagina, and then rotating it in an anti-clockwise direction until the tip locks into the cervix. The bottle containing the semen dose can then be attached to the other end of the catheter and the semen runs in under gravity slight pressure. The insemination process may take up to 15 minutes.

c. **Heat detection and timing of insemination**

It is very important note that higher conception rates are achieved with AI approach than those that occur with natural service. Accordingly, accurate heat detection must be carried out, preferably using a boar twice a day in order that the timing of insemination is correct. To overcome inaccuracies in the detection of the start of oestrus and the natural variations in time of ovulation two inseminations approximately 12 hours apart are recommended. More recently, devices have been developed which measure the electrical resistance of the vaginal mucosa. As this varies in relation to hormonal events, it can be used to predict more accurately the timing of ovulation and hence the optimum timing of insemination.

System of semen storage

(a) **Frozen semen**

In contrast to bull semen, the nature of boar semen renders it susceptible to damage by the freezing and thawing procedures, and as a consequence only relatively recently have successful techniques for freezing boar semen been developed. Frozen semen can be obtained in either pellet form or in straws, and acceptable conception rates obtained, this has provided a major breakthrough for the introduction of superior genetic material into developing pig industries.

(b) ‘**Long-life’ semen**

Extenders have now been developed which allow for the storage of fresh semen for up to seven days without any marked loss in fertility. This allows for fresh semen to be sent by air around the word and used to impregnate sows successfully in the country of destination

3.5 Some Inherited Defects to be Avoided

There are many anatomical defects for example in pigs which can affect performance. The majority of these are genetic in origin and therefore likely to be inherited from generation to generation. Tests are conducted to detect defects. These defects may be simple (i.e. controlled by one pair of genes) or complex (controlled by several pairs of genes). At the end of the test, the feed conversion efficiency is calculated, and the fat thickness is measured by an ultrasonic machine. Pigs are assessed on the basis of an index derived from the relative economic values of feed conversion efficiency and fat thickness; animals which do not pass the index are culled. In addition, animals with any abnormal sexual characteristics, blind or insufficient teats, or other defects such as weak legs or undesirable body conformation are also culled.

On – farm performance tests are then carried out on the sons and daughters of approved centrally – tested sires. Pigs are inspected for any weaknesses and, if they attain certain performance standards in terms of growth and fat thickness, they are made available for sale.

The potential value of regular performance –testing can be seen from the results of a control landrace herd, in which both boars and replacement gilts were selected on the above scheme over eight generations. The improvement in feed – conversion efficiency represents a considerable saving in costs.

Simple defects

The can be effectively eliminated from a herd by culling. The main defects in this category are:

- Congenital tremors in this condition, piglets are born with rhythmic tremors of the head and limbs. It occurs at a frequency of about 0.1 percent in the population. The recessive gene is carried by the dam, and in carriers 50 per cent of male piglets are affected. Dams of affected litters should be culled.
- Club foot this defect causes a deformed and swollen foot. It has a very low incidence and is restricted to the landrace breed. Both male and female parents should be culled.

Complex defects

These are more difficult to eliminate, but greatest response will be achieved by culling boars. However, the incidence of these defects is generally relatively low, so it may be more economic in the long run to keep a good boar which is a carrier of a known defect rather than replace it with a genetically inferior boar which is not a carrier. If good records are available, the cost of the defect can set against the gain in pig performance attributable to the carrier boar. Such a boar should only be used for the production of slaughter stock and none of his progeny should be retained for breeding. The main defects in this category are:

- Scrotal hernia: A weakness in the body wall allows part of the intestines to pass out into the scrotum. It occurs at a frequency of around 0.7 per cent and has an estimated heritability of 15 per cent.
- Umbilical hernia: A similar condition which occurs at the site of the umbilicus. Found at a frequency of around 0.6 per cent.

- Imperforate anus: The incidence of this condition in piglets is around 0.3 per cent. Mortality in male piglets is always 100 per cent, but often around 50 per cent of females survive as the faeces are voided via the vagina.
- Splaylegs piglets are born with either the front or hind legs splayed, sometimes both, and are unable to stand. The incidence is around 1.5 per cent and can be worsened by nutritional deficiencies. If piglets survive for three days, the condition often tends to disappear.
- Hermaphroditism: In this condition, females tend to exhibit male characteristics. Incidence is estimated at 0.07 per cent.
- Cryptorchidism: Also known as a ‘rig’ pig, one testicle in the male fails to descend into the scrotal sac. Found at a frequency of 0.22 per cent.
- Female genital defects, including ‘inverted nipples’. These occur at a frequency of around 0.15 per cent.

4.0 CONCLUSION

The principles and techniques of breeding advance knowledge; and application of selection and cross-breeding are means of farm animal improvement. They have been used as major tool in animal production in combination with environmental management of stock.

Genetic improvement forms the foundation upon which appropriate feeding; healthcare management, housing and other environmental management efforts are built. Tremendous progress can be attributed to genetic improvement of animal traits. Genetic and environmental factors are however not independent rather both have large area of overlap or interaction.

5.0 SUMMARY

Selection and cross breeding are the most common methods for genetic improvement. Either method involves culling and promoting characters of animals which are undesirable and desirable respectively by farmers. These require that farmer is able to identify specific traits that are genetically heritable; have high selection differential and in animal with short generation interval in order to attain high genetic progress. The two methods similarly require preliminary testing and evaluating animals to be used in the improvement scheme. Cross breeding in farm animal has improved livestock productivity greatly and widely as a result of artificial insemination, benefiting specifically from semen collection and preservation technology. Much as desirable characters are known, some undesirable simple and complex traits must be identified and using appropriate method discriminated against them.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the principles of animal breeding
2. Describe methods for genetic improvement
3. Highlight procedure for an improvement programme you desire for a named livestock specie in Nigeria
4. How will you discriminate against certain undesirable traits with known heritability coefficient?

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MODULE 2

UNIT 1 LIVESTOCK BREEDING IN THE TROPICAL ENVIRONMENT

CONTENTS

1.0 INTRODUCTION

The much wider gap between performance of tropical livestock species and those of the temperate climate demand a critical review and consideration by learners and practitioners of animal production. A foundation course in animal production, such as this, requires students to be acquainted with the existence of the performance gap which has often been attributed to genetic, environmental, and genetic-environment interaction variables. The essence of familiarisation with this challenge may stimulate the desire to finding ways of meeting domestic demands and reducing the performance gap. The identity and measures of productivity of breeds of livestock in Nigeria compared with some exotic breed ought to agitate the minds of students as to what motive or factor underlies the disparity between production capacity of exotic and local breeds of stock.

2.0 OBJECTIVES

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

- differentiate between the past and current efforts towards tropical livestock breeding
- explain crossbreeding as a tool for tropical livestock improvement
- recognise major genetic differences between tropical and temperate livestock breeds
- describe options for genetic improvement in tropical livestock.

3.0 MAIN CONTENT

3.1 Past Livestock Improvement Efforts

The temperate – zone countries particularly in Northwest Europe earlier commenced livestock improvement through general improvement of environment for livestock such that at the beginning of 19^{th} century improvement efforts were directed towards taking economic advantages of livestock. Economic advantages were easily achieved as at then by improving on the housing facilities for livestock to prevent adverse climatic effects. Advances in livestock breeding started in 19^{th} century particularly in the United Kingdom. The advances were however based on limited records, acute observation and trial-and-error efforts compared to modern genetic theory being used these days. Science of genetics began to gain recognition in the early 20^{th} century revolutionising animal breeding with the application of genetic principles combined with new knowledge on physiology of reproduction. Today, the pace of progress is tremendous with the advent of knowledge on molecular structure of DNA (Deoxyribonucleic Acid) and location of genes on the chromosomes. Genetic engineering will soon take animal production to a new stage.

In contrast, these practices are extremely slow to be applied in the tropical countries. Although livestock owners in the tropic developed rules or customs towards better breeding of their stock, but these seem to be haphazardly applied and uncontrolled probably due to inefficient grasp of the challenge or its solution. As such efforts to improve the productivity of livestock in the tropics have always moved in a cyclic manner perhaps for a few reasons. One, the original domestication of most species probably occurred in the tropics and/or subtropics. Two, large movement of stock from their origin of domestication to isolated areas resulted in natural development of characteristics that adapted them to their new environment. Three, breeding of animals in some cultures was restricted to cultural, magical or religious rather than economic perspective. Four, importation of improved breeds from Europe to the Americas thrived in the temperate climate but parallel importation from Europe to the tropical countries of Africa and Asia was not successful except for Criollo cattle breed of tropical Central and South America. After a few attempts to improve the genetic make-up of stock, a new stream of importation to Africa followed without success, until it was realised that highly productive European and American breeds cannot thrive in tropical Africa and Asia unless epizootic diseases are controlled and nutrition and management are improved.

3.2 Modern Approach to Livestock Breeding

A new direction is to identify tropical breeds and to initiate selection within them. Yet this has proved to be disappointing. Current efforts are towards introducing productive temperate-type livestock into the tropics primarily by cross breeding, which seems to be succeeding although at very slow rate. This effort is not without its warning on the consequences of losing the purity of genetic resources of tropical livestock. Thus improvement of tropical livestock lies in greater knowledge of their characteristic traits and those of temperate stock as well. It also involves being better able to control and improve the tropical environment. The priority will however vary from an area to another. For example, in areas where epizootic diseases are still prevalent, disease control will be a priority. Elsewhere in which considerable control of disease has been achieved, nutrition and management need to be accorded priority. It is important to note that it is needless to improve genetic merit if environmental factor remains unimproved. Also, any improvement in genetic merit implies a major step up in both feeding and other management aspects of production. It is important to appreciate the theory that indigenous livestock breeds adapted to the tropics have achieved some level of adaptation by a natural selection against productivity. Studies (Payne and Hancock, 1957) have shown that high rates of milk production and rapid growth rate increase effects of climatic stress by increasing the metabolic heat output of the animal. In this situation, a number of breeding policy options is available.

- Husbandry may select for productivity in indigenous stock.
- Upgrade indigenous stock by the introduction of exotic males or by importation of the semen.
- Introduce a crisscrossing breeding system using exotic and indigenous males.
- Introduce exotic stock and attempt to select for adaptation.

- Ameliorate the climatic stress in the tropic to such an extent that exotic stock of high merit can be used (the economic viability of this option is untenable).

The choice of one or a combination of these options varies from country to country and from region to region within countries. It also depends on a number of factors such as:

- Type of indigenous livestock available
- Agricultural system prevailing in the area
- Managerial ability of the local farmers
- Type and size of the market for livestock products

In Nigeria some form of crossbreeding using indigenous (White Fulani) and exotic (Friesian) breed at 50:50 or 25:75 is being carried out at the National Animal Production Research Institute, Shika -Zaria. An earlier report (Knudsen and Schael, 1970) has shown that lactation yields of White Fulani (840 kg) and Friesian 92,550 kg) improved after crossbreeding in the first generation offspring, Friesian/White Fulani (1, 688 kg). A complementary option to this is to intensify pure breeding of the White Fulani and other indigenous breeds to preserve their genetic resources for the future. This implies that a good safeguard for the existence of purebred indigenous cattle is by encouraging the selection of the most productive indigenous stock in special bull breeding herds. It seems there is no effort in this direction at present. However, it is of little use to upgrade indigenous cattle or any livestock species if the managerial abilities of the local farmers are not upgraded simultaneously.

3.3 Crossbreeding as Tool for Tropical Livestock Improvement

A breeding system in which unrelated livestock are mated is known as crossbreeding. The offspring (or progenies) of crossbred livestock are heterozygous for those traits that differ in their parents and the greater the degree of heterozygosity on the offspring. A crossbred progeny inherit the totality of parental characteristics and tend to resemble each other. First-cross generations are usually superior in productive traits to the mean values of both parents. This phenomenon is known as Hybrid Vigour or Heterosis. The degree of hybrid vigour depends on the extent to which the characteristics of the parental stock are complementary.

In general, the greater the differences in the parental genetic make-up the greater the degree of hybrid vigour which may be expressed in terms of improved fertility, viability and general thriftiness. The degree of heterosis depends also upon the level of the environment (Barlow, 1981), such that the more stressful the environment the greater the heterosis. Hybrid vigour, however, disappears when hybrids are mated and in the offspring produced. As such new parental stock are continually required if livestock owner wishes to apply or use hybrid vigour optimally.

Crossbreeding may be useful in three ways to livestock owner in the tropics. It can be used for breeding replacement stock. The indigenous and low-producing livestock can be upgraded by continually backcrossing them to more highly productive exotic/introduced stock. New synthetic breeds can be produced by cross breeding indigenous with introduced stock and then selecting the type of animal or trait required. Both advantages: hybrid vigour and being complementary can be achieved by using some form of systematic crossbreeding between 2 or more breeds of indigenous and introduced stock.

Genetic engineering or recombinant DNA technology is a new practice likely to become needful in the near future as it is possible to use it for modification of the function of animals for better adaptation and productivity. New generation of animals may be made through this technology. Presently, the technique is being exploited in production of vaccines for use against some animal viruses. It is possible to copy genes or manipulate to increase bulk of genetic materials by introducing genes into bacteria and inducing the same to multiply or reproduce very rapidly, attenuated and used for vaccine production. This method is known as gene cloning. Foot and mouth disease vaccine of cattle is being prepared by this technology.

3.4 Major Genetic Differences between Tropical and Temperate Livestock Breeds

Sufficient evidence exist to suggest that more than 50% of the differences in performance of tropical and temperate-type breeds of livestock are due to their inherent genetic abilities or merits. In other words, under fairly conducive environmental conditions, tropical and temperate stock exhibit clear difference in economic traits as a result of genetic differences. In cattle for example, traits showing genetic differences are: age at first calving, calving percentage, milk yields, length of lactation, birth weight, rate of daily live weight gain and mature body weight. In addition, McDowell (1972) listed gestation length, generation interval and carcass killing-out percentage as traits showing genetic difference between tropical and temperate stock. Further evidences have emerged to prove that some tropical breeds such as Bali cattle are not inferior to temperate breeds with respect to some traits like calving percentage, mature body weight and carcass killing-out percentage. In the light of genetic differences in traits, tropical livestock breeders must make efforts to adopt suitable breeds and breeding system that will address traits of economic advantage in their stock.

3.5 Options for Genetic Improvement in Tropical Livestock

(i) **Use of Indigenous Breed**

As earlier suggested, tropical livestock breeders must depend on the use of indigenous breeds for utmost advantages since the indigenous breeds are readily available, well adapted or acclimatise to the immediate environment and possess matching genetic traits with such environment. However, a major limitation, to this option, is that selection for increase productivity is likely to be for a lengthy period due to, previous natural selection for survival, which was at the expense of productive traits. Thus, priorities of breeding efforts in the tropical region under the option of using indigenous breeds are:

(1) Genotype-environment interaction improvement
(2) Liveweight gain as the most important economic trait and other adaptive traits such as tolerance to diseases and pests (e.g. trypanotolerance of N'dama cattle).

(ii) **Upgrading**

Another option earlier mentioned is the importation and use of exotic breeds for purpose of upgrading indigenous breeds. Consideration for importation of exotic breed should be restricted to exotic stock from temperate climate. There could be genuine rationale to import exotic stock from one region of the tropics to another. The use of exotic breed for upgrading has the unique advantage to hasten improvement of productivity where suitable exotic breeds are used and the local environmental conditions are improved. Major limitations have to do with high cost of upgrading and loss of genetic resources of the local breeds where upgrading is done indiscriminately. Acclimatization of exotic breed to the local environment may be time consuming and expensive. The option of upgrading with exotic breeds should focus on:

(1) Areas with moderate climatic, disease and nutritional stress, or montane regions in the tropics.
(2) In case of dairy animals, lowland humid areas have sufficient forage year-round.
(3) Areas where no indigenous breed exists to exploit the specific peculiarity of the ecological environment. For

example it may be reasonable to import water buffaloes or pigs for the creeks of the Niger Delta region of Nigeria.

(4) Importation is strongly suggested for livestock species whose production system can be restricted from the influence of external environment e.g. intensive poultry or swine production in tropical countries.

(iii) **Crossbreeding**

Crossbreeding as option has its own advantage of combining desirable traits in two or more breeds in one which is usually higher in hybrid vigour. Expressed hybrid vigour is notably in traits not largely moderated by genetic or inherited factors but more by the environment such as vigour and fertility. Heterosis decline with age and its influence is greater in females than males and in stressful condition than in moderately good condition. Limitations of crossbreeding option concern obtaining suitable breeds to combine, expensive and complicated management system to be evolved to obtain good results. This possibly explains reasons where crossbreeding practices are limited to poultry, pigs and ranches in government farms or research centres in the tropics. Also, planning a crossbreeding scheme for livestock improvement may be a very difficult exercise. Planned crossbreeding should concern:

(a) Areas or breeds, which research has sufficiently approved to show tangible value, advantage or merit.

(b) In areas infested with tsetse fly that debar livestock production, crossbreeding with trypanotolerant breeds.

(iv) **Developing New Synthetic Breeds**

Developing a new synthetic breed is an option that seems to streamline limitations of upgrading and crossbreeding options for genetic improvement of livestock in the tropics. It explores crossbreeding or upgrading of indigenous stock using a superior stock and then systematically selecting the offspring to form a breeding much. It may be extremely long and expensive as it is also require competent personnel. It is often undertaken by very large private organisation, government or international agencies. However, it has an enduring result and may revolutionise livestock in the entire tropical regions. The option is highly versatile as it can be applied on dairy cattle, goat, sheep, poultry and pigs for different enterprises and for diverse production conditions.

4.0 CONCLUSION

An in-depth understanding of the past and modern approaches to livestock breeding is fundamental to our understanding of the challenges in animal production practices in the tropics. Crossbreeding has been offered as intervention to reduce obvious gap in the genetic merits existing between temperate and tropical breeds. There are a few other options (e.g. use of indigenous breeds, developing new synthetic breeds etc) still available but have not been applied or perhaps reserved for the future. Practitioners and students are required to appreciate the genetic constraints tropical livestock and be armed with sufficient knowledge for improvement.

5.0 SUMMARY

The study unit has endeavoured to present a body of knowledge on past and current approaches and efforts at improving genetic make-up tropical stock. Crossbreeding as tool for improvement has been widely applied but certainly not only the tool applicable. Equally important options are the use of indigenous breeds and upgrading with exotic or local breeds of proven genetic merits. Developing new synthetic breeds and the application of genetic engineering techniques are being advocated for national or regional livestock genetic improvement.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss past efforts at improving tropical livestock breeds. List modern approaches.
2. Explain crossbreeding as a tool for livestock improvement and highlight its advantages.
3. List options available to livestock breeders for genetic improvement of tropical stock. Highlight areas of focus, benefits and merits of two of the options listed.

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UNIT 2 GENERAL PRINCIPLES OF CATTLE PRODUCTION

CONTENTS

1.0 INTRODUCTION

Cattle resources in Nigeria are mainly concentrated in the Sudan, Southern Guinea, Northern Guinea and the Sahel ecological zones in a descending order of distribution. Cattle production is a major part of the livestock sub-sector contributing substantially into the national economy through its supply of animal proteins in form of beef and milk, raw materials to agro-processing industries in form of commodities such as hides, beef, milk, bones, horns and hooves; provision of gainful employment and livelihood to a host of people and families as well as a source of farm power in animal traction and cow dung for bio fuel and soil fertility. The valuable contributions of the cattle industry relate to foreign exchange earnings, instrument for capital accumulation or saving and a number of socio-cultural roles in different societies. However, cattle production in Nigeria lags behind meeting all the expected contributions satisfactorily. The output of cattle is low and this reflected from less than 2kg of beef and 23g of milk is derivable by an individual Nigerian annually from local stock. A number of constraints are involved ranging from nutritional, genetic make-up, to socio-economic and institutional constraints. This study will endeavour to put status of cattle production into perspectives that will enable students appreciate and develop focus to finding lasting solutions.

2.0 OBJECTIVES

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

- identify and describe breeds of cattle in Nigeria in relation to their adaptation, physical features and productivity as dairy, beef or dual-purpose breed
- describe systems of cattle management and the underlying factors determining preference for one to another under different circumstances
- list some constraints to cattle production in Nigeria
- discuss strategies for improving cattle production using opportunities lying around us optimally.

3.0 MAIN CONTENT

3.1 Breeds of Cattle in Nigeria

The Nigerian cattle population is dominated by the zebu breeds. Data from FAO (1980) and Lamorde and Franti (1975) indicate the following percentage composition of the national herd:

Breed	%
(White Fulani) Bunaji	51.0
(Red Fulani) Rahaji	14.0
(Sokoto Gudali) Bokoloji	11.5
Adamawa Gudali	11.5
Others	12.0
Total	100.0

In addition to indigenous breeds, various exotic breeds have been introduced mainly for cross breeding to improve milk and meat production of the indigenous cattle; these include the Holstein-Friesian, Brown Swiss and Jersey for milk production, and the South Devon, Sahiwal, Brahman. Santo Gertrudis, Droughtmaster and Butana for beef production. Nearly all the exotic introductions are found on government and institutional ranches and dairies, and they constitute a very small percentage of the national herd.

The other production coefficients of the national herd are more difficult to derive. The calving rate has been estimated to be 45 per cent (Lamorde, 1974, Saka Nuru, 1976). There appears to be general agreement to an estimate of 15 per cent for calf mortality, whilst the adult ornon-calf mortality rate has averaged 4 per cent. Off-take is generally assumed at about 10 per cent, although there is no statistical basis for this as a considerable proportion of the slaughtering is not recorded. The cow culling rate has been estimated at about 10 per cent, whilst the replacement rate is about 15 per cent. Pullan working with traditional herds on the Jos Plateau has given live weight estimates of cows, heifers, and steers as 250 kg, 175 kg and 235 Kg respectively. ILCA (1980) studies indicate the possibility that a high proportion of the animals sold are for reasons of sickness or unthriftiness, and in some cases this may account for as high as 50 per cent of the sales. Hence an average carcass weight of 125 kg at 49 per cent killing out has been suggested. Extrapolating from a national herd of 9.3 million and an average killing out percentage of 49 per cent, the above model would give annual sales of around 117,000 tonnes of dressed beef. At N2.25/kg, this would represent a farm gate value of about N262 million. The combined value of stock and milk sales at the farm gate is therefore in excess of N400 million per annum.

There is a need for caution in the use of these data as the absolute basis for projections, especially when the data cover a relatively short period of time, which may not entirely reflect the typical cyclic pattern of weight losses and gain experienced by most traditional herds. The off take rate has been estimated to be as high as 16.9 per cent among traditional herds (Lideco, 1980) while live weights observed over a longer period of time indicate higher average than those of Pullan or ILCA (1980). Recorded live weights of Sokoto Gudali and Bunaji yearling bulls and steers purchased from traditional herds on delivery at the Feed Lot Operations, Mokwa, indicate an average of 230 kg (Olaloku, 1977). In addition, there are other components of national herd productivity including manure and draught power. These become relevant and of great significance in an integrated crop and livestock farming system. Indeed, the value of the manure is underscored in the existing symbolic relationship between arable crop farmers and pastoralists in which the latter is allowed to graze crop residues in exchange for manure from the stock.

Nigeria has indigenous breeds of cattle from which could be raised animals of suitable type and productivity, whether for economic production of beef or milk; but that nutrition must be improved in order to achieve optimum productivity. Generally speaking, the yield per animal unit is very low but it is pertinent to remember that this is from herds subsisting on the savannah lands of the most northerly states, which provide, during a wet season of from four to five months, a coarse herbage of only very moderate feeding value, being almost bare of keep during the seven or eight months of the dry season. Thus the animals suffer annually, a prolonged period of malnutrition, often of near –

starvation and at no time in the year do they live on what can be regarded as nutritionally adequate level.

3.2 Systems of Cattle Production

The Traditional System

Outline: Cattle production under the traditional system is generally associated with the pastoralist transhumance which has developed over the years as an adaptation to environmental and historical factors; it constitutes the main component of cattle production in the country with the pastoral Fulani as the centre of focus. The traditional livestock grazer was faced with the problems of seasonal variations in forage availability, water, disease, social interactions with the arable crop farmers, government taxation demands, and the need to cater for his family. The resulting evolution has led to a range of husbandry practices geared to overcoming these problems, particularly availability of grazing and the need to avoid the tsetse fly transmitting trypanosomiasis.

Classification of Pastoralist: Ethnic, ecological and economic factors all influence ownership and management of cattle, independently and in combination. As a result, there is an almost infinite number of permutations, but four groups can be broadly recognised:

1. **Nomadic or Fully Mobile Pastoralist**

   These practice pure transhumance, with no permanent place of residence and no regular cultivation. They and their families move with the herds, generally in a southward direction during the dry season and moving back during the rains. They have average herds of about 80 – 100 head of cattle together with some sheep and goats (20 – 40). In the search for grazing and water, areas of tsetse fly infestation and other diseases are avoided; their movement is also determined by the location of arable framing communities which provide crop residues for grazing, as well as markets for sale of produce and purchase of essential needs.

2. **Semi-Nomadic or Less – Mobile Pastoralists**

   In contrast have a permanent place of residence where the elderly members of the family stay with some of the stock, such as the Lactating cows. The other stocks are moved away in search of grazing and water for long periods of time during the dry season. They practice some cropping (often hiring outside labour) although livestock remains their most important economic activity. This group generally does not own as many cattle as the former group, but all their other practices are similar. Indeed, it is claimed that this is a transition stage to full sedentarisation.

3. The Semi – Settled Pastoralist

These have a permanent place of abode and practice some supplementary cultivation for food production. They keep smaller herds and usually only move out in search of grazing and water towards the end of the dry season. They sometimes construct temporary shelters, and grow and harvest crops at the beginning of the rains before moving back to their home base.

4. Settled Pastoralists

These live continuously in permanent settlements all year round, and practice arable cropping in addition to livestock husbandry. Herds are grazed during the day by children or hired hands and the animals are tethered at night. Some of these look after stock for owners who live in the urban areas.

Pastoralist Management: In order to survive in a purely nomadic system, each unit must control enough livestock to sustain itself. While many forces have led to the continual process of settlement a key factor is herd size which, either due to inheritance or disease may cease to be viable economic unit in its own right so that recourse to cultivation is necessary for survival. However, with allowance made for a total dependence on the proceeds of livestock husbandry and the constraints of perpetual mobility, the husbandry system holds good for both nomadic and settled Fulani.

The Mobility of Cattle is a Feature of all Extensive Grazing System: At the extreme the pure nomads may move hundreds of kilometers and stay nowhere more than a few days while for the permanently settled, the grazing zone may be within say five kilometers of the camp. For the latter there are three, albeit indistinct, phases in the year. During the growing season the herds are kept off the crop lands in large units. Immediately after harvest the cattle are put in is graze crop residues; this is often, but not always, by arrangement with the farmers. As the dry season progresses the herds; are progressively subdivided for grazing, smaller units being better able to seek out and utilise small patches of grass, crop residues, etc. in some areas there is a separation of the ‘wet’ animals; (cows and calves) and cows that are in an advanced stage of pregnancy, which are left behind in the ‘Mashekari’ or permanent place of abode while the rest of the herd is moved out in search of feed. The wet herd is grazed in areas like the fadamas (the low plains) that have good dry season supplies of forage and water.

A close examination of the traditional pastoralist system reveals a stronger emphasis of milk production than beef, and the system of management that ensures all year round supply of milk from the herd. Milk is a major source of income for the family's day to day needs, and women attend markets daily in order to sell the sour milk (nono), butter (mai) along with millet or sorghum ball (fura); the fura is sold with the nono mixed by the vendor and is consumed on the spot. Household heads also attend market regularly and the trading pattern leads to a natural affinity between herd movement and the location of markets and population centres.

In conclusion, it should be stressed that the general concept of the traditional grazier as a nomad who cannot settle is fast disappearing. The picture that now emerges is that between 40 – 50 per cent of traditional Fulani graziers are settled, another 20 – 30 per cent are estimated to be semi-settled, whilst only about 20 per cent now remain in the traditional nomadic system of production. This is significant for it means that the often stated constraint that nomadism has on introducing technology to the cattle industry does not apply to over 50 per cent of cattle owners.

The Modern System

The introduction of semi-intensive and intensive methods, modeled on those successfully employed for beef and dairy production in agriculturally advanced countries, is largely confined to government, parastatals and institutional research farms. They commenced with the establishment of a number of governments Livestock Improvement and Breeding Centres (LIBC) in different parts of the country during the late 1940's and early 1950s. This trend continued into the 1960s and has attracted the attention of some farmers in the private sector, who, in corporative groups or as individuals have started mixed farming enterprises. These mixed farming operations have gained popularity amongst the educated groups (retired public servants, etc) who are taking advantage of the Federal Government's encouragement of agricultural production through the provision of guaranteed credit facilities. Though initially influenced by Fulani systems cattle production on these units has some element of specialization into beef and milk production whereas in the traditional system, both are complementary products of the cattle industry.

Beef Production: The establishment of beef cattle ranches has taken place mainly in the Guinea Savanna zones. The ranches are stocked with indigenous cattle breeds such as the Gudali (Sokoto and Adamawa), the Bunaji, and in the ore southerly areas the trypanotolerant N'Dama has been introduced along with the Ketuku or Borgawa cattle. Management plans on most ranches have included provision of extensive range grazing, sometimes undersown with legumes, with allocations of 3 – 4 hectares/animal in the Southern Guinea to 4 – 6 hectares/animal in the Northern Guinea and Sudan Savanna zones. Some of the ranches provide improved pasture areas of about 0.125 ha/animal for dry season feeding (Upper Ogun Ranch in Oyo State) or maize and grass silage also for dry season feeding and feed lot operations (Mokwa Ranch, Niger State). Mineral salt licks are provided in the paddocks and all year round watering from dams and bore holes. Deworming and vaccination against the major cattle diseases are carried out routinely, and cattle dips are provided for control of ectoparasites, particularly ticks, some recording has been carried out but because of the inconsistency with which this has been done, it has not been very easy to utilize these records in a meaningful evaluation of technical and economic performances.

A ‘Steer Fattening Unit’ scheme was introduced for small-scale producers in the Derived Savanna areas of the old Western Region in which, under a system of continuous bush grazing with adequate water supply, mineral salt licks and facilities for tick control and deworming possibility of profitable beef production using trypanotolerant breeds and crosses was investigated. This idea caught on with many farmers in the area, and has continued with modified aspects of the scheme and today a good number of them fattern steers for supply to slaughter houses in Ibadan and other urban areas. A recent apparently successful development along these lines is the Smallholder Fattening Scheme introduced by the World Bank Assisted Livestock Project Unit (LPU).

Feed lot fattening of yearling bulls steers on a commercial scale was introduced into the Nigerian beef industry about a decade ago on the Mokwa Cattle Ranch. A significant development was the introduction of sugarcane molasses from the Bacita Sugar Factory into the fattening diet in late 1972. The fattening programme was planned to coincide with the end of the sugar cane harvesting season, so that large quantities of molasses would become available for feeding during the long dry season period of November to April.

The bulls and steers were purchased from the traditional herds as yearlings aged 18 – 24 months, predominantly Sokoto Gudalis with some Bunajis with average weights of 200 – 240 kg. They were quarantined for 30 days during which they were vaccinated for CBPP, anthrax, and proplylactic treatment with ‘Berenil’ against trypanosomiasis, as well as drenching for worms and spraying for ectoparasites. Therefore, they entered the feedlots with two-week adaptation period on the molasses based feeding regime. Group fed, each animal received approximately 3 kg molasses, 3 kg cottonseed, 5 kg grass/maize silage *plusad libitum* supply of salt licks and water. Over a- three-month fattening period, the animals average 300 kg live weight at average, daily gains 682 gm. The dressed carcasses were marketed through the cold stores and supermarkets in urban centres of Lagos and Ibadan.

Although the records indicate substantial improvements in the physical performance of the indigenous breeds under the modern as compared to the traditional system of management, it is pertinent to note that the different models of the modern sector taken together only account for a very small percentage of the National Herd and their contributions to the beef market is therefore correspondingly small.

Milk Production: Milk production under the system of management is confined almost exclusively to government or institutional experimental farms. The dairies are generally located within easy marketing distance of consumption centres, and attempts have been made to organise dairying countries. Herd size varies from 30 to 50 on the experimental stations and from 50 to 200 on the ‘urban’ dairies operated by various State Ministries of Agriculture. The animals are housed, milked by hand and/or machine, and the milk is usually processed before distribution to consumers. The animals are maintained on cultivated pastures with supplementary concentrates, and standard milk recording is practiced on most farms.

Although milk production per animal under the modern system has been substantially higher than that obtained by traditional producers, the results have not been very encouraging when compared with their counterparts elsewhere. Low performances have been attributed to poor management resulting in low pregnancy rates due to poor organisation of the breeding programme especially heat detection for Al, long calving intervals, short lactations, and little attention to balanced feeding in terms of concentrate or forage use. In addition, there tended to be very little selection of stock at the time of purchase.

In terms of increased milk production in their own right, the contribution of these dairies has been insignificant and they have incurred high costs and considerable manpower demands. Although it could be argued that their role is as research and development centres, this could be justified if their breeding and production objectives are carefully defined and satisfactorily implemented along with the generation of records from which objectives evaluation of performance can be made; in most cases this has been the case.

3.3 Major Production Constraints

Feed Supplies: The provision of feed that is adequate both in quantity and quality are available all year round countries to be one of the major problems of cattle production in Nigeria. Communal grazing of the natural range is the primary source of nutrient supplemented by crop residues during the dry season. Feed supplies during the latter when natural vegetation becomes rank and unpalatable, are particularly acute and is aggravated by an imbalance between stocking rate and range carrying capacity. A consequence of overstocking is a high incidence of erosion and a reduction in the capacity of such areas to produce feed in the following growing season. This is the case in many of the country's high cattle production areas (e.g. Mambilla and Jos Plateau) and becomes extremely acute in the Sahelo-Sudanian savannah ecologic zone, where the dry season is often long and severe.

When it is prolonged for more than a season, as was the case during the Sahelian drought of 1972 – 74, considerable losses in animals usually result. Apart from the drastic reductions in productivity of the surviving stock, some impairment of the reproductive function may result as well as a general lowering of the animal's resistance to disease.

Expanding arable cultivation is further limiting the natural range area that is available to the livestock owners and in 1965 a programme of establishing grazing reserves was initiated in an attempt to secure a year round source of forage feeding for the traditional herds. The reserves were to provide infrastructures – water, access roads, and centres for the provision of inputs such as feed supplements and minerals licks. However, the grazing reserve programmes have not provided the expected solutions to the feed problem of the traditional herds, and further review of their function and development is required.

A supplementary feed programme was also initiated to prevent the seasonal weight losses resulting from low quality herbage and from the long distances trekked by the animals with the attendant risks of disease transmission and parasitism. It was also seen as an attempt to encourage settled animal production among the traditional livestock producers. The first attempt was in 1962/63 by the then Northern Nigeria Government under the 'Fulani Amenities Programme' aimed at introducing concentrate feeding to cattle to reduce loss in weight especially during the peak of the dry season. The subsidy element of the programme was to be phased out over a 6 year period by which time stock owners were expected to recognise and appreciate the benefits of supplementation.

The supplementary ratio took the form of equal parts of groundnut cake and cotton seed cake, 2% common salt plus mineral salt licks.
The scope of the programme has since been broadened and redesigned to demonstrate to the traditional livestock producers the economic benefits of feeding supplements such as hay, groundnut, cottonseed cake etc. Observations however indicate that the programme has not had the desired effect due largely to inadequate and untimely distribution of the supplements. To some extent poor infrastructural facilities (transport, storage) and lack of personnel have been responsible for this and has led to poor coverage of the remote areas along with inconsistent supply. An imbalance between demand and supply has encouraged undesirable commercial exploitation, and there is evidence of an increasing shortage of the major ingredients used in the supplementary ratio formulations in the last few years.

Breeding: Breeding programmes to achieve improved milk and to a lesser extent meant production, have adopted the following approaches:

a. crossing indigenous cows with bulls (naturally or by Artificial Insermination (AI) of higher producing exotic breeds, mainly the Holstein – Friesian and to a lesser extent the Brown Swiss and South Devon cattle.
b. importation and maintenance of purebred exotic herds.

Achievements in both approaches have so far been impaired due largely to lack of a properly coordinated national breeding policy programme. Cross-breeding has not followed clearly outlined objectives; rather some form of upgrading has been done but there is no definite evidence yet as to what stage this upgrading should be stopped. . Reproductive performance of cows is an important consideration when assessing the achievements of breeding work already carried out, since this trait is correlated with milk production. Data from both Agege and Vom which showed large variations in all the traits, indicated that little culling had been practiced. The long calving intervals recorded may be due more to management problems, particularly heat detection and prompt service especially where AI is practiced. Faulty feeding has also been implicated, as well as the lack of regular pregnancy checks as cases of ovaries were quite common in some of the herds.

The conclusions from the experiences of the breeding approaches on the government ranches and dairies so far, are:

a. that there are possible benefits in crossbreeding, but there must be well-defined national objectives for milk and beef production and a well organised AI programme. Such objectives will guide the choice of exotic breeds to use and possibly the source of such importation

b. the programs should be clearly spelt out so as to ensure continuity in execution and a continuous evaluation of achievements
c. the pioneer or pilot urban dairy projects have made some contributions to our knowledge of the problems of commercial milk production in Nigeria. They therefore remain a useful component in our attempts to establish an organised dairy industry in the country
d. there is now sufficient technical base on which to formulate guidelines for the management of existing and proposed stations for commercial dairy and beef breeding and production operations
e. given such condition, it should be possible within the next decade to extend the benefits of these programmes to increase productivity of the national herd.

Disease: The important epizootic diseases of cattle in Nigeria include rinderpest, contagious pleuropneumonia, foot and mouth disease, anaplasmsis, babesiosis and of course trypanosomiasis. These diseases limit production in cattle wherever they occur. In particular, trypanosomiasis has rendered millions of hectares of land unsuitable for cattle production. Dematophilus has become important particularly among the imported stock on government dairies and amongst the indigenous breeds, particularly in the higher altitude areas of Jos, Mambilla and Obudu Plateaux. Foot and mouth disease is also assuming importance with the increase in importation of exotic cattle. Mastitis is also known to be assuming significance especially in view of the increasing emphasis on commercial dairy development. Tick-borne diseases, such as heartwater, babesiosis, anaplasmisis are especially important in imported cattle herds.

Although some progress has been made in the diagnosis and control of some of these diseases, those remaining constitute a potential hazard to cattle production in Nigeria. Not much headway has been made against such as coetaneous streptothricosis, heartwater, brucellosis, tuberculosis, vibrosis, and mastitis, most of which may result mainly from bacteriological infection. There are also nutritional, toxic, metabolic and organic diseases. Together these reduce the productivity of the national herd, although their effects may not be as telling as those of the major epizootic diseases.

Land Tenure: The trend of increasing settlement by pastoralist cattle owners, which has occurred over the last decade, can be attributed to a number of reasons:

- The Sahelian drought of 1972 – 1974 which severely affected the crop farmers, also indirectly affected pastoralists, for apart from feed shortages for their stock it also upset the pastoralists ability to get food in exchange for milk and milk products. This forced many to cultivate crops for their own consumption.
- The need for a national, state and LGA identity, particularly the struggle for ethnic recognition was more emphasized during the last decade than ever before, and has provided an additional motivation to settle.

Despite the trend however, land tenure remains a major obstacle to development for the grazers do not have secure individual rights to land. For with very few exceptions, right over a land, whether cultivated or uncultivated, is already claimed by the traditionally settle communities practicing crop cultivation. As a result, the presence of settled pastoralist is accepted as a concession rather than a permanent tenure, and rarely extends beyond the area of crop cultivation except with regard to the traditionally recognised rights of communal range grazing. In such cases, the grazers have neither the opportunity nor incentives to invest in land improvement so that they are unable to realise the full potential benefits that settlement should allow. This remains a critical issue in cattle development in Nigeria, the implications of which are outlined below.

3.4 Strategies for Improving Cattle Production in Nigeria

The Situation: Communal grazing of the natural range is the primary source of herd nutrition and there is an inverse relationship between actual stocking density and range carrying capacity. This is largely due to the incidence of tsetse fly which requires a certain degree of humidity to survive so that infested areas have relatively good rainfall and a high natural forage growing potential. Serious overstocking occurs within these areas of cattle concentration to the extent that malnutrition is the single most important disease affecting cattle in Nigeria at the present time.

The fact that overstocking occurs is a function of both communal land ownership and the propensity of cattle owners to increase their herd numbers. Various reasons account for the latter including prestige, security and the frugal demands of cattle owners for cash income other than that required for the welfare of their stock. This notwithstanding, there are two overriding factors which must be borne in mind.

- Provided that mortality is less than inflation and the demand for cash income is low, it is economically rational to build up herd numbers rather than increase off-take

- Even if overstocking is a generally recognized problem amongst cattle producers, no one producer would be encouraged to destock without the assurance that other producers would not build up their numbers to fill the vacancy that this destocking has created.

In consequence of the above, herd numbers, even in areas of serious overstocking, continue to rise partly as a result of natural herd increase but possibly, due to in-migration of herds from neighbouring countries.

The effects of overstocking are that the carrying capacity of the range itself declines, herd productivity deteriorates to a level that counterbalances or exceeds the effect that the increasing herd numbers would otherwise have on off0takem and nutrition becomes such a limiting factor that the opportunity for raising herd productivity by means of other technologies, such as veterinary and genetic improvements is very limited.

The Options: To a large extent, therefore, production improvements from increase in the national herd will only materialized if:

a. The areas of cattle distribution are extended either by control of the tsetse fly, chemotherapy or a wider use of trypanotolerant breeds
b. Natural range production is supplemented by use of purchased feeds, or
c. Natural range production is improved either by controlled grazing (which would generally imply some stratification of the transhuman pastoralist system) or, more importantly, through pasture and forage production.

Nutritional Improvements

Extending the Range Area. While significant progress in physical control of the tsetse fly has been made, eradication is expensive and can induce undesirable environmental changes when the technique is based on persistent toxic insecticides.

Control procedures are also becoming increasingly more complex as the fly free front moves southwards.

Chemotherapy is effective in areas of medium to low tsetse challenge but correct dosage and regular application are necessities which poses considerable organizational problems when applied to large numbers; incorrect or indiscriminate drug usage also runs the risk of certain strains of trypanosomes becoming resistant to chemotherapy. The alternative of using trypanotolerant breeds faces a severe and expensive supply problem since most of the breeding stock would need to be imported. Although the productivity of trypanotolerant breeds such as the N'Dama have been shown to be comparable with that of Zebus which have a much larger body size, their importation is beneficial only in terms of improving domestic meat supply rather than resolving the problems of Nigeria's significant cattle population which is 96% Zebu unless a crossbreeding programme with N'Dama bulls is carried out over successive generations. Importation of these breeds also requires a high degree of organization and control for their tolerance does not make them immune to tsetse challenge.

During the last decade there has been a significant build-up of cattle numbers in hitherto regarded tsetse infested areas in the Middle Belt due both to the pressures of overstocking in more northerly areas and to the natural control of the savannah species brought about by rising population pressure and expanded settlements. There remains, however, a considerable risk of severe trypanosomiasis problems if cattle numbers were substantially increased in these areas without being preceded by a formal tsetse clearance programme.

Supplementary Feeds: The use of supplementary feeds must be viewed to a large extent as a short term solution and is in any case constrained by supply. It does not address the root cause of overstocking and therefore does not prevent the continual degradation of the range that overstocking causes. Agro-industrial by-products are in very short supply in the context of national herd development, and that which is available is to a large extent already accounted for. The prospects of a domestic grain and vegetable protein surplus becoming available for conversion into cattle feeds is extremely doubtful particularly when account is taken of the demands which the more efficient monogastrics are also likely to have on feed supplies. For the ruminant group, the economic and foreign exchange implications of using imported feedstuff to supplement the national range are highly disadvantageous.

Notwithstanding the above, agro-industrial by-products have a major role to play in specific development schemes and given the constraints on national supply it is important that mechanisms are introduced which will encourage their most effective use.

Thos would include directing available supplies towards those classes of livestock which will generate the most significant impact on production, and also ensuring that priority is given to cattle owners who are to receive an integrated package of technological improvements, the benefits of which would be severely constrained by inadequate nutrition. These opportunities are expanded later in the report.

Range Improvement: Various possibilities exist for improving the carrying capacity of the natural range. These include introducing grazing practices which are in harmony with the agronomic characteristics of natural range species, stratifying production into a form which exploits the comparative advantages of different agro-ecological zones, and planting improved pastures to replace the natural range species. Considerable problems however are encountered in the application of this technology to the pastoralist cattle owner. First and foremost is that to be effective requires control of both stock movements and stock numbers and the record of success in both of these is particularly not encouraging. Pasture improvement faces the additional problem of seasonality of production and the need to either conserve wet season surpluses to meet the critical shortage of the dry season or to use pasture species with the ability to produce green foliage in the dry season, the former, in the context of pastoralist units on the communal range, is extremely difficult to apply.

Land Reform: While the ability of the pastoralist communities to exercise traditional control measures on number and movement of cattle should be fully exploited, the record of success is extremely poor. It must therefore be anticipated that under a system of communal land ownership cattle owners will wish to maximize their herd size rather than optimize returns to land. Without an incentive for the latter, which would require fundamental land reform, all measures to improve herd nutrition must be considered partial or short term solutions. Furthermore, in the absence of individual incentives to invest in land improvements, rangeland development will depend heavily on public sector services which will further limit the scope for development from the standpoint of manpower, finance and logistics constraints.

To date there has been no progress on land reform which offers any means of resolving this pressing problem for cattle development. This subject will be further pursued later. But the need for government to seriously address this issue must be continuously stressed. In any event however, progress will be a long term undertaking and the scope for improvement within the existing tenure system must be exploited.

Other opportunities

Genetic Improvements: Compared with twelve indigenous breeds under similar management, the Bunaji is above average in main productive traits.

However, the breeding programme at Shika between 1929 and 1959 which has as its main objective an increase in genetic potential for milk production of Bunaji, gave an annual increase of only 1 – 1.5 per cent. Exotic breeds usually have a higher genetic potential than indigenous breeds: Table 1A and B shows the yields of imported and of cross-breed cattle at various centres in Nigeria indicating that the first cross of Zebu with Frisian could potentially double milk yield. The results achieved so far underline the possibilities of increasing productive performance through crossbreeding with a well organised A1 programme.

Improved genetic potential however will not be realized if other factors of production are in limited supply and exotic breeds, particularly as purebreds, are generally more susceptible to disease, climatic and adverse management practices. Since the lower genetic potential of local breeds is in most cases not fully utilized because of inadequate nutrition, genetic improvement will only be applicable to areas where these more fundamental problems of production have already been successfully resolved.

Veterinary Improvements: While nutrition may be regarded the most important livestock problem in Nigeria today, it is essential that development package is implemented within the framework of a comprehensive veterinary health programme. Veterinary services are also in high demand and have affected a higher proportion of livestock owners than any other development component; veterinary technology is far more advanced than production technology and its benefits are more immediately visible to the livestock owners.

Production technology must therefore be extended within an integrated package in which disease prophylaxis and treatment is a key component.

Pregnant Cow Recovery

Considerable improvements could also be made in building up the national herd by culling of unproductive stock and alternative stock and altering the ratio of adult males: adult females from the current estimated figure of 1; 1. 25 to about 1: 20. Additional contributions to the buildup of the herd can also be expected from a successful salvage programme of pregnant cows bought for slaughter. On the basis of surveys carried out in Zaria and Kaduna areas. About 300 pregnant cows are slaughtered monthly in each of these areas. Spread over the country, such losses constitute a major constraint tot the achievement of a rapid buildup of herd numbers and the growth of the national herd.

4.0 CONCLUSION

Improvement in cattle productivity lies in identifying the cattle resources and opportunities available and applying technical know-how to harness the resources for ameliorating the constraints. This is the import of learning this unit. For instance, selection of individual animals and breed, and optimal exploration of feed resources have been combined with effective implementation of policy and health management to bring about tremendous improvement on the supply of animal products by nations like India, and recently Kenya is heading for similar feat. Nigeria seems to have the potentials to attain higher level of productivity faster compared to many developing nations.

5.0 SUMMARY

The study unit focused on cattle resources of Nigeria as an important segment of the livestock sub-sector contributing goods and services to the national economy. It potentials of industry to attain optimal supply of these values are being constrained by a number of factors, which can be improved upon if strategies and efforts are carefully deplored by individuals, government and institutions that together form the stakeholders.

6.0 TUTOR-MARKED ASSIGNMENT

1. Identify two breeds of cattle with potential for beef or dairy production. Describe each breed under the following points: ecological adaptation, physical features, performance and productivity characteristics.
2. What factors are underlying the presence of several management systems of cattle?
3. Give account of distribution of cattle in the ecological zones and changes in the distribution accompanying the seasons.
4. Enumerate the management systems for cattle production and discuss one you considered amenable to adoption for quick and far reaching improvements.
5. Recommend a set of production strategies for developing a beef cow-calf enterprise in one of the North Central States. Give some economic benefits of your recommendations.

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UNIT 3 GENERAL PRINCIPLES OF SHEEP MANAGEMENT

CONTENTS

1.0 INTRODUCTION

Recent estimate of sheep production in Nigeria puts number at about 22 million. The production objective for raising sheep is essentially for meat supply and for some socio-cultural interests. Breeds of sheep found in Nigeria seem to be more adapted for meat rather than wool. The socio-economic importance is reflected from a survey which indicated that out of about 82 per cent households found to keep livestock, 67 per cent own sheep. Each household has between 3 to 10 sheep. Production of sheep is mainly forage-dependent and represents an important segment of the Nigerian national livestock resources. Its numerical strength implies widespread distribution in all ecological zones of Nigeria, where sheep demonstrate adaptation to the environment, hardiness, profligacy. These characteristics enable sheep to generate diverse animal products, employment and forms a commodity for internal and sub regional trades in Nigeria and West Africa.

2.0 OBJECTIVES

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

- describe origin and distribution of sheep
- identify breeds of sheep in Nigeria and their relative productive performance
- explain principles of sheep production
- describe methods of stocking and other general principles of sheep production
- explain and possibly apply feedlot fattening of ram as a source of generating income.

3.0 MAIN CONTENT

3.1 Breeds of Sheep in Nigeria

Breed Characteristics for Selecting Sheep

There are four main breeds of sheep in Nigeria. These are the West Africa Dwarf, Yankasa, Uda and Balami. All are hairy types.

The West Africa Dwarf sheep is a small, short-legged animal found in the humid zone of southern Nigeria. Animals vary in coat color but black predominates. The males have horns while females are hornless. It is the smallest of the Nigeria breeds, with a mature body weight of 18 to 25 kg. Because the breeds thrive in areas that are heavily infested with tsetse fly, it is considered to be tolerant to trypanosomiasis.

The Yankasa sheep is the most numerous and is found throughout the Guinea and Sudan savanna zones. It has a predominantly white coat colour, with black patches around the eyes, ears, muzzle (nose and mouth area) and hooves. Mature rams have curved horns and heavy, hairy white mane. The females are hornless. It is a fine-looking breed, hardy and of medium body size. The adults reach weights of 30 to 40 kg. It adapts well to intensive production and has a relatively high growth rate.

The Uda sheep is a large, long-legged breed with a convex facial profile, found in the Sudan savanna zone, especially in the North-western part of Nigeria. It has a characteristic pied coat colour pattern of an entirely black or brown head and fore quarters and white hind-quarters. The ears are large, long and droopy. Mature males have horns white females are normally hornless. The breed is particularly abated to extensive grazing and is renowned for its trekking ability. Mature animals weigh 35 to 45 kg.

The Balami sheep is the biggest of the Nigerian sheep breeds and is found mainly in the drier Sudan and Sahel Savanna zones. It has an all-white coat. Mature weights of 40 to 50 kg are common. Experience has shown that the different breeds of sheep are adapted and perform best in their specific ecological zones. Because of the variations in the amount of rainfall, temperature and relative humidity, all of which indirectly affect performance, farmers are advised to raise those breeds that predominate in their ecological zones. Thus, while the Yankasa and Uda are suitable for the Guinea and Sudan zone. The West African Dwarf and Yankasa breeds should be raised in the humid Forest and Derived Savanna zones.

3.2 Stocking and Production Practices for Sheep

Procuring Foundation Stock for Breeding

Ideally, foundation-breeding stock should be purchased from reputable sheep breeding farms or government Livestock investigation and Breeding Centers LIBC so as to be certain of their purity, high genetic quality and freedom from diseases.

Unfortunately, such sources are too few at present and where they exist, the number of breeding animal available for sale is limited. This leaves the open market as the main source of breeder stock for farmers.

In purchasing animals from the market, major consideration must be given to the animal's health, age and physical appearance. The behavior and posture of an animal are reflections of its health status. Age can be determined from the number and size of teeth. Therefore, the farmer is advised to:

a. Buy animals that are free from obvious diseases such as catarrh, diarrhea and skin diseases. Also ensure that, animals are free of ectoparasites such as fleas and ticks on their bodies.
b. Avoid animals with physical defects such as lameness. Walk the animal around to find out, blindness and malformations.
c. A lean or stunted animal should be avoided. Buy only alert, fine-looking and active animals with bright eyes and fine coat.
d. Ewes (female sheep) should be between 1.5 and 3 years of age.
e. A -1.5 to 2 year-old sheep has two broad (big) central teeth, a -2 to 2.5 year-old has 4, while those aged about 3 years have 6 big teeth.
f. Buy in small batches from many markets in different localities so as to have animals that are as unrelated as possible and to have genetic variety in your foundation stock.

Initial Health Precautions

A number of health precautions should be taken before introducing newly purchased animals into your farm of flock. These precautionary measures are aimed at preventing the introduction of diseases into the farm and also to improve the chances of survival of your newly purchase stock.

It is good husbandry practice to have an isolated area away from your main flock where newly purchased stock can be quarantined for a month before introduction into the main flock. Adequate feed, water and shelter should be provided in the quarantine area.

Recommended treatment for a one month quarantine period are as follows:

- **1st day**: Give prophylactic antibiotic treatment for 3 days
- **4th day**: Give broad spectrum anthelmintics and coccidiostat treatments. Coccidiostat treatment should continue for 7 days.
- **7th Day**: Give tick-bath against ectoparasites.
- **28th day**: Repeat treatment with anthelmintics and also repeat the tick-bath. Trim overgrown hooves
- **30th day**: Animals can leave quarantine to join the main flock

In the humid zones of Southern Nigeria where PPR (pests des petit ruminants, a disease of sheep and goats also known as "kata") may be a problem, the following vaccination schedule should be included in the quarantine procedures outlined above:
Recommended treatment for a one month quarantine period are as follows:

- **1st Day**: Give prophylactic treatment with hyper-immune PPR antiserum (raised in cattle) subcutaneously (4 ml for full-grown adult).
- **10th day**: Give TCRV vaccination against PPR (one cattle dose) subcutaneously in the neck region above the shoulder. Of course initially, when starting a sheep farm you will certainly require assistance from a veterinarian or trained personnel to carry out these procedures but except for the vaccination you will be able to carry them out routinely yourself from then on.

3.3 System of Sheep Production

Intensive sheep production aims at obtaining two lambing per year and achieving high growth rates. Breeding and reproduction management should therefore receive proper attention. This involves the adoption of a number of simple, yet highly essential practices based on knowledge of the reproductive physiology of sheep. To start with it is good husbandry practice to separate male and female lambs after weaning and to raise them in separate opens or buildings this will prevent indiscriminate breeding and facilitate breeding during specific periods of the year. Male lambs attain breeding age at about nine months while female lambs attain breeding age between five to eight months however rams should not be used for breeding until one and half yearof age when they would be more efficient in serving more females due to greater development of their sperm reserves. Likewise, female lambs should also not be bred until they are nine to twelve months old when they will be big enough to carry a pregnancy with less difficulty it is good practice to replace breeding rams with newly selected ones after each breeding season or at the least ewes may however remain in the breeding flock for four to six years to lambs by older ewes. Rams to be selected for breeding should preferably have been born as twins (only one member of a twin pair should be selected to high body weight at weaning and six months. A minimum of six rams should be used in a flock of one hundred ewes to minimise inbreeding. Breeding ram should be given better feeding from at least six lambs by older ewes.

Rams to be selected for breeding should preferably have been born as twins (only one member of a twin pair should be selected to minimize inbreeding) and should be from among those that attained high body weight at weaning and six months. A minimum of six rams should be used in a flock of one hundred ewes to minimise inbreeding. Breeding rams should be given better feeding from at least six weeks before they are intended for use. The estrous cycle in sheep is 16 to 17 days and the duration of estrus is one to two days. Means that the ewe will accept to be mated by a ram for only one to two days in each cycle of 17 days this is the estrus or heat period. Ewe will normally ovulate (that is, produce an egg) shortly after the onset of oestrus (about 16 hours later) when breeding the whole flock by introducing rams for a period (flock mating). The breeding rams should be left with the ewe flock for six to eight weeks (equivalent to about three oestrous cycles) to ensure that all ewes are bred. They should be withdrawn after this period. Rams should be joined to ewes for breeding as from two weeks after lambing the ewes will still be nursing their lambs at this stage but this does not prevent them from getting pregnant if lambing extends over several weeks the ewes can be separated for rebreeding in batches according to their lambing dates.

Ewes may be synchronised for breeding about two to three weeks after lambing, using progestagen sponges. Synchronisation helps to reduce the spread in breeding dates and slightly shortens the rebreeding interval (period from lambing to subsequent conception) of ewes. The treatment is simple and consists of vaginal insertion of one progestagen sponge per ewes for 12 days within two to three weeks after lambing. In order to improve ovulation rate breeding rams should be introduced to the treated ewes two-day before the sponges are withdrawn, mating will not commence until after the sponges. Oestrous is usually spread over four days after sponge removal. Non –pregnant ewes usually return to oestrus 16 to 21 days after sponge withdrawal.

Gestation period or pregnancy duration in sheep is about five months or 152 days.
Ewe failing to lamb on two occasions, those weaning lambs of poor weight and old ewes (above seven years) should be culled (that is, removed from the breeding flock).

Nutrition exerts a big influence on reproductive performance in sheep. Under-nourishment during late pregnancy may cause pregnancy toxemia (a metabolic disease), low birth weight of lambs and poor lamb survival. Under-nourishment during lactation and rebreeding may result in depressed lactation, delayed oestrus, lowered ovulation rate and poor fertility. Poor nutrition at this period also increases lamb and ewe mortality rates up to weaning, and in addition, results in lowered weaning weights in lambs that survive. Under good nutrition and management, at least 80 per cent of ewes mated should lamb with about 25 per cent of the ewes producing twins.

Identification of individual animals facilitates many breeding operations such as selection of replacement stock and in the culling of unproductive animals. Metal or plastic ear tags are ideal for this purpose but where these are not available, wooden tags with numbers painted on them may be hung around the animals' necks. Such identification helps proper record keeping.

Feeding

Sheep must be adequately fed for optimum performance. Poor feeding is one of the major factors limiting productivity. Essentially, feeds contain energy, protein, fibre, minerals, vitamins and water

Energy is present in feedstuffs in the form of carbohydrates, fats and oils. An animal must have sufficient energy to maintain its body functions and produce meat and milk. Grains, molasses and brewers dried grains are good sources of energy.

Proteins are essential for the repair of worn out tissues and the building of new ones. Young and nursing (milking) animals in particular need proteins. Oil seed cakes wheat offal and legume hays (harawa) are good sources of protein.

Fibre is made up of cellulose. High fibre feeds are commonly known as roughages .Ruminants extract energy from fibrous feeds.

Minerals and vitamins are essential for body functions and health of animals. Although all feedstuffs contain some amount of minerals and vitamins nevertheless mineral salt licks, bone meal and local rock salts are major sources of these nutrients and should be added to locally compounded feeds.
Water is essential for the maintenance of body temperature and functions therefore water must always be available to animals.

The most commonly available feedstuffs for livestock in Nigeria are roughages (grasses legumes, browse plants and crop residues), oil seed cakes (cottonseed cake, groundnut cake and palm kernel cake), molasses wheat offal rice bran, dust (local bran) and brewers dried grains.

Roughage is the cheapest feed for sheep being ruminants this can be derived from rangelands (natural vegetation), sown pastures fallow lands and crop residues. For an intensive sheep production system, pasture establishment is a good investment, as a well-established and well-managed pasture will provide good quality feed (fresh grasses and legumes or hay). This will considerably reduce the amount of concentrate supplements and hence the production cost. A well-established and well-managed pasture can support 25 to 40 sheep per hectare under grazing in the wet season and 5 to10 sheep per hectare in the dry season. The quality of pasture deteriorates considerably during the dry season, often requiring supplementation with concentrate feed.

The amount of concentrate to be utilised will largely depend on the quality and quantity of roughage available. A rule of thumb guide is to allow the animals to graze for at least 6 hours daily or be given 1.5 kg of good quality hay per head per day. In addition, the animals should each receive 0.2 to o.5 kg concentrate supplement per day. Ewes in late pregnancy and nursing animals should receive the higher level of concentrate.

Concentrate feeds for ruminants are now marketed country-wide in 25 or 50 kg bags. It may however be cheaper to compound your own concentrate feeds. Examples of 3 formulated rations are given in the section on feedlot fattening of sheep.

Sheep require two to six litres of water per day, depending on age, physiological status, and type of feed and ambient temperature. Both water and mineral salt licks should always be available to the animals.

Housing, Equipment and other Facilities

Housing is an essential requirement for intensive sheep production. Apart from providing overnight shelter and security for the animals it also provides protection against rain and cold. Housing also enhances close supervision of the flock. In short, provision of housing leads to an overall improvement in the performance of the animals.

Sheep houses need not be elaborate and can vary in type from a low mud-wall building with thatched roof, through corrugated iron walled building, to brick or block housing. Such housing should be located on well-drained soil and should be well ventilated to avoid dampness. The floor can be cemented or made of rammed earth. The floor should be easy to clean and should be covered with suitable bedding material such as straw or wood shavings, which can be changed from time to time.

The building may be divided into pens. Floor space requirements for lambs and adult sheep are about 0.4 and 1.7 m^2 respectively. In addition, floor space should be provided for feed and water troughs. There should be a minimum of three pens, one each for male and female sheep, and a sick pen. Ideally there should be more pens per building or more than one building, with separate one for males, females and weaners.

A store and a hay barn could form part of the building. Alternatively, the hay barn could be a separate structure. A run (enclosure) made of chain-link wire, waist-high, may be constructed in front of the pens, divided into at least two sections for males and females if housed in different pens in a single building.

Water supply can be from a well, tap, and bore hole or river. It should be clean and in sufficient quantity.

Feed and water troughs should be provided in every pen, either built-in or moveable type. A rectangular feed trough measuring 4 x 0.3 x 0.15 m is adequate for 10 adult sheep. Simple feed troughs could be made by cutting a drum lengthwise into two halves. If cut drums are used, the edges should be made blunt to avoid injuries to the animals. Large plastic basins are better as water troughs as age unlike metal drums they do not corrode.

A foot-bath is required for the prevention and treatment of foot-rot, a very common problem with sheep on wet grounds. The most common type is the walk-through type which is a shallow, long receptacle. Where a small number of sheep is involved, a bucket of basin may be used.

A dip is an essential structure in a sheep farm. The walk-in, short-swim type is the most common. In this type, the animal enters the vat through a walk- down ramp into a deep section of the vat which contains the dipping solution, and swims out. Dip vats are best made with concrete. A vat measuring 6 x 1.2 x 0.75m has a capacity of about 2000 litres. It is necessary to put a roof over the vat to prevent rain from diluting the chemical. In small-sized flocks, a 200-litre drum opened at one end can be used. The animals are immersed, one at a time, in the dipping solution contained in the drum for about 30 seconds. A knapsack sprayer can also used.

Routine Health Management

Routine flock health management is very important in an intensive sheep production system if mortality is to be kept at a reasonably low level. Advice in this regard should be sought from the nearest veterinary department of the Ministry of Agriculture.

Significant common diseases of ruminants in different parts of Nigeria are as follows:

- **South-west zone:** PPR (or kata), pneumonias (viral and bacterial), trypanosomiasis, helminthiasis, coccidiosis, bacterial infections and ectoparasites.
- **South-east zone:** PPR, pneumonias, trypanosomiasis, helminthiasis, ectoparasites, bacterial diseases and coccidiosis.
- **Northern zone:** pneumonias, trypanosomiasis, helminthiasis, ectoparasites, bacterial diseases, ectoparasites, skin disorders and coccidiosis.

The most basic health precautions are provision of adequate nutrition and maintenance of pen hygiene. Animals on low plane of nutrition are more susceptible to diseases than well-fed ones. Sheep pens should be cleaned at least once a month and periodically disinfected. Overcrowding should be avoided. Sick animals should be transferred to a sick or isolation pen for proper veterinary care to reduce chances of infecting other animals. Newly purchased animals should be properly quarantined before introduction into the main flock.

PPR, which is a major disease especially in the southern parts of the country can effectively be controlled though vaccination.

Helminthiasis and ectoparasites can be controlled by routine de-worming and tick baths. Their importance varies from farm to farm depending on grazing management as well as between seasons. These diseases are more prevalent in the rainy season. Routine deworming with anthelmintics and tick-baths with acaricides should be carried out once in three months during the dry season depending on the severity of the problem.

The farmer should ensure that lambs receive colostrums from their dams after birth. The navels of newly born lambs should be swabbed with iodine tincture. Coccidiosis tends to become a problem in newly weaned lambs and should be treated against as advised by a veterinarian.
In general, it is good practice to do the following:

1. Maintain environment sanitation especially in pens

2. Adopt good internal and external parasites control measures.
3. Observe the flock closely early in the morning and at other times for early detection of sick animals
4. Isolate sick animal and seek prompt veterinary attention for diagnosis and treatment.
5. Keep proper health records and have animals that died autopsied.
6. Keep newly purchased animal under for 30 days if possible before introduction into the main flock
7. Provide mineral salt licks and clean water in pens always.
8. Ensure that animals are receiving adequate and balanced ration.
9. Where pastures have been established rotational system of grazing between paddocks should be enforced to avoid build up of parasites on pastures.
10. Trim hooves and horns when necessary.

3.4 Feed Lot Fattening of Rams

A major attraction of intensive sheep production is the opportunity it offers for large scale production of rams especially for sale during festivals when they can be sold at very high prices. Before 'rushing into the business however, there is need for careful planning if the venture is not to fail. Important points to consider include source of rams, healthcare, housing, feeding and the market. All these must be properly taken care of.

Rams for fattening can come from the farm flock or may be purchased on the open market at a time when prices are relatively low. For best results rams should be fattened for 3 to 4 months before sale. The buying periods can be timed accordingly. When buying rams from the open market the relevant precautions listed in section 2 should be observed. In particular a festival ram should have well grown horns and be free from any deformities which may affect its subsequent market value. The rams should be between 1 and 4 years old. There is generally a good market for large grown animal. Avoid very young and very old animals.

After purchases, the rams should be quarantined during which time they should be de-wormed, given tick bath and treated against coccidiosis.

Feed supplies and feeding practice considerably influence the weight gains of animals and consequently the profit margin. Therefore it is essential to feed animals adequately both in terms of quality. Feedlot rams should be fed good quality grass or legume hay at daily rates of 1 to 2.5 kg, depending on size of ram and type of hay, plus 0.2 to 0.5 kg of a concentrate mixture. Three examples of suitable fattening concentrate rations for sheep are as follows:

A.	Maize	25%
	Cottonseed cake	25%
	Wheat offal	30%
	Brewers dried grains	20%
B.	Wheat offal	40%
	Cottonseed cake	25%
	Brewers dried grains	25%
	Molasses	10%
C.	Wheat offal	35%
	Palm kernel cake	30%
	Brewers dried grains	25%
	Molasses	10%

Where labour costs are low rations may be given in equal installments two or three times daily otherwise the rations can be fed ad libitum. Where rams for fattening are to come from the farm flock weaned lambs should be kept in groups and fed high quality chopped hay (preferably legume) ad labium until they weigh above 20 kg each thereafter they should be transferred to the feedlot pen and fed as described above. Feedlot rams should be washed with soap and groomed to make them more attractive to buyers, about four days before sale.

4.0 CONCLUSION

The study content has shown that different breeds of sheep are adapted and perform best in their native ecological zones. Production therefore must need to follow the dictates of the climatic environment. In the alternative, sufficient provisions in terms of adoption of appropriate stocking and production procedures must be in place to raise a profitable flock. These procedures have been stated and packaged to offer theoretical and practical knowledge required in this level of animal production course.

5.0 SUMMARY

Sheep in Nigeria are categorized into four, namely the West African Dwarf, Uda, Balami and Yankasa. The body features, native ecological zone, body size, height at withers, shape and size of certain body parts are their distinguishing characteristics. Production performances vary with their genetic inheritance, management system, feeding and other production practices applied to harmonize genetic potential and performance. Principles underlying the production practices are mentioned in course of stating the procedures to enable student grasp the study content and apply appropriately.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain factors underlying the distribution of sheep in Nigeria
2. Distinguish between sheep breeds
3. Describe systems of sheep production
4. State the general procedures and methods for stocking and managing a sheep flock.

7.0 REFERENCES/FURTHER READING

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UNIT 4 GENERAL PRINCIPLES OF GOAT PRODUCTION

CONTENTS

1.0 INTRODUCTION

Goats were probably the first ruminant animal to be domesticated some 8000 years ago. In the ancient civilisations along the rivers of Nile (in Africa), Tigris and Euphrates (in Asia) and Indus (in India) when populations migrated from these areas, the domesticated goats spread through the continents of Europe and America. There are several good reasons for keeping goats even in preference to larger animals such as cattle.

These include:

(a) low purchase price
(b) goats reproduce at an early age and have younger ones per litter than cattle.
(c) they have innate ability to survive on low quality feed or in difficult conditions or on relatively small amount of feed. In Nigeria goat keeping is a major form of investment which keepers in rural area easily use to meet urgent financial needs. A lot of social and religious functions demand the use of goat for exchange of goodwill, marital gifts, sacrifices and ceremonies. Goat meat is a highly cherished delicacy in drinking places and hotels because of its favourable attributes of low fat, flavour and relatively low fibre. For these and other peculiarities of goat keeping, its production is popular by its contribution to the national economy through the earning of foreign exchange from export of goat skin also known as “Morocco Leather” as well as

providing employment for a host of individual being a major commodity for trade between regions.

2.0 OBJECTIVES

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

- describe the origin, distribution and breeds of goats
- explain the various systems of goat production and factors influencing their adoption
- explain the basic principles of goat production
- apply the knowledge of feeding and grazing habits of goat for production purpose.

3.0 MAIN CONTENT

3.1 History and Distribution of Goats

1. Origins and history

Goats and sheep are small ruminant belonging to the tribe, called caprini. This tribe is divided into two parts or genera, Capra and Hemitragus. The Hemitragus, also called Tahrs, are wild goats found in Arabia, the Himalayas and south India. They have short stout horns, no beards, and long shaggy coats. They have only 48 chromosomes in their cells and do not cross breed with the Capra, which has 60. The domesticated goat originates from the Capra genus and this includes five groups or species predominating in regions indicated as follows:

- Capra hircus (Bezoar) West Asia
- Capra ibex (Ibex) Central Asia, Near East, Alps
- Capra caucasia (Tur) West Asia
- Capra pyrenaica (Spanish Ibex) Pyrenees
- Capra fakciberi (Markhor) Afghanistan, Pakistan

The Bezoar is thought to the main ancestor of today's domesticated goat, but the Markhor has had a strong influence in Central Asia where many goats show the long coarse hair and scimitar type horns which are characteristic of both species. The influence of the Ibex is seen in the prominent 'Roman nose of breeds such as the Nubian, Jamnapari and Beetal.

Distinguishing the origin of goats is not an easy task. It is practically difficult to tell the difference between a goat and a sheep. The most effective and simple away is to look at the tail. In good health and not under stress, a goat's tail points upwards, that of a sheep hangs down. Goats can also have beards and the male have tail glands, which sheep do not. Horn shapes and tail or fibre covering may help classify goats, but this can be an unreliable method.

2. Goat population and distribution

There are some 639 million goats in the world, of which nearly 80 per cenr are found in the tropic and sub- tropics. This compares with world population of 1,067 million for sheep and 1,306 million for cattle. All of these figures are estimates.

Table 9.1 Goat Populations of the Tropics and Sub- tropics

	Millions	%
Africa	145	41
W. Asia	53	15
S.E. Asia	14	4
Indian sub – continent	110	32
Central America / Caribbean	11	3
Other Areas	18	5

The largest populations of goat are found in Africa and on the Indian sub – continent. In the tropics, 20 per cent of the ruminants are goats. It is also known that the population of goats has been growing at a faster rate than other ruminants. Goats are found in all types of environments, from arid to humid zones. They do very well in the drier tropics, where their ability to withstand dehydration and their browsing habit enable them to survive where cattle or sheep cannot. This means that they can exist in fragile ecosystems such as the Sahel where, consequently, they are often blamed, sometime unfairly, for degrading the natural resource base.

3.2 Breeds of Goat

There are some 300 breeds of goat, many of them located in the tropics and subtropics. They have developed not only in response to a particular environment but also because man has selected animals for specific characteristics. These characteristics include temperament, productivity and ease of management. There has also been a great deal of crossing between breeds to produce animals that have the characteristic that are genetically controlled. Goat breeds are not well recorded in the tropics and are often defined only by the geographical area in which they live.

Goats can be characterised by

- Origin
- Function
  milk, meat, fibre
- Appearance
  Ear shape and length
  Body size
  Height
  Colour
  Horned or polled shape of face

No one particular method of identification is satisfactory when taken by itself. Details of some of the most interesting and important breeds in Africa are presented in Table 9.2.

Table 9.2: Goat Breeds in Africa

Breed Type	**Location**	**Height at Withers (cm)**	**Function**
Large goat			
Benadir	S. Somalia	70 - 78	Meat
Boer	S And E Africa	75 – 80	Meat
Landim	Mozambiqure	65	Meat
Maabite	Algerial	70 - 83	Milk
Mudugh	N. Somalia	65 – 75	Meat and Milk
SahelLong legged)	W. Africa	70 - 85	Meat
Sudan Desert	Sudan	65 – 80	Milk
Sudanese Nubian	N. Sudan	71 – 80	Milk
Sukria	W. Ethiopia	70 – 80 70 - 85	Meat
Tswana	S. Africa	60 - 75	Meat
Small/medium goats			
Angora			
Boran	S. Africa	61 – 65	Fibre
Kigezi	E. Africa	60	Meat
Maradi red Sokoto	Uganda	60	Meat and hair
Masai	Niger, N. Nigeria	62 – 72	Meat and skins
Somali	E. African	64	Meat
Dwarf Goats	Somalia	62	Milk
Congo Dwarf			
E. African	Uganda, Zaire	45 – 50	Meat
Kosi	E Africa	50	Meat
S. Sudan	Cameroon	45 - 50	Meat
W. African Dwarf	Sudan	40 – 50	Meat
	Ghana	40 – 50	Meat

Description of Goat Breeds in Nigeria

Sahel Goat (W. African Long- legged goat)

This is also known as the Arab goat in Chad and the Maure in Mauritania. It is similar to other breeds in North Africa, being very long legged (70-85cm), and is found in the semi-arid areas in the north of W. Africa. Many goats of Sahel breed are kept by pastoralists in mixed flocks with sheep. Not being trypano-tolerant the breed does not survive in forest and dense savanna where the tsetse fly, the carrier of trypanosomiasis, is found.

Males weigh 40 kg and females 27 kg when mature. They have small triangular heads, usually with horns. Their coats are short and very fine.

Sahel goats are primarily kept for their meat, and little milk (less than 80 litres/lactation) is produced. Around 40 per cent of births give twins, and under pastoral conditions the kids grow very slowly. A carcass dressing percentage of 48-50 per cent is common in adult goat. Like many desert breeds, Sahel goats have the ability to maintain their weight long periods under adverse conditions.

Maradi

This distinctive re-coloured goat lives in Nigeria and Niger where it is kept in small flocks by Hausa-speaking tribes. Animal are confined away from growing crops and may be stall-fed. The breed is well adapted to arid conditions and grows to 25 kg for females and 27 kg for males. Both sexes have similar shaped horns and males have beards.

Because of the importance of the breed for their skins, the ratio of males to females in flocks is higher than in many other breeds. The skins are of the highest quality in the tannery trade and are known as Morocco. Their ease of tanning makes them very popular for shoes and gloves.

Twining is very common and a litre size of 1.8 is the average. Milk yields of 0.5-1.0 litre per day have been recorded in experimental stations over three-month periods. Nannies with twins out-yield those with singles by some 20 per cent. When killed for meat the carcass yield is 45-50 per cent of live weight.

West African Dwarf Breed (Fouta Djallon Dwarf)

This breed is very short-legged and measure 50 cm or less in height. They are usually also in the 18-25 kg weight range. Dwarfs can be proportionately small all over or just short in the leg.

This dwarf breed is found in west and central Africa, along the Atlantic coast. It is trypanosome- tolerant and is adapted to the humid forest zone. Goats are kept in small groups and left to roam about homesteads as scavengers. In Nigeria, few bucks are kept. In Senegal, flocks are owned by women and numbers rarely exceed five. When crops are growing goats will be tethered.

Bucks weigh 25 kg and nannies 22 kg when mature. Their height is 30-50 cm. Both sexes have horns and toggles whilst bucks have beards. Colours vary from dark brown to white and red. Twinning is very common, so average litter size ranges from 1.4 to 1.85kids. Milk yields reach 0.3 litre per day.

3.3 Systems of Goat Production

A number of different of goat production systems exist, including subsistence, extensive and intensive. The number of goats kept is often a helpful factor that indicates the type of system.

Subsistence

Subsistent farmer usually keep small number of animal and manage to use whatever feed resource are available at village level. This may involve feeding crop or household residues to stall-fed goats, tethering individual animals to verges or allowing goats to scavenge.

Tethering is common in parts of South East Asia, South America and the Caribbean where crops are grown and the goat must be prevented from damaging feed or cash crops. Goats are tied with ropes or chains to pegs, trees or post to constrain their movement. They are moved to a fresh area of grazing once the current patch is eaten down. Supplementary feeding with crop residues or household waste may be given, but not usually concentrate. Water is provided at night, when the goat is returned to its home. Goat may be tethered in small groups or even led by ropes held by children or woman.

In the middle East, where there is little groundcover for goat to graze, especially in the summer, small groups of goat owned by farmers growing dates and catching fish are kept in tiny shaded corrals. There they exist on a combination of cut grass legumes and leftovers from the house meals.

Also in the same region are to be found small flock of scavenging goats that, during hours, forage in dustbins, on rubbish dumps, in urban building sites, unguarded gardens and on low growing trees. Only at night do they make their own way back to their owner's home.

Extensive

Under extensive production systems, goats graze and browse large areas of land that are usually of a marginal nature, and unsuitable for other agricultural use. This is usually because rainfall is low or unreliable.

Goats can make good use of these areas provided the number of animals is controlled to match the carrying capacity of the land. The carrying capacity is the amount of forage available to sustain a set number of animals in a given area. The size of flock within this system is often large, and other species, such as sheep, may also be grazed at the same time.

Under sedentary systems the grazing available to a flock is limited by the distance it can travel daily to reach water, shelter at night and the pastures themselves. A sedentary system is one with a fixed homestead and set grazing area. Some flocks may be moved to grazing area in different part of the country to utilize seasonal grazing or crop residues that are available only for limited period of the year. This is a migratory system which in some part of the tropics has developed over many centuries to become a very efficient way of using marginal agricultural hands.

In parts of African, Asia and India there are two traditional systems of extensive production which have utilized marginal area very successfully over long periods. These are nomadism and transhumance. Nomadism was widespread in the Sahel region of Africa and in the middle and near East but it is now becoming less common. Nomads have camps which they move depending upon the amount of water and pasture available within an area. As traditional livestock keepers they follow set routes within what are considered tribal lands. Modern day national boundaries are often ignored.

Transhumance involves the movement of flocks between permanent settlement and temporary and seasonal pastures as well as between settlement and temporary and seasonal pastures as well as between different regional areas. In Europe the flocks are kept in the lower plains during a winter period and moved to higher mountainous area when the climate is warm enough to allow vegetation to grow and be accessed. Apart from altitude, transhumance also occurs between different areas with the change of season, as in the north- south movement in the Sahel.

Transhumance is found in Africa, S.E. Asia; the near and Middle East and also in the Mediterranean, Europe and S. America. Animal from different families may be grouped together for the summer as one large flock and goat keepers may be hired if the families have other duties. Goats are often moved to pastures at higher altitudes than cattle because they are more agile and can better use the sparser vegetable that grows at these heights.

Intensive

Intensive systems of goat production are those where the goats are confined and so not allowed to forage for themselves. In Oman, large numbers of goats are reared for meat production in small group of 10-15 animals of similar ages and separated into males and female. Two hundred goats may be kept on one hectare of land with no access to grazing. These feed lot or zero grazing systems involve feeding cut grasses (Rhodes, Buffel, and Signal) and cut legumes (leucaena, gliricidia, stylos) as well as concentrates, mineral and vitamins.

Other system include grazing improved pastures where may be used to boost yield, supplementary feeding of agricultural by products and supervise grazing of animal on limited areas. In South India and parts of S.E Asia stall feeding of goats in crop growing areas is a very efficient method of converting poor value crop residues and tree leaves into useful feed production for humans. It also avoids damage by the goats to growing crops.

Most intensive management involves high cost resulting from high labour cost, expensive feed, or a large investment in the inputs such as land or animals. It may be a combination of several factors to which there must be a high priced product.

Keeping number of goats confined in a limited area requires meticulous health care if disease, particularly parasite problems, are to be avoided. Care must also be taken to see that all animal are properly fed, have access to clean water and are regularly cleaned out.

Many methods of goat keeping combine the different systems of management as described here. It is, for example, common in parts of Africa to use children, on returning from school, to shepherd goats that are confined to stall during the day.

3.4 Principles of Goat Production

Feed and Feeding

Goats are animals known to convert low quality fibrous vegetation into useful products for man. These include meat, milk, skin and manure. Goats prefer a varied diet and to be able to wander and browse a broad range of plants. In traditional systems they make good use of the available vegetation. Because of their browsing habit they are often able to exist in areas of low rainfall and poor growth, where cattle and even sheep would not prosper. If their numbers do not become excessive, a good ecological balance can be maintained.

Goats, being inquisitive eaters, will eat all types of vegetation as well as articles which have little feed value, such as cardboard and human hairs.

However, given the opportunity, they seek good pasture where they can select the grasses they prefer. They will often reject the legume clover which is favoured by sheep and cattle. This means that combining sheep and goats to graze in a single flock does not necessarily lead to competition between the two species. Where a wide range of plants is available it is possible to keep more animals on a given area of land because each species grazes on a different type of vegetation.

Goats are ruminants. This means they have four – stomach digestive system which comprises rumen, reticulum, omasum and abomasum in the adult goat with which they extract nutrients from fibrous materials using bacteria and protozoa that live in the rumen and reticulum. Feed is initially chewed in the mouth and mixed with saliva before it passes to rumen. This material is returned to mouth for further chewing so that the particle size is reduced, speeding up subsequent digestion. This regurgitation is called chewing the cud. Like all ruminants goats can be seen chewing and re- chewing this material between grazing periods. They chew the cud more at night than during the day. After thoroughly chewing cud the feed passes to rumen and reticulum, where micro-organism break it into simple chemicals which are either absorbed into the body or are used by the micro –organism to reproduce.

The populations of micro-organisms break it into simple chemicals which are either absorbed into the body or are used by micro –organism found in the gut. Digestive microbes are specific to particular diets and gradually change in response to changes in the types of feed being eaten. If a sudden change of diet occurs the system is upset because the micro-organisms cannot digest the new feeds. It takes days for the appropriate micro-organism populations to build up to cope with the new diet. The sudden introduction of a new feed can lead to scouring and loss of condition or even death in severe cases. For goat keepers, this means that any change in diet must be very gradual. A new feed should be given in very small amounts at first, with the quantity being increased progressively over a period of days.

The liquid mixture of rumen and reticulum passes to the omasum, where most of the water removed, and then to the abomasums. This stomach is very acidic and any micro-organism reaching it is killed. Digestion from this point progresses with the addition of enzymes which are secreted from the gut wall. The digestive contents are now broken down into nutrients that are useful to the body. These are absorbed by the small intestine. This part of the gut is very long but is accommodated as a series of coils so it takes up as little room as possible. More of the water is removed in the large intestine before the very dry dung pellets are expelled from the rectum through the anus. Goats are able to extract almost all of the water from the contents of the digestive system, which means they can make very efficient use of whatever water is available. This is one of the reasons why goats can survive in arid regions. It is considered a sign of good health if the dung is reasonable dry.

Feed intake

In the tropics, dairy goats will eat up to the equivalent of 4-5 per cent of their own body weight in dry matter daily. Meat goats will consume about three per cent. In cooler parts of the world dairy goats have been known to eat up to eight per cent. Goats have a much better capacity for forage than sheep of a similar size. How much a goat eats depends on its:

- Age
- Breed
- Production capacity, or
- Whether it is pregnant or lactating.

Younger goats eat more than older ones because they are growing. Pregnant and lactating animals consume more than non-pregnant and non-lactating ones because they need more feed to produce milk and to enable the foetus to grow.

Goats with free access to feed will vary their intake depending on the energy available from the feed. One average bigger goats eat more than smaller ones. All goats will eat more if the feed is in a fine rather than coarse form. The goat keeper can influence how much goats eat by:

- How finely ground the feed is; and
- How much useful energy the feed has (measure in ME per kg DM)

If hay or straw is chopped, more will be eaten than if fed without chopping. Finely chopped straw is often fed as part of a concentrate ration. More feed is eaten if the feed has a high energy density. So if a high-energy feed such as or molasses is mixed with a fibrous feed such as straw, goats will eat more.

Feed intake is generally measured in dry matter terms. Dry matter (DM) is the amount of feed remaining when all the water has been removed. It is used as a guide to how much fresh or moist feed can be fed.

Feeding example 30 kg goat

A 30 kg goat requires:

1.	For maintenance 1.6% DM as % live weight	= 0.5kg
2.	For production 3.0% DM as % live weight	= 0.9kg
		1.4kg

If DM of feed is 25% four times as much is needed to achieve a set target figure, therefore:

- 1.4 x 4 = 6.4 kg fresh material daily

Nutrients

Much of the information used to calculate nutrient requirements for goats is based on research with sheep and cattle.

For goats you need a balance of five basic components.

1. energy
2. protein
3. vitamins
4. minerals
5. water

All goats have a basic need (maintenance) for energy nutrients but some will also require additional (production) nutrients at particular times, for example, nannies in the final stages of pregnancy or when lactating or kids when they are growing.

The energy from feed is used by the goat for maintenance. Maintenance energy is that amount needed to maintain the animal in a stable body condition and provide enough energy for walking. Production is that required for growing and for producing milk or a foetus. It is required over and above the energy for maintenance. Not all energy in feed can be used by the goat and so only the part that, the metabolisable energy

(ME) part, is used to calculate how much energy is needed for a goat's maintenance and production.

Energy is measure in Mega joules (MJ) or calories. (One calories = 4.2 joules). An average diet contains about 8.5 Mega joules (MJ) of Metabolisable Energy (ME) per kilogram of dry matter (DM). However, the amount may range from 6 to 13 MJ/ME/kg DM.

To estimate the amount of ME in a feed it is necessary to undertake a feeding trail to find out the digestibility measures of that part of the feed which is absorbed from the digestive tract into the body. There is direct relationship with ME, shown as:

- ME = 0.15 X DOMD

ME is in mega joules per kilogram of dry matter (Mj/kg DM). DOMD is digestibility of organic matter in the dry matter.

Alternatively, small amounts of feed can be placed in an animal's rumen in a small bag and the amount absorbed recorded over a period of time.

Very few of either of these measurements have been undertaken with goats in the tropics, so the amount of information specifically applicable to goats is limited. In consequence, calculations for nutrition often have and also often based on data from the temperate regions of the world rather than the tropic.

Table below has been derived from experiments undertaken in the tropics and gives a guide to daily amounts of energy required by goats of different weights kept under different husbandry systems.

For pregnant or lactating females or growing kids energy is required over and above the amount needed to maintain body condition given in Table 9.3

Table 9.3 Energy Requirement of Goats

Goats live weight (kg)	Requirement (MJ/ME)	
	Confined	Intensive
10	2.32	3.25
20	3.91	5.47
30	5.30	7.42
40	6.58	9.21
50	7.78	10.89
60	8.92	12.49

Source: Devendra, 1982

For lactation the energy (ME) required relates to the energy content and composition of the milk produced. A typical energy requirement is shown below:

Table 9.4 Nutrient Requirements for Lactation (per kg of milk)

Fat content of milk (%)	ME (MJ)	DP’	CALCIUM	PHOSPHORUS
3.5	4.5	47	0.8	0.7
4.5	5.2	59	O.9	0.7
5.5	5.7	73	1.1	0.7

Source: Devendra and Mc Leroy, 1982
*grammes per kg of milk
DP = digestible protein

Pregnant goat requires sufficient energy to feed the growing foetus or fetuses. In the last part of pregnancy the female’s requirement rises substantially and particularly if she is carrying two or three kids. Other nutrients follow a similar demand curve. The quality of feed and its energy density must rise in this part of the pregnancy if the kids are to be born at a reasonable weight. If the nanny receives too little energy she will become thin as her own body reserves are used to grow the kids. She may develop pregnancy toxemia (ketosis) and die if the situation gets worse. Levels of energy intake are also required to achieve sexual maturity and for successful conception.

For growth the level of energy available to growing kids depends on the rate at which they grow. Research in East Africa suggests 0.035 MJ/ME is required per gram of growth. A 20 kg animal gaining 50g daily requires 1.75 MJ/ME for growth.

All goats should have a minimal level of crude protein each day. Crude protein (CP) is calculated from the nitrogen content of a feed.

1. CP = nitrogen x 6.25
   (It is expressed as a percentage (%))

Protein can also be synthesized from non-protein nitrogen such as urea. The crude protein content of a feed is calculated in the laboratory and, in temperate countries, tables are available showing values for many feeding materials. This is infuriately, not the case with most tropical feedstuffs. Much less is known about specific protein requirements for goats in the tropics. Figures that relate to sheep are commonly used instead (Table9.5).

Table 9.5 Crude Protein Levels of Typical Feedstuffs

Typical feedstuffs	Crude protein content in DM %
Straw	2-4.4
Cereals	10-12
Grass	10-22
Oils seed by-products	22-55
Green legumes	17-20
Fish meal	65-70

So if a very high fibrous diet (e.g. straw) is fed it may be low in protein. Additional crude protein, such as fish or oilseed meals, should then be added to the feed as a supplement.

A 35-40 kg doe requires about 30g/day DCP (Digestible crude protein) for maintenance. For pregnancy and lactation this rises to 70g/day. For growing kids the requirements vary with size of kid and daily rate of growth. A 10 kg kid gaining 100g/day would need some 30g DCP whilst one at 30g would need 50g/day.

Vitamins

Little research has been done on the vitamin requirements of goats and on vitamin deficiencies in tropical diets. In many situations goats do not suffer from a lack of vitamins where they have access to pasture or rangeland. Most diets have sufficient vitamin A (carotene), Vitamins D and K if green vegetation is available. If vitamin B_{12} is deficient, as characterised by anemia, loss of appetite and poor growth goats should be given cobalt, which will assist intestinal micro flora to synthesis the vitamin. Vitamin C does not need to be added to the diet as the goat is able to synthesize sufficient for its needs.

Minerals

Minerals are important in the diet to keep goats healthy. There are two groups of minerals. Macro mineral nutrients (major) are in relatively large amounts while micro minerals (minor) are needed in very small quantities. The minerals needed in goat diets are given below:

Macro Mineral	Micro Mineral	
Calcium	Iodine	Fluorine
Phosphorus	Copper	Iron
Potassium	Cobalt	Manganese
Sodium	Selenium	Zinc
Chlorine	Molybdenum	Nickel
Magnesium	Sulphur	

Table 9.6: Typical Mineral Deficiency Symptoms

Cobalt Copper/molybdenum Iodine Selenium Iron Magnesium Calcium Phosphorus	Poor appetite, dull coat, anaemia, reduced milk swayback, scouring, stiff legs, dull coat Goitre, weak legs, low milk yield Infertility Anaemia Grass staggers Poor bone growth Arthritis

Some soils suffer from mineral deficiencies or have minerals that are not available to plants and so are not ingested by goats. Copper, cobalt and selenium are good examples. If goats receive insufficient copper they grow slowly and kids may be born unable to walk on their back legs. Giving copper to the nanny can prevent this condition, but care must be taken not to overdose, since this may lead to death from copper poisoning. The only exact way of knowing whether a goat is short of copper is to take a blood sample and have it analyzed.

One method of giving copper is by an injection under the skin twice yearly. Alternatively, boluses can be given to the goat to swallow. These remain in the stomach and slowly release copper over a six-month easiest solution to most minor mineral deficiency problems is for goats to have access to a composite mineral lick. These can be purchased from feed companies or sometimes local rocks or salt blocks are available. In intensive systems minerals can be added to the concentrates feed. Selenium and cobalt can be added to the concentrates feed. Selenium and cobalt can be given as a liquid drench to counter any deficiency of these mineral.

Calcium (Ca) and phosphorus (P) are important minerals in milk production and a lack of calcium in the diet may lead to milk fever in newly-kidded nannies. This condition can be fatal. As a guide 0.9g of Ca and P should be available per 1kg of milk produced.

Mineral toxicity or deficiencies are less commonly seen in an acute form than a chronic one. Copper deficiency, when most severe, will produce swayback in kids. Where the deficiency or toxicity is less severs, more chronic symptoms include:

- scouring
- poor fertility
- hair loss
- Poor appetite and growth.

Because these are also normal indications of poor nutrition and parasite infestation, identifying mineral deficiencies is difficult and best confirmed by the analysis of blood samples.

Water

All animal require access to water to enable them to perform normal body functions. This should ideally be fresh and clean. The more continuous the access the better the animal's metabolism performs and the higher its production. In practical terms, however, watering animals usually takes place once or twice daily or even very other day. The amount of water needed by a goat depends upon:

- Amount of dry matter eaten
- Whether the goat is lactating
- Air temperature
- Drinking frequency
- Water temperature.

If goats eat succulent feeds, which have high moisture content, they need to drink less than they do when fed on dry feed. In desert conditions they will lick the dew from the trees. If water is cool or available at all times goats will drink less. In hot conditions goats keep cool by seeking shade under trees or rocks and will pant and sit when the air temperature exceeds 39^0c. Panting causes loss of heat by evaporations of water from the lungs. Indigenous goats have a reputation for being very tolerant to heat stress and having a reduced demand for water. Long or shiny coats are thought to help protect the skin from the sun's heat. Exotic breeds, on the other hand, are less adaptable and tend to eat less in hotter conditions which leads to body weight losses. Compared with sheep, goats pant less and lose less water in the faeces and urine.

To achieve maximum efficiency, goats need to drink 4kg of water for every 1kg of dry matter they consume.

Water is more critical for growing kids and pregnant or lactating nannies than it is for other goats. The smaller an animal is the more water it needs relative to its size. This is because it has a large body surface in relation to its body size which makes it susceptible to heat stress.

Goats tend to thrive better than sheep under difficult range conditions because they are able to tolerate brackish or salty water which is often found in high temperature areas or near the sea. For example, salt concentrations of 10,000 ppm (parts per million) in the water are well tolerated.

In arid regions or in the dry season the number of watering places declines and flocks may have to travel long distances to drink and then wait their turn behind herds of larger camels or cattle. This reduces time available for grazing as well as causing overgrazing around waterholes.

Supplementation

Most farmers in the tropics cannot afford to give their goats any feed over and above what the animals can graze. By being able to select particular plants, goats may be able to increase the quality of their diet, especially with regard to energy or protein levels. In practice, their diet consists almost entirely of low-valve roughages. In these situations feeding a supplement to the diet can have a dramatic effect on productivity especially during the dry season, during late pregnancy or where animals are still fed.

Supplement can be given as:

- Concentrates containing extra energy (molasses, cereals)
- Protein source (legumes)
- Non-protein nitrogen (urea)
- Minerals/vitamins (salt licks).

Supplementary feeding is a costly exercise and only worthwhile if the improvement in performance gained it greater than the cost. If feeding pregnant nannies in the final month of gestation gives larger kids that grow well and can be sold for higher prices then supplementation may be worth doing. This is especially so if the supplementation is cheap to obtain. Tree fodder is one example and agricultural by-products may be the other.

Practical feeding

In practical terms the following period are important ones to consider when feeding goats:

- Bucks and nannies 1 month before mating
- Nannies for the 3 weeks after mating
- Nannies the final month before kidding
- First 2 months of lactation
- Growing kids, especially post weaning.

Only in selected situations are concentrates likely to be either available or given as a supplement. More likely supplements are legumes or crop residues. These might include leucaena, stylos, pigeon peas, sweet potato stems/leaves, groundnut haulm and cassava leaves.

When not being used for mating, bucks do not normally need supplementary feed. A small quantity of concentrate in the 3-4 week period before breeding will help build up body condition of bucks. This is important if the males have many nannies to mate or if climatic conditions are harsh. Bucks can lose a great deal of weight during the mating period.

Feeding nannies immediately before and for three weeks after mating keeps them in good condition and will help the implantation of fertilized eggs in the uterus.

By far the most critical period during which correct feeding is important for the nanny is the last month of pregnancy when the foetuses are growing very rapidly and causing a severe strain on the mother's body reserves. Reducing the ration immediately after kidding and then building it up again for the first three weeks of the lactation until weaning, will encourage good milk production.

If nannies are in very poor condition at weaning, supplementary feeding will enable them to regain body condition and to be in a good state for mating and conception. It is hard to justify the cost of feeding kids concentrates. Supplementary feeding of kids after weaning will stop them losing weight that often occurs when the nannies' milk is no longer available to them.

3.5 Feeding and Grazing Behaviour of Goats

Many parts of the tropics have long periods when little or no rain falls consequently vegetations dies back and surface water disappears. The quantity of the vegetation also declines, with the best being eaten first. The longer the dry period lasts the poorer the quality of the roughage becomes (Fig 3.2). Goats will then eat less of this material.

If the nutrients in the feed are less than required for an animal's maintenance it will begin to lose weight as body reserves are depleted. As this happens the females will become anoestrus and so not breed. Nannies that are already pregnant will produce very weak kids. In very long dry seasons animals will die, with the youngest, weakest and oldest dying first.

Goat keepers may counter these adverse effects by feeding goats on tree leaves or legumes. This practice can lead to deforestation problems when many animals are kept. This has happened in some areas of the third world such as Nepal and the Sahel region of Africa.

Goats are selective and agile feeders. They will walk long way searching for feed and are happier having a range of vegetation available to them including trees, shrubs and grasses. Shoots and leaves are preferred to stem. In intensive unit, if not managed effectively, goats will refuse and spoil a high percentage of forage offered.

When goats are first let out on to pastures in the mornings they will initially graze unselectively but then start to wander and become increasingly selective. Unlike sheep, goats will scatter and graze and browse individually, climbing trees or standing on their hind legs to browse at higher levels. They will stop grazing if disturbed, for example, by rain. In hot conditions goats favour grazing in the early morning and evening. In Arabia they will graze at night if allowed, preferring to seek out comfortable shade during the heat of the day.

Where goat keepers can control their animals under extensive system they may be able to use range better if they allow sheep and goats to graze together. These two species are complementary in habit which means more animals may be kept in a set area. The sheep will graze the lower grasses whilst the goats will browse shrubs and trees.

Good goat keepers will know the browsing habits and movement patterns of the flock and their favourite watering and sheltering spots. They will allow natural resting times in the middle of a day and know when to move the flock. Goats are much more difficult to move during cold, wet or windy periods.

Goats change their feeding habit between seasons. In the dry season they will eat bushes and trees which in wetter periods they would ignore, preferring in this season grasses and legumes. They can distinguish bitter, sweet, salty and sour tastes and show tolerance to bitter and salty tastes.

Although goats do not flock together in the way that sheep do, they do have a good herd instinct and if handled frequently become used to being moved or herded in large groups. Calling to animals in specific sound or tonation when feeding, will teach them to move together for handling. Identifying the dominant females and males whom others will follow can also be useful.

Agro-industry by-products

Industries that process agricultural produce often leave residues by-products that can be fed to animals. The feeding value of such by products varies considerable. Some examples are listed in Table 9.7 but the same product's feeding value will change with different samples feeding a product to a small number of goats to observe the effect is one solution to this problem. Some by-products, such as molasses and cassava, are high in energy but low in protein whilst others, such as linseed meal or desiccated cotton seek cake, have good levels of both protein and energy.

Table 9.7 By-products as a Source of Energy and Protein

	Protein	Energy
Brewers' grains	√	√
Cassava peelings	—	√
Rice husks	— —	√
Sorghum Stover	√	—
Wheat bran	√	—
Coconut cake meal	√	√
Cotton cake meal	√	√
Cotton seed cake	√	√
(decorticated)	√	√
Linseed meal		
Soya bean meal		

√ = good

3.6 Reproduction and Kid Rearing

1. Terminology

Listed below are some of the most common terms used when referring to reproduction in goats:

Fertility	ability to produce sperm or ova
Prolificacy	ability to produce young
Litter size	number of kids born to each nanny each birth
Kidding percentage	number of kids born or reared in relation to nannies exposed to buck
Kidding interval	number of days between two successive kidding
Service	implant of fertilized ova that grows to foetus
Foetus	growing kid in uterus
Service	mating
Heat	oestrus

Fertility is affected by both environmental and genetic factors.

For the farmer, fertility is seen as the ease with which a doe successfully conceives after kidding. The shorter the period, or the fewer the number of services, the more profitable the exercise; and the happier the farmer. The farmer would consider the number of services needed to get the nanny pregnant to be an indicator of fertility of the buck.

Prolificacy improves with age, with most nannies progressively giving more kids per litter up to their fifth or sixth kidding. Prolificacy is measured by litter size, kidding interval, kidding percentage or service period. These figures are usually expressed as per animal or for a group of animals. Thus the average kidding interval for the West Africa Dwarf is 258 days. Its litter size is 1-6 kids.

4.0 CONCLUSION

The significance of goat production makes understanding of its management worthwhile and highly profitable. The adaptive characteristics and productivity of goats endear goat production to nearly every household in the rural area of Nigeria. Goats are known as the poor man's cow because of their ability to provide sufficient meat, milk, skin and fibre for smallholders unable to raise cattle. Greater benefits and expansion of current production status are possible if proper management is diffused among producers through informed experts undertaking animal production as a course.

5.0 SUMMARY

This study unit has attempted to provide students with basic understanding of the origin, distribution and breeds of goats found in Nigeria. The stockholding size, agricultural production system, level of investment and environmental factors underlying the system of production adopted in a place or at a particular session. Like in other system of production, basic theoretical principles are needed to effectively and efficiently manage goat production in terms of feeding, reproduction, health and housing for improved productivity and profitability.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe the visual and productive characteristic of three breeds of goats found in Nigeria.
2. (a) Enumerate factors influencing systems of goat production.
   (b) Describe two common systems of goat production in Nigeria and identify their various sub-systems.
3. The National Open University has requested you to provide a technical proposal for setting up a goat unit in the University farm, give an outline of your proposal based on the most suitable production and management system you may consider.

7.0 REFERENCES/FURTHER READING

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MODULE 3

UNIT 1 GENERAL PRINCIPLES OF PIG PRODUCTION

CONTENTS

1.0 INTRODUCTION

Estimates of the world pig and human populations equate one pig to six people in the world. Highest world meat output is derived from pigs according to FAO (1989) statistics. Similarly, in Nigeria the Central Bank annual reports for a decade indicated pig production as the fastest livestock enterprise in generating output. This brief statistics attests to the significant contributions of swine to human and national needs. Perhaps pig production would have contributed much more except for constraints imposed climate and religious belief in addition to usually constraints known depress livestock productivity. Notwithstanding these negative factors, pigs are outstanding in the number of offspring it can produce in a litter and its efficient growth rate that are in comparable to ruminant animals. The unselected indigenous types are extremely poor in performance than the proven exotic breeds such as land race, large white and duroc. The study unit is devoted to basic principles underlying the management of pigs for the overall good and productivity. The principles cover feed and feeding, growth and development, reproduction, housing and disease management.

2.0 OBJECTIVES

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

- outline global distribution, consumption and constraints to pig production and its potentials
- distinguish between various systems of pig production
- review basic biology and essential principle of pig production as it relates to feeding, growth and development
- interpret the behaviours of pigs from the stress imposed by climatic environment and limitation of the body structure and physiology
- choose out of several remedies housing facilities and designs to mitigate negative effects of the environment
- apply preventive and control measures against swine diseases and pests.

3.0 MAIN CONTENT

3.1 Distribution Consumption and Constraints to Pig Production

The estimated world pig population of 286 million (FAO, 1988) means that there is approximately one pig to every six people in the world. Although pigs are numerically fewer than some other domestic species, more pig meat is produced than other meat (Table10.1). This reflects the greater productivity of the pig when compared with other domestic species.

Table 10.1: World Comparison of the Main Livestock Species in Terms of Number and Meat Production

	Numbers (million head)	Meat output (000 metric tons per year)
Cattle	1,253	50098
Buffalo	137	
Sheep	1174	8801
Goats	521	
Poultry	10050	11495
Pigs	826	63917

Source: FAO Quarterly Bulletin of Statistics, 1989

Distribution and consumption

The distribution of pigs throughout the world is not uniform. Nearly half the world's pig population is in Asia, with a further 30 percent in Europe and the USSR. In contrast, the population in large parts of the tropical and sub-tropical developing regions (e.g. Africa and Latin America) is relatively small (figure10: 1). Nevertheless, the increase in the world pig population over the last decade is largely attributable to increase within the developing world, which now constitutes some 60 percent of the world population of pigs. It is noteworthy that the majority of the pigs in the developing world are located in one Asian country, namely China.

Fig. 10.1: Regional Distribution of the World Pig Population (FAO 1988)

Similarly, marked differences exist in the consumption patterns of pig meat throughout the world. In some parts of Europe, annual per capita consumption of pig meat is over 50 kg, and represents some 60 per cent of the total meat consumed. At the other end of the scale in areas of the developing world and particularly in Africa, estimated annual per capital consumption ranges from 1 to 3kg, and form less than 10 per cent of the total meat diet.

The reasons for the uneven distribution of pigs throughout the tropical and sub-tropical world are manifold. In tropical Asia and parts of China, pork is the predominant component of the diet. On the other hand, in areas where the Islamic religion prevails, e.g. the Middle East, Pakistan and part of Africa, Muslims are forbidden to eat any pig meat. Similarly, believers in the Jewish faith are instructed not to eat pork meat, and Zionist sects occur throughout the developing world. Social factors also play a part and these may have a positive or a negative effect on the pig population. In some Pacific islands, such as Tonga and Papua New Guinea, pigs are highly regarded as a source of wealth and associated with marriage customs. On the other hand, in Africa people have traditionally obtained their meat supplies mainly from ruminants, particularly cattle and this preference persists.

The pig has historically been considered an unclean animal, wallowing in filth, an object of distaste and a hazard to human health. Clearly, there is some truth in this assumption if the pig is used as a scavenger but the exact opposite pertains if the pig is well managed under confined conditions.

Climate has an influence on distribution. Pigs can be reared almost anywhere given suitable housing and management. But in situations of extreme temperatures, humidity or lack of rainfall they cost more to produce, because of the need for more expensive housing and because suitable feeds may not be available.

The Potentials and Constraints to Pig Production in Developing Countries

The world trend is towards the consumption of more white than red meat. Thus the potential for increased meat production from pigs in the developing world is enormous. When compared with cattle and other ruminants, pigs have some major potential advantages, namely:

- They produce meat without contributing to the deterioration of the natural grazing lands. This is of paramount importance in relation to the current steady desertification, soil erosion and loss of productive land in tropical and sub-tropical parts of the world.

Overstocking and consequent overgrazing by ruminant is a primary cause of this degradation.

- They covert concentrate feed on meat twice as efficiently as ruminants.
- They possess the potential to be highly productive. Because they are capable of producing large litters after a relatively short gestation period, and have a short generation interval and grow rapidly, their output in terms of yield of meat per tonne of live weight of breeding females per year is in the region of six times that of cattle.
- If confined maximum use can be made of their manure and effluent.
- Their relatively small size, when compared with cattle, provides for more flexibility in marketing and consumption.
- The meat pigs produce is particularly suitable for processing: some of the processed products have a longer shelf life than fresh meat, and can thus be distributed to a wider section of the population.
- Quicker turn-over rate to investment compared with cattle. Apart from the social and religious constraints mentioned, other constraints to pig production are:
    - As simple-stomached animals, they compete directly with humans for feed, especially the staple grains and oilseeds. This can be partly overcome by making maximum use of crop by-product, waste feeds and grain unsuitable for human consumption.
    - They cannot provide a source of draught power for farming operations.
    - Since they tend to be raised close to human habitation, their effluent may cause a pollution problem
    - Because pigs and man are co-hosts to a number of parasites, if pigs are not confined they can pose a problem to human health.

3.2 Origin and Breeds of Pigs

Although the actual origins of the domestic pig are obscure, it is probable that it is mainly derived from the European wild boar (*Sus scrofa*). Originally pigs colonised the forest and swamps (as does *Sus scrofa)* to this day, and were thus designed to live in a moist, shady environment. Their short legs and powerful streamlined body were built for moving through dense undergrowth and the strong head and tusks, with a cartilaginous disc in the snout, for digging and rooting.

Biblical writings indicate that pigs were first domesticated as early as 200 BC. As man has developed the pig as a meat animal, major changes in conformation have occurred from the typical, unimproved type. The relatively large, narrow head, heavily forequarters, tapering light hindquarters and compact body have been replaced by a smaller head, lighter forequarters, and a longer and wider body with bigger capacity and well-developed, meaty hindquarters.

Breed types

Although some are numerically small in number, there are over 90 recognized breeds and estimated 230 varieties of pig in the world. They can be broadly classified into indigenous or unimproved type or the more modern exotic type, which have been selected and developed for specific purposes.

Indigenous breeds (Domesticated)

These predominate in the tropical and developing world, and have evolved a variety of shapes and sizes in order to survive in a range of different environments. In general, they are smaller and have shorter legs than exotic types, with the typical unimproved conformation of a large head, well–developed forequarters and relatively light hindquarters. This renders them more mobile and better able to forage and root for themselves. They are early sexually maturing and females may show first oestrus as early as three months of age. There are many variations of coat colour, but black and brown are most common and white is frequent. The degree of hairiness also varies, and hairless and relatively long- haired types are found. Within the major regions of the tropics, the main breeds and types are as follows.

Africa

In many countries in Africa, pigs have not been characterised into specific breeds, and are variously referred to as 'indigenous" "local' or "unimproved" pigs. The situation is further confused in some areas by inter-breeding with imported exotic strains.

Clearly the productivity of these unimproved breeds in Africa is influenced by their environment, and some typical reproductive performance figures are shown in Table 10.1. In trials in Zimbabwe, although litter sizes tended to smaller, total live weight of the litter as a proportion of the weight of the sow at farrowing was of the same order as exotic sows (11per cent).

The efficiency of conversion of feed to body weight in indigenous sows is also equivalent to that of exotic types. Indigenous sows showed excellent mothering ability, which resulted in very low piglet mortality without sophisticated housing. However, during the growth phase, growth rates and feed conversion efficiencies of indigenous pigs are below their exotic counterparts (Table 10.2).

Table 10.2: Some Fertility and Performance Figures for Indigenous Sows in Africa

	Nigeria	Zimbabwe	South Africa	Ghana (Ashanti) (Dwarf)
Litter-size at birth	6.5	7.9	7.2	6.3
Litter-size at weaning	5.5	7.5	_	_
Pre-weaning mortality (%)	15.0	5.0	_	_
Average weaning age (weeks)	9.0	8.0	8.0	8.0
Average weaning mass (kg)	_	7.6	9.0	7.0

Table 10.3: A Comparison of Growth Rate Conversion Efficiency of Zimbabwe Indigenous and Large White Pigs Fed and Feed a Commercial Diet from 8 to 32 Weeks

	8-16	17-24	25-32
Body weight gain (kg/day)			
Indigenous	0.28	0.51	0.45
Large white	0.44	0.58	0.68
FCE (kg feed per kg body weight gain)			
Indigenous	3.1	3.6	5.0
Large white	2.7	3.3	4.0

Exotic breed in the tropics

The Large White (Yorkshire)

The large white breed was first developed in Yorkshire, England in the middle of the nineteenth century, and has since become a very popular breed throughout the world. It is a fast growing; strong- framed pig with good length and is renowned for its strength of leg. Females are prolific good mothers and adapt well to confinement conditions.

The breed is widely distributed throughout the tropics, and is used extensively for cross-breeding. In Africa, for instance, the Large White X Landrace female is the most popular cross for commercial production. It is also used as grandparent stock in some of the main hybrids produced in Europe. In common with the Landrace, unless provided with adequate shade or wallows, the white skin renders it particularly susceptible to sun burn under tropical conditions. On the order hand, the white hair and white skin render the skin on the carcass more acceptable to the consumer than from the coloured breeds.

The Landrace

This breed originates from Scandinavia and is characterized by its forward-pointing lop ears. It was specifically developed for the bacon trade and typically possesses a long, smooth body with light shoulders and well–developed hams. It is a prolific breeder with excellent mothering qualities and produces lean, fast-growing progeny. The landrace has a higher level of susceptibility to stress than some other breeds. Although not as numerous as the large white, it is also common throughout the tropics, and is highly favoured for cross- breeding purposes.

The Duroc

This breed has been developed in the USA, although there have been suggestions that the British Tamworth breed was involved in the original stock. It is characterised by its deep red or rusty colour. The Duroc is a fast-growing large breed, which has been selected specifically for overall muscle and meat production. One important characteristic is its ability to grow to heavier weights without depositing too much fat. In the female litter–size and mothering ability are only average. It is claimed that the Duroc possesses a higher proportion of marbling fat in the meat.

An outstanding trait in the Duroc is its hardiness and resistance to stress, which results in lower levels of mortality. In tropical zones this is an important consideration, and the breed is consequently increasing in popularity. In commercial production in parts of Africa, it is frequently used as a terminal sire on white cross- bred females.

The Hampshire

The Hampshire is a medium-sized, black pig with a distinct white saddle which encircles the forequarter. Originally a native of England, it has been developed as a modern breed in the USA. Hampshire sows are prolific, good mothers and possess above – average milking ability. They are also better able to cope with more extensive condition than white breeds. It is meaty, well–muscled breed which shows good efficiency of feed conversion. The Hampshire is very popular in cross-breeding programmes, both in order to produce a cross–bred female and as a terminal sire.

The Berkshire

Although the Berkshire breed is on the decline on a worldwide basis, it remains popular in cross – breeding programmes in parts of the tropics. It is smaller, early –maturing pig which was first developed in England for the pork trade. It has a black coat with characteristic white feet and nose. In the tropics it has proved very hardy, and crosses well with indigenous stock. In certain areas, for instance in Burma, it is prized for its fat content, as pig fat used extensively for cooking purposes.

Other breeds of interest

The Chester White

This breed was developed in America and has spread particularly into central and South America. Females are highly prolific, but growth rate tends to be slow, and carcasses are shorter and fatter than average.

The Large Black

A hardy British breed, sows are very good under extensive conditions. However, growth rates tend to slow and carcasses are relatively fat. Although now rare as a pure bred, there is evidence of the influence of large black throughout the tropics.

The Pietrian

Of Belgian origin, this is a very lean and meaty pig, and is widely used in the production of modern hybrids. Introductions to the tropics have largely been unsuccessful due to high level of susceptibility to stress. As an example, all the pietrain pigs imported into Zimbabwe (then Rhodesia) in the 1960s died from heart failure as a result of one stress or another.

The Poland China

This breed of pig was one of the earliest to be developed in USA. It tends to be large and fat but has been widely used in Central and South America. Improved strains of the breed are being developed.

The Tamworth

Characterised by its red colour, this is one of the oldest breeds of pig in England. The breed is exceptionally hardy, but is relatively slow-maturing. In the past it has been very popular for cross- breeding purpose in tropical regions.

The British saddleback

This is another hardy British breed, formed from the combination of the Essex and Wessex Saddleback breeds, with good milk production and mothering ability. It is named after its distinctive markings of black coloration with a white saddle. In the UK it has gained a new lease of life for the introduction of hardiness and mothering ability into hybrids used in outdoor production systems.

From the point of view of genetic improvement of pigs in the tropics it is important to realise that pigs selected for their superior performance in one environment will not necessarily be superior in a completely different environment. This is known as genotype – environment interaction. An example of this type of interaction is that restricted feeding regimes will have a greater effect in reducing back fat thickness in genetically fat pigs than in genetically thin pigs. When selecting genotypes to help improve pig performance in tropical environments, it is crucial to understand the fact that such interactions will occur. If genotypes are selected under intensive conditions in a temperate environment and then transferred to the tropics, the environment must be modified, by means of housing, feeding and management, to suit that genotype. In extreme cases, genotypes are selected under intensive, temperate conditions. In such situations the animals have difficulty surviving, let alone growing and reproducing, and local or cross- bred genotypes will be far superior under these conditions.

3.3 Systems of Pig Production

Scavenging or Extensive Small-scale System

This is the traditional system of rearing pigs in most parts of the tropics. It is also the simplest and cheapest. Each family, kraal or village keeps a few stocks which are allowed to wander freely and pick up food when and where they can. If extra food is available, they may receive supplementary food. This supplementary food will generally consist of foods of low nutritional quality such as banana, crop residues, water hyacinth, and rice bran, local herbaceous plants, by products of beer-making or kitchen wastes. Where pigs are particularly valued for festival or ritual slaughter, as in parts of Asia and Africa, a few may be confined and fed for a three-to-six month fattening period prior to important ceremonies.

Indigenous breeds of pigs predominate on the scavenging system; because they are adapted to the local environment and their relatively small size and mobility render them best able to cope with the conditions. Productivity is normally low with the erratic and often seasonal food supplies resulting in irregular breeding of female animals, high rates of offspring mortality and low growth rates. Stocks raised on this system are particularly susceptible to infestation with parasites, and invariably carry a heavy burden of intestinal worms and ectoparasites. A particularly hazard of the scavenging system is that animals have access to sources of parasites, e.g. human waste, which can then be transmitted back to man when he eats meat.

The majorities of scavenging domestic pigs are owned by subsistent farmers, and are not produced with any particular market in mind. Rather the animals play an important socio-economic role as a form of bank, and stock are sold at times of cash shortages or unexpected needs in the family. The numbers are usually kept small, in the region of 1-10 breeding females per herd.

Semi-intensive production

In these systems, often also known as 'backyard' systems, animals are confined and therefore present a commitment on the part of the farmer to feed his stock. Pens or sites are mainly of very simple construction and in some countries of south East Asia and West Africa, may be made of bamboo and elevated. Of the other hand, animals are sometimes constrained by tethering in larger yards or paddocks.

Feeding is based on kitchen waste, vegetables and by-product foods, and management is generally minimal. As a consequence, productivity tends to be relatively low and mortality can be high. Although local and indigenous breeds of animal predominate, crosses between indigenous and exotic breeds can be found in this system of production throughout the developing world. Marketing is largely indiscriminate and is dictated by the immediate financial needs of the owner. Generally, herd sizes and productivity tend to be higher in these systems than in the scavenging systems.

Intensive production

These systems are characterized by the fact that the small-scale producer has moved away from subsistence production to the commercial pig production. Units may comprise up to 50 head, and the producer will grow and/or purchase food specifically for his pig enterprise. The system of housing becomes more sophisticated shade and open space, and appropriate feed and watering facilities. In order to justify the increased capital cost, the farmer will attempt to manage his stock to optimize output, including some veterinary protection against parasites and diseases. The breed of animal raised will tend to be mainly the higher-performance exotic, or a cross between exotic and indigenous breeds. Marketing may be informal, through local butchers, or into the large-scale commercial sector, but in any event it will be planned to bring in a regular income for the enterprise.

Large-scale systems

Intensive

This is the most common system of large-scale production. Units are generally capital intensive and may involve a large herd from 40 up to 1000 heads. Modern high-performance breeds of pigs, or hybrids, are used, and provided as far as possible with optimum conditions of housing, feeding and management in order to ensure maximum output. Housing will often be designed specifically for the different classes of stock and environmental conditions.

These units, especially the larger ones, are particularly amenable to integration with grain production and stock feed manufacturing operations on the one hand, and processing and marketing on the other. The farm animals will invariably be marketed through a processor in order to maximize returns on the carcass.

Extensive systems

These are a trend throughout Europe and America towards less intensive systems of production. These systems, often known as 'outdoor' systems, entail keeping animals in paddocks or ranches and providing individual pens for parturition and shelter. Younger stocks are generally raised under more intensive conditions. In Europe, hybrid crossbreds, with a greater ability to withstand climatic vagaries, are produced specifically for use on this type of system.

Production systems of this type exist in the tropics, and there is clearly potential for further expansion. The major advantages when compared with intensive systems are that less capital is required for establishment, and animals can gain access to bulky foods such as pastures, crop residues, cassava roots and sweet potatoes. In tropical regions it is essential that adequate shade and housing be provided. Moreover, there must be tight control of parasites and adequate fencing to prevent contact with endemic disease, e.g. in Africa, contact with wild animals and avoid transfer of diseases.

Integrated systems

The integration of pig production with other ancillary enterprises has long been widely practiced in tropical Asia, involving various combinations, fish farming production of algae, methane gas generation, duck water hyacinth and vegetable production. Such bi-or tri-commodity operations enhance the efficiency of resource use and increase output for the overall operation.

For instance fertilizing fish ponds with pig manure and effluent, algae are generated which can then be utilised by fish. As long as sufficient water is available for suitable fish ponds, pig sties can either be constructed above the ponds so that the manure can drop straight into the water, or close by so that the effluent can be channeled into the ponds. The various species of *Tilapia* spp are the most commonly used fish, often mixed with small populations of carp (*cyprinus spp)* and catfish (*clarias spp)* or other predators. Fifty to sixty pigs produce sufficient effluent for one hectare, fishpond, which, if stocked at between 20 000 and 50 000 fish per hectare, can produce annual edible fish yields or 3.5 to 5 tonnes per hectare.

In some countries, water hyacinths used to harvest nutrients from the fishponds, and this is then fed back to the pigs. Alternatively, the nutrient-rich water can be used for irrigating vegetables, or in other systems. Ponds can be dried in rotation and vegetables grown in the dry pond beds. In another alternative system, where other food is available, the pig effluent is used to produce algae, which is then harvested and dried and fed back to pigs or other livestock. If the pig effluent is insufficient for any particular system, ducks can be used to augment the fertilization of the ponds with their manure.

The solid fraction of animal, especially poultry, manure can be used as an effective fertilizer for crops, particularly if it is properly composted, and this may prove to be the most cost-effective use of the by-product. A further important development has been the anaerobic fermentation of farm animal effluent for the production of methane gas. Relatively simple digesters can produce a steady source of methane which can be used as a means of energy for domestic or agricultural use. These digesters are now in use in rural areas throughout the developing countries of Asia, and it is estimated that seven heads of pig for example will provide enough dung to ensure the supply of sufficient methane for house fuel for a family of five.

3.4 Principles of Pig Production

Feeding and digestion

The first 72 hours after birth are very critical for the baby pig. During this period the colostrums of the sow has a high content of antibodies and the piglet intestine is able to absorb intact proteins. As the piglet has very little of its own resistance to disease, it is essential that it gets a good suck of colostrums and acquires passive immunity from the sow.

Failure to take in sufficient colostrums will invariably result in the pig succumbing to infection before it can develop active immunity of its own. Once the piglet has established a teat position, which normally occurs in the first 24 hours after farrowing, it will retain this position for the remainder of the suckling period. As long as milk production continues the dam suckles her litter every 60 to 90 minutes.

Alimentary canal

Although pigs in tropical regions may eat a lot of fibre they are simple-stomached animals and not ruminants which possess a complex stomach with a large microbial population which enables them to digest large quantities of fibrous material. Thus, their ability to digest and utilize fibre is restricted to that digested by the microbial population in the caecum which is of relatively small volume when compared with the rumen. It has been claimed that unimproved breeds found in Africa have an enhanced ability to utilize fibrous feeds compared with exotic breeds. While this may be so to a small extent, there are no anatomical differences of the digestive tract between the two types. Accordingly, with all pigs, high-fibre diets will have the effect of diluting the amount of nutrients available to the animal. In contrast to ruminants, pigs are unable to utilize non-protein sources of nitrogen for the production of microbial protein in the rumen. This makes them dependent on both the amount and quantity of protein in their diet.

The alimentary tract of the pig is designed to digest and absorb concentrate feeds. Feed taken in at the mouth is ground into a pulp by mastication. At the same time it is moistened and mixed with saliva. Saliva contains the enzyme ptyalin which initiates the breakdown of starch to simpler carbohydrates. The feed then passes on into the stomach, which provides an acid environment due to the presence of hydrochloric acid. The gastric juice contains the enzyme pepsin which begins the breakdown of protein.

The small intestine is the major site where feed absorption occurs and digestive juices from the pancreas, liver and the small intestine complete the process of digestion as follows.

Starch is hydrolyzed to maltose by amylase from the pancreatic juice. Specific enzymes break down maltose and other disaccharide sugars in the intestinal juice, e.g. maltase, lactase and sucrose into monosaccharides such as glucose and fructose. These are then absorbed through the gut wall.

Trypsin in the pancreatic juice acts on protein to produce polypeptides, which are then broken down to amino acids by various peptidases in the intestinal juice and subsequently absorbed.

Bile, which is secreted by the liver, serves to emulsify fats into smaller globules, which are then broken down by the enzymes lipase into fatty acids and glycerol ready for absorption. Lipase is present in both the pancreatic and intestinal juices.

Pigs are omnivores and will consume a wide range of feeds from both plant and animal sources. The natural inclination of the pig is to eat on a 'little and often' basis, and this is likely to maximize both total feed intake and the efficiency of feed utilisation.

Growth and Development

In practical terms, growth is measured as the increase in body weight with time, and is largely dependent on the amount of feed or total nutrient intake. However, there are major differences between the feed intake of different breeds of pig and this affects their growth response per unit of feed ingested. Because man has selected pigs for high growth rates in order to improve biological efficiency, he has selected for a large mature size. In consequence, unimproved types of pig common in developing parts of the world which have not been selected for increased growth rates will tend to grow more slowly to a smaller mature size when compared with improved breeds. It follows that if unimproved pigs are slaughtered at the same weight as their exotic counterparts, they will be relatively more mature and therefore at a different stage of development.

Equally important as rate of growth is how the pig develops. Selection has resulted in a greater propensity to lay down protein tissue in improved breeds. Thus the plateau for maximum growth potential in an improved breed can be 600g compared with 400 g for an unimproved pig. As the level of feed intake increase, the unimproved pigs will deposit more fat in comparison with improved types. Because too much fat is neither a consumer desirable, nor is it cheap to produce (approximately five times the nutrient cost of lean tissue deposition), it is critical that pigs are fed according to their ability to grow and lay down lean tissue.

Entire male pigs grow faster; have leaner bodies and convert feed more efficiently than females. If males are castrated the case is exactly opposite. Traditionally, pigs have been castrated in order to improve carcass quality and to prevent boar 'taint' or odour in the meat, which tends to occur as boars approach puberty. Nowadays, modern pigs grow faster and are slaughtered at younger ages and the problem of taint is considerably reduced. Unless pigs are grown slowly or are required for a highly sophisticated market, there would appear to be no justification for castration in pigs destined for meat production.

Baby pigs are born with less than two per cent of fat in their bodies, which makes them particularly susceptible to cold stress. Thereafter they deposit fat rapidly, and will usually have a body fat level of over 15 per cent by the time they are three weeks old. This serves as a reserve of energy as they adapt to a reduction in milk intake and to overcome the stress associated with weaning.

Reproduction

Males

The male reproductive system is characterised by a pair of relatively large testes, which can weigh over 300 g each in some exotic breeds. Together with the secretions from the accessory sex glands, the testes can produce up to a liter of semen in a single ejaculate.

To facilitate the transfer of these large quantities of semen at coitus, the end of the penis of the boar is spiral in shape which enables it to lock, into the cervix of the sow. The duration of coitus varies but may last for 20 minutes.

Puberty, or the ability of the boar to serve a sow, generally occurs around four months of age, but may be earlier in unimproved breeds. However, boars should not normally be used until seven months old. Young boars are susceptible to bullying by mature sows. And this may adversely affect their subsequently mating performance.

Females

The female reproductive tract is distinguished from other farm species by the long, convoluted uterine horns (700 to 800 mm in length), which are designed to accommodate large numbers of foetus. The sow will ovulate simultaneously from both ovaries, normally shedding between 11 and 24 eggs.

Puberty, marked by the onset of oestrous cycles, occurs between five and seven months, but may be as early as three months in unimproved breeds. The number of eggs shed at ovulation, and therefore potential litter-size, increases gradually over the first few oestrous cycles.

The sow will cycle and show heat every 21 days (range 18 –24). She will not cycle when she is either pregnant or lactating, although sows will sometimes show heat during lactation when run in groups. A heat last from one to three days, and ovulation occurs by the second day of estrous or any time thereafter.

After coitus and fertilization have occurred, the embryos space themselves evenly throughout the entire uterus before implantation. Competition for space, nutrients and other unknown factors results in uneven growth rates *in utero*, which gives rise to variation in piglet birth weight. The lighter pigs then suffer a disadvantage in the competition of early post-natal life. This problem tends to be accentuated in older sows, due to the effects of wear and tear on the uterus.

Pregnancy lasts for 114 days but will tend to be extended slightly with smaller litters. Farrowing may vary in duration from 2 to 24 hours and will tend to be longer the more piglets that are produced. However, due to the relative difference in size between piglets and the dam, and the type of placentation in sows, farrowing is normally a straightforward process. The incidence of stillborn piglets, which may be due either to death *in utero* or during the birth process, is greater in large than in smaller litters.

Overall, reproduction in the sow results from a complex hormonal interplay between the brain, the pituitary gland, the ovaries and the uterus. These complex relationships must be borne in mind by the pig keepers when management strategies are designed, otherwise optimum reproductive performance by the sow will not be achieved.

3.5 Pig Behaviour and Effect of Climate

Pigs are not solitary animals and will generally benefit from social contact with each other, even if only by sight or smell. At the same time, groups of pigs will always establish a social hierarchy and this starts at birth when the piglet struggles to commandeer a teat position. If strange pigs are penned together later in life, fighting invariably ensues, and this can lead to considerable stress and physical damage to individual pigs.

Once settled, however, pigs will huddle together in order to retain body heat in cold weather.

In common with the female of those species, sows are notably more docile during pregnancy than they have just produced young. Just prior to farrowing, the sow will prepare a nest from her bedding. She is often irritable during this period, and if she is confined without access to bedding material, this can lead to stress during the farrowing process.

Contrary to popular belief the pig is not a dirty animal and will normally defecate and urinate away from its resting or lying areas. However, this pattern tends to break down if pigs are overcrowded or stressed in other ways. Also, when temperatures are high they will often roll in their own faeces and urine in an attempt to increase evaporation and keep cool.

Recent studies have highlighted the importance of the interaction between pigs and humans in relation to productivity. If pigs live in fear of their stockman, both growth and reproductively performance are likely to be depressed.

In order to cope with forest conditions, the pig has better mechanisms for retaining heat, especially a well-developed subcutaneous fat cover, than for losing heat from the body. Because the pig possesses sweat glands only on the snout, it is unable to dissipate large amounts of heat by sweating. Furthermore, the skin of certain breeds of pigs, e.g. Large White and Landrace, has no protection against the sun, and unless they have access to shade, or mud in which they can wallow, they can become badly sun burnt.

Like man, the pig is a homeotherm, and needs to maintain its deep body temperature constant. Nature has designed the metabolism of the pig to operate most effectively at 39ºC. For a certain range of environmental temperature, known as the zone of thermal neutrality the pig finds this easy and can maintain the correct body temperature by varying blood flow to and from the skin. The extent of this zone changes quite markedly according to the weight of the pig.

At the bottom end of this zone a lower critical temperature is reached when the pig required diverting feed energy to increase heat production in order to maintain body temperature. The lower critical temperature will vary between pigs according to a number of factors, for instance how fat (well-insulated) the pig is, how much feed it is eating and therefore how fast it is growing. Whether it has bedding to help prevent heat loss, whether it is in huddle with pen mates, and whether it can make postural changes to minimize heat losses. Eventually, with decreasing ambient temperature the pig can no longer maintain its body temperature in spite of high heat production, and hypothermia and death ensues.

Of greater interest in the tropics is the effect on the pig as ambient temperature rises. When the environmental temperature approaches body temperature, the pig will attempt to increase evaporative heat loss by sweating (through its limited sweat glands), panting, postural and positional changes, and wallowing in water, mud or excrement. In addition, it will reduce its energy output by decreasing its feed intake.

However, as the means of dissipating heat in the pig are not very efficient, particularly in the absence of the opportunity to wallow, it will soon reach an upper critical temperature. This is associated with hyperthermia and heat stress and the pig will die if the situation cannot be reversed.

At the other end of the scale, the piglet at birth is particularly sensitive to low ambient temperatures. Pigs are born with virtually no subcutaneous fat cover and limited carbohydrate reserves and therefore at birth they will suffer an immediate drop in body temperature. In the case of weaker piglets they may battle to obtain an adequate milk supply; if they require energy to keep warm they very quickly develop the condition of low blood sugar (hypoglycaemia), and die of cold.

Stress

From the foregoing it is clear that stress factors can take many forms, and in fact can involve fear, pain, temperature, direct sunlight, restraint, fatigue and interference with natural behaviour patterns. Stress will quickly lead to reduced performance and productivity, and specifically to gastric ulcers (just as in humans), greater susceptibility to infectious diseases and higher mortality rates. It is therefore paramount that we understand what constitutes the major stress factors in pigs in different circumstances so that production systems can be designed to minimize these effects.

3.6 Housing

The most productive pigs are likely to be those contained in a thermally neutral environment; that is, when the environmental temperature around the pig is insistently between the pig's lower critical temperature (LCT) and upper critical temperature (UCT). The pig's metabolic heat production is then at a minimum, and it is neither using feed energy to keep warm, nor reducing feed intake to keep cool.

Other considerations for pig comfort and well–being in addition to temperature are:

- Protection from other climatic extremes such as direct sun, wind and rain
- Provision of dry conditions which are hygienic and do not predispose the pig to disease
- Allowing, as far as possible, for inherent behavior patterns of the pig, and minimizing the effect of social dominance
- Provision of accessible feed and clean water
- Providing conditions so that good stockman can practice
- Effective disposal of effluent.

General considerations of design

Any buildings, whether simple or complex, cost money, both to build and to maintain. This makes it imperative that careful thought is given to the right design, so that the investment is justified by improved productivity. Moreover, considerations that affect design of houses in the tropics can be very different from those in more temperate parts of the world.

Under tropical conditions, the paramount consideration is generally to ameliorate the effects of excess heat. At the same time, it is important to minimise temperature variations, keeping as close as possible to the pig's zone of thermal neutrality. This often involves keeping pig cool by even under tropical conditions; a separate creep area for the piglets which is warmer than the ambient temperature is generally an advantage, especially at night. This is because the optimum environmental temperature for the sow is between 16 and 18^{o}C, whereas that of the newborn pig is 33-35^{0}C. A simple, enclosed creep box is perfectly adequate for the piglets to creep into and generate their own warmth by huddling together. If electricity or a paraffin source is available a light or simple heater can be provided in the creep box. This not only provides extra warmth, but attracts the piglets into the box and away from the danger of being crushed by the sow.

If separate arrangements are not made for the piglets and the whole furrowing room is warm, this reduces sow productivity. American work has shown that for every ^{o}C rise in temperature from 25^{o}-30^{o}C, daily feed-intake by the sow declines by 400grams.

Multi-purpose pig pens

These are liable to be more appropriate to the tropics and the developing world, as they are cheaper and more flexible. Removable structures, such as creep barriers and furrowing rails, provide protection for the piglets and make the pen suitable for furrowing. At weaning, these are removed, leaving a fattening pen in which the winners can be fattened through to slaughter.

Follow-on pens

If specialised farrowing houses are used, sows can normally be removed into cheaper housing after 10-14 days when all danger of sow-related piglet deaths is past. Piglets then require a separate creep area, similar to that provided by a multi-purpose pen. This has the advantage of allowing the sow to exercise and move around freely.

Weaner cages

The combined trauma of weaning from the sow and change in diet makes the young pig very susceptible to disease, particularly digestive diseases. This can result in fairly heavy mortality of weaners. The weaner cage was originally designed in Europe with the idea of providing conditions for the weaner which would help overcome these problems. Weaner cages have since been adapted for hotter climates and basically consist of a covered solid-floor sleeping and eating area and a dunging area floored by either wooden slats or metal mesh during cold periods, pigs can huddle and generate enough heat for their comfort inside the covered kennel section. Ventilation is provided by the centrally-hinged roof of the kennel. In hot weather, pigs can keep cool by lying out on the meshed floors, and are protected from the sun by an umbrella roof over all the cages. As dung and urine falls through the wire mesh or slats, this can be cleaned from below and there is therefore no need for stockmen to enter the cage with contaminated boots, brooms or shovels.

Pigs normally remain in the cages for three to four weeks before being transferred to fattening accommodation. The feed hoppers can be moved to allow additional space as the weaners grow.

Weaner pools

The traditional system of housing weaners is to take litters of similar age and move them into large pens holding up to 50 weaners. After three-four weeks, pigs are batched into groups of equal sizes for transfer into growing / fatttening pens

Ample watering and feed trough space must be provided, and some form of bedding is preferable. Kennel area, which can be insulated by a ceiling of hay bales or wood, can provide for added warmth.

Growing / fattening accommodation

The basic needs for good fattening pens are relatively simple, namely, a dry lying area and a demarcated dunging area the building should provide shade, some protection and adequate ventilation. Solid walls are not required between pens, as they will decrease ventilation and flow within the building. Pens designed to hold 8-10 pigs through to slaughters are the ideal size.

Extensive systems

Extensive systems are particularly appropriate for sows. Sows are run in paddocks and have access to ark or huts in which to farrow. In trials in Zimbabwe, sows were allowed a choice of different designs of arks at farrowing time, and it was found that they preferred a design similar to those found in the UK. The major difference is that under tropical conditions, the roof should be insulated with a 5 cm layer of grass or similar material. Arks can be constructed from cheaper materials, but it is difficult to make them sufficiently robust to avoid destruction by the sow. Ample deep shade and wallows should also be provided for sows run under this system. As mentioned previously, tethers can be used as a means of restricting sows within a paddock. They can then be rotated around a given area of pasture or other forage.

3.7 Disease Prevention

Once disease affects a pig herd the impact on the economics of pig production in terms of the cost of control and decreased productivity can be enormous. The first priority must therefore always be to try to prevent the occurrence of disease. Thus, many of the management procedures considered here are aimed at disease prevention or at mitigating the effects of those diseases that cannot be prevented. With skilled management, combined with well-designed housing and sound nutrition, an overall strategy to minimise the possibility of disease attack can be formulated.

At the same time a basic knowledge of the main diseases which may affect a pig herd is necessary so that a producer can diagnose the condition and implement control measures as quickly as possible. This is of particular significance under tropical conditions where the regular services of a veterinarian are often not available. The major disease problems are parasites, infectious disease and a few non-specific diseases. Nutritional deficiency conditions are also common causes of health problems.

Parasites

Parasites are defined as organisms which live on and obtain feed from the body of another, known as the host. They may live on the exterior of the pig when they are known as external parasites, or within the internal tissues and organs when they are known as internal parasites. Parasite will seldom result in the death of the host except in the case of massive infestations or if the host is also stressed in other ways.

External parasites

These mainly cause irritation to the skin surface, often leading to wounds and an increased susceptibility to other infections. The most common external parasites are mange-mites, ticks, lice, fleas and flies.

Mange-mites

Mites, which are scarcely visible to the naked eyes, spend their entire lifecycle under the skin of the pig, but they can survive off the host for as long as eight days. The most common species is *sarcoptes scabiei* which cause sarcoptic mange.

First signs of infection are a crusty, dry-looking skin around the eyes, ears and snout. The mites then spread and multiply over the body, and their burrowing causes the skin to become inflamed and swollen. The pig will be seen to be constantly rubbing itself and performance is depressed.

Control is best affected by regular treatment, either dipping or spraying with an anti-mange medication, including spraying of pens. Chronically infected animals should be culled. There are also some recent systemic drugs on the market which are very effective against the mite.

Ticks

Ticks are only a problem in scavenging or more extensive systems of pig production. There are a number of different species which suck blood and can transmit serious disease (e.g. Babesiosis or redwater). They generally require more than one host to complete their life cycle. Ticks are easily controlled by spraying or dipping with suitable acaricides.

Lice and fleas

Both lice and fleas can become a problem in dirty and unhygienic conditions, as they live on the skin surface, suck blood and cause irritation. Spraying of the pigs and pig quarters with suitable insecticides are effective ways of controlling the pests. In the case of lice, particular attention should be paid to the ears.

Flies

Flies have a major nuisance-value around pigs as they cause annoyance, can bite, and carry infectious diseases. They are always attracted to any fresh abrasion or wound on the animal.

Control measures should involve spraying of insecticides on suitable fly-breeding areas, e.g. manure heaps, refuse areas and ponds, pig-buildings and the pigs. Baits which attract the flies and are poisonous to them but not the pigs can also be effective.

Internal parasites

Round worms

These are a particular hazard when pigs are free-ranging or not kept on concrete floors. The large roundworm (Ascaris lumbricoides) is very common and can cause a lot of damage in pig herds. Adults live in the small intestine and can grow up to 300 mm long a 6mm thick. The female is capable of laying thousand of eggs per day, which pass out in the dung and become infective, if ingested by other pigs, after 21 days. These eggs are extremely resistant and can remain infective for many years. As part of the life-cycle, eggs hatch out in the pig after ingestion and the larva migrate through the liver and lung. Irritation in the lungs causes coughing and ill thrift, particularly in younger pigs. Damage is also done to the liver which renders it liable for condemnation at slaughter (‘milk-spot liver’). Moreover, if infection is heavy the adult worms can partly obstruct the small intestine, causing weakness and loss of weight by the pigs.

Contaminated feed and water are the usual source of infection with internal parasites. Control can be effected by breaking the life-cycle, which means regularly moving ranges pigs on the fresh ground and frequent cleaning and removal of faeces in housed pigs. At the same time, unless there is good evidence that there is no worm infection in the herb; breeding pigs should be routinely dosed with broad spectrum anthelminthics and young stock dosed soon after weaning.

Tapeworms

The common tapeworm is *Taenia solium*. The pig is its intermediate host and the adult worm lives in man. Pigs become infected by picking

up eggs from human faeces and the larvae then encysted in the pig's muscle, particularly in the region of the heart and tongue.
If the pig meat is then eaten by man, the larvae hatch out and the cycle is completed. As a consequence, bodies which are affected (measly pork) are condemned at slaughter. By preventing pigs having access to human faeces, the parasites can be eliminated. In some countries live pigs are checked at the market place by trusted experts for the presence of tapeworm's cysts in the tongue. The result of the examination influence the price paid to the producer.

Infectious diseases

The following diseases are notable in most countries.

African swine fever

This is a highly contagious virus disease which in the acute form can cause 100 per cent mortality. Typical symptoms are loss of appetite, pigs huddling together, small purplish blotches on the skin, incoordination and laboured breathing.

In Africa, both bush pigs and warthogs are carriers of the virus but are immune to the disease, and it is therefore very important to prevent direct contact between domestic pigs and wild species. This contact can be prevented by double penning and the control of animal movements. Moreover a soft tick (ornithodoros moubata) which infests the warthog is a biological carrier. Otherwise infection occurs by contact with other sick pigs, or through contaminated feed or water. There is no effective vaccine or treatment an infected pig should be isolated from healthy ones. Although the disease originated in East Africa, it is gradually spreading west through Africa.

Foot-and-mouth disease

Regarded as the most contagious of all known viral diseases, infection causes blisters on the feet, snout, and udder and in the mouth and throat. It is very painful to the pig, which cannot eat and often has to be destroyed.

The disease is endemic in parts of Africa and the virus is carried by the buffalo. Infection can occur by feeding infected bones or cooked meat.

There is no cure. If an outbreak occurs in adjacent area, pigs can be vaccinated, but as there are many different strains of the virus it is important to ensure that vaccination is against the right virus.

Other infectious diseases

Brucellosis

This disease, which is caused by a bacterium, is also known as contagious abortion. Brucellosis can result in temporary or permanent sterility in females. Abortion is the most common symptom and can occur at any stage of gestation, depending upon the time of exposure to infection with the bacterium. In boars, testicles may become inflamed and permanent sterility may result.

The disease is transmitted at mating or by contaminated feed or water. There is no treatment and infected animals should be culled, particularly as brucellosis is transmissible to humans, and the risks of transmission are relatively high under some traditional systems of pig management. Brucellosis appears to be widespread in pig herds in south East Asia and the pacific Islands.

Coccidiosis

This is caused by organisms known as coccidia, of which are 13 known infective species in swine throughout the world. They cause damage to the intestinal wall, and are believed to be an increasing cause of diarrhea in piglets, particularly in confined housing. Piglets show a grey-green diarrhea, lose weight and rapidly become dehydrated.

Coccidiosis is spread by contaminated faeces and thus good management and regular cleaning of buildings will prevent the disease. Drugs, known as coccidiostats, are available for prophylaxis and treatment.

Salmonellosis

Salmonellosis is another enteric disease, caused by the salmonella spp. of bacteria. Pigs generally are affected around two months of age, and become gaunt, with a high temperature and a foul-smelling diarrhea. There are usually some deaths in a group of infected pigs.

An outbreak is often triggered- off by a stress condition, particularly heavy worm-infestation. The disease can therefore be prevented by good management and sanitation. Antibiotics and sulpha drugs will aid in the control of the disease.

SMEDI

SMEDI is an acronym for reproductive failure conditions involving stillbirth (S), mummification (M), embryo death (ED) and infertility (I). It is caused by viruses, mainly porcine parvovirus and the enteroviruses. The symptoms will vary according to when the sow or gilt becomes infected. If infection occurs during the oestrous cycle and at service, the sow will show a regular or irregular return to oestrus, or if only some embryo die she will produce a very small litter. If infection occurs after 35 days of pregnancy, the foetus die and dry up and are presented at farrowing as “mummified” foetus. The condition can cause a serious decrease in sow productivity within a herd.

There is no treatment but effective preventative vaccination programmes are now available. If vaccines cannot be obtained, all gilts and new animals entering the herd should be given access to farrowing house waste 30 days before breeding. This exposes them to the viruses and stimulates immunity.

Swine dysentery

This disease is caused by a large spirochaete, and is manifested by a severe diarrhea producing reddish – black faeces. Infected pigs rapidly lose weight. The disease is spread by infected dung and can largely be controlled by good hygiene. There are effective antibiotic medications on the market.

Swine influenza

Swine influenza is a highly contagious respiratory disease caused by an influenza virus. It is normally triggered off by a stress, particularly rapid changes in temperature. Although mortality is low, the disease has important economic consequences due to stunting and reduced liveweight gains. The first sign of the disease is normally a cough, with a high temperature and loss of appetite. The disease spreads rapidly, breathing becomes jerky and the hair coat develops a rough appearance. Secondary infection with bacteria may complicate the condition.

There is no treatment or preventive vaccine available. Infection can be prevented by good management and the avoidance of stress.

Swine pox

Swine pox is a virus disease, and is transmitted either by direct contact or by ecto –parasites such as lice. Small red areas (about 1.25cm in diameter) appear on the skin around the head, ears and ventral surface which eventually form scabs.

There is no treatment for swine pox, but although unsightly it rarely causes serious loss and clears up after a short time.

Transmissible gastroenteritis (TGE)

TGE is a virus disease which causes acute diarrhea; vomiting and early death in young piglets. It also affects older pigs causing diarrhea and vomiting, but rarely death. There is no treatment. Infected pigs can be isolated, or killed and buried. After infection, the whole herd is likely to be immune.

Non – specific diseases

Abscesses

Abscesses can occur as the result of any irritation, inflammation or wound which allows access to bacteria, normally strains of Staphylococcus or Streptococcus. The body of the pig reacts to the invasion of the bacteria, and a pocket of pus is walled off from the body. Abscesses are seen as swellings or lumps, often hot to touch and they will in time develop a soft area which can be lanced and drained. They may be superficial or they may form deep within the body, where they can cause lameness, interfere with breathing or swallowing, or may not be discovered until slaughter. As abscesses are painful and can markedly depress performance and reduce carcass value, every effort should be made to minimise the possible causes in a piggery. Preventative measures include the removal of any sharp or rough object from pig pens, ensuring the floors are not too rough, especially for baby pigs, making sure that injection equipment is sterilized and providing overall good sanitation. Abscesses can be treated with antibiotics, but this is not always effective.

Gastric ulcers

Ulcers tend to occur as a response to stress in pigs of all ages, and are particularly prevalent in genetic strains bred for fast growth and a thin covering of back fat. The nature of the ration is also important with a higher incidence of ulcers occurring on finely ground, highly –energy concentrate diets.

There may be no specific external symptoms, unless haemorrhaging occurs. Otherwise pigs show lack of appetite, will huddle together and become thin. Mortality varies according to the extent of the ulceration.

There is no specific treatment apart from reducing stress. Changes in the ration, involving an increase in fibre levels is often useful in ameliorating the condition.

4.0 CONCLUSION

Pig production is one of the most profitable livestock enterprises to engage in where environmental condition, feed resource and attitude favour it production. The physical characteristics of the meat output make the product amenable for industrial production valuable meat products. Thus it is quickest means of raising meat consumption in a country where religious bias against pork consumption is not present.

5.0 SUMMARY

The study unit covers basic biology that forms the basis for various principles enthused, and it further points students to simple application of the principles. Notably the system of production is related to climatic effects that dictate feeds and feeding, growth and reproductive activities as well as disease occurrence and management. Many have made fortunes from mere keeping of pigs in their backyard. Profitability is also at the root of expansion and growth being witnessed in modern pig farming. It is desirable that students who have gone through this study should consider himself an entrepreneur that would seize every opportunity to be at the top of his colleagues.

6.0 TUTOR-MARKED ASSIGNMENT

1. Write a brief action note to your Local Government Chairman to adopt pig production enterprise as a socio-economic intervention.
2. Distinguish between systems of pig production highlighting their unique advantages.
3. Relate the tropical climatic environment and body physiology of pig with feeding, housing, behaviour and growth of pig.
4. Highlight routine health management practices for a piglet at day-old up to weaning.

7.0 REFERENCES/FURTHER READING

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UNIT 2 GENERAL PRINCIPLES OF POULTRY PRODUCTION

CONTENTS

1.0 INTRODUCTION

The term poultry refers to the class of animals called Aves. There are several members of this class that have been domesticated but the most popular families are the Phasianade, Meleagridae, Anatidae and Numididae. Of these, the genus and species Gallus domesticus (chicken), Meleagris (gallopavo (turkeys), Anas platyrhynchos (ducks) and Numida meleogris (guinea fowl) are well known in Nigeria. In terms of commercial production however, the chicken has been the most extensively exploited. Most the discussion in this study unit will be centred on the chicken.

Poultry meat and ages are amongst the most nutritious products for human consumption. The nutritional quality of the egg is so good that it has often been used as the standard for assessing the quality of other food protein sources. Compared with other forms of livestock farming, poultry farming has the following well-known advantages:

1. Short generation interval and rapid fecundity
2. Rapid turnover of invested capital. Broilers can be invested in 8 weeks while pullets begin laying eggs at five month of age
3. Small space requirement and low initial capital investment requirement.

These advantages no doubt account for the fact that commercial and backyard poultry rearing is very popular in this country. In addition to these advantages, the chicken is an outstanding laboratory animal that has been exploited for teaching biology, demonstrating the principles of animal husbandry, investigating the nutritional requirements of animals and extensive physiological and biochemical studies in other biological and medical sciences.

The wealth of knowledge that has been accumulated about the biological needs of the chicken for optimum productivity forms the basis for the management practices for successful poultry production. This unit summarises the basic management practices essential for the efficient and profitable production of poultry eggs and meat products.

2.0 OBJECTIVES

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

- distinguish between the two types or strains of poultry
- engage in practical production of any of the poultry operation
- identify and choose systems of poultry production most suitable
- enumerate preventive measures against heat stress and diseases
- list useful records for good farm management.

3.0 MAIN CONTENT

3.1 Types or Stains of Poultry

Poultry are kept primarily for egg or meat production. Many years of scientific breeding and selection has produced specialized breeds of birds that are either capable of growing very fast and are heavy (meat type) or are prolific egg producers (egg type). In both cases, it is possible to rear parent stock that will produce fertile eggs from which the commercial broiler or pullets are obtained. The prospective farmer's first major assignment is to decide on a suitable poultry production enterprise that can be established within the limits of available resources and which is also relevant to the market demands for poultry products in his locality.

3.2 Production Practices for Poultry Operations

There are three primary farming enterprises. These are breeding and hatchery operations, commercial egg production and broiler production. Other enterprises that provide supportive services are specialised breeding farms for production of pure lines, grandparent and parent stock, feed milling and processing and marketing of poultry products. In addition products and services are also closely associated with the primary enterprises.

Breeding and Hatching of Commercial Day Old Chicks

This enterprise involves the rearing of parent stock hens and cocks in the correct ratio to produce fertile eggs, which are then hatched with the use of incubators and hatchers. The chicks so hatched are then sold out to poultry producers who are engaged in the production of table eggs or commercial broilers.

The primary products of this enterprise are day-old chicks. Eggs that are not good for hatching and the old hens and cocks are secondary products. Breeder's flocks may be egg types or broilers.

Table Egg Production: For table egg product, pullets are purchased from a hatchery and these are then brooded and reared to the age of about five months before they begin laying eggs. The chicks purchased must have been separated (sexed) into male and females prior to sale. The primary products of this enterprise are eggs, which are sold for consumption. The hens are sold out as spent hens at the end of their laying cycle, which is usually about one year.

Broiler Production: broiler production has the fastest rate of return of all the poultry enterprises. Commercial day old broiler chicks are purchased from the hatchery and reared to market between seven to ten weeks old, when they should be ready for market between 1. 6 – 2. kg each. The broilers may be sold live or processed (fresh or frozen).

Integration Projects: The three primary enterprises are often integrated on large-scale farms. Integration often includes feed milling and product processing as well as other ancillary enterprises. The major advantage of such integrated projects is the reliability of sources and supply of primary inputs. It also promotes the enforcement of quality control measures in the production of feed and poultry products.

Feed Milling: Because feed accounted for between 60 – 80% of the cost of producing meat and eggs and the crucial need for quality controls, most large-scale poultry producers often make their own feed. Feed milling involves the procurement of ingredients needed to produce feed, grinding, mixing and enclosing in bags.

Line Breeding and Grandparent Stock Production: The production of pure lines and the different types of parent stocks are highly specialised fields of poultry production that rely on the expertise of well trained and tested poultry breeders. It is extremely critical since in the long run commercial egg and broiler production would phase out if such breeding work is not maintained. Furthermore, it is at that level that the initial selection and breeding for desirable economic traits occurs.

Brooding Management

Brooding is the art of caring for young chicks after hatching. It involves the provision of those factors that are necessary for the survival and rapid growth of the chick. Such factors include heat, light, humidity, ventilation, feed, water and disease control. In Nigeria and indeed most tropical countries, humidity and ventilation can be taken care of by means of properly designed housing, but heat light, feed and water have to be provided as necessary.

During the first few weeks of the bird’s life (between 0 – 6 weeks) it is usually necessary to provide supplementary heat to keep the birds comfortable. This period is referred to as the brooding period. Basically there are two methods of brooding:

1. **Natural Brooding**: This is the method whereby a broody hen takes care of the chicks she hatches, although she can also be made to adopt purchased day-old chicks. The local fowls are suitable for this purpose and some Rhode Island Red birds may occasionally be reliable. A good-sized broody hen can be given as many as 12 chicks in cool weather and up to 15 in the hot season. Natural brooding is only practiced when small numbers of chicks are reared. It is quite unsuitable for a commercial scale operation.
2. **Artificial Brooding**: This is brooding without the mother hen. It necessitates the use of equipment which provides conditions similar to those of the broody hen, such as adequate warmth, protection against harsh weather and predators. It also makes for proper feeding, watering and disease control. Artificial brooding is the best method for the commercial producer. It is advisable for the beginning poultry man to try his luck at brooding a small

number of chicks. If he is successful, i.e. with less than four per cent mortality up to eight weeks of age then he can go on to brood larger numbers.

Facilities Required for Brooding and Rearing

A. **Housing**: Houses for brooding should be such that they conserve heat to keep the room warm. Houses meant for young chicks should be located at least 50m (150ft) away from houses containing older birds in order to minimise the risk of transferring diseases from old to young stock. In constructing a house, it is important to note the following:

a. **Foundation and Wall**: A solid and strong foundation is necessary. Digging should be done to a depth of between 0.5 – 0.7m (1.5 – 2ft) or more depending on the nature of the soil. After digging, a layer of concrete should be poured in to a depth of about 10cm (4”). This will form the basement upon which the blocks will be laid. To minimize the effect of termites, an anti-termite chemical can be poured on top of this basement. For growers and broilers the wall should be half-open sided but for layers the solid wall may be anything between 1/3 – 1/2. If cages are to be used, the solid wall should only be 1/3 of total height to the caves. It is essential to plaster the inner walls. The open sided portion of the wall has to be screed with 1/2 – 3/4” chicken wire mesh. The total height of the wall need not exceed 1.9m (6’) from the floor to the caves.

b. **Roof**: Roofing materials such as zinc and alumimum roofing sheets are good for poultry houses. Asbestos is best because it doesn’t absorb as much heat but it is very expensive. Thatch roofing should be discouraged because of maintenance problems, difficulty of clearing parasites from the house and fire hazards. It is important to provide a good roof overhang of about 0.9 (3ft). This is necessary to prevent rain draft from entering the house through the open sides of the wall. The roof overhang may be longer than this on the side of the building facing the rain bearing wind.

c. **Doors**: Doors should be wide enough not less than 0.9m (3ft). This is to facilitate easy movement of staff, equipment, birds and manure in and out of the house. A footbath of disinfectant is needed at the foot of each door. This may be built in at the doorstep or it may be a movable container.

d. **Storage Space**: Provision should be made in the house for storage space for equipment, feeds and other items that have to be kept in the house. The size of such a space should be about one-tenth of the total size of the house.

B. **Equipment**: A number of equipment is needed for the supply of heat and light, feeding and watering, manure handling and egg handling. These can be made locally, or purchased from a poultry equipment dealer. Factors to consider when buying equipment are cost, durability and ease of handling.

a. **Brooder Boxes**: The use of brooder boxes is necessary to conserve heat within a limited area when lamps (kerosene or electric) are used as source of heat for brooding. Brooder boxes can be made from wood or metal or may be improvised from thick cardboard paper or wooden boxes. All brooder boxes should be constructed with holes at the top to provide for the escape of fumes especially when kerosene lamps are used. A space allowance of 7sq cm per chick under the brooder bow is adequate, i.e. a bow measuring 1.25 x 1.25m (4 x 4ft) is adequate for up to 400 chicks.

b. **Source of heat**: Warmth is the most important requirement for the day old chicks once the environment becomes too cold they can easily die especially when reared in large numbers. Heat for brooding may be supplied through kerosene lanterns, electricity lamps, charcoal, gas brooders or hot water pipes. Whatever source is used for heating, it is essential to prevent it from direct contact with chicks, litter material and brooder boxes. Two to three kerosene lamps placed on the floor or two 100 watts bulbs hung at about 20 cm (8 – 10 inches) above the floor is sufficient to provide heat and light for up to 75 – 100 chicks. A recent report indicates that under Nigerian conditions brooding with kerosene lamps as heat source is much cheaper than other sources although it requires more care (Federal Ministry of Agriculture and Rural Development, 1985).

c. **Feeding and Watering Troughs**: These are used for feeding and watering the chicks. Feeders maybe longitudinal or conical in shape. A linear feeding space of 2.5 meters (8ft) is adequate for up to 100 chicks from 0 – 4 weeks of age for broilers and from 0 – 6 weeks for pullets. Such a feeder should be shallow, not more than 7.5cm (3 inches) deep and be placed on the floor. The feeding space should be doubled for broiler chicks from four – 10 weeks and for pullet chick six – 14 weeks. For this age and beyond, the feeder should be about 1.5cm (six inches) deep. This means that 100 chicks would require one 1.25cm (4ft) long feeder up to four – six weeks of age use three of such feeders up to 10 or 14 weeks of age. Beyond 14 weeks of age use three of such feeders per 100 pullets or layers. Feeders should be constructed with lips to minimize feed wastage and fitted with rollers at the open end to prevent chicks from jumping in and contaminating the feed with their faeces. Feeders may be metallic or wooden. Most waterers are conical in shape. Two, four-litre capacity waterers are adequate for up to 100 birds from day old to six weeks of age. They should be used.

Two waterers of 10 – 15 litre capacity may be used for 100 chickens up to 200 weeks and three of such waterers should be provided for 100 birds during the laying period. Waterers should not be too large since they will be too heavy and tend to waste water. Waterers usually made of metal, glass or plastic materials. In general feeders and waterers are often constructed in two standard sizes, one for chicks and the other for older chicken, the chick feeders and drinkers are used during the brooding period while the bigger sizes should replace these as soon as the birds outgrow them, usually between four – eight weeks of age, depending on whether they are broilers or pullets. The poultry keeper may find it convenient to improvise his own feeders and waterers. The points to observe in such a case is that the feeders and waterers should be designed to minimise feed or water wastage and to prevent chicks from jumping in to feed or water wastage and to prevent the chicks from jumping into feed or water and contaminating it. For waterers there should be no leakage and it should be easy to wash.

d. **Litter Materials**: It is necessary to cover the floor of the brooder house with some dry, clean, coarse and absorbent material before putting in the chicks. Such materials is meant to absorb the moisture from water as spillage and chick droppings in such a way that the house is kept dry all the time. The most popularly used litter material is wood shavings, available from sawmills and carpenters' sheds and usually given free. Other litter material include: chopped maize cobs, guinea-corn and millet husks, chopped rice straw, chopped fry grass, crushed groundnut shells and rice husks.

e. **Miscellaneous Equipment**: In addition to the list enumerated above, the poultry keeper would need things like buckets, brooms, shovels, wheelbarrow, feed scoops, chicken crates, ropes for hanging feeders, water tanks for water storage, egg laying nests, egg trays, weighing scale and for big operations, office space and equipment would also be needed. Other equipment may also be purchased depending on availability and need.

Preparation for the arrival of chicks

A. Buying chicks

Day old chicks should be purchased from a reliable hatchery in order to obtain quality chicks, which are very healthy and have the genetic production potential. Place your order well in advance (about six months) and remember to indicate the sex, strain and quantity required. Seek the advice of your nearest poultry/livestock extension officer on the choice of breed and the hatchery.

Some poultry keepers might prefer to buy only starter pullets so that they do not have to brood the birds themselves. Starter pullets at point of lay chicken are not being produced commercially in this country but it is one form of poultry business that can be very profitable if there is good co-operation between the pullet rearer and the egg producer. Before buying starter pullets, be very such that the producer had done a good job of rearing by going through the records and by physical examination and weighing a sample of the birds to see whether they have attained recommended weights for the breed or variety at that age.

It is very important to be fully prepared before you collect day old chicks. This will ensure that they are properly transported and received at the farm. This increases their survival rate during the brooding period.

B. Brooder House

Get the brooder house ready about three weeks before the chicks arrive. Work to be done include:

1. Making necessary repairs to mend leaking roofs, repairing doors and plastering cracks in the walls.
2. Removal of old litter from the house already in use sweeping, thoroughly washing and disinfections of the house using a suitable disinfectant such as Izal, Dettol, Sanities or Milton.
3. Feeding troughs and drinkers already in use should also be thoroughly washed and disinfected.
4. Making sure that all the necessary equipment have been purchased and are in good working condition.

C. Two Days to Arrival

1. Sweep the house and clean the equipment
2. Put litter on the floor. If the floor is not cemented, put a layer of dry clean sand before putting the litter. Put the litter to a depth of about 7.5cm (three inches)
3. Cover the litter material with rough brown paper or old newspapers. This is to prevent the chicks from eating fibrous materials while learning to eat. The paper may be removed after four days.
4. Assemble all equipment with the brooder box in the middle and the feeders radiating from the source of heat should be distributed evenly under the brooder box. The water fountain may be set between the feeders but near the edge of the hover. The whole arrangement is then enclosed by a chick guard of cardboard per about 45cm (30 inches) high and about 1.5m (5ft) away from the brooder box. Blocks or any other suitable material can also be used. The purpose of the chick guard is to prevent the chicks from drifting too far away from the source of heat. The guard may be removed back a little every day and then completely removed after 10 days.
5. Test all equipment to make sure that they are in proper working condition.
6. If a half-open sided house is to be used, cover the open sides with plastic sheets, thick cardboard paper, native mats, empty feed bags or any other suitable material.

Brooding Management Practices

Arrival of Chicks

1. About 6 hours before the chicks arrive, fill the drinkers with medicated water, put on the heat source to warm up the room and place feed in the feeders. Some feed may also be sprinkled on the used as feeders during the first week.
2. Transport the chicks as fast as possible from the hatchery to the farm with minimum disturbance and preferably during the cooler part of the day. Ensure that the chicks are adequately ventilated while in transit, e.g. the chicks should not be up inside the boot of a car while in transit.
3. Collect all relevant information about the chicks from the hatchery of purpose. Have they been vaccinated? Are there any special management practices to be observed? What is the anticipated growth or production potential?

4. As soon as the chicks arrive, count and put them immediately under the hover. Remove all deformed chicks. Teach the weak chicks to drink if chicks are transported over long distances by road, the addition of glucose (or sugar if glucose is not available) to the drinking water may help to increase their survival rate.
5. After putting down the chicks stay and watch them for the next one hour and observe how comfortable they are. If they spread under the hover, they are comfortable. If they huddle in the center close to the source of heat they are cold. If the room is too hot, they will move from the source of heat and be pushing up against the chick guard. The heat supply should then be adjusted accordingly.
6. Chicks have a tendency to crowd around corners of the building especially when frightened or if they feel cold. Piling can lead to mortality. It is therefore advisable to round off any sharp or square corners of the house with boards, bricks or jute sacks in order to prevent piling.

Daily Activities

1. During the first week, inspect your flock as early as possible in the morning, as late as possible in the evenings and occasionally at other times to ensure that the birds are comfortable.
2. Remove any dead birds and dispose properly by burial o ruse of a disposal pit
3. Remove mould or contaminated feed and add fresh supply. Feeders should only be filled about half to two-thirds capacity in order to minimise feed wastage. They should also be placed in such a way that no bird has to walk more than 3.05m (10ft) to get feed or water.
4. Remove waterers and wash properly before refilling with fresh clean water that is fit for human consumption. Use medicated water throughout the first week. The water should be changed again in the afternoon, if it becomes dirty or refilled any time it is empty. Waterers may be raised on blocks to minimize contamination.
5. Remove wet litter and replace with fresh and dry litter materials.
6. When kerosene lanterns are used
    a) Fill them up only two-thirds full every morning and evening
    b) Remove any accumulated soot
    c) Trim the wick periodically in order to obtain uniform flame.
7. Fill in the records. For small holders a hard covered notebook is adequate but for large units a number of forms with the appropriate columns is usually kept for each pan.

8. All corridors and storage spaces should be swept clean and all equipment not in use should be neatly packed in such storage spaces.
9. If abnormal signs are observed, such as decreased feed consumption, bloody faeces, descried activity or droopiness report immediately to your nearest livestock or veterinary officer.

Periodic Activities

1. Cull birds that are deformed, stunted or are manifesting lack of growth and poor productivity. This cuts down on the cost of feed and also increases the space allowance for the healthy birds.
2. Debeak the birds at three – five weeks old and between 15 – 17 weeks of age by cutting off about 1/3 of the upper and lower beaks. Electric debeaking at about three weeks of age give a more permanent debeaking than old scissors debeaking.
3. Deworm at eight weeks and thereafter as necessary depending on the incidence of re-infestation of the flock by worms.
4. Following the routine vaccination programme recommended for your area.

Broiler Management

Broiler production should be an attractive enterprise for school projects and backyard poultry producers because of its fast rate of return. Within a school term of ten weeks, broiler can be raised from day old to market weight. For the beginning poultry farmer it offers the unique opportunity to acquire basic poultry management skills, which can then be extended to larger flocks and other forms of livestock farming enterprises. Well-managed good quality broilers should be ready for market by eight weeks at which time they should be averaging 1.7 – 2 kg each.

Housing and Equipment

Housing

The most practical system for broiler management is the “All in” and “All out” method whereby chicks are brought into one house at day old and reared to slaughter weight. They are then removed at once; the house is cleansed, washed, disinfected and allowed to rest for not less than two weeks before a new set is brought in. housing designed for brooding only can be use during the cold months in the North but at other times the conventional open-sided houses can be used so long as the recommendation for optimum brooding conditions are observed.

Equipment

The equipment for broiler production are as described under brooding management because the watering chore takes more time than other routines, it is advisable to install and automatic water system. Automatic watering only requires an overhead tank, a pump to deliver water into the tank and the automatic waterers. Once the tank is full, water fills the waterers naturally by the force of gravity. However, it is important to check the watering lines everyday to ensure that there are no blockages.

Feeds and Feeding

Broiler feeds are high energy, high protein-containing feeds designed to promote rapid growth. There are two types of broiler feeds available commercially. The broiler starter which should be fed for the first one – five weeks and the broiler finisher should be fed from five weeks to finish. Although both feeds can have the same energy level (300 ME Kcals/kg of diet), the broiler starter should have a higher protein (23 per cent) than the finisher (20 per cent). Studies by Olomu and Offiong (1980) have shown that good quality vegetation protein can be used as the sole source of protein in finishers but not in starters. Hence there is the need to ensure that broiler feeds contain a good quality to meet the indispensable amino acid requirements. Good quality feed is an absolute necessity for the successful production of broilers and other poultry.

Broilers are usually fed at libitum. The use of artificial lights to stimulate feeding day and night can increase feed intake and promote a more rapid growth. To make feed available all the time means that care must be taken to minimise feed wastage as this tends to increase with such liberal feeding practices.

The amount of feed required to raise a set of broiler would depend on the quality of feed, the duration for which the broilers are kept and the amount of feed wastage. The consumption of starter mash should be between 1.5 – 2.0 kg/bird from 0 – five weeks, while the amount of broiler finisher should be between 3 – 4kg/bird. Table 11.1 summarises the requirement per 100 broilers.

Table 11.1: Broiler and Requirements per 100 Birds

Feed Name	Age to Feed	Quantity/100 birds	
		Kg	No. of 25kg bags
Broiler Starter	0 – 5 weeks	200	8
Broiler Finisher	5 – 9 weeks	300	12

Table 11.2: Broiler Management Guide

Week	**Age of birds (weeks)**	**Activity**
0 – 2	-	• Sweep, wash and disinfect house. Assemble all equipment and check to ensure they are in working order. Carry out house repairs if needed.
1 – 2	0	• Allow house to rest
2 – 3	0	• Set brooder house ready for arrival of chicks.
3 – 4	0 -1	• Arrival of chicks • Provide optimum brooding care • Vaccinate birds against Newscastle disease, marcks and Gumboro before 10 days of age.
4 – 5	1 – 2	• Continue Brooding care • Complete vaccinations as above
5 – 6	2 - 3	• Gradually reduce supplementary heat.
6 – 7	3 – 4	• Gradually reduce supplementary heat.
7 – 9	4 – 6	• Discontinue supplementary heat • Vaccination against Newscastle disease, Gumboro and Fowl pox • Change feed to broiler finisher • Change to adult feeders and drinkers.
9 – 10	6 – 7	• Activate the machinery for marketing
10 – 11	7 – 8	• Complete arrangements for marketing
11 – 13	8 – 10	• Sell off broilers • Sweep, wash and disinfect house and get ready for new set

Management Routines: Daily and periodic routines during brooding have already been described. However, broiler production had the following peculiarities: No de-worming is necessary. Check weights weekly by sampling about five per cent of the birds.

Pullet Management

Pullets are young chickens that are grown to start laying eggs by the time they are 20 – 24 weeks old. The primary goal of the pullet grower is to produce a lean, large-framed pullet that will become an economical and profitable layer.

Housing and Equipment

Housing: Pullets like broilers are most often reared on deep litter floors. The discussion on housing under brooding is therefore relevant to pullet housing. However, it is important for the farmer to decide whether to have separate brooding and pullet rearing houses or use the same facility to brood, grow and lay. For ease of management, it is better to have a separate house for brooding and rearing. Since it takes four – five months to brood and grow pullets to point of lay, one brood and grow house can be used to produce pullets that will occupy three or four laying houses. For a farm that plans to produce eggs year round, the first set of pullets would be brought in January and be transferred into a laying house in April; the second set begins in April/May which would be transferred into a second laying house in August. The third would be started in August/September, which would be transferred into a third laying house December.

Brooding-grow pullet rearing houses should be designed to give a space allowance of 0.14sq m/bird (1.5 sq. ft). The floor space requirements/bird for chickens of varying ages is given in Table 11.3.

Table 11.3: Floor Space Requirements/Bird for Chickens of Varying Ages

Age of Birds (weeks)	Broiler Chickens		Pullets (brown eggers)			
	Sq. ft.	Sq. ft.	Floor rearing		Cage rearing	
			Sq. ft.	Sq. m	Sq. ins.	Sq. cm
0- 6	0.5	.046	0.5	.046	28	181
6 – 10	0.8	.074	0.8	.074	48	310
10 – 15	-	-	1.0	.093	55	355
15 – 20	-	-	1.5	.140	55	355
20 – 72	-	-	2.0	.186	70	452

In order to produce pullets that will be economical and profitable layers, great care must be taken to provide the management that will enhance good body development without accumulating fat. It is therefore necessary for the pullet grower to periodically (two weeks intervals) monitors their growth and compares with acceptable growth standards for his breed. It is desirable that 80 per cent of birds weighed must weigh within 10 per cent of the mean weight of the sample because the uniformity of individual weights is just as important as the average flock weight. The sample should be a random selection of about 100 birds per house.

Delaying sexual maturity is often a desirable goal because this helps to reduce the number of small eggs/bird.

Mortality rate from day old to 20 weeks should not exceed five – six per cent.

Feeds and Feeding

Feeds: There is a tendency to think that pullet feeding is not critical since rapid growth is not a priority; more so that delay in sexual maturity is often a desirable goal. This is an erroneous concept because a badly reared pullet can never be a good layer.

Commercially, growers' mash is the available feed for pullets from about eight weeks old to between 18 – 20 weeks of age. Chick mash would have been fed fro 0 – eight weeks. However, the present trend worldwide is to have two types of pullet developer ratios, one to be fed from eight up to about 14 weeks and second from 14 weeks to point of lay. Table 11. 4 gives the feed names and quantities per 100 birds based on the two feeding regimes with no feed restriction.

Table 11.4: Pullet Growing Feeds and Feed Requirements per 100 Birds

Feed	% Protein	Age to Feed	Quantities Required	
			kg	25kg bags
Programme 1				
Chick mash	20	0 – 8 weeks	200	8
Grower mash	16	8 – 20 weeks	550	22
Programme 2				
Chick mash	20	0 – 8 weeks	200	8
Pullet mash 1	16	8 – 14 weeks	250	10

Pullet mash	14	14 – 20 weeks	300	12

Feeding Restriction: When pullets are full fed, they tend to mature early and may begin to lay from 18 weeks of age. Most of these eggs would be too small to fetch good prices. It has therefore become a common practice to restrict feeds for growing pullets the advantages of feed restriction are:

a) It reduces the number of small eggs because the birds produce larger eggs soon after the commencement of lay
b) Trends to reduce laying house mortality
c) It often produces a bird with a larger frame and capacity at point of lay
d) May result in increased egg production
e) May produce significant savings in feed cost/pullet. Feed restriction however, should be practiced only when sample weighing indicates that the birds are growing too rapidly. One of three methods can be used:
    1. Skip-a-day: Full feed for two days and then skip a day without feed. This is the easiest method and it also tends to be less harsh on the birds.
    2. Restrict total feed intake: Feed only about 80 per cent of the regular feed intake on a daily basis
    3. Restrict the intake of protein or energy: This method can be applied if the farmer mixes his own feeds or is custom mixed.

Although feed restriction is a good management practice for pullets it must be applied only if a definite need for it has been established. The fact is that most commercial grower mashes are already restricted in energy and protein, this means that further physical restriction of feed intake would lead to excessive feed restriction that will be harmful to the birds.

Precautionary measures necessary for effective application of feed restriction procedures include the following:

a) Be sure to have adequate feeder space, especially if daily physical feed restriction is adopted.
b) Birds must be properly debeaked as there is a tendency towards increased incidence of cannibalism could be a serious threat.

Table 11.5: Pullet Management Guide

Age of Birds Weeks	Management Practices
0	• 2 – 3 weeks before arrival of chicks thoroughly wash and disinfect house. Allow house to rest for at least two weeks.
0	• 2 – 3 days before chick arrival, set up facilities for brooding (see brooding management)
0 – 1	• Receive chicks and produce optimum brooding care • Vaccinate chicks against Newcastle, Marck's and Gumboro before 10 days of age • Feed chick mash.
1 – 2	• Continue brooding care • Complete vaccination as above.
2 – 4	• Debeak if not done at day old • Continue brooding care • Gradually phase out supplementary heating
4 – 6	• Continue brooding care • Discontinue supplementary heating • Vaccinate against Newscastle disease, Gumboro and Fowl pox
6 – 8	• Separate cockerels from the pullets if straight run chicks were brooded • Continue with routine management practices.
8 – 10	• Change feed to grower mash • Change to adult size feeders and drinkers • Deworm the birds if possible
10 – 12	• Initiate feed restriction if necessary • Continue with routine management
12 – 14	• Continue feed restriction feed restriction if necessary • Continue with routine management practices.
14 – 16	• Continue feed restriction if necessary • Debeak if necessary (Be sure to have ample feed and water on days after debeaking).
16 – 18	• Full feeding • Vaccinate against Newscastle • Vaccine breeder flocks against Gumboro at 18 weeks
18 – 19	• Move birds into laying house. (Be sure to leave about one week between vaccination and movement of laying house).

	Introduce layers mash after 19 weeks but before 21 weeks.

Debeaking: This is very important pullet management practice which if properly done have the following advantages:

a) Reduces mortality due to feather and vent pecking
b) Decreases egg pecking
c) Improves feed efficiency by decreasing feed wastage

Early debeaking at six – 10 days is the most preferred because chicks are easier to handle than pullets, it prevents the cannibalistic habit at an early age, there is less interference with later vaccinations and there will be greater bird uniformity in the flock. Debeaking may also be done at four – six weeks and from 14 – 16 weeks.

The debeaking process is a major stress factor regardless of the age of birds on which it is done. It is therefore important that it is done with cold scissors but this often leads to excessive bleeding and high mortality. The best method is to use an electric debeaker. The procedure for debeaking is summarised as follows:

1. Mobilise a sufficient numner of staff for holding the birds and trained personnel for debeaking
2. Work during the cooler periods of the day. If possible avoid debeaking during the hotter periods of the year
3. Work out a system for the most efficient and rapid handling of birds during the process
4. Cut between 1/2 to 1/3 of the upper and lower beaks. Cut sharply and cauterise properly to avoid excessive bleeding
5. Provide plenty of feed and water after debeaking
6. Use anti-stress feed or water additives for about three days after debeaking
7. Do not debeak birds that are already under some kind of stress e.g. vaccinations.

Moving Pullets into laying Houses: The movement of pullets from a rearing house into laying facilities is a significant stress factor. Care must therefore be taken to ensure that the effect of such a stress is minimal. Movement should take place between 18 – 20 weeks old i.e. before the birds begin laying. This procedure should be followed:

1. Move birds during the cooler periods of the day, best of all in the evening
2. Get the laying facility fully supplied with feed and water prior to stocking. Use anti-stress feed or water additives

3. Eliminating feed 12 hours before moving may be helpful in decreasing pullet dehydration
4. Birds should be handled gently. Scratches or bruises can produce cage layer fatigue
5. Avoid overcrowding. Provide a minimum of 150 sq m. (2sq ft.) of space per bird in the laying house if deep litter is to be used.

Management of Layers

Pullets fed liberally under good management conditions may begin to lay eggs anytime after 18 weeks of age. However, delaying sexual maturity is a common management practice, which often leads to hens coming into lay after twenty weeks of age. Good layers should attain 50% hen-day egg production by 26 weeks of age.

Egg Production Goals

The profitability of any egg production enterprise depends largely on the number of eggs produced per laying hen. The primary goal of this enterprise is therefore to produce the maximum number of eggs at minimum cost. Under Nigerian conditions a good laying hen (medium sized brown eggers) should be able to produce about 220 eggs/yr and consume an average of 120g of feed/day. Mortality rates should not exceed about one per cent every month. The financial analysis of cage versus deep litter egg production systems is given in Table 11. 6.

Housing and Equipment

The farmer is often faced with the dilemma of raising layers on deep litter floor or in cages. In both cases solid structures have to be erected, but if cages are to be installed additional expenses must be incurred in the flooring construction to provide for heavier concreting with deep pit. Both the deep litter floor and cage systems have their advantages and disadvantages.

Table 11.6: Financial Analysis of Cage vs Deep Litter Egg Production Systems -Based on a 1983 Case Study

Parameter	Cage System	Deep Litter
1. Investment per bird (N)	23.31	15.01
2. Return on Investment	7.8%	21.5%
3. Cost of producing one egg (N)	0.15	0.14
4. Payback period (years)	12.9	4.6

Source: Federal Ministry of Agriculture, Water Resources and Rural Development, 1985. A comparative analysis of the deep litter vis-à-vis battery cage.

3.3 Systems of Poultry Production

A. **Battery cage system:** Most of the commercial layers today are kept in cages. This is particularly true in countries where the production processes are highly automated. The birds are easier to manage in cages.

Cage types: Many types of cages exist but the stair-step double decker type has become popular because unlike the vertical multi-stacked system, it does not require dropping boards or cleaning belts below the upper decks of cages. However, bird density per given volume house is lower for the stair-step cages compared to the stacked types. Cages should be placed in open-sided houses with dwarf walls. Under very hot conditions, the house may be no more than a roof over the cages.

Stocking density: It has been proved that when caged birds are fewer in number, they tend to waste more feed. Results of many researchers conducted in the last decade with regards to how much we can crowd layers in cages have, however, indicated that crowding is more profitable only when egg prices are high and feed costs are low. Attaining high egg prices without corresponding increase in feed cost is very unlikely in this country.

Manure Disposal: Where small (backyard) or medium size farms are involved, manure accumulation may not pose much problems. The manure produced can be collected and spread on farmlands. This method is easy and less expensive. However, in large-scale operations consisting of thousands or millions of layers, and with land becoming scarce, manure disposal may become a serious problem. Lagoons, oxidation ditches, drying (dehydrating) and besides these methods being expensive, there is still the odour problem and / or the need for final disposal of the treated manure. Poultry manure can also be fed to animals, particularly ruminants, after it had been treated. Proper disposal of manure is necessary so that offensive odour do not accumulate and pollute the neighbourhood. Apart from constituting a nuisance to the birds themselves by attracting many flies, these odours and the flies make the working environment uncomfortable for the attendants.

Cage-Related Problems: Layers kept in cages sometimes develop some problem whose specific causes have not been ascertained. Such problems are not common among layers managed on the floor. The main cage-related problems most commonly encountered are cage layer fatigue (birds are unable to stand due to weakened bones), fatty liver syndrome (lots of the oviduct to retract after laying) and egg drop syndrome. Stress may be involved in cage layer fatigue. However, it does not seem to have any adverse effect on egg production. The proper maintenance of automatic waterers and feeders are critical. A block in the water line for example can lead to a sharp drop in egg production.

B. **Deep litter floor system**: Install nests and fresh nesting material such as wood shavings, rice hulls or sawdust. Well-designed nests should be provided to reduce time needed for caring for the laying flock and the eggs. Nests may be made of wood or metal and of varying arrangements, but should provide for convenience in egg collection. They may be placed in the middle of the pen or along the walls inside the building. Provide one nest measuring 30cm (12”) wide, 35cm (14”) high and about 30cm (12”) deep per 4 hens. For community nests should be cleaned regularly and new nesting materials added as needed to produce clean eggs.

The litter should be stirred frequently and new materials added. Wet and “caked-over” spots should be removed and replaced with fresh, dry litter.

A common problem with hens on deep litter is floor eggs. Eggs laid on the floor easily become dirty and are susceptible to breakage. The following management practices will help to ensure that the birds lay inside the nests rather than on the floor:

1. Have nests in the laying house before the pullets are housed or introduced the nests before the pullets commence laying
2. Provide adequate, well-ventilated nests to prevent overcrowding
3. Round off corners of the house, which serve as nesting places
4. Close nests at nights
5. Provide nests with clean nesting materials
6. Use darkened nests and place them in darker sections of the house.

Feeds and Feeding

Layers mash may contain between 2400 – 2800 Kcals of ME/kg of diet and 16 – 17 per cent protein. The peculiarity of layer’s feed, however, is its high calcium content, which may be up to 3.5 per cent. The high calcium is necessary for laying down the eggshell.

In recent years, phase feeding of layers has been advocated to be in line with the different phases of an egg production profile. The first phase start at point of lay to the period of peak production i.e. between 20 – 35 weeks, the second phase begins at 35 weeks and ends at about 55 weeks while the third lasts to the end of lay. Under such a system the ration for phase one should have 17 per cent protein, phase two 16 per cent and phase three 15 per cent protein. This takes cognizance of the differences in egg production during the three phases. The calcium level however, should be slightly increased from phase one to phase three to minimise egg breakage which normally increases with age of the hen. Feed and water should be given liberally.

Management Guide for Layers

The following is a summary of management routines for laying hens:

1. Provide optimum space per bird. A space requirement of .186m (2sq ft) is adequate at point of lay
2. Introduce the pullets to layer's mash preferably after the first eggs have been dropped (a production level of 2-5%)
3. Inspect birds daily for any signs of disease or abnormal behavior
4. Maintain accurate records of feed consumption, egg production and disease control measures. A sharp drop in feed consumption is often the first indicator of a pending disease outbreak or response to a major environmental stress.
5. Under hot weather conditions, provide plenty of cool drinking water, if possible, use artificial lights in the early mornings (from about 3:00 am) to stimulate feed consumption during the cooler times of the day.
6. Always enter the house courteously, rude entrance can create hysteria
7. Regularly cull unproductive birds. Removal of such hens creates more space for the remaining birds and saves on the feed cost that would have been expended on them. These birds may also fetch a better price at the time of culling than if they were left to be older before sale. All layers should be sold off after about one year of lay unless they are still economically productive
8. At the first signs of disease or any other problem, set up the preventive or corrective measures promptly
9. Prevent feed wastage.

Egg Collection and Handling: The chicken egg is one of God's most wonderful creations. Inside it is a warehouse of nutrients in such a way that they can form a chick if the egg is fertile. This concoction of nutrients is held inside the shell, built in such a way that it is strong to bear the weight of a brooding hen but weak enough for the completely developed chick to break through at hatching time. The shell is also porous enough to allow gaseous exchange between the inside contents and the external atmosphere.

This delicately designed bag of nutrients manufactured by the laying hen must be properly cared for if its original quality is to be retained during handling and storage. The conditions for handling and marketing of good quality eggs are as follows:

1. Provide adequate nests for hens of deep litter. The nest may have a hinged door at the top to facilitate easy collection of eggs
2. Keep litter dry. The egg is at its best at the point of oviposition. To prevent it from picking up dirt, the litter should be kept fresh by regular turning of the older litter, removal of wet spots and topping up with fresh dry litter when older litter becomes "caky" or too moist.
3. Collect eggs at least three times a day. Frequently egg collection prevents the unnecessary accumulation and trampling of eggs by hens. The use of paper or plastic egg trays is best for egg collection because they make it possible to collect and stack eggs with minimum breakage.
4. Store eggs in a cool place. Egg quality deteriorates very rapidly in a hot environment. The optimum temperature for storing eggs is about 13^0 C (55.4^0F) at 75 – 80 per cent relative humidity.
5. Use the egg room only for eggs. Eggs should be kept away from onions, kerosene and other products with pungent odour that eggs might absorb.
6. During periods of egg glut, spraying or dipping eggs in minerals oil (groundnut oil, cotton seed oil or palm oil, etc.) for one minute will preserve egg quality under normal room storage conditions for about four weeks.

Selection and Culling

The selection and culling of unproductive hens from the flock has the following advantages:

1. More floor space will be created for the good producers.
2. Saves on the feed cost of maintaining unproductive birds
3. Culling at an earlier age may fetch a better market price for the bird

4. May lead to a reduced incidence of diseases
5. It results in an improvement of feed efficiency for the entire flock.

Culling is a process that should actually begin at day old. Weak, diseased and unthrify birds should continuously be culled out during the growing period.

In laying flocks culling should commence soon after the hens attain peak production. The characteristics used to distinguish between good and bad layers are summarised in table below:

Table 11.7: Culling Chart for Separating Good from Poor Layers

Character	Good layer	Poor Non-layer
Comb	Large, smooth, bright red, glossy	Dull, dry shriveled, scaly
Beak	White	Yellow
Vent	Large, oval, smooth, moist and bluish-white	Shrunken, puckered, dry yellow of flesh colour
Public bones	Thin, pliable, spread apart	Blunt, rigid, close together
Abdomen	Full, soft, pliable.	Contracted, hard
Skin	Soft, loose	Thick under-laid with fat
Plumage	Worn, soiled feathers broken or roughened	Not much worn, appear glossy months after reaching maturity.

The best time to cull is in the evening just after dark using a flashlight, but culling can also be done during the day.

The age at which to dispose of old layers is the point at which the cost of egg production exceeds income from sale of eggs. Layers can be recycled by using a force molting programme.

Management of Breeders

Breeders are essentially managed like layers except that management procedures must be more strictly adhered to. The following management practices must be given special attention.

- **Selection and Culling**: Must be routinely and vigorously practiced.
- **Vaccinations**: There may be need for some vaccinations at point of lay which can serve to transfer immunity from hen to chicks e.g. IBD vaccine.

- **Feeding**: Feeding breeder mash, which usually contains a higher level of vitamins and some minerals than the regular layers mash. Feed restriction is often necessary for broiler breeder. A common practice is to limit feeding to only about 80 per cent of daily feed intake. Such diets must, however, be optimally fortified with minor nutrients.
- **Egg Collection**: Collection is at least five times a day.

3.4 Measures for Combating Heat Stress

Having outlined the consequences of heat stress to poultry, it is appropriate to discuss what can be done to combat heat stress. Both short and long term measures that have to be done immediately to cool down birds that are visibly suffering from heat stress. As may be expected, the subject has been of interest to researchers from all over the world. For example, in 1977, a group of researchers from the University of Ibadan compared the effects of forced ventilation, night feeding + light, drinking or dunking in cold water and dunking in normal water once a day in the afternoons on heat stress the researchers reported that night feeding + light resulted in best egg production and egg weight. However, forced ventilation, day feeding + light, drinking cold water and dunking in normal water also produced favourable results. In another study, the same workers found that the feeding of ascorbic acid at 100mg/kg of diet or aspirin at up to 0.2 per cent of the diets were also effective in alleviating heat stress. The beneficial effects of ascorbic acid feeding for counteracting the effects of heat stress on broilers, was recently confirmed.

These researches demonstrate the array of short-term measures that can be taken to combat heat stress. From a practical and economical standpoint, the use of artificial lights to stimulate nighttime feeding is perhaps the most advantageous method for combating heat stress.

The minimum temperatures, which are usually recorded in the early morning, are within the range of ideal temperatures for laying hens throughout the year. Therefore if light is available, the birds will be able to maintain a high level of feed intake during the cool parts of the day. However, during the hot afternoons when the risk of death from heat prostration is high, the provision of ice cooled water or spraying the birds with water from a garden hose are also practical considerations for alleviating heat stress.

The installation of electrically operated mechanical gadgets to improve ventilation or spray water in and around the poultry houses, are extensively used in many parts of the world. The most common of these gadgets is the fan. When placed on the windward side of the house, fans tend to increase the air speed as it blows through the building. At exceptionally high temperatures, it may be better to place the fans inside the house to blow the air lengthwise of the building. In some parts of the world, circulating micro jet sprinklers are installed at the point of the roof. Such sprinklers are used to spray the roof or the ground area around the poultry house with water. This aids in cooling the house and its surroundings. The installation of foggers which emit a fine mist of water that keep the chickens wet to aid in cooling the birds have also been utilised.

A short term measure to combat the effect of heat stress that is little known to poultry farmers is the manipulation of poultry feed formulas to provide feeds with lower energy content but adequately fortified with other essential nutrients. This practice is based on the principle that the amount of feed consumed by a bird depends on the energy requirement. For the poultry man who has control over his feed formula, it is recommended that during the hotter months of the year, feeds should be formulated to contain lower than usual energy levels but optimally fortified with other essential nutrients. Such diets should stimulate an increase in feed intake and consequently an increase in egg production for layers or growth rate for broilers. Related to this is the use of feed ingredients that contain fat. Where fats are economically available, they should be used as the preferred energy source for feed formulation because they are known to produce less specific heat than other sources of energy.

Whatever methods are used for combating heat stress must be weighed against the economics of such a practice. The farmer should be free to try any methods accessible to him and select the most economical management practice in his situation.

Good housing design and construction is the most important long-term measure for combating heat stress. Nigeria is fortunate to be in a geographical region in which good poultry housing can be constructed at minimum costs. A good poultry house must provide the following necessities: protection from rain, sun, and pest, adequate ventilation, minimise ammonia build up and reduction in humidity. The design that best satisfies these requirements in most of the tropical world is an open sided house with a suitable roofing material. A house constructed with about two-thirds of its sidewalls open but screed with chicken wire mesh and less than 11m in width in most cases will have adequate natural ventilation for most of the year. Adequate ventilation is the most important factor for the control of ammonia build up, humidity and poultry house temperatures. The ideal poultry house should have an East-West orientation to prevent sunrays from entering the house and should be located on a well-drained site selected to take advantage of topographical features that favour free air movement in and out of the open-sided poultry houses. Other construction details of the ideal poultry house include the selection of economically suitable roofing materials that will produce a cooling effect in the house and floors and sidewalls that can easily be cleaned and disinfected. The use of gable roofing with ridges is increasingly being used as further means of enhancing adequate ventilation in poultry houses. The presence of trees around the houses can result in shades that will produce a cooling effect in the house environment.

3.5 Disease Prevention and Management

As has often been said, prevention is better than cure. This is particularly necessary in poultry production where an outbreak of a disease can wipe out a whole flock. A much better and more practical way of dealing with disease is by prevention. It does not mean vaccination alone but constitutes a host of other practices, which must be followed regularly.

Cleanliness: This means that whatever the bird is given or made to come in contact with should always be clean. Regular use of disinfectants is important in controlling pathogenic microorganisms. The farm and its premises should be kept clean. It is also important that employees be provided with showers and clean clothing on the farm.

Pollution Control: Keep dust and offensive odour off the poultry house. Often, dusty air and bad odour are as a result of poor ventilation. Poor ventilation promotes rapid spread of respiratory diseases.

Dead Birds and Waste Disposal: Avoid throwing dead birds and refuse all over the farm premises. Dead birds should be properly disposed off. There are many ways of achieving this:

a. Incinerate (burn) in specially constructed facilities (incinerators) which when well operated are nearly odourless
b. Use plastic bags to hold the dead birds, seal and remove from the farm
c. Construct disposal pits in the ground into which dead birds are deposited for bacterial decomposition
d. Bury dead birds, deep enough to avoid being dug up by dogs, rats or other animals.

Consultation with other farmers and poultry experts

The “Lone Ranger” approach to poultry farming should be discouraged because more often than not, it is farmer who refuses to seek the advice and/or opinions of poultry experts and experienced and successful poultry farmers that runs into serious disease problems. Experts (poultry specialists, poultry pathologists and veterinarians) should be consulted at the beginning and regularly thereafter, for information on good source of day-old chicks, suitable housing designs, good management practices and recommendations that will ensure good performance from the birds. Consulting is a necessity for a beginner and should be important to those who have been in the business for a long time as is often the case, two heads are better than one.

Good Water and Feed Supply: Most sources of water (pipe borne, borehole or well water) often contain some impurities. Ideally, water supply to the farm should be tested for chemical contamination and purity. Avoid using nearby streams as source of water as chemical fishing upstream may render the water poisonous to birds. Adequate feeding is important for good health and productivity. Feeds fed should be well balanced so as to prevent occurrence of nutritional problems and to enable the bird withstand stress and disease attacks. Always inspect feeds for possible presence of decayed material, moldy grains, poisonous weeds and other possible sources of trouble.

Vaccination: Any poultry disease prevention strategy should involve a vaccination programme because the spread of some disease, particularly those of bacterial and viral origin is difficult to control even under the best management practices. Such diseases are therefore prevented by routinely vaccinating the birds. Just as there are many vaccines, so are there many vaccination programme.

A suggested programme is given in table 11.8 for layers and broilers. This suggested programme is based on experiences in the Zaria area and can only be used as a guide. You should consult your local veterinarian for the best programme for your area.

Post Mortem Examination: This means finding out the cause of death of the bird. It involves physical examination and laboratory tests, and should be conducted by a trained person. Information from this exercise is important in changing or modifying your management practices in order to avert future occurrence of similar or other disease problems.

Control of external Parasites and Predators: The presence of external parasites on birds and rodents in poultry houses is a sign of poor management. These parasites irritate the birds and heavy infestation may cause heavy reduction in performance. The three main external parasites of poultry are lice, ticks and mites. They live within the feathers in all parts of the body and feed on the feathers or scales, while others bite or suck the blood of the host. Chemicals such as Malathion, carbaryl

(Sevrin), Coumaphos, Rabon and Vetox can be used to control external parasites. Rodents (rats and mice) eat and destroy feeds and feed bags, transmit diseases and constitute a nuisance. Best control of rodents require general clean up and the use of baits such as warfarin, zinc phosphide, Epi Block and Havoc.

Other Preventive Measures: State with good quality chicks, do not mix birds of different ages and from different farms; restrict or prevent visitors into the poultry house; isolate sick birds as soon as discovered and seek veterinary attention; keep birds as comfortable as possible and avoid sudden changes in their environment which may cause stress.

3.6 Record- Keeping and Performance Evaluation

Beside other uses, one of the purposes for keeping records on the farm is the information it provides on the health and health history of the flock. Veterinarians are often invited whenever there is a disease problem on the farm and they are expected to find the causes and correct them. To do this successfully, background information or the history of the flock is necessary. Certainly, it is difficult to provide such information correctly without records. There are different types of records, depending on the type of poultry enterprise. Irrespective of the type of production, farm records should provide information on medications, types of vaccines and how administered, feed consumption, mortality and cause.

Records are essential as profit and loss indicators. They also help to identify disease problems at the very early stage when they can be more readily controlled. There are three records that must be kept by all poultry farmers.

1. **Inventory**: A list of all equipment, drugs feeds and other items in u se on the farm; date of purchase, cost and quantity of items should be appropriately kept.
2. **Production Records**: Should show date, status of birds; numbers, mortality, feed consumption, culls and in the case of layers egg production. It is usual to maintain a record sheet for each house of flock for daily recording. Weekly and monthly summaries should be made and used as a basis for evolving the appropriate operational management decisions.
3. **Sales Records**: Show total product sales (chicks, broilers, culls and eggs) and revenue collected. It is absolutely essential to use different people for maintaining the production and sales records. It is the responsibility of management to ensure that all eggs collected or birds produced are properly accounted for from day to day. The theft of birds, eggs, and other farm supplies by farm

workers are commonplace so it is extremely important to have proper accountability.

Sample record forms may be used but it is best to evolve one based on field experience and the needs of the particular farm. Records should be few but comprehensive enough to supply needed information.

Performance Evaluation

Poultry keeping like any other business demands that the producer must be able to assess from time to time whether he is gaining or losing money in the enterprise. It is therefore important that the poultry keeper should periodically go through his records and compare with established performance standards in order to determine how well the birds are growing or laying eggs. The major parameters used in measuring productivity from chickens are: weight gain, mortality, hen-day and hen-housed egg production rates, and efficiency of feed utilisation.

1. **Mortality**: Keeping the mortality rate as low as possible in any flock should be the ambition of every poultry keeper. It is usually expressed in percentages:

   Mortality: $$= \frac{No\ of\ birds\ dead}{No\ of\ birds\ started}\ x\ 100$$

   For broilers a mortality rate of less than four per cent is considered normal rates. For pullets from day one to point of lay (about 20 weeks) is five – six per cent. For laying birds the mortality rate should not be more than 10 per cent throughout the laying period. An unusual increase in mortality is often the symptom of a major disease outbreak and should be promptly and thoroughly investigated by a veterinarian.

   Weight Gain: In broiler production, the rate of live weight gain is a very important parameter. It is good practice to weigh a sample of the broiler flock at two–week intervals. These weights should be compared with established standards in order to determine whether the birds are growing well; if the birds are not growing well, the quality of the feed is often a major contributing factors. Disease conditions, poor quality birds and bad management are other possible factors.

2. **Live weight**: In pullet production, weight gain is not an important parameter but the weights need to be checked periodically (four

week – intervals) in order to make sure that the pullets are developing properly.

In commercial production it is standard practice to control the growth rate of pullets in order to produce pullets of uniform size at point of lay as well as delay sexual maturity.

3. **Hen-day and hen – housed egg production:** The rate of egg production in a flock is often expressed in terms of the percentage of birds laying eggs relative to the total number of the birds in the flock at any given time.

$$\text{Hen-day egg production} = \frac{\text{Average daily egg production}}{\text{Average daily number of laying hens}} \times 100$$

$$\text{Hen-housed egg production} = \frac{\text{Average daily egg production}}{\text{No. of laying hens house at the Beginning of the laying period}} \times 100$$

The difference between hen-day and housed egg production lies in the fact that while hen-day is concerned only with the production from the birds that are alive, hen-housed production of the cost of production of poultry meat and eggs, it is important to use good quality feed. The better the quality of the feed, the better its rate of conversion into meat and eggs. Feed efficiency is a measure of how efficiently a given feed is being converted into products.

In broiler production, there are three ways of expressing feed efficiency.

a. $$\text{Feed efficiency} = \frac{\text{Weight gain}}{\text{Feed Intake}}$$

Feed efficiency is always less than 1.

b. $$\text{Efficiency of feed utilisation} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

c. $$\text{Feed conversion} = \frac{\text{Feed intake}}{\text{Body weight}}$$

In commercial production feed conversion is commonly used but the term feed efficiency is a more common terminology in scientific literature.

A desirable goal for commercial broiler production is a feed conversion of 2.0 at market weight.

In egg production, feed efficiency may be expressed in terms of feed/dozen eggs or feed per kg of eggs.

$$\text{Feed/dozen eggs} = \frac{\text{Feed consumed}}{\text{No of eggs production in dozens}}$$

$$\text{Efficiency of feed} = \frac{\text{Feed consumed kg}}{\text{Kg of eggs produced}}$$

Table 11.8: A Suggested Vaccination Programme for Poultry

Age	Vaccination Required
1 day old	1. 1st dose of Newcastle disease vaccine
0 – 2 weeks	2. A dose of mark's disease vaccine
3 – 5 weeks	3. 1st dose of Gomboro disease vaccine
	4. 2nd dose of Gomboro disease vaccine (vaccine usually given 3 weeks after the first dose
6 – 8 weeks	5. A dose of fowl pox vaccine
	6. 2nd does of Newcastle disease vaccine
16 – 18 weeks	7. 3rd does of Newcastle disease vaccine
	8. 3rd dose of Gomoboro disease vaccine for breeder flocks

4.0 CONCLUSION

Poultry are kept essentially for egg or meat production. The duration and management practices required for egg and meat type of production differ, though the two may be integrated naturally as in backyard poultry production or by sharing the same poultry equipment and appliances or facilities. In either of the two enterprises (broilers or pullet production), production operations are undertaken in phases – brooding and rearing, starter and finisher phases (for broiler management), pullet and layer phases (for pullet management). Productivity and/or profitability is dependent on the appropriateness in time and effectiveness with which routine management practices are applied. Understanding of the principles of poultry presupposes their application which this study unit endeavours to provide to students in this course.

5.0 SUMMARY

The study unit has attempted to touch on essential areas of poultry, especially domestic chicken, management in order to cultivate in the minds of students both theoretical and practical understanding of the subject matter. It is organized to expose learners to the two major enterprises in poultry production, routine practices in the various production operations associated with the intensive and extensive systems of management. Ancillary management practices such as heat stress and diseases management, record keep and performance evaluation are also discussed from practical point of view to enable student develop can do attitude towards animal agriculture.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe production practices for a specific poultry enterprise under a named management system. What advantages has your chosen management system over others
2. Describe long and short term measures from combating heat stress in broiler raised in a deep litter system
3. Outline vaccination regimes for pullets up till the point of lay. Enumerate economic importance of name poultry disease.
4. List types of records you need to take in a layer farm. What parameters will you measure to properly assess the performance of the layer farm?

7.0 REFERENCES/FURTHER READING

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UNIT 3 GENERAL PRINCIPLES FOR RABBIT MANAGEMENT

CONTENTS

1.0 INTRODUCTION

Rabbit is one of the latest domesticated livestock in Nigeria. While in the wild, rabbit is commonly referred to as hare. Rabbit production in Nigeria became popular following its earlier introduction in the Western States of Nigeria by the United States Department of Agriculture and the subsequent creation of awareness for its popularization by the Directorate of Food, Roads and Rural Infrastructure (DFRRI) in 1988/1989. Rapid spread of rabbit production arises from its large scale advantages over many other species of livestock. The feeding habit of rabbit confers the ability to utilise forage and concentrate diets efficiently as sources of needed nutrients. This ability further assists to reduce feed scarcity and cost for rabbit production. While the growth rate is comparable with chicken in terms of meat production, it costs far much less to feed rabbit than broiler chicks. Its high reproductive efficiency measured by number of young ones per birth, fertility and short generation interval makes rearing of rabbits a highly attractive and profitable enterprise. The quality of rabbit meat product is nutritious and it is relished in social gatherings and drinking places as “bush meat”. Rabbit production above all is environment friendly; rabbits are not known for noise making, fierce fighting, attack on the husbandman or poor defecating habit that may result in stench environmental pollution. Thus, new entrants into livestock production often commence building up their skills through backyard rabbit production because of its attractiveness.

2.0 OBJECTIVES

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

- identify breed characteristics and select for desirable traits
- explain the principles of reproduction in rabbits
- mention feed ingredients available for rabbit and their nutritive values
- describe the basic principles underlying housing designs for rabbits
- explain principles of health management in rabbitery.

3.0 MAIN CONTENT

3.1 Breed Characteristics of Rabbit

There are several breeds and strains of rabbit that have been introduced into Nigeria. The breeds vary in the pattern of coat colours, sizes and productive characteristics. Most common coat colours are of dark, white brown, gray or ox-blood or a combination of two of these colours exhibited in a characteristic pattern for a given breed or strain of rabbit. However, much greater interest to the producers relates to the productive characters inherent in a breed. In terms of size, there are medium-sized or heavy breeds of rabbits which vary in their relative suitability for home and commercial meat or fur production. For fast growth, rapid attainment of mature body weight at 4.1-5.5 kg and 5.9-7.3 kg respectively for medium and heavy breeds is more desirable compared to small-sized breeds weighing 1.4-1.8 kg at maturity.

Some medium and heavy breeds of rabbits commonly found in Nigeria are listed in the table below:

Breed	**Weight at Maturity (Kg)**	**No. of Kittens Per Doe/Year**	**Coat Colour**
Flemish giant	5.9-7.3	36	Light grey American
Chinchilla	4.1-5.5	38	Fur grey, blue grey, Belly White
New Zealand	4.1-5.4	50	White, Red or black
Californian	3.6-5.0	48	White, black patches on Nose, ear, feet or tail
Dutch	2.5-3.5	45/48	Black, with belted white
English Spot	4.1-5.4	40	White black or

			chocolate spots
Champagne d'argent	4.1-5.4	40	Dark under fur slate white

The objective of the producer most importantly dictates the choice of breed or direction of selection.

Breed selection is commonly based on healthcare and vigour which is evidenced by alertness, brightness of eyes, coat colour, smooth and glossy coat, reproduction performance, type and conformation. Light coloured skins are often preferred to dark coat coloured rabbits. A good age to start production is at weaning or maturity. Selection for breeding and rearing must be decided on the basis of rabbit performance records on the farm. However, such records are hardly available. Rabbit breeds commonly found in the locality with proven assurance of good health and productivity from the producers nearby may suffice for a beginner. For example the New Zealand white and American Chinchilla are the most adapted exotic rabbit breeds in Nigeria, and they thrive very well in most ecological zones. Among the local types the light and dark brown are most preferred. Note that a breed name depends on location or place of origin, coat colours, breeder nomenclature or size.

Rabbits that have white coat colour are preferred and sell faster in Nigeria than those with dark coat colour. For wool production, the English Angora and French Angora have higher preference. For new starter, rabbits at maturity are easier to manage than newly weaned stock. However, matured rabbits are more expensive than weaners but they hasten to attain the breeding age of 5 or 6 months. It is important to rely on the health status and records of performance in selecting rabbits for breeding. The adaptability of a breeding stock may be easily accessed from the breed most populous in the community, this will also guarantee early disposal of stock whenever the producer desires.

3.2 Selecting and Improving Desirable Traits

Breeding stocks are selected predominantly from past records of a rabbit or its parents. Selecting on the basis of coat or eye colour is secondary. Quantitative traits such as fertility, growth and feed efficiency, milk production, disease resistance and carcass quality are more desirable basis for selection. High heritability percentage of most quantitive traits in rabbit further ensures that larger proportion of the characters can be passed from parents to offspring, and makes parent's records a dependable tool for the selection of good traits. Besides selecting desired characteristics in the animal, other techniques for improving such traits in the flock are:

Line Breeding	This is a continuous mating of subsequent generation to an identified male or its offspring.
Out crossing	Mating of unrelated individuals or lines of different breed. This often increases heterozygosity of the genotype
Cross breeding	Mating of individuals of two different breeds
Inbreeding	Mating of individuals that are more closely related than the average population e.g. mating sire-offspring, brother-sister or offspring-Dam

3.3 Principles of Reproduction in Rabbits

Rabbits are known to be highly active in sexual activities, as such, if undesirable mating (including mating prior to maturity, mating between closely related members of a family or mating between wrong partners) are to be avoided, rabbits should not be allowed to live communally. Males (Bucks) and females (Does) prior to age of maturity must be separated into single cages or hutches. Mature female rabbit (also known as Doe) normally comes into 'season' or 'heat' periodically by demonstrating signs of high receptiveness to male for purpose of mating. Such sign may include restlessness in the cage; making frantic efforts to leave the cage to join other rabbits in the next cage, rubbing her chin on the hutch, water or feed troughs. Other signs observable are physical changes or discharge from the vulva such as redness or swollen genital. When these occur, the producer is encouraged to transfer the doe to the cage where the buck is housed without any further delay. Some bucks may be timid to mount on the doe if such bucks are taken from their cages to where the doe is housed. A delay in introducing a doe on heat to a buck immediately may result in loss of the experience to be receptive to the male. The act of mating or copulation also stimulates the release of eggs (oval) in the does for fertilization and conception within the reproductive organ of the female rabbit, usually 10 hours after mating. For this reason i.e. release of eggs only after the act of mating has taken place makes rabbit to be described as a "silent or included ovulator'.

It is important to regulate the mating ratio in a large stock of rabbits. Mating ratio refer to the number of male allotted to a group of female for purpose of mating for efficient reproduction and without over tasking the sexual stamina of the male. Recommended mating ratio is modestly put at one buck (male) to two-five does (females) daily.

A successful mating results in fertilization and pregnancy which extends between 28 and 32 days. Often kindling or parturition occurs between 31 and 32 days or an average of 30 days gestation period. Young rabbits (or kittens) grow for four-12 months to the maturity age and ready for breeding, depending on the breed. For example the small polish breed may be breed at four months, medium New Zealand white at six-seven months and heavy Flemish at nine-12 months of age. In many breeds sexual maturity may be attained at five months after birth but it is not recommended to opt for breeding doe immediately attaining the sexual age of maturity. Consideration must be given to the physical ability of the doe to carry pregnancy to term and to kindle young ones safely. Good quality feed and adequate feeding plus sound management care from birth may encourage a producer to breed a fast growing doe much earlier than its other mates lacking adequate quality and quantity of nutrients and growing slowly. This implies that age is not an absolute consideration in breeding but rather size, which is often from 2.0kg live weight. Please note that the doe must be returned to her cage and separately kept as soon as copulation with the buck occurs, to avoid abortion or loss of developing embryo as a result of struggling and fighting by the buck to have another round of mating with the doe if fertilization had taken place. Sometimes inexperience doe may resist mating, it is therefore important for the rearer to assist by restraining the doe to enable the buck to mount on her.

About four-five days before kindling nesting box is required to be placed within the closest reach for the pregnant doe. The nesting box should be stuffed with succulent bedding materials such as wood saving or grasses. The pregnant does on her own would naturally shed part of her hair covering to create warm cover for the hairless kittens to be delivered. Kittens cohabit with their dam in the nesting box for about two weeks during which the eyes are open and hair covering also develops. Re-breeding of the doe can be done shortly after kindling; however, re-breeding of doe four times in a year will suffice for good results. A good doe produces on the average 28 kittens per year.

3.4 Rabbit Feeds and Feeding

Management of kittens from birth through weaning to maturity depends largely on quality of feeds and appropriate application of feeding principles during the growth period. Young rabbits are left with the does to have access to milk until weaning at 56-60 days to attain 1.5kg weaning weight. Litter size (number of kittens per birth) determines the average litter weight due to competition for milk and feed. During lactation, adequate good quality concentrate, sufficient succulent greens and plenty of clean fresh water should be provided to ensure production of abundant milk for the young ones. Milk consumption at early stage of life of a kitten offers nutrients that ensure immune protection and rapid growth during the pre-weaning growth period. As such kitten weighing about 60g at birth attains 1.8-2.0kg at the weaning age of 50-60 days. At four-eight weeks, kitten would have grown hair coat to conserve body heat without the dam providing warmth for them. They should on their own eat some concentrate, greens and root supplied to their dam. At weaning, the dam is simply removed from the litter and kept separately away in another hutch. Sudden removal of the dam while the milk still flows may results in a caked udder. In order to avoid this condition at weaning, a few kittens especially those having slow rate of growth be left with the dam for few days until milk flow ceases.

Besides the removal of dam at weaning a number of activities are usually carried out immediately for ease of good management such as:

(1) Identification of individual weaners using ear tags, tattooing or notching methods.
(2) Sexing: separation of males and females weaners.
(3) Selection for breeding especially for replacement stock.

It is important to note certain principles guiding the feeding and nutrition of rabbits. The domestic rabbit is primarily herbivorous and will eat most types of green vegetation, hays, grains, tubers and roots. Thus rabbits may thrive on feed ingredients from plant sources. This convenient feeding habit derives from the special adaptation of the digestive system of rabbit. The digestive tract basically is that of a monogastric consisting of a simple stomach and a pair of large caeca (plural) where cellulolytic microorganisms reside. The latter additional structures aid in digestion of forage feeds which other simple stomach animals cannot easily digest. Another special ability of rabbits supporting the use of poor quality feed ingredients is the recycling of soft faecal pellets to supplement protein quality and B-vitamins and further aids better digestion of poorly digestible feed. The protein-rich soft faeces (coprophage) is produced from bacterial protein synthesised in the caecum (singular). The stomach adaptation of empowers rabbits to utilise non-protein nitrogen ingredients (urea, poultry manure, biuret) as sources of protein which further ease feed and nutrient requirements of rabbit while contributing to faster growth.

The nutrient needs of rabbits consist of suitable amounts of protein, carbohydrates, fat, minerals, vitamins, water and roughage. It is essential that feeds containing these nutrients must be provided in a palatable form and sufficient quantity. Nutrient requirements of 17 per cent crude protein (plus 0.65 per cent lysine and methionine), 2450 kcal digestible energy have been recommended the protein sources may include soybean, groundnut, cottonseed, palm kernel and sunflower meal in combination with non-protein nitrogen sources. While the energy may be derived from fats, tubers, grains and forage feeds. Fat supplementation as energy source should not exceed 20-25 per cent depending on age. It is of necessity to add a satisfactory level of roughage or any fibre source into the diet of rabbits to avoid enteritis and to aid both microbial activities and bowel movement. Staple food by-products commonly consumed in many Nigerian cultures have been tried and found to be useful for feeding rabbits e.g. dry cereal and legume grains. The use of cassava tuber peels and leaves, bambara nut wastes, poultry manure, maize and sorghum offal have been recommended as cheap alternative feedstuffs for rabbit without comprising growth rate and development of body tissues.

3.5 Basic Principles of Housing and Sanitation for Rabbits

The underlying principle of housing for rabbit is that housing accommodation should protect stock from predators, extreme climate, accidents and injuries. It should also aid comfort, growth and reproductive wellbeing of the rabbits and conveniently permit all operations to be carried by the husbandman. In its characteristics habits rabbit houses may be sited close to human habitation because rabbits are not noisy and their faeces are not stenchy-like in poultry and piggery. Rabbit houses ought to be a simple, cheap labour saving and easy to operate without compromising adequate ventilation and convenience of stock and workers. Specific designs of rabbit houses vary from one location, climate, scale of operation and investment to another. Materials for construction also determine the durability of the houses and their facilities.

Rabbit hutches or cages have been recommended to measure 0.9-1.2 m in length, 0.6-0.9 m in width and 0.6 m in heights with a clearance from the ground level of 1m. In principle a breeding doe or buck should be provided with 0.09 m^2 floor spaces for each 0.5 kg body weight. In another words, 5 kg live weight doe would require 0.9 m^2 of floor space for its convenient accommodation.

The type of flooring installed in rabbitry, influences the easy and frequency of cleaning of the cage. Wire mesh flooring is widely used where self-cleaning hutches are desired. Other types of flooring are solid and slat flooring or their combination with wire mesh flooring. Where solid flooring is installed slanting of the floor and frequent cleaning to remove urine, faeces and left-over of feed stuff on the floor is suggested. Slat flooring requires that hard wood slats are spaced closely to avoid trapping of rabbit feet in between slats. It is advisable to double wire mesh at base of hutches to avoid trapping of feet, breaking by predators or weakened by urine.

Provision of component facilitates such as nesting box, feeder, waterer, rack for forage and saltlick are important consideration for the construction of a rabbit hutch. Different materials ranging from metal sheets, wood, concrete, mud, plastic to earthen pots are commonly in use. The choice of material depends on capital, labour and preference of the owner. Rearing of rabbits in colony cage ranges from 0.37 to 0.55 cm^2 for a cage. Colony or cage rearing is often used for raising young rabbits especially for meat production. A space of 60 x 43cm types of housing are briefly described as follows:

- **Pens:** These are partitions in housing where rabbits are kept on concrete floor surrounded by wire mesh, wooden or concrete wall. All components facilities are placed on the floor for easy access by the rabbits. Note that matured rabbit reared as replacement stock are not suitable for this type of housing.
- **Paddocks:** These are fenced area in fields where rabbits are allowed to freely graze on the growing vegetation; portable hutches are usually placed within the fenced area to provide accommodation for the rabbit while they remain in the area or at night.
- **Underground Housing:** This type of housing permissible for rabbit to create a natural mode of living similar to condition in the feral state. However, concrete flooring must be provided beneath the underground to prevent rabbit burrowing to escape. Rabbit burrows into the underground where they live most part of the day but occasionally come up to the surface to feed and drink. Both the top and underground spaces are fenced to avoid escape.
- **Portable Hutches:** These are light movable hutches to accommodate and transfer hutches from one point to another usually in the backyard where rabbits can be grazed on vegetation or in paddocks.
- **Nesting Boxes:** Nesting boxes are special housing facilities designed to accommodate the dam and the kittens prior to kindling and during the period of nursing to weaning. They provide convenient place for kindling for the breeding doe and prevent kittens from wandering away from their source of warmth and suckling. Cushioning materials such as succulent hay, cotton wool, shredded paper or hair are provided by doe or rearer to aid survival of the kittens at their early life.

Ease of attention and disposal of dirt for a clean environment should form a strong consideration for a choice of accommodation for rabbit.

3.6 Principles of Disease Prevention and Health Management

Rabbits in good health and vitality are easily recognized by their bright eyes, alertness to sound, smooth and glossy coat and good appetite. The immediate surrounding including hutches, equipment, water and feeds are the points of attack by parasites and diseases. Cleaning and hygiene of the sanitary conditions of these ports determine the health status of the rabbitry. Cleaning and hygiene implies prompt disposal of manure, used bedding materials, stale food, providing wholesome water and feed and keeping the entire hutch and its components clean and disinfected. Sanitation in the rabbitry forms the best method for the prevention of disease outbreak. Similarly, rabbits entering into the rabbitry from an outside environment must be quarantined for two-three weeks prior to introducing into the stock. The quarantine provides a period of observation and treatment of worms and external parasites as well as other diseases that may be noticed. Isolation of any sick rabbit immediately on notice of certain habits or symptoms of a disease condition helps a great deal to prevent spread of diseases in the herd. Habits associated with disease condition include: listless (or restlessness), isolation from other mates or sitting hunched up in a corner, not actively feeding or drinking, dull eyes, rough coats. These observations are indicative of disease infection and the immediate attention of veterinary personnel is most desirable. Most disease conditions of rabbits may be categorised into viral, bacterial, parasitic, fungal and non-infectious diseases:

a. Non-Infectious Diseases:

- **(i) Cannibalism:** Does may sometime be predisposed to killing and eating up their kittens. Lack of sufficient or good quality feed or water, nervousness and crowdy accommodation may trigger such a vice habit. Does found in this vice behaviour consistently should be culled or disposed off.
- **(ii) Bloat:** This is a condition associated with the distention of the abdomen due to accumulation of fluid in the stomach as a result of malfunctioning of the digestive system. Excessive feeding of carbohydrate-based diets, slimy forage or certain legumes are predisposing factors. Addition of fat or hay to diets and reduction of grains in concentrate diet eliminate bloating condition in rabbits.

b. Fungal Diseases

Ringworm: This is a disease of the skin coat caused by fungis *Trichophyhton mentagrophytes.* It is characterized by circular loss of hair at a spot on the skin or thinning of the fur. The affected portion may be inflamed or covered with bran-like flaky skin debris. Treatment is often effected by sprinkling of powdered sulfur to nesting boxes or on infected spot after scrapping off the whitish flakes.

c. Parasitic Diseases

- **(i) Coccioliosis:** Coccioliosis is caused by protozoa known as *Eimeria spp.* Infected rabbit show signs of diarrhea, lack of appetite, rough coat and poor growth rate. The diarrhea may be accompanied with stained feaces. Treatment with sulfaquinoxaline often suffices.
- **(ii) Mange:** This is a disorder associated with *Sarcoptes scabiei or Notoedres cati* infection. It is characterized by scratching of the spot of infestation and loss of hair on the chin, nose, head, base of ears and eyes. Dipping rabbit in lime sulfur preparation has aided in treating the disease.

d. Bacterial Diseases

- **(i) Pasteurellosis:** This is a disorder of the nasal membrane, air passages and the lungs. It is highly contagious disease caused by *Pasteurella multocida.* Rabbit exhibit snuffles or nasal catarrh and inflammation of mucous membrane. The bacterial parasite is responsible for abscesses which may be found in any part of the body or head.
- **(ii) Conjunctivitis (Weepy eye):** Infected rabbit is prone to rub the eyes with her feet resulting in watery exudates or discharge from the eyes, reddening of the eyes and eventual inflammation of the eye tissues. Treatment is done with eye ointments containing sulfonamide, antibiotics and/or steroids.
- **(iii) Pneumonia:** This is bacterial infection arising from dampy and unsanitary hutches and inadequate bedding. The body temperature of the affected rabbit rises up to 40^0C and the animal exhibits off-feed, dyspnea and lassitude. Antibiotics such as oxytetracycline, penicillin or combination of penicillin and streptomycin are used as effective treatments.

4.0 CONCLUSION

The focus of this study unit is on the basic management principles guiding rabbit production. For a fresh beginner in rabbit rearing, there is need for clarity on the advantages of choosing rabbitry as an enterprise among other livestock production engagements. He must have the understanding of identifying breeds or strains of rabbit required to meet his production objectives and subsequently selecting for specific traits of interest. The realisations of the farmer's objective are predicated on his knowledge and application of the principles of rabbit management and husbandry which are concisely discussed under the six themes of the main content.

5.0 SUMMARY

Domestication of rabbits from the wild is recent. Rabbit production has several advantages over other farm animal production enterprises especially in terms of low cost and easily available feedstuff, high reproductive efficiency and above all, high profitability. As such fresh beginners, be they farmers or students, must be acquainted with the basic principles of selecting, breeding, feeding, housing and managing the health of rabbit to achieve the production objectives.

6.0 TUTOR-MARKED ASSIGNMENT

1. Identify three breeds of rabbit you consider suitable for your local environment. Describe how you will establish a rabbitry for your college to enable it sell replacement stock to your community.
2. Describe a housing system for a tenant who lives in an upstair and desires to keep rabbit for family consumption.
3. Itemise routine daily husbandry activities for feeding and healthcare of rabbits reared in a backyard hutch.

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UNIT 4 LIVESTOCK MANAGEMENT TIPS

CONTENTS

1.0 INTRODUCTION

In spite of all attempts to present this course 'Principles of Animal Production' in a form that offers students the principles and techniques for livestock production and stimulate practical desires to engage in actual production or provide expert advisory services to producers, such efforts would fail if consideration is not given to some additional salient management tips. This study unit provides a rap-up of information required to further manage or establish a livestock enterprises bearing in mind the important economic factors to achieve high productivity and profitability. The general management tips provided in the unit is applicable to productive livestock enterprises widely present in the tropics and particularly in Nigeria where commercial livestock production may be described as being at infancy. It is envisaged that the management tips would assist learners gain insights to both production and management aspects of a profitable livestock enterprise management as it may concern various farm animal species.

2.0 OBJECTIVES

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

- recount some salient points required to fortify their knowledge of managing different classes of livestock
- explain the economic considerations in livestock enterprise management.

3.0 MAIN CONTENT

3.1 General Management Considerations

It is important to note that the more time manager can personally devote to the maintenance of the herd the better the chances of success. It is also crucial for the producer to have sound knowledge about animal management because ignorance of certain basic facts or principles can result in great loss of stock or income. Experience in most instances guarantees confidence to succeed. Suggested practical steps or tips are meant to inspire confidence in farm animal production.

- **Stockmanship.** This concerns relationship and rapport between a husbandman and his stock. A good stockman is firm and irregularities pays attention to the needs of his stock. He is highly sensitive to and watches for in the behaviour or condition of individual animal. He also anticipates problems ahead of action or inaction. He carries out his routine activities with calmness and diligence, and minimises upsetting or scaring the herd or flock of stock. Even in an attempt to restrain or attend to a member of the herd, calmness of the herd is minimally disrupted through the use of retraining materials or facilities that guarantee peace.
- **Cleanliness and Hygiene:** Maintenance of good hygiene in the livestock farm environment does not only reduce incidence of diseases and parasites in farm animals but it also has a beneficial effect on staff morale to work in clean environment. Routine farm operations should allow for periodic cleaning, emptying and resting of pens for sufficient time before stocking. Cleaning of a used pen must be immediate involving scrubbing, washing and disinfecting and left dry to break lifecycle of parasites and recurrence of diseases.
- **Evaluation and Selection for Replacement:** The stock population of a farm is dynamic. New purchases and selection from the existing herd is being consistently undertaken for replacement. Evaluation and selection of desirable animal is the first test for considering eligibility for the replacement of old, non-performing or disposed animal. New purchases from open market scarcely have records to use as basis for evaluation. The stockman in such circumstance is left with option of visual evaluation or the physical appraisal/scoring technique. Traditionally this involves observation of physical appearance relating to its health, alertness, agility and absence of other defects. The relative meatiness or physical body condition may be determined on the basis of a combination of physical feel at various points such as the pin bones, tail setting, loin area,

backbone or ribs. A simplified guide is provided in the table below:

Table 13.1: Livestock Condition Scoring System

Score	Description	Assessment of fat covers over: Backbone, transverse spiral process or hips.
0	Emaciated	Exposed, no cover on bones
1	Poor	Bones prominent, little cover
2	Moderate	Bones easily felt without palm pressure
3	Good	Bones easily felt with firm palm pressure
4	Fat	Bone cannot be felt with firm pressure
5	Grossly fat	Further deposition of fat impossible

Besides its traditional use in identifying, selecting and purchasing stock, physical appraisal is quite useful as a guide for management and feed requirement. For example in beef production enterprise, animals identified to have finished in terms of the required conformation and deposition of fat may be culled for slaughter or market while those that are yet to meet the target are offered high level diet to finish early. In few instances feed quality is reduced to lower the rate of fat deposition.

- **Record-Keeping:** In order to measure both the technical and economic efficiency of a livestock enterprise, it is essential to keep some basic records. These should cover all aspects of the enterprise especially those concerned with the evaluation of the efficiency of the enterprise. For example, sire or dam productivity, lactation or growth performance of individual animal may be measured. The type and detail of a record depends on the information it is intended to provide and the accuracy of the recorder. The record sheet need not be over ambitious in showing too many details that lead to ambiguity. Record must be clear, dated and should indicate the period covered by information e.g. monthly and six monthly basis. A comparison of individual farm records with other farms or regional averages enables farms to assess their performance or efficiency as well as competition. One other important use of record keeping is to maintain overall productivity in the herd by having a culling policy, so that animals are moved as soon as performance falls below predetermined due to age, injury, lameness, poor litter-size, poor mothering ability, low fertility are rationales for culling. Note that lifetime performance of a stock will be necessary for the selection of its offspring or progeny for replacement.
- **Water and Feed Consumption:** The importance of water for consumption, cleaning and ambient temperature control in the tropical herd cannot be ignored in the productivity of stock. The

absence of regular supply of clean, fresh water is often the first factor that limits feed intake. While specific objectives of the enterprise and the management system adopted dictate the sophistication of the feeding method. Feeding and management must be geared to optimize performance. The small-scale rural producer, for example, will attempt to maximize the use of cheaper, lower quality feedstuff. It is expected that stock produced under such feeding condition will experience slower growth rate as a consequence of limitation of farm animal to utilise bulky fibrous and low quality feedstuff. Under commercial conditions different priorities may give feed utilisation efficiency and cost, growth rate, carcass leanness and grading according to the relative economic advantages they provide. Other major decisions relating to feed system to be adopted may include:

(i) **Restricted or ad lib feeding:** Restricted feeding is known for its firm control on feed wastage and feed cost, excess fattiness in carcasses. *Ad lib* feeding saves labour gives faster growth rate and larger carcass weight, as well as removes competition at the feed trough which must be designed to operate efficiently to minimize waste. Both restricted and *ad lib* feeding methods should be combined to yield the most desirable result.

(ii) **Meal or Pellets:** Pelleted feeds have consistently shown to be superior to meal by as much as about 5% in promoting live weight gain and food conversion efficiency. The marginal gains must be compared with extra cost of pellets above the cost of meal.

(iii) **Separate Feeding System:** Handling of bulky feed separately from protein concentrate has proven to optimize economic efficiency of production. In such system for example bulky feed such as fresh cassava roots are dry and fed directly to pigs to appetite twice weekly. Protein concentrate is then fed daily according to a fixed rate (500g for weaners up to 50kg live weight, 75g for finishers above 50kg). The system maximise added value from farm production. Nutrient balance may be sub-optimal but it is highly efficient in term of economic of production.

(iv) Special Feeding or Lifecycle Feeding Techniques are widely gaining importance due to their timely effectiveness. Examples of such techniques are:

- **Creep Feeding –** As the name implies feeding young animals especially piglets in nest or creep where the dams have no access to consume the feed. Weaning feed for young animal can be easily consumed by adults if enough protection is not provided to deter the adult pen mates. Creep feeding enhances growth of the piglets, helps the digestive system to adjust to change from milk to solid diet prior to weaning and prevents nutritional stress associated with 'suckling pressure' of the dam.

- **Topping:** This is another form of feeding specially applied to dry animals in preparation for breeding. It is offered three-four weeks prior to breeding. The feed is required to be of relatively high quality in terms of energy, protein and mineral-vitamins to enable growth and development of body tissues needed for efficient reproduction. Both breeding male and female may benefit from topping at the beginning of breeding season. It may also be extended to pregnant female during foetus growth.

3.2 Economic Consideration

The potential profitability of a livestock enterprise varies considerably from country to country and between regions within a country. In either large or small scale production, prospective livestock producers need to consider some economic points or questions before undertaking an enterprise particularly involving live animals or animal products to avoid disillusionment and loss of money.

(i) Is there an assured market for the stock or animal product intended to be produced. Closely related to this is how to sell the products without incurring too high cost? Is the price on offer adequate for products adequate to justify cost and profitability? Will it be necessary to site the farm closer to the market and what is the possibility to expand the market or production in future for increased income?

(ii) Do I have sufficient funds to get started? Money is needed for fixed capital costs i.e. buildings and equipment and working capital to pay for stock, feed and labour for the first year of operation. Note that cash expense tends to increase in the first year and cash receipt takes similar duration to begin to come after the take-off of the enterprise.

(iii) What are the possible directions for expansion or integration to enable the enterprise take advantage of various opportunities- production or marketing available. Is there more suitable stock or breeds available for the type of system or operations in managing the enterprise?

(iv) Do I have unhindered access to input supplies at suitable costs especially for feed resources, water, drugs, power as well as infrastructures such as access road and construction materials?

(v) Do I have the requisite managerial competent to engage in the enterprise or employ competent experts and labour force to undertake production at desirable level.

(vi) Specifically important to these considerations is the overall security of the farm against corrupt tendencies of the employees, over invoicing of purchases by contracting agent, pilfering or organised act of robbery at every unit of the enterprise.

It is also important to bear in mind a few concepts of financial and economic analyses to enable quick determination of profitability. Financial analysis has to do with returns to the farmer or operator of enterprise. It gives an indication of the profitability level of the enterprise when both costs of production and the returns are considered. The cost of production consist of variable and fixed costs while gross return or gross revenues concerns the total value of production. The profit is the difference between gross return and total cost of production. Fixed cost is derived from expenses incurred in acquiring the breeding/replacement stock, housing, waterers, feeders' crates, measuring scale, farm land, equipment and infrastructures. Variable costs arise from expenditures pertaining to concentrate feed, hay, labour, drugs, transportation, marketing and miscellaneous expenses. Net returns or profit is derived from the gross profit after deduction of marketing, administrative costs and taxes have been made. It is advisable for beginner to raise his own stock and initiate his own project within his own resources without any external source of funds.

Economic analysis covers profitability of the entire farm enterprise. It discusses pay-back period, break-even analysis, benefit-cost ratio, internal rate of return and net present worth which are indicators of profitability and sustainability of enterprise.

4.0 CONCLUSION

Producers must strive to integrate all considerations relating to the well being and productivity of his animals with those relating to cost-effectiveness. Success in this regard invariably depends on relatively high degree of attention to details, technical and economic factors as well as competence of the operator.

5.0 SUMMARY

The theme of this study unit is by no means exhaustive. Management tips for livestock production enterprise intends to stimulate desire for profitable engagement in livestock operation while providing additional information to understand principles of animal production. Primary focus is on general and economic consideration in establishing and maintaining a profitable farm but greater success relates to technical and managerial competence and experience of the operator, scale of production and ability to pay attention to details.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe general and economic considerations you need to take in establishing a named livestock production enterprise.
2. Explain the usefulness of the following operations
   a. Record keeping
   b. Water and feed consumption
   c. Financial analysis
   d. Stockmanship

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