AGRICULTURE, RENEWABLE NATURAL RESOURCES, ANIMAL HUSBANDRY AND HEALTH

AGRICULTURE, RENEWABLE NATURAL RESOURCES, ANIMAL HUSBANDRY AND HEALTH

A Textbook for GES 105

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INTRODUCTION

The idea behind the General Studies Programme (GSP) as recommended by the National Universities Commission (NUC) is to ensure that University graduates have basic knowledge in other areas different from their areas of specialization so that everyone appreciates what others are doing and will be able to contribute towards multi-disciplinary approaches to national development. Thus the course is meant for non-science based disciplines. A former Commissioner for Agriculture in Oyo state was a Barrister by profession and such course she offered as an undergraduate must have contributed immensely to his success during his term in office. GES 105 is designed to increase the basic knowledge acquired in secondary school agriculture and not to make professional agriculturists out of the student/reader.

The course is taught through ten (10) weeks of lectures followed by two (2) weeks of practical/field trip and rounded off by continuous assessment and examinations. Students should be reminded that 75% attendance at lectures is mandatory before they can be allowed to sit for the examination. This course material is to aid comprehension and for reference; it is not a substitute to class attendance. Students remember more what they hear than what they read, but they also need a reference material to get more details.

Finally, we welcome you to this course and we hope you will find it beneficial after graduating from the University. Do not be surprised if this course stimulates you to engage in backyard gardening, pet rearing, aquaculture, ethnobotany and or poultry rearing.

Dr. Adetola Jenyo-Oni
Course Supervisor
GES 105
2012.

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AGRICULTURAL DEVELOPMENT PROCESS AND LAND USE, TENURE AND CONSERVATION IN NIGERIA

F. Okunmadewa, V. O., Okoruwa, and R. O. Adegboye

Introduction

Agriculture covers all human activities in producing raw food and fibre commodities. Farming is the nucleus of agriculture. However, other related activities such as processing, transportation, storage and other business activities called marketing are also regarded as agricultural activities. So, agriculture includes a wide range of activities many of which do not occur on farms and are not managed by farmers.

Role of Agriculture in Economic Development

Agriculture plays a dominant role in the economy of most nations, especially the developing countries like Nigeria. The role of agriculture in the economic development of Nigeria can be summarized as follows:

1. Agriculture provides food both in quantity and quality for an ever increasing population, and at affordable prices. With Nigeria's population believed to be increasing at about 2.8 % per annum (CBN, 2002), food production is expected to be increasing at about the same rate to meet the demand of the increasing population, failure of which will result in the under-nourishment of the population. This situation will invariably affect the productivity of the people. The only other option to inadequate local food production is importation. However, but considering our inadequate foreign exchange and the demand of such by competing needs, direct local production is the surest means of providing food needs.
2. Agriculture provides a large percentage of raw materials to agro-allied industries such as feed mills, beverage industries. In developing countries such as Nigeria, the industrial sector depends on agriculture because most of the industries are agro-allied. This thus buttresses the popular slogan "if agriculture should remain stagnant, industries will not grow" (Lewis, 1964).
3. In economic development, agriculture is expected to provide employment opportunities to the population and also supply to industrial and other sectors. Agriculture performs these dual roles of employer and supplier of labour to other sectors of the economy.

4. Agriculture contributes to foreign exchange earning through the export of cash crops such as cocoa, rubber and oil-palm. This has been one of the traditional roles of agriculture since the pre-independence and immediate post-independence era. Nigeria depended largely on this resource of foreign exchange earning until the 1970s when crude oil became prominent.

5. Though the share of contribution of agriculture to the Gross Domestic Product has been on the decrease, it is, however, noteworthy that agriculture still contributes significantly to the country's GDP with about 41% in 2002 (CBN, 2002).

6. Agriculture holds the key to increase in rural incomes, leading to increase in the living standards of the rural people and their income. Again, such agricultural development agencies as River Basin Development Authorities (RBDAs), Agricultural Development Projects (ADPs) and Directorate for Food Roads and Rural Infrastructure (DFRRI) have induced rural development by making it possible for amenities and utilities to be provided in the rural areas which hitherto were being neglected. For example, new roads are constructed to evacuate farm products and water and light are being provided to make life more comfortable for the rural people.

7. Agriculture provides a ready market for industrial products and so induces industrial growth. The agricultural sector with its large and growing population potentially serves as an effective market for many manufactured goods and services such as tractors, farm implements, fertilizers, chemicals, livestock drugs and feeds, etc. The effective demand, i.e. demand backed by ability to pay, provided by the agricultural sector to goods from the manufacturing sector is necessary if production in this sector is not to stagnate or even decline.

Table 1: Percentage Share of Gross Domestic Product from Agriculture, 1960-2011

Period	*Agriculture's share of the GDP (%)*
1960-1965	59.8
1966-1970	52.2
1971-1975	38.1
1976-1980	23.3
1981-1985	22.7
1986-1990	41.0
1991-1995	38.0
1996-2000	40.1
2001-2005	38.4
2006-2010	34.0
2011	35.4

Recent Trends in Agricultural Performance in Nigeria

Agriculture plays an important role in the economic development of Nigeria as indicated above. However, its performance in recent times has not been impressive. There is a not too impressive share of the sector in the total economic activities measured by the Gross Domestic Product (GDP) in export and foreign

exchange earnings. Consequently, Nigeria is faced with mounting importation of food as a result of inadequate local production (see table 1 for the performance of agriculture). However, there is a slight growth in the use of non-traditional inputs and a growing class of medium and large- scale farmers.

Constraints to Agricultural Development in Nigeria

The noticeable poor performance of Nigerian agriculture may be attributed to some major constraints which include, among others:

1. Inadequacy of supporting physical infrastructures; these physical infrastructures include feeder roads, water, electricity, telephone lines and storage facilities. Agriculture in Nigeria has the potential to carry out its roles if all these infrastructures are adequately provided.
2. The land tenure system; Thus deals with ownership of land and the control over its use. As practised in Nigeria, is not favourable to increased agricultural production as land is believed to belong to "a vast family, some member of which are dead, few are living and countless members are still unborn" and is not passed on to a stranger without the consent of the group that owns the land. This often leads to fragmentation of land, when available, and low productivity. Even the Land Use Decree of 1978 which confers ownership of land on the "state" promulgated primarily to permit easy access to land and consequently create an atmosphere of increased productivity per unit of land has not really improved land acquisition and use in Nigeria.
3. There is inability of the traditional farming system to provide adequate incentive (farm power) for the farming operations required to generate (enough marketed) surpluses of food. This situation is aggravated by the massive drift of able-bodied farm youth to the urban areas, leaving an ageing farm labour force.
4. There is a very rudimentary farm credit system that almost always guarantees that most farmers and agro-based entrepreneurs do not get farm credit in the right amounts, in the right place, in the right form and at the time they are needed most.
5. There is the failure of the national agricultural research system to generate new technologies and management practices that are adaptable to particular environments as well as the failure of the agricultural extension services to extend available new technologies.
6. There are inadequate incentives, e.g. price support to meet the escalating farm production costs, a situation induced by artificial increases in off-farm opportunity costs of labour.

Major Agricultural Policies and Programme Efforts in Nigeria and their Impact

Olayemi (1989) identified three distinct agricultural policy eras in Nigeria. These include the first era, between 1960 and 1969; the second, 1970-1984; and the third, beginning from 1985 to the present.

1. *The first era (Pre-1970)*

The era was characterised by minimum direct government intervention in agriculture. The private

sector, especially the small traditional farmers, produced the bulk of food and export crops; and the government concentrated efforts on agricultural research, extension, export crop, marketing and pricing, that is, the government efforts were largely supportive. It was the era of *laisez faire*. The only governmental agricultural policy worthy of note during the era is the farm settlement scheme policy of the then Western Regional Government under which young school leavers were provided with employment, to increase the production of export crops such as cocoa, palm produce and others; and to "modernise" agriculture.

The agricultural sector performed creditably during this era with Nigeria being virtually self-sufficient in food. And most of the foreign exchange earnings of the country was from agriculture. The impressive performance of agriculture then (as shown in table 1) was not, however, due to any particular progressive policy since even the aims of the farm settlement scheme were not achieved and the scheme was formally declared a failure in 1972 (Oni, 1972). The good performance was as a consequence of generally good socio-economic climate of the country which encouraged the production of food and cash crops.

2. *The 1970—1984 era (Second era)*

This era was characterised by maximum government intervention (Olayemi, 1989). Both macro-and micro-economic policies were instituted which had far-reaching effects on the agricultural sector.

a. *Macro-economic polices*

The fiscal and monetary policies instituted in the country during this period were generally expansionary but more so with regard to agriculture. Federal government capital expenditure on agriculture increased from ₦35.4 million in 1973 to ₦602.2 million in 1982. It, however, declined to ₦160 million in 1984. The interest rate (monetary policy) on agricultural loans was pegged at a maximum of 6% per annum. This was increased to 9% per annum in 1980. This was at a time when interest rate in other sectors stood at 15% per annum and the minimum share of commercial bank loans to agriculture was stipulated to be at 12%. Also, the Nigerian Agricultural and Credit Bank (NACB) was established in 1973 and the Rural Banking Scheme and the Agricultural Credit Guarantee Scheme were launched in 1977. All these policies and institutional arrangements were aimed at greater flow of credit to the agricultural sector.

There were, however, some other macro-economic policies that were not favourable to agriculture during this period. Such policies include import liberalisation with respect to food, agricultural inputs and raw materials, agricultural machinery and equipment. During this period all sorts of food were imported and sold at prices lower than unit costs of locally produced food items. While production was declining as a result of this, the Naira value was appreciating and this was a great disincentive to exports of agricultural products while encouraging imports.

The government wage policy during the 1970-84 era was anti-agricultural to a large extent. The large wage

increase to public and private sector workers, i.e. Adebo interim wage and salary awards of 1970, Udoji wage and salary awards of 1974 and Shagari awards in 1979 all contributed in no small measure to reduced agricultural development in Nigeria. These wage increases especially the Udoji awards were inflationary and also widened rural-urban wage differentials. This led to the acceleration of rural-urban migration. As a result of the acute shortage of labour, there was and still is a decline in agricultural production.

b. *Micro-economic Policies*

There were several micro-economic policies with far-reaching macro-economic implications during the 1970-84 era which affected the agricultural sector both favourably and adversely. Six national commodity boards were established in 1977 to replace regional marketing boards that were in existence since 1954. The boards were for cocoa, groundnut, palm produce, cotton, rubber and grains, making it the first time there was a board for food crops, i.e. the Grains Board. The importance of these boards has been a matter of debate for years in first decades, yet the end of the debate is not in sight. A glorious end to commodity boards seemed to have followed the introduction of the Structural Adjustment Programme in 1986 but recent events in the cocoa industry prove otherwise.

Fertiliser procurement and distribution were centralised in 1975 and a policy on manufacture of fertiliser was formulated. However, the problem of fertiliser procurement and distribution continued unabatedly.

The National Seed Service (NSS) was created in 1972, networks of agro-service centres were created and the National Accelerated Food Production Programme (NAFPP) was launched in 1973 to promote improved packages of technology being developed in various research institutes. All these policy instruments were adopted with respect to farm inputs and to promote the use and acceptance of these inputs. An agricultural input subsidy policy was adopted in which fertiliser was subsidised by about 75%, agro-chemicals by over 50%, seeds 50% and tractor hire services by about 25-50%. A number of other policies and programmes that were aimed at influencing agricultural activities during this policy era are discussed below:

i. *Agricultural Development Projects (ADPs)*: This started with the World Bank's identification of the first three ADPs in Funtua (Katsina), Gusau (Sokoto) and Gombe (Bauchi) in 1972 as the pilot enclave projects and these have grown from a modest beginning covering 24,400 farm families and 17,750 km^2 to state-wide projects with each state and the Federal Capital Territory having its ADP. The ADPs aim at greatly enhancing the accessibility of the farm sectors through the provision of networks of feeder roads; providing seed multiplication farmers with needed seeds; evolving strong project management; and, a re-organising and revitalising agricultural extension system.

ii. *Tree Crop Management*: Agricultural management activities already embarked upon under this programme included the World Bank assisted oil-palm, cocoa and rubber development programmes in Ondo, Old Oyo, Old Bendel, Rivers and Cross Rivers States. They have achieved varying degrees of success, but some of them have been abandoned.

iii. *Agricultural Research Institutes*: By 1977, the Federal Government streamlined the agricultural research system by creating 18 agricultural research institutes, each having statutory responsibility for specific commodity research. The administration of all agricultural research institutions was transferred from the Federal Ministry of Agriculture to a newly created Ministry of Science and Technology.

iv. *River Basin Development Authorities:* The Federal Government's commitment to comprehensive development of the country's water resources dates back to the River Basin Authorities decree 25 (1976) as amended in 1977 and 1979. Several issues, however, remain to be resolved before these River Basin Authorities can realise their full potentials and become truly effective in the supply of the required volume of water to the aimed farmland at the right time.

v. *Federal Government Parastatals*: The 1970-84 policy eras witnessed an unprecedented increase in the number of parastatals in Nigerian Agriculture. A number of them were set up to be involved in direct food production and these include the National Grains Production Company, the national Livestock Production Company, the Nigerian Food Company, and the National Fish Production Company. By and large, these have been a waste of public funds.

vi. *Strategic Grain Reserves*: The aim of the government was to build up to 250,000 tonnes strategic grain reserve capacity during the 1975-80 plan periods. However, little was achieved in this direction as a result of the tight domestic market. The period witnessed the introduction and execution of laudable national programmes such as the Operation Feed the Nation (1975-79) and Green Revolution (1980-83) aimed at boosting agriculture but with doubtful success.

Most of the policies during the period did not make any significant positive impacts on the Nigerian agricultural sector. In fact some had negative impacts. As shown in Table 1 above, the share of agriculture in the country's GDP declined substantially, importation of food increased at an alarming rate in the early 80s, and local prices of locally produced foods soared at unprecedented rates.

This situation was thus indicative of the ineffectiveness of the agricultural policies of the 1970-84 period. Specifically, many of these policies had serious problems of implementation and this was an inevitable consequence of a system that had no institutional monitoring and evaluation mechanism for most of its programmes and projects. The structural Adjustment Programme in Nigeria has its objectives stated as follows:

i. Establishment of Commodity Marketing Boards (1947-1986)
ii. Agricultural Research Institutes (1964-date)
iii. National Accelerated Food Production Project (1970s)
iv. National Agricultural Cooperative Bank (1973 to date)
v. Agricultural Development Projects (1975 to date)
vi. Operation Feed the Nation (1976 to date)
vii. River Basin Development Authorities (1977 to date)
viii. Green Revolution (1979 to 1983)
ix. Directorate of Foods, Roads and Rural Infrastructures (1986-1993)
x. National Agricultural Land Development Authority (1991 to 1999)
xi. Presidential Initiatives on selected commodities: Cassava, Rice, Cocoa, Vegetable oil, Livestock and Fisheries (1999 to 2007).

3. *The Post -1984 (Third era)-The SAP Era*

The post-1984 era witnessed the period of Structural Adjustment Programme (SAP). The factors that led to the institution of the SAP in 1986 actually started to manifest in the 1970-84 policy era.

The Structural Adjustment Programme as related to Agriculture was designed to reverse the agricultural development philosophy in the earlier era. The SAP philosophy is that agriculture is essentially a private sector business with the role of the government being that of a facilitator and supporter, and that market forces should be allowed to play dominant roles in directing the economy. The agricultural economy should be more inward-looking and self-reliant. SAP also places more emphasis on the developmental role of agriculture as it emphasises a broadening of the productive base of the economy and reducing dependence on petroleum.

It should be noted that the overall macroeconomic policies of SAP are basically deflationary and belt-tightening. The economic reform in SAP as related to agriculture is discussed below.

Structural Adjustment Programme (SAP) was administered on the Nigerian economy to correct what was referred to as fundamental distortions in the economy which arose from the ineffective policies and programmes of the 1970-84 policy era. The distortions resulted in internal and external disequilibrium in the economy,

The general philosophy of SAP is that external disequilibrium is the main cause of internal disequilibrium. Thus the solution lies in addressing the external component of the national income equation. This is the reason for the emphasis of SAP on exchange rate flexibility, whose effect is the devaluation of naira, export drive, reduction in public expenditure, credit controls, etc.

The Structural Adjustment Programme in Nigeria has its objectives stated as:

1. restructuring the economy by diversifying the productive base,

2. rationalising consumption patterns and reducing the economy's dependence on petroleum exports and commodity imports,
3. expanding non-oil exports,
4. reducing the import content of locally produced goods,
5. attaining self-sufficiency in food and raw materials production within the shortest possible time,
6. rationalising the country's fiscal and monetary policies, and
7. liberalisation of the country's trade and payment system.

The success of SAP was therefore largely dependent on agriculture as most of the objectives were closely related to agriculture. The macro economic policies adopted under SAP that directly affected agriculture may be divided into fiscal, monetary, trade and pricing policies. Each of these is highlighted below:

a. The fiscal policy instruments include:

i. a five year tax free period for profits of companies engaged in agricultural production and processing;

ii. increase in capital expenditure by the government inspite of a generally tight fiscal policy.

b. The monetary policy instruments include:

i. Interest rate deregulation,

ii. Liberalisation of agricultural loan terms so that small scale farmers can obtain loans of up to N5,000 without collaterals,

iii. Increase of grace period for the repayment of commercial bank loans and advances; long gestation for cash crop plantation from 4 to 7 years and increase in investments mechanised large scale farms from 5 to 7 years, and

iv. Increase from 40% to 45% in the minimum share of deposits generated by rural banks which must be given loans and advances in the rural localities.

c. The trade and exchange policy instruments include:

i. Naira devaluation through the Foreign Exchange market,

ii. Trade liberalisation in terms of reduction and/or abolition of some import and excise duties,

iii. Export promotion of non oil goods by allowing exporters to keep up to 100% of their foreign exchange earning in domicilliary accounts, and

iv. Ban on the importation of some food and industrial raw materials to encourage local production, e.g. wheat,

d. The institutional policy instruments include:

i. Privatisation and commercialisation of some government enterprises,

ii. Reorganisation of the River Basin Development Authorities,

iii. The creation of the Directorate of Food, Road and Rural Infrastructure to execute rural development programmes,

iv. The creation of the National Directorate of Employment to promote employment programmes, and

v. The creation of the Nigerian Agricultural Insurance Scheme.

It then becomes obvious that the success or otherwise of SAP depends largely on the success or failure of the present agricultural policies and programmes. This is because the export promotion and food production policies which are crucial to the success of SAP should be directed at sectors that are less dependent on imported inputs (Ajakaiye, 1990). The agricultural sector in Nigeria is probably the least dependent on imported inputs when compared to other productive sectors. This implies that agricultural policies that will lead to the success of SAP should de -emphasise the importation of agricultural inputs.

The "boom" that seemed to greet Nigerian farmers at the advent of SAP has disappeared now. This situation which has been described as "fallacy of composition" is partly as a result of farmers being faced with pre- SAP costs, of low input prices while reaping SAP benefits of increased output prices. However, a meaningful agricultural success during SAP should keep production costs low by depending less on imported inputs.

Overview of the Post SAP Policies.

The introduction of SAP brought sweeping policy changes in Nigeria, which aimed at restructuring and diversifying the country's productive base in order to increase efficiency and reduce dependence on the oil sector. SAP policies favoured a liberalized economy. SAP was officially terminated in 1992.

However, post- SAP. An overview of some post-SAP macro/micro-economic policies is hereby discussed briefly.

The direction of the fiscal policies after the introduction of SAP was to reduce government expenditure and eliminate fiscal deficit. To do this, emphasis was placed on the rationalization of government programmes and reduction or total elimination of government subsidies on selected products including petroleum products and agricultural inputs. Cost recovery pricing was adopted for basic infrastructures and parastatals in the social service sector. This led to the privatization of many parastatals.

The share of the agricultural sector in the federal government capital expenditure dropped from an average of 13.5 per cent between 1987-91 to 8.4 per cent in 1992-96 period. In the year 1997, the Federal government aggregate expenditure increased by 23.7 per cent with an initial increase of 15.8 per cent in 1996. Thus, total expenditure as a percentage of GDP rose from 10.2 per cent in 1996 to 11.4 per cent in 1997. This increase was attributed largely to the rise in domestic debt service payments as well as outlays on the National Priority Projects. In the year 2000, aggregate expenditure of the federal government was estimated at ₦701, 059.4 million, indicating increases of 25. 3 and 7.3 per cent over the level in 1999 and the budget estimates for the year respectively. The increase reflected the higher personnel cost arising from the upward review of the emoluments of civil servants.

Recurrent expenditure amounted to ₦461, 608. 5 million or 65.8 per cent of the total, while capital expenditure accounted for the balance of ₦239, 450.9 million, or 34.2 per cent (CBN, 2000). The year 2001 also witnessed the continued expansionary fiscal operations of the three tiers of government as a result of the monetisation of the excess crude oil receipts and the proceeds from the GSM license later in the year.

The objectives of monetary policy in the late 90s to year 2000 were aimed at maintaining internal and external balance including sustenance of a single-digit inflation rate. The thrust of the 2002 monetary and credit policies was a continued observance of appropriate grace periods on agricultural loans in recognition of the differences in gestation periods of various agricultural products. Government also in pursuit of the developmental role of the Agricultural credit guarantee scheme and to ensure the flow of credit to the agricultural sector, authorized increase in share capital of the scheme to be reviewed upward from ₦100.0 million to ₦3.0 billion in 1999 (CBN 2002). Following the increase, the loan limits under the scheme were raised from ₦5, 000 to ₦20, 000 for unsecured loan and ₦100, 000 to ₦500, 000 for secured loans to individuals, as well as from ₦1.0 million to ₦5.0 million for corporate borrowers. Furthermore, to ease private sector participation in banking and eventually create a competitive environment, the conditions for licensing banks were liberalized and this resulted in an increase in the number of banks from 41 in 1986 to 120 in 1992, though it dropped to 92 in 1999. The nominal prime lending rate increased from 9.6 per cent in 1986 to 36.1 percent in 1992 implying an average annual growth rate of 21.5 per cent. The lending rate, however, dropped to 26 per cent by 2000. The agricultural sector had to compete for credit at these high market determined interest rates, which were beyond the reach of small scale farmers (CBN, 2000). To avoid duplication of efforts and as well attain efficiency in the use of resources among government rural developmental agencies, the People's Bank of Nigeria (PBN), the Nigerian Agricultural and Cooperative Bank (NACB) and Family Economic Advancement Programme (FEAP), were merged to form the Nigerian Agriculture, Cooperative and Rural Development Bank (NACRDB) in the year 2000. The Bank was established to provide micro-credit to farmers and rural households.

As part of the on going effort aimed at stimulating growth and development within the economy, the federal government in 2001 established the Small and Medium Industries and Equity Investment Scheme (SMIEIS). The scheme also is expected to develop local technology and generate employment. Otherwise known as Small and Medium Enterprise, the SMIEIS is said to be a voluntary initiative of the Bankers' Committee whose membership includes all the Managing Directors and Chief Executive Officers (MDs/CEOs) of banks in Nigeria, which require all licensed banks in Nigeria to set aside 10% of their Profit Before Tax (PBT) for equity investment in, and promotion of Small and Medium

Enterprises (SME). Activities to be covered under the scheme include:- agro-allied, information technology and telecommunications (ICT), manufacturing, educational establishment, services (excluding banking and insurance), tourism and leisure, solid mineral, construction and any activity that may be determined from time to time by the bankers' committee. Beneficiaries of the scheme as at that time include 130 companies among which 55 of them belong to ICT, about 50 to manufacturing, while agriculture and agro-allied takes the remaining share.

The government in 2001 also established three multi-commodity developments and marketing companies which were expected to be entirely private sector corporate enterprises, with the ultimate ownership belonging to bonafide farmers and farmers' organizations in the country. Forty percent of the take off granted for the companies was provided by the federal government while the remaining 60 per cent came from the farmers. Specifically, they were to function to promote increased production, better processing, modern storage, and marketing of the agricultural commodities at both the domestic and foreign markets. The three companies include:

(i) Arable Crops Development and Marketing Company-, responsible for crops such as maize, rice, sorghum, millet, beans, yam, cotton, groundnut, soybeans, beniseed, cassava, fruits and vegetables.

(ii) Tree Crops Development and Marketing Company-this would develop crops like cashew, cocoa, oil-palm, rubber, timber, gum Arabic and citrus, among others.

(iii) Livestock and Fish Development and Marketing-this focuses on cattle, goats, rabbits, pigs, fish and shrimps, among others.

Trade policy during the post- SAP era sought to promote agricultural exports and production of food and raw materials to discourage importation. Four strategies were proposed to discourage importation of food and raw materials. These strategies were trade liberalization, export promotion, backward integration (in which firms establish their own farms for the production of raw materials) and discontinuation of direct production by government and effect partial or total privatization of its farm. In addition, the government put in place an agricultural pricing policy which aimed at making input easily accessible to small scale farmers and in the process, encourage farmers to adopt improved production practices and new technologies. The major agricultural input marketing policy put in place centres on three major agricultural inputs- fertilizer, seed and agro-chemicals. The policies put in place are as follows:

- The Fertilizer Liberalization Policy in 1996. The policy aimed at improving production, procurement and marketing efficiency and encouraging transparency and competition. Government completely withdrew from procurement and distribution activities and discontinued

the subsidization of fertilizer for a while. Import tariff on fertilizer was reduced from 10 per cent to 5 per cent in 1997 and zero per cent in 2000. It also abolished the value- added tax (VAT) and excise duty.

- The national seed policy formulated in 1992 provides guidelines for the development of the seed sector. The National Agricultural Seed Decree No. 72 (1992) gave legal backing to the seed policy. The policy makes provisions for the withdrawal of public sector agencies in favour of the private sector in key areas of the seed industry. However, in practice, public- and private- sector roles are not clearly delineated.
- The policy strategy on agro-chemicals supply encouraged the establishment of plants to manufacture or process agro-chemicals in Nigeria. However, the marketing of agrochemicals in Nigeria has remained unorganized and lacks proper legislative control. The de-regulation policy has attracted many unprofessional dealers in agro-chemicals sub-sector.

Recent Policy Direction to Enhance Agricultural Development

The Vision 20:2020 which enlists Nigeria to be one of the biggest twenty economies by 2020 brought about the seven-point development agenda in the fourth republic (2007 till date). The agenda evolved from synthesizing the NEEDS, CAADP, and NEPAD documents. Two points of the agenda which are crucial to the development of agriculture include the third point (Food Security), which is expected to enhance agricultural and water resources to ensure adequate food supply for local consumption and export, and the fifth (Land Tenure and Home Ownership), which seeks to review land use laws to facilitate proper use of the nation's land assets for socio-economic development and citizens' access to mortgage facilities. The Food Security component of the agenda led to the formation of the National Special Programme for Food Security (NSPFS). The programme had the main objective of coordinating all donor-assisted agriculture and rural development projects within the Ministry of Agriculture and also the most recent Agricultural Transformation Agenda (ATA), which aims at strengthening the value chain of various agricultural crops and livestock. Key features of the programme include:

i. Provision of a conducive environment for private sector involvement,
ii. Encouraging large scale commercial farming with strategic linkages to small holder farmers, and
iii. Significant reduction of post-harvest losses through adequate storage, processing and appropriate market outlets.

The agricultural transformation agenda rests on the foundations of the post Obasanjo (2007-2010) regime. The agenda is described as the pillar of economic transformation and hence, the key driver of the other transformation agenda. The ATA has the following objectives: To

i. secure food and feed needs of the nation;

ii. enhance generation of national and social wealth through greater export and import substitution;
iii. enhance capacity for value addition leading to industrialization and employment opportunities;
iv. ensure efficient exploitation and utilization of available agricultural resources;
v. enhance the development and dissemination of appropriate and efficient technology for rapid adoption;
vi. achieve self-sufficiency in rice production; and
vii. achieve self-sufficiency in fertilizer production.

Other additional programmes include the Growth Enhancement Support Programme (GES) *incited* by the Federal Ministry of Agriculture and Rural Development, which seeks to lift 20 million poor farmers out of subsistence into self-sufficiency. Unlike previous approaches to lift the productivity of the Nigerian farmer, the GES programme among others, puts the resource-constrained farmer at the centre of the agriculture value chain and creates a series of incentives to encourage the critical actors in the fertilizer value chain to work together to improve the productivity, food and income security of the Nigerian farmer; gets government out of the procurement and distribution of fertilizer and gets private sector actors such as banks, producers, distributors, agro-dealers to own the value chain for fertilizer; and stimulates demand for fertilizer by putting a cash component of the product value directly into the hands of the farmers via mobile wallets.

The whole essence of the GES, with respect to fertilizer distribution is to get the government out of the business of fertilizer procurement and distribution and rather, involve the private sector in the distribution so that fertilizers can reach the farmers.

Strategies for Increasing Agricultural Production in Nigeria

1. *Proper planning:* Public planning seeks to attain desired agricultural production and consumption pattern that would not have emerged if left to market forces alone. The state is expected to construct irrigation dams; encourage and actively support a national research and extension system; build feeder roads and improve transportation system as well as intervene whenever there is divergence between private and social benefits, new technologies, and activities which a market solution would fail to provide adequately. Also, the state is to provide the complementary agricultural incentives and environment to encourage private farmers to do what they know best, i.e. farming.

2. *The role of government in agriculture:* The last two decades have witnessed the rise and fall of government in direct agricultural production and distribution. The government should play more active roles in facilitating and supporting agricultural activities as witnessed in the 1960-1969.

3. *Small scale versus large scale farmers*. In the Nigerian agricultural setting, the number of small scale

farmers is very high and constitutes a large proportion of Nigerian farmers. However, the choice between the small scale and large scale farmers is one of scale of operations and, in our free market context, the optimum scale is determined by private profitability with both scales of operations requiring the policy and infrastructural support of government.

4. *National food self-sufficiency drive:* Self-sufficiency strategies must be understood within the overall context of a country's goals, aspirations, values and opportunities matched against its developmental constraints. There is always an inevitable existence of trade offs in self-sufficiency, e.g. incremental maize production may come only from new imports of fertiliser and/or machinery. Increasing self-reliance in the coarse grains may, therefore, be accompanied by increasing importation of seeds, chemicals and farm implements,

5. *The role of budget allocation to agriculture*: Though it is absolutely important that state and federal governments greatly increase their agricultural budgets, these must not be seen as ends in themselves. For one thing, actual releases must correspond to nominal budget allocations if the budget exercise is not to amount to a grand deception. The Timing of releases must be synchronised with farm field operations if the releases are to be effectively utilized.

6. *Investment in human capital*: Strategic investment in human capital for agricultural development is necessary to enhance literacy levels among Nigerian farmers. Such investment, in the immediate term, would improve farmers in numerate and verbal skills. In the long term, it would lead to a higher production level for farmers, and as such, have a direct effect on the number of researchers that can be used in agriculture.

7. *High rating of complementary investment:* Agriculture is but a sector of the larger economy. Policies and investments in other economic sectors thus have an effect on agricultural production. The challenge in this is to ensure that agricultural policies do not exist in vacuum while infrastructural and technological components must be incorporated into the planning of agricultural programmes and interventions.

8. *Social and environmental protection*: All facets – physical, economic, biological, geographical and institutions of agricultural environment must be adequately protected to sustain agricultural production. The multiplier effects of a disruption in any of these facets do not augur well for overall agricultural development. The safety of lives and the ensuring of environmental sustainability are thus worthwhile goals.

9. Encourage private sector involvement with minimal government intervention, limited to providing enabling business environment in the agricultural sector.

Agricultural Land use, Tenure and Conservation in Nigeria

One of the key strategies to increase agricultural production in Nigeria is to relieve the constraints associated with ownership and use of land. This section

will, therefore, discuss land use, land tenure and land conservation in Nigeria.

Land Use

Land has many competing uses which can be broadly divided into two: agricultural and non-agricultural.

The agricultural uses of land include direct agricultural (crop, animal and fish) production, seed multiplication and plant propagation, infrastructural purposes (e.g. experimental stations and farm buildings) and regenerative purposes such as pastures, forests and fallow *rotation.*

Table II: Agricultural Land Use in Nigeria

Type of Activity	Area Covered ('000Ha)	Percentage (%)
Total Land Area	92377	100.0
Arable Crops	28500	30.9
Permanent crops	2700	2.9
Arable and Permanent crops	31200	33.8
Permanent pasture	39200	42.4
Total Area Cultivated	70400	76.2

Source: FAO Statistical Database (2003).

The non-agricultural uses of land are commercial industrial uses, residences, recreation, infrastructure and mining / quarrying uses. The different agricultural uses of land are as seen in table II.

From Table II, it is seen that land put to pasture is greater than land used for arable purposes. This land, with irrigation and sound husbandry, could be used for food production to feed Nigeria's millions of people.

Land use, whether agricultural or non-agricultural, is a simple demonstration of man's ability, willingness and freedom to put land into such uses as will satisfy human needs both now and in the future. And since man's needs are many and changing, it becomes necessary to recognise certain factors affecting land use. We must assume that every piece of land is useful for one purpose or the other, depending on:

1. natural limits, i.e. total land area under the user's control,

2. state of technology, i.e. the science, education and skill available for crop/livestock production,
3. population growth or decline, migration, nomadism, and
4. living standard as it portrays income, diet, leisure, security and poverty.

In developing countries, land use is characterised by poor technology, low yields, continuing poverty, soil degradation and increasing population pressure, limited management skills and restricted farm size.

Land Tenure

Land tenure refers to the arrangement made to regulate the relationship that exists among the owners, the users and the society in which the land is located. Land must be allocated to particular individuals for particular uses purposes in a way that satisfies the expectations of the clan, tribe and the society at large.

These arrangements have become necessary as the population on the land grew from sparse/scanty to dense/ thick and as the uses purposes multiplied. Land owners enjoy the rights to preserve their holdings for their own generations yet unborn. Tenants, on the other hand, are made to seek permission to use the land for specified purposes and conditions.

The focus of Nigeria's land tenure system is the family as part of a clan which also forms part of a tribe. The concept of transferring through sale or purchase is not readily embraced by the members of the extended family. This, over the years, has made it difficult for free movement of enterprising farmers into areas outside their family land even when the population pressure in their area no longer permits economic allocation of land to agricultural use purpose, while there are other pockets of virtually un used land.

The Land Use Decree which later became Land Use Act was devised in 1978 as a land use policy to permit enterprising farmers to move from their family land to any other areas of their choice in order to pursue more rigorously the establishment of larger cultivable areas. Land use and allocation committees were set up by state governments to administer and supervise the allocation of land to land-seekers from within and outside each state in order to create proper integration in resource use and to permit more effective use of such lands that would otherwise lie idle. The Act also made it possible for state governments to acquire compulsorily lands for eventual redistribution among would -be- users and to set lands aside for public purposes uses such as for schools, hospitals, markets, public office buildings, development projects and rural development schemes. The government took advantage of the Act to prosecute their own projects within the state but it has not yet been easy for enterprising farmers to secure enough land for their uses nation-wide.

Many states do not readily give land to people of other states. Many states would like to see farmers as tenants once they leave their place of birth. Boundary disputes, clashes and tenure instability are so common that the fear of losing one's property to natives of

another state is enough to keep any enterprising farmers from achieving the desired objectives of expanded output and increased productivity. The Land Use Act may need to be reviewed or strengthened to provide protection for easy migration of farmers from heavily to sparsely populated areas of Nigeria. In many parts of the country there is usually the conflict between political and established farms of government, thereby creating confusion as to which group could validly allocate farm land (and whose farm land) to enterprising farmers. Sometimes there is also a lack of clear understanding of the sufferings of land-seekers on the part of those who exercise the allocation of needed land.

The expression of scholars with respect to the problems of land tenure could be interpreted based on the duplicity of ownership of land with consequent excessive transaction costs, fragmentation of land into uneconomic sized tracts, and inalienability of land, which makes land part of the physical capital but not a part of financial capital. The need to ensure equitable access to productive opportunities on the land and security of such access once gained makes land reform measures mandatory. To worsen the situation, wide scale speculative purchases of large tracts of (communal) land, in the absence of land taxes has reached a crescendo.

Most of the purchases were done by wealthy non-farmers who held the land idle, waiting to capitalize on an appropriate market situation, while food production is on the decline (Fabiyi, 1976). Experiences in Nigeria have shown that development cannot take root in a situation where agrarian reform is haphazard and directionless. For this crusade to become an agrarian reform, the programme should have a comprehensive policy and regulatory framework, institutional development and capacity building, a systematic and transparent land registration plan, civic and human rights education, civil participation and self development as well as capacity for land management.

Land Conservation

Conservation of agricultural land means the wise use of land, leading to a continuous flow of benefits to the land users of this and future generations. This means that the land user does not see himself as the last to benefit from the land resources. He provides for regeneration and replenishment in order to promote an increase in the flow of future benefits.

The three broad types of land resources are stock resources, flow resources and composite resources (having both stock and flow characteristics. The land resources that fall under stock type are coal, petroleum, metals, stones, etc. These resources are not renewable. They must be used with caution in order to leave some behind for future generation. A method of conservation would be to invest the revenue from such land in profitable and lasting ventures.

The flow resources are those of continuous supply such as sunlight, streams, precipitation, etc. They must be used when available, otherwise their services will be lost. Modern technology is however, gradually making it possible, though expensive, to store what has been

regarded hitherto as flow resource, e.g. solar energy, dam and dykes to store stream water etc.

The composite group of resources has characteristics of both flow and stock which can be divided into biological resources such as plants, animals, fish and wildlife, soil resources, man-made improvements, particularly rural infrastructure, that complement agricultural land resource use.

Agricultural land resources are sensitive to bad management apart from natural hazards of drought and flood. Conservation practices must, therefore, incorporate the following:

1. prevention of erosion arising from excessive farming and overgrazing,
2 building of dam to retain water for multi-purpose uses of pasture development, crop production and fisheries. This changes the streams annual problem of drying up,
3. afforestation to influence precipitation and climate,
4. flood control, and
5. education for awareness about fire use for land clearing,

The government should play an active role in land use, tenure and conservation. It should be realised that a nation that cannot feed her citizens cannot claim equal partnership with others whose citizens are well fed in addition to possessing economic strength and technology.

The government must focus its attention on the following:

1. protecting the land resources from abuse and degradation at all times,
2. regulating land use rights through inheritance laws and owner/ tenant relationships,
3. preserving forest and grazing reserves,
4. reclaiming mined lands through technology of agro-forestry and alley cropping,
5. promoting crop and livestock mixture so as to keep the land in a better condition and increase its productivity. The wastes from livestock are nutrients for crops while the residues from crops are feed for livestock.
6. regularising population pressures to minimise the dangers of erosion, and
7. enforcing the Land Use Act provisions for free movement of enterprising farmers from land-short areas to sparsely populated and more fertile lands within and outside the land seekers' state of origin.

This promotes unity and integration.

This also makes it mandatory for government to create political atmosphere of peace and acceptance needed for migration and settlement.

REFERENCES

Ajakaiye, D.O. (1990), Inter Industry Linkage in Nigerian Economy. NISER Monograph Series. No. 2

Central Bank of Nigeria (CBN) (2000), Statistical Bulletin, Vol. 2, No.2

Central Bank of Nigeria (2002), Annual Report and Statement of Accounts, for the year ended 31st December, 2002. http://www.cenbank.org/OUT/

PUBLICATION/REPORTS/RD/2002/
AREPORT-02 PDF

Food and Agricultural Organisation (F.A.0.) (1986), Atlas of African Agriculture, Rome.

Food and Agricultural Organisation (2003): Agricultural Production Data on Nigeria: FAOSTAT Database. http://www.fao.org

Olayemi, J.K. (1989), Policies and Programmes in Nigeria Agriculture Department of Agricultural Economics, University of Ibadan.

Oni, S.A. (1972), "Increased Food Production Through Agricultural Innovations In Nigeria" *West African Journal of Agricultural Economic* Vol. 1, No. 1, pp. 162

2

AGRICULTURAL EXTENSION EDUCATION

Stella O. Odebode and Akinbile, L. A

Introduction

Agricultural extension is one of the essential instruments for improving and promoting agricultural development. It centres on the needs for individuals to be assisted to achieve their full potentials through planned change. It is a science of change and a way of assisting rural people in improving their standard of living through improved farming methods. It is an informal process of educating the rural people to improve their livelihood (Bindlish, et *al,* 1993) As farmers transit from subsistent to market-led production, to become modern farmers, they definitely need assistance and linkages beyond their local production environment as well as with the economy of their country. Agricultural extension tends to facilitate such linkages. This chapter defines the meaning, scope, principles and philosophies of agricultural extension. It also describes the extension agent and the rural change process.

Meaning and Scope of Agricultural Extension

The word 'extension' connotes an informal educational process directed towards the rural population. It is an informal, voluntary and out- of-school educational process aimed at improving the standard of living of the rural people through their own efforts. In other words, agricultural extension education imparts educational gains on the rural populace in an informal way. This enhances the standard of living of rural people by improving their economic and social standards. This is realized through acquisition of knowledge, attitudes, and skills, leading to increased productivity and ultimately better way of living (Blackburn, et *al 1984).*

It is also described as an educational process, which assists farmers in bringing about continuous improvement in their physical, economic and social well-being through individual and co-operative efforts (Swanson and Clair, 1984). It is a process of passing useful information to people and assisting them to acquire the necessary skill, knowledge and attitude to utilize effectively the information. Extension education describes a continual and changing process in rural areas (Zijp, 1994). It is a two-way process in which the extension agent transfers knowledge and ideas to farmers and their families and takes feedback from

farmers to the research institutes. Extension, therefore, aims at changing the outlook of farmers towards their difficulties to improve their livelihood.

Scope of Extension Education

Extension education is dynamic because, its interpretation changes form time to time. Agricultural Extension is part of a system of factors, which influence farmers' decisions. It includes, among others, agricultural researchers, political authorities, farmers' organizations, non-governmental organizations (NGOS), farmer training centres and the media. Extension activities can be practised by government and church organizations, commercial companies, large farmer organizations and locally based, formal and informal grassroots organizations (Adams, 1982). Extension activities are applicable in the promotion of commodity, use of input as well as credit and sustainable management of natural resources. Management counselling may be at the farm level; community level and self help initiatives (Mosher *et al,* 1985). Extension education has expanded in scope against the focus on agriculture. Extension component exists in different fields such as engineering, family planning, environment, community health and demographic studies.

Functions of Extension Education

Extension education is a means by which new ideas and knowledge are passed down to the rural populace, to bring about change in farmers' lives and their families'. Other functions of extension education are listed below:

- Transmission of research results to the farmers and the problems of farmers to the researchers,
- Dissemination of relevant information from diverse sources,
- Promotion of awareness of existing problems and solutions to such problems,
- Preparation of work plans and materials to establish extension goals with clients, and
- Helping farmers to help themselves through their own efforts

The extension agent is, therefore, an adviser, motivator, educator, problem solver and information disseminator (Patel, et al, 1985). He acts as an intermediary between agricultural development organisations and target groups, mobilizing them to attain independent action. Extension disseminates results of research to farmers and brings feedback from farmers.

Objectives of Education

The main objectives of extension education are to change people's outlook toward their difficulties (Savile, 1968). This helps in raising the standard of living of the rural populace. Other specific objectives include:

- Development of responsible and responsive village leadership.
- Development of the rural people to become self-reliant, responsible citizens, capable and willing to participate effectively in community development programmes,

- Upgrading the social status of the villagers, and
- Improvement of agricultural practices and methods essential for increased agricultural production.

Principles of Agricultural Extension

Extension involves alleviating the problems of rural people and teaching them how to formulate means of satisfying their own needs. The principles of extension are therefore, the rules of conduct to work most efficiently.

These are listed below:

- Extension activities should be based on the principle of helping people to help themselves.
- Extension programmes should be a two-way link between the farmer and research and vice-versa.
- Extension programme should be based on the knowledge and facts by working in collaboration with researchers and the farmers. Extension programmes should be based on felt needs and desire of the people.
- Extension programmes should be based on existing local condition.
- Extension should be continually appraised to ensure that the objectives are achieved.
- Extension activities should involve proper understanding of the culture of the people.
- Extension innovation should be socially desirable, financially profitable, locally tested and technically sound.
- Extension should work with trained personnel and co-operate with other information system and agriculturally acknowledged agencies. Extension should be based on consultation with village people through local leaders and organizations.

Philosophies of Agricultural Extension

Agricultural extension is based on some qualities, which include the following:

- Agricultural extension has its origin in democracy, i.e. development of people by the people and for the people.
- It is based on voluntary co-operative participation in programmes and leadership development.
- It involves a two-way channel of knowledge and experience.
- It involves creating interest by seeing and doing.
- It is based on self-help.
- It is a programme of change in attitude, habits, ways of thinking and relationship among people.
- Extension is a never-ending process.

Communication Techniques in Extension

Agricultural extension involves educating the rural people/ farmers. It is a process of effecting maximum desirable changes in human behavior through communication. Communication is the process by which people exchange ideas, facts, and feelings so as to gain proper understanding of the meaning, intent and use of a message (Odebode *et al,* 2002).

Communication in extension can be defined as the conscious attempt to share information and ideas with others. The success of an extension agent lies in his ability to communicate good ideas to others.

The tool employed in producing desirable changes among rural people is called *Extension Teaching Methods.* Good communication between the farmer and the extension worker helps the extension and enhances proper understanding of the ideas being disseminated. A proper understanding of these method is essential in carrying out extension programmes success-fully (Ahmed, 1982).

The three methods of communication in extension include:

1. **The Individual Contact Method**: This involves face-to-face relationship with village people. It deals with the farmers on a one-to-one basis, e.g. farm and home visits, office calls, telephone calls, letters and informal contacts.
2. **Group Contact Method**: This involves working with groups, e.g. result demonstration, method demonstration, general meetings, group discussions, excursion, fie1d trips and tours
3. **Mass Media Methods**: These are channels of communication, which can exposed large number of people to 'the same' operation through the use of bulletin, news, articles, cinema, posters, newspapers, radio, audio cassettes, moving pictures, television and films.

The Extension Agent and the Rural Change Process

Extension agents are involved with the process of rural change through the knowledge of rural sociology, which encompasses the study of life in the rural environments, rural social happenings and relationship and interactions in the village community. It examines the rural community to discover their conditions of living in order to formulate principles for progress. The rural sociologist also studies the non-material culture of villagers and the effect of material culture of urban population on rural people (FAO, 1993). He also deals with the social psychology of life, rural organization and social values.

Importance of Rural Sociology to Agricultural Extension

1. It gives the knowledge of the rural life, as the village is the centre of culture of any country.
2. It helps to bring reformation and welfare to the rural community.
3. It studies social relationships and proffers solutions to human problems.
4. It lays emphasis on education as the solution of rural problems.
5. It encourages the development of various plans for rural development programmes
6. It provides technology and systematic reforms to farm production.
7. Rural sociology emphasizes increasing quality and quantity of pro-duction.

The Rural Change Process

Introduction

Change is a constant phenomenon in both rural and urban communities. It involves adjustment by both human beings and material objects and is either planned or unplanned (accidental). Planned changes are often desirable, while unplanned changes often bring effects that are not desirable. It is therefore necessary that changes are planned in both rural and urban communities.

The rural environment is important in the management of renewable and non- renewable natural resources as the exploitation of the nation's resources is still predominantly domiciled in rural communities. The need to utilize the natural resources for a nation's wealth implies that the rural people and their interrelationships are understood so that the changes that take place in these communities can be predicted and moderated. This will ensure meaningful and sustained intervention in rural communities with the ultimate aim of improving rural situations.

It is necessary that the social and cultural factors affect the lives of those in rural or agrarian communities through the social action process. A study of rural people's diffusion and adoption of innovations as well as their group formation and dynamics is conducted so as to be able to influence beneficial changes in rural communities.

The social action process

Social action describes how social change activities are executed, that is, how to get things done. It involves the undertaking of collective action to get things done to mitigate or resolve a social problem. The aim of social action is to achieve social change in a direction desired by the change agents, with the philosophy that man can improve his society through organized collective efforts. Social action is thus a process of social intervention, that is intervening into a social situation and attempting to improve that situation. All social action takes place within some general social system and may be preceded by some previous actions and decisions. The general social system may be a village community, a local government area or a state.

There are six different stages in the social action process. The stages are not clearly separated as there is overlap among them. Also, the stages have no definite order in which they occur but vary in various social action processes (Ekong, 1988). The six stages of the social action are:

(1) *Inception of the idea:* This involves the emergence of a group to initiate the idea. It entails the group having a good understanding of the social system and its power structure, formal and informal sub-groups, and any restriction in behaviour which prevail within the system. It suggests a situation analysis to define the problem(s) and the probable solutions.

(2) *Legitimisation:* At this stage, the legitimisers (i.e. those that have the authority and prerogative to sanction

activities) are carried along. They have the authority to block any change process if they are by- passed as they feel their position is threatened.

(3) *Diffusion stage:* This involves creating awareness of the identified problem for the need to effect changes. People with skills in communication, known as "diffusion sets" are used for this purpose. They have access to people and have good public relations ability.

(4) *Determining the goals:* The goals to be achieved are set at this stage and are clearly specified in achievable terms.

(5) *Mobilisation for action and implementation:* The means and methods for attaining the goals are identified and mobilised at this stage for adequacy, efficiency and effectiveness.

(6) *Execution:* The change process is then executed through social action to bring about the desired change. There must be continuous evaluation throughout the process to ensure that the action is not derailed. Through these processes, social changes are brought about in rural communities. This is important as accidental changes are often not desirable. There is the need for planned changes to ensure that the abundant resources in rural communities are properly harnessed for developmental purposes.

Diffusion and adoption of innovations

Diffusion is the process by which an innovation spreads, while the diffusion process is the spread of new ideas from its source of invention or creation to its ultimate users or adopters. Adoption on the other hand is a decision-making process that involves the decision to continue full use of an innovation, while adoption process is the mental stages through which an individual passes from the point of first hearing about an innovation to the final adoption. Generally, while the diffusion process involves the passing of news about an innovation between persons, the final decision to adopt or reject the innovation is purely a personal or individual decision. The diffusion process, according to Ekong (1988) involves four essential elements, that is:

- The innovation,
- The communication from one individual or group to another,
- A social system within which the process occurs, and
- A time / period over which the process is effected

The adoption process on the other hand involves:

(1) *Awareness-:* This is the point at which an individual becomes aware of the existence of an innovation. The awareness can be through Whatever medium and it is very important in the process, as one cannot adopt an innovation one is not aware of.

(2) *Interest-:* At this stage, the individual becomes interested in the innovation as something worthy of being considered and thus seeks more information about the innovation. This is to make the individual proceed on the idea if it is found to be worthwhile or drop it if it is not worthy of being considered.

(3) *Evaluation-:* The individual's interest has been enhanced and he considers the applicability of the innovation to solve particular problem(s) or fulfil desired needs. The evaluation makes the individual assess the comparative advantage of the innovation and the alternative that he will have to forgo if the innovation is -adopted.

(4) Trial-: The individual practises the innovation on a small scale to really ascertain the submissions from the evaluation stage. The individual's experience at this stage will go a long way to determine the individual's eventual response to the innovation. Attempt is made at this stage to actualise the saying that a trial will convince you.

(5) *Adoption-:* This is the final decision stage of the adoption process. At this stage, the individual decides to continue full use of the innovation. The rate at which an innovation is adopted is the number of items on a package an individual has adopted.

It should be noted that there is the phenomenon of the partial adoption of an innovation in which case an individual adopts some of the items in a package or prastices an innovation alongside the previously existing idea. There is also the phenomenon of discontinued adoption, in which case an individual drops an innovation he had previously adopted. The knowledge of these factors and their causes will give a better understanding of change processes that involve the diffusion and adoption of particular innovations.

Innovation characteristics that ensure their continued adoption are:

- Cost and their cost effectiveness,
- Relative advantage,
- Complexity,
- Divisibility,
- Compatibility, and
- Ability to satisfy felt need.

Role of change agents in the adoption process

Change agents perform the following roles in the process of adoption of innovation by the beneficiaries:

(a) Creation of awareness about an innovation among potential adopters,
(b) Provision of necessary information to sustain adopters' interest,
(c) Provision of technical assistance and other relevant materials to enable adopters to compare innovations with existing practice,
(d) Provision of assistance necessary for small scale trial of innovation on farmers' plots, and
(e) Provision of additional information and other necessary inputs required to facilitate continued use of innovations by adopters.

Group formation and group dynamics

Social groups refer to aggregates or categories of persons who have a consciousness of belonging or membership and interaction. Social changes which involve changes in the way people interact socially in

their structured relationships often involve the use of groups. Such groups are formed through several methods and motivated by different criteria. The criteria vary from economy to social characteristics or benefits, while the method of formation depends on the type of groups formed. Such groups may be primary or secondary. The focus here is on groups that are relevant for implementing changes in rural social setups.

Group dynamics involve the changes that take place in the structures of functions of groups. All groups as well as societies are changing at all times, that is, they are dynamic. This is because change is normal and inevitable. Since groups exist only to the extent that there is reciprocal psychological interaction, every group changes as long as the psychological interactions that bind her members together change. It is important to understand group dynamics as the changes that take place in a group affect the types or level of use to which the group can be put in efforts at effecting social change.

Importance of groups in extension work

Groups are important in extension work for:

(1) Legitimization,
(2) Socialisation,
(3) Information dissemination,
(4) Serving as pressure groups,
(5) Economic purposes e.g.labour exchange ('aaro') and informal credit ('esusu'), and
(6) Educational purposes.

Conclusion

It is important that extension agents understand the dynamics of groups. This is because it is essential that extension agents work with groups. There may be the need to liase with existing groups in extension work or create new ones where none exists. Research has however, shown that it is better to work with existing groups where they exist as they are usually more sustainable. A good understanding of how groups are formed, for which purposes and the dynamics among the groups will make extension or change agents be able to make the best use of them in providing extension services to rural dwellers. There is the dire need to achieve changes in the human and infrastructural resources that are abundant in rural communities. This will ensure sustainability in processes aimed at achieving change in rural communities.

REFERENCES

Adams, M. E. (1982): *Agricultural Extension in Developing Countries*. Burnt Mill, Essex. Longman. Pp 3-8.

Ahmed, A. (1982): *The Role of Information System in Development Study Series, No.* 314. Baghdad, Iraq: Ministry of Culture and Information. Pp 11-14.

Akinbile, L. A (1994): "Analysis of Attitudes of Maize Farmers to Indigenous and Scientific Knowledge in Odeda LGA, Ogun State" Unpublished M.Sc Thesis, University of Ibadan. Pp60-117.

Akinbile, L. A (2001): "Group Formation and Group Dynamics" in Oyedokun, A.O and O.I.

Anderson, W.A and F.B. Parker (1964): *Society-its Organization and Operation* Nostrand Company Inc. pp117-130.

Bmdlish, V. and Evenson, R. E. (1993): Evaluation of the Performance of T and V Extension in Kenya. *World Bank Agricultural and Rural Development Series.* No.7. Washington, D.C. World Bank.

Blackburn, D. J. and Vist D. L. (l984): Historical Roots and Philosophy of Extension. In D .J. Blackburn (Ed.), *Extension Handbook (listed).* Guelph, Ontario: University of Guelph.

Ekong E.E (1988): *An Introduction to Rural Sociology* Second Edition.Dove Educational Publishers, Uyo pp 134-340.

FAO (1993): *The Potentials of Microcomputers in Support of Agricultural Extension Educdtion and Training.* Rome: FAO. Mosher, A. T (1978): *An Introduction to Agricultural Extension.* New York Agricultural Development Council.

Odebode, S. O. and Olowu, T. A. (2001): Agricultural Journalism and Audio Visuat Aids. In Ogunmola B. O. (ed). *Agriculture Inputs and Product Management.* Oyo State College of Education Publication Series. pp 140-165.

Odebode, S.O. (1999) Referencing Approaches In Oladele, I.O., Akinbile, L.A. and Adekoya, A.E., (eds.) *Social Science Research: Approaches Techniques and Reporting,* Shanu Books Ltd., Ijebu-Ode, 51-68.

Odebode S.O, and Omoloye A. A. (2010) Complementary Issues in Preparing a Research Report. In Aiyelari E.A, Odebode S.O, Omoloye A. A, Fregene Tosan (eds) (89-99).

Oladele (eds) *A Handbook of Agricultural Extension Services and Communication.* Codat Publications, Ibadan pp 13-19.

Patel, A.U., Singh. D. and Ghouri, A. S .K. (Eds 1985): Managing Agricultural Extension in Nigeria.

Proceedings of National Workshop on Agric Extension Jan. 22-25 1985. Ibadan. Federal Agricultural Co-ordinatine unit (FACU).

Rogers, E.M (1995): *Diffusion of Innovations* Free press, New York pp161-201.

Savile, A. H. (1968): *Extension in Rural Communities.* New York: John Wiley and Sons. pp 5-10.

Sites, P (1995): *Control and Constraints-an Introduction to Sociology* Macmillan Publishing Co.Inc., New York pp. 89-201.

Swanson, B. E and Claar, J. E (1984): *Agricultural Extension: A Reference Manual* pp 2-19

Zijp, W. (1994): *Improving the Transfer and Use of Agricultural -Information.- A guide to Information Technology.* World Bank Discussion Paper 247. Washington, D.C:The World Bank.

3

AGRONOMY AS A SCIENCE

G. O Adeoye and O. O. Adeoluwa

1. Agronomy as a science
2. Components of agronomy
3. Principles of crop production and farming
4. Soil as a factor of crop production
5. New concepts of Agronomy

Agronomy as a Science

Agronomy is the science and technology of using plants for food. Evidence points to the Middle East as the site of the earliest planned harvesting of plants. Agronomy is coined to explain the concept of crop production system. There is a strong link between crop and the major medium of its production (soil). Production connotes management. Therefore, Agronomy is a science of management of soil resources to produce crops.

Agronomy is therefore the science of soil management for crop pro-duction i.e. adapting crops to soil environment for optimum and sustain-able crop production. The Greek words Agros (field) and Nomos (to manage), aptly explains the term.

Agronomy and agriculture have been around for many years. Agriculture is the heart of a society, without the help of agriculture a society will not be able to grow. From the Stone Age, about 10,000 B.C., the early man initiated a sedentary life from being a hunter and a gatherer of fruit, he started to domesticate livestock. He also instituted principles of selection from wide varieties from over 250,000 species of higher plants. He used about 3000 and today, over 50 species are widely cultivated. This principle is referred to as plant domestication, and it has gone through research for improvement over the centuries.

The concept of crop production has been evolving until scientific approach was introduced in Rothamstead Experimental Station in the United Kingdom in 1834 and, by 1900, universal acceptability was accorded this science. The fundamental sciences of which Agronomy is a derivative includes Botany, Chemistry and Physics. The introduction of Biotechnology and Hydroponics is a new dimension in crop production systems. Today, geography and environmental sciences boost agronomy and have become an integral part of the concept of sustainable crop production

Components of Agronomy

Crop and **soil** are the two basic components of agronomy. These two components are further divided into the following applied sciences:

A. Crop components include:

1. Crop production / Crop physiology,
2. Plant nutrition,
3. Weed science,
4. Forage / Pasture agronomy,
5. Plant breeding and seed technology / Tissue culture,
6. Horticulture, amd
7. Farming systems.

B. Soil components include:

1. Fertility / Soil testing,
2. Soil Biology (macro and micro),
3. Soil Physics,
4. Soil Chemistry,
5. Soil survey / Pedology,
6. Mineralogy, and
7. Soil conservation and mechanization.

Each of these components makes significant contribution to sustainable optimal yield and high crop quality.

Principles of Crop Production and Farming

The focus of crop production is realizing optimal yield of any cultivar. Thus, the following are the steps involved in raising crops:

1. Land clearing,
2. Tillage for seed bed preparation,
3. Crop establishment or planting,
4. Weeding,
5. Fertiliser application (chemical, organic, and organomineral or bio-fertilisers),
6. Pest control,
7. Harvesting, and
8. Consumption, Storage, Sales or value addition by processing / packaging.

Farming Systems in Crop Production

Various combination patterns of crops on the field are captured by the term 'farming system'. The traditional farm-ing system started from shifting cultivation and advanced to bush fallow system. When land became constrained due to population pressure, shifting cultivation gave way to continuous cropping with different crop combinations. The following are common examples of ways crops could be combined:

- Sole cropping: planting a single type of crop per time on a field
- Mixed or Multiple cropping: planting more than one crop at time on a field in either of the following:

(a) Intercropping – planting a crop within the production cycle of another plant, e.g. maize within yam

(b) Relay cropping – planting of a crop toward the end of another crop, e.g. maize and cowpea

- Crop rotation: planting of at least four crops, one per time on a piece of land.

Influence of Climate and Environment on Crop Production

Nigeria is a land of contrast. From the coastal plain across the primary forest, to derived savannah, Guinea, Sudan and Sahel savannahs. Climate, length of rainy season and vegetation dictate what crops to culture and what yield expectancy is.

Basically, there are two cropping seasons in the south: Rainy and Dry seasons. There are advantages and disadvantages in these two seasons, favouring or otherwise affecting yield and crop quality. With the incursion of desert (desertification), most ecological zones are now reduced to only one season.

This modification of seasons is man-made and is responsible for environmental degradation, drops in crop production potential of the soil and hunger. For economic viability of crop production, factor inputs need to be optimally and efficiently managed. Transition from peasant- hoe/cutlasses agriculture to mechanised farming has been slow due to low managerial competence and rudimentary mechanical knowledge and adoption rather than adaptation to our environment.

Classification of Crops

Crops are classified in line with:

A. Their agronomic uses. The various classes are:
1. Cereals, e.g. maize;
2. Legumes, e.g. cowpea;
3. Forage and fodder crops, e.g. guinea grass
4. Root and tuber crops e.g. cassava, yam, cocoyam, sweet potato;
5. Fibre crops, e.g. cotton, jute;
6. Fruits and nuts, e.g. banana, citrus, mango, guava, cashew;
7. Sugar crops, e.g. sugarcane;
8. Spices, e.g. ginger, pepper and cinnamon;
9. Drugs and beverages, e.g. tea, coffee, cocoa and kola;
10. Essential Oils, e.g. lemon grass oil and citrus oil;
11. Oils and fats, e.g. groundnut, oil palm, soybean, sunflower; and
12. Vegetable crops, e,g. 'Tete' (Amaranthus), 'Ewedu' (Corchorus),'Soko'(Celosia). Fruity vegetables are Okro, Tomatoes, etc.

B. Their special purpose or uses in the temperate region are:
1. Cover crops,
2. Cash crops,
3. Fertility crops,
4. Silage crops
5. Companion crops, and
6. Trap crops.

Soil as a Factor of Agricultural Production

Definition of Soil

Soil is the collection of natural bodies on the outermost part of the Earth's crust, that support plants, and that have properties due to the integrated effects of climate and matter acting upon parent material, as conditioned by relief over periods of time.

Soil is the thin cover of the earth's crust as the medium of plant growth: Crops, weed and natural vegetation inhabit the soil. The earth's crust is the bedrock of the soil and could be several kilometres thick, while the soil ranges from few centimetres to a few metres deep. In between the soil and the earth's crust is the weathered (decomposed upper part) of the earth's crust.

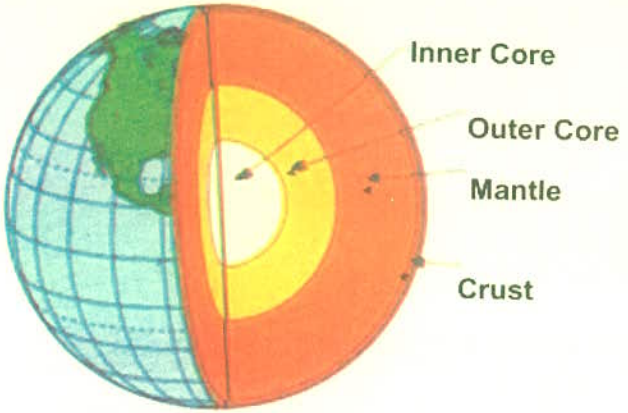


Fig 1: The earth's crust and its soil cover

The Soil Profile

A segment of the upper part of the earth's crust magnified, represents a hypothetical soil profile.

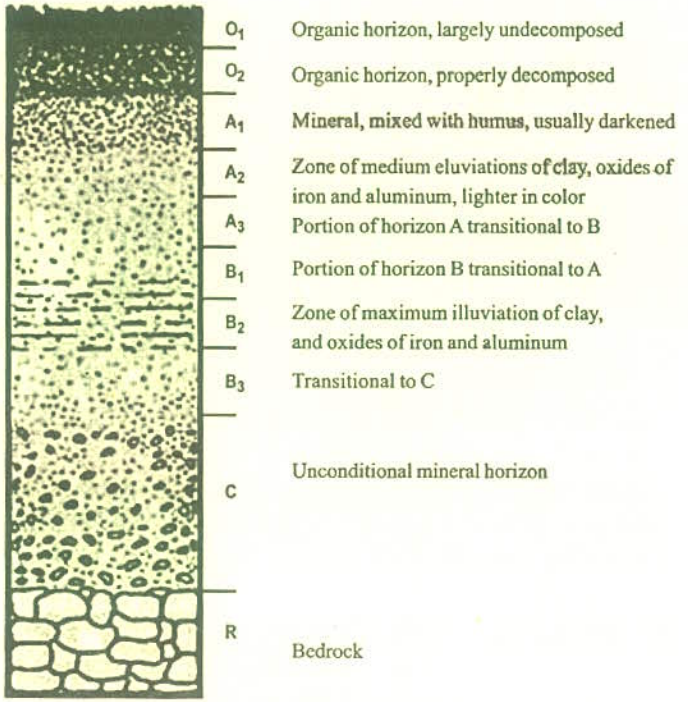


Fig 2: Hypothetical Tropical soil profile

It is a vertical succession of horizontal layers of the soil on which plant grows and man lives and sustains. Man uses the soil as foundation for roads, buildings and other structures and receptor of waste for both human and other non -living things. Above this is the major medium for growing crops. The surface (top) soil also has a volume composition which consists of mineral, air, water and organic matter in a proportion of 45:25:25:5 respectively.

Volume composition of Surface soil.

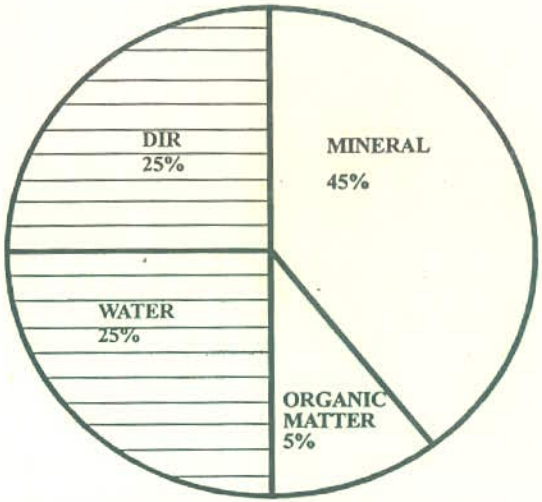


Fig 3: Volume composition of Surface soil.

Soil can be described in terms of its features: physical, chemical and biological.

Physical Characteristics

The mineral fraction results from decomposition of hard rock to sand, silt and clay; and it is called soil texture. This is the relative proportion of sand, silt and clay. An ideal soil is Loam with relative proportions of 6-28% clay, 28-50% silt, and 24-52% sand. The textural triangle gives the textural class of any soil. A clayey soil has more than 55% clay, sandy soil has more than 85% sand.

Soil Structure

Organic matter component binds the texture to form particles into aggregates. This gives the soil its physical frame for good crop production. The organic matter content of tropical soils is always below 3 % but good agricultural soil has a range 3-5% organic matter.

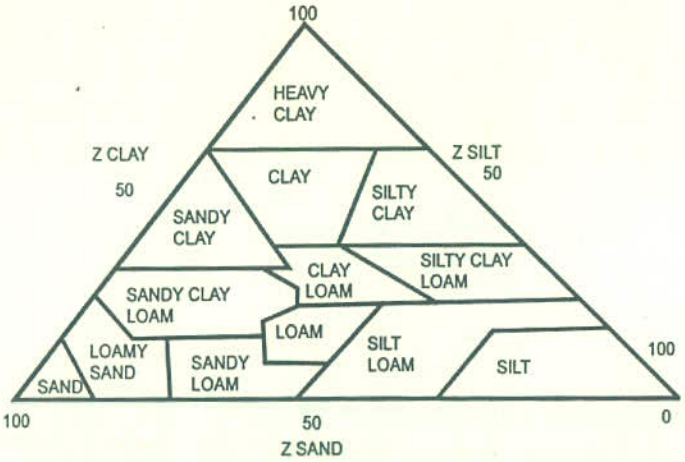


Fig. 4: Textural Triangle

Chemical Characteristics

The chemical composition of the soil affects soil fertility and productivity. They include pH which is the soil reaction. The soil could be acidic, neutral or alkaline. It is calibrated from 0-14. A pH reading less than 7 is acidic, 7 is neutral and greater than 7 is alkaline. This determines the availability of nutrients in the soil for plant uptake as well as other several chemical processes in the soil.

Soil Organism

Soil is living because a vast number of micro- and macro-organisms live in it. Large proportions of them belong to plant, and some to Animal Kingdom. They are called soil micro-organism. Examples of the large soil organisms are earthworms, insects, rodents, etc. They burrow through the soil and take part in soil structuring and aeration. They do the work of reworking the soil and incorporation of organic matter to "deeper depth while stirring up soil from deeper levels also. They are therefore, involved in mineralisation of organic matter, soil structure and aggregation of soil particles, nutrient recycling and ion exchange processes that sustain plant and animals living in the soil.

Plant Essential Nutrient Elements

There are 16 essential plant nutrient elements required by crops. These essential nutrient elements are divided into three broad categories; major, macro (primary, secondary) and micronutrients. The major nutrients are mostly supplied by nature and include carbon (C), hydrogen (H) and oxygen (O). Macro nutrients are required by plants in large quantity. They are further divided into 'Primary' and 'Secondary' macronutrients. Primary macronutrients include nitrogen (N), phosphorus (P) and potassium (K). Secondary macronutrients are calcium (Ca), magnesium (Mg) and sulphur (S). The last category of plant essential nutrients are micronutrients which are needed in small quantities by plant. They include iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), and chlorine (Cl).

These aforementioned nutrient elements are all essential because the lack, inadequacy or surplus of any of them will result in abnormal growth of the crop, low crop yield and quality. Any of these conditions can predispose crops to pest and diseases. To correct these abnormalities, the concept of fertiliser application is therefore introduced in soil management. The three principal fertiliser elements are NPK and can be applied as compound or single fertilisers. Examples of compound fertilisers are NPK 15-15-15 and 20-10-10. Other fertiliser grades like NPKMg 12-12-17-2 have been introduced to include magnesium which is also needed by oil crops. The current trend in fertiliser use is the introduction of compost mixture with mineral fertiliser called Organomineral Fertiliser. It is more stable, balanced and environmental friendly, cheap and sustainable. Since it is produced from domestic, municipal or agricultural wastes, it also helps in environmental sanitation as waste to wealth.

Types of Fertilisers

1. Mineral: Derived from rock minerals or synthetic materials; e.g. urea, muriate of potash
2. Organic: Derived from plant or animal origins; e.g. compost, green manure, farmyard manure, etc.
3. Organo-mineral: Combination of organic and mineral fertilisers; e.g. compost + Urea

4. Biofertilisers: The use of some micro organisms in improving soil fertility; e..g. mycchoriza, rhizobium, blue-green algae, etc.

Sources of principal fertiliser elements (NPK)

- N : sources are urea, CAN (Calcium Ammonium Nitrate), ammonium nitrate.
- P : the source is single or triple super phosphate
- K: sources are KCI (Potassium Chloride) also called Muriate of potash (MOP) or potassium nitrate

These nutrients can also be supplied through organic sources.

Soil Management for Agricultural Production

Soil is a major factor of crop production; therefore, it must be well managed and maintained. There are however, a lot of problems in soil management due to the inherent nature of tropical soils of which the Nigerian soil is typical. The soil is described as fragile due to:

1. Low activity lay,
2. Low cations exchange capacity,
3. Low organic matter (OM) and high loss of OM due to high Temperature, and
4. Susceptibility to rain and wind erosion due to torrential rainfall and high wind velocity in the arid regions.

The soil degrades very fast immediately it is cleared. This has been responsible for failure of large scale farming in Nigeria. The recipe for minimising soil degradation, therefore, is proper management strategies.

Development of management techniques that fit the tropical soil is the main trust of agronomy. They include:

1. Minimum disturbance of soil during land clearing and tillage by avoiding the use of heavy equipment (uncontrolled tractorization) of seed bed preparation called ploughing, harrowing and ridging.
2. All year round coverage of the soil surface by vegetation i.e. multiple cropping (mixed cropping farming system.)
3. Serial land clearing. Avoid a large-scale mechanical removal of trees and grass without adequate precaution for soil conservation.,
4. Proper fertiliser use to replenish nutrient loss and depletion.

Major Soil Types in Nigeria

There are five major soil types in Nigeria. They are:

1. ***Alfisols***

They have relatively adequate nutrient components. They are dominant in the moist savannah, dry, and moist rainforest. They belong to a family of Ferrugenous and Latisoic soils. (40%)

2. ***Entisols***

Soils of alluvial flood plains or poorly developed shallow rock ground and unconsolidated Aeolian deposit on the edge of the Sahara Desert. (5%)

3. ***Inceptisols***

Soils nearing maturity of development with strong evidence of the deomposing parent rock visible.(25%)

4. ***Oxisols*** . .

Variously caned Latosolsor Ferralsols, Lateratic or Ferraliti soils. They are the oldest, most intensely weathered and nutrient deficient soils in the tropics. In Nigeria, they are most abundant in the South Eastern States and wetter parts of Nigeria.

5. ***Ultisols***

These are intermediate in character between Alfisol and the deep very old Nutrient-poor Oxisols. They are almost equally distributed between the humid and the moist forest Zones in Nigeria. (30%)

6. ***Vertisols***

They are heavy clayed soils. They are localised and found in some depressions along the riverbanks. An example is Vertisols of Benue Basin in Taraba State. (not more than 5%).

You can now appreciate the need for management strategies to maintain and sustain productivity of such a delicate soil system on which an exploding population depends for food and nutrition.

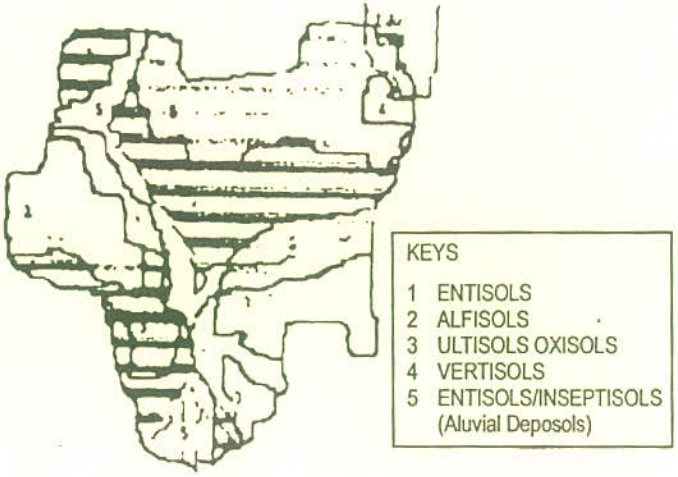


Fig 5: Soil map of Nigeria.

SOME NEW CONCEPTS IN AGRONOMY

Since knowledge in any field is dynamic, there are now new concepts in agronomy which evolve in the quest to meet the need of man for quality food and fibre, combined with sustainability of the environment. Some of these are:

Organic Crop Production: Organic agriculture, as defined by IFOAM, includes all agricultural systems that promote environmentally, socially and economically sound production of food and fibers (IFOAM, 2004). Recycling nutrients and strengthening natural processes helps to maintain soil fertility and ensure successful production. By respecting the natural capacity of plants,

animals and the landscape, it aims to optimize quality in all aspects of agriculture and the environment. Organic agriculture dramatically reduces external inputs by refraining from the use of synthetic fertilizers and pesticides, genetically modified organisms and pharmaceuticals. Pests and diseases are controlled with naturally occurring means and substances according to both traditional as well as modern scientific knowledge, increasing both agricultural yields and disease resistance. Organic agriculture adheres to globally accepted principles, which are implemented within local socio-economic, climatic and cultural settings. Organic agriculture practices of which organic crop production is a section is based on four principles: Health, Ecology, Fairness and Care.

Ecological Agriculture: Agro-ecological farming is the design and management of sustainable agricultural systems, using state of the art ecological science and principles integrated with local and indigenous knowledge. (Hans Herren, pers. comm.). It includes the study of the ecological processes in farming systems, [surrounding landscapes and relevant watersheds] such as nutrient cycling, carbon cycling/sequestration, water cycling, food chains within and between trophic levels (microbes to top predators), lifecycles, herbivore/predator/prey/host inter Initiatives, pollination, etc. It also includes the examination of the role of and impacts on farmers (both men and women), who are themselves recognized to be an inseparable, integral part of any agro-ecosystem. The design of agricultural systems in such a manner can help put an end to food insecurity and address climate-change and poverty-related challenges. Ecological agriculture depends on and sustains ecosystems services as well as the knowledge, practices and innovations of local communities, leading to more reliable and increased food security and incomes.

Energy Saving Farming: This is a concept based on reduction in the utilization of fossil fuel in order to reduce effects of agricultural operation on global warming and ecological conservation. Generation of gas (biogas) from the right combination of animal and plant wastes in replacement of petrol or diesel for farm operations is a good example. Today, some farms also use solar power generator and wind mill to drive some of their equipment. One thing that is common to farming system based on energy saving is the conversion of organic wastes to re-useable forms as well as the optimization of environmental resources to achieve the barest minimum external farm inputs.

REFERENCES

Agronomy in Nigeria (2000), Department of Agronomy, University of Ibadan, Nigeria.

Aiyelari E.A., Abatan M.O., AKinboade O.A., and E.O. Lucas (1993) *Fundamentals of Agriculture.* Afrika-Link Books pp 1-13.

Dirk A. Tel and Myrna Hagarty (1984). *Soil and Plant Analyses study guide for laboratory directors and Technologists Working in Tropical Regions.* Institute of Tropical Agriculture (IITA), Ibadan, Nigeria: and Univeristy of Guelph, Guelph, Ontario, Canada. Pp 1-22.

4

LIVESTOCK PRODUCTION IN THE TROPICS

Anthony D. Ologhobo, Eustace A. Iyayi and Olujide A. Sokunbi

Introduction

Protein is of prime importance in life sustenance and it is found everywhere in nature: in human beings, animals, plants and microbes. Protein provides energy for the body in times of emergencies such as during starvation, extreme dieting and the wastage produced by diseases such as cancer. Vital components of the body like collagen, heamoglobin, myoglobin, hormones, insulin and enzymes are made up of amino acids which are products of protein breakdown. Although protein is obtained from animal and plant sources, the source from animal is of a greater quality than that of plants.

Sources of animal proteins for human consumption are usually from animals termed livestock. Livestock are animals raised for food or other products, or kept for use, especially farm animals. Farm animals are classified based on anatomical and physiological differences into two groups: monogastric or non-ruminants (simple stomached animals) and ruminants (complex stomached animals). Ruminants' stomach can be divided into four compartments; rumen, reticulum, omasum and abomasum. The rumen compartment is very important as it contains millions of beneficial microorganisms that help ruminant livestock break down the fibre components that are mainly contained in the forages (grasses and legumes) and roughages they consume. The abomasums compartment is also referred to as the 'true stomach' as it functions like the simple stomach of non-ruminants.

Livestock are primarily raised for their meat (beef, pork, mutton, etc.), milk (from ruminants), lard (from pigs) and eggs (from poultry). Secondary considerations are the production of skin, bristles, offal, manure, etc. Examples of monogastric livestock are poultry (chicken, turkey, duck, guinea fowl, goose, quail, etc.), pigs, and rabbits. Examples of ruminant livestock are cattle (meat and dairy), sheep, and goat. The rabbit is a peculiar farm animal, because of its ability to grow and develop solely from the consumption of fibrous feed. The rabbit is thus, referred to as a monogastric herbivore or pseudo-ruminant. The rabbit possesses enlarged caecum, which contains large populations of micro-organisms that give it the ability to degrade large amounts of fibre. This section will focus on the breeds, management and

nutrition of two livestock intensively reared in Nigeria; chicken and pigs. Also, aspects on animal feedstuffs and their processing will be discussed.

Chicken Breeds, Management and Nutrition

Breeds of chicken

All breeds and varieties of birds are due to natural and artificial selections. Commercially speaking, this may be referred to as egg type, broiler or table type, and dual purpose type.

Important characteristics that breeders select for and improve in poultry include:

a. Egg production, size, shape, colour and quality,
b. Body weight and rate of growth,
c. Feed efficiency, high liveability and resistance to diseases

Important Terms in Chicken Breeding

Class: This is used to designate groups of poultry breeds, which have been developed in certain geographical regions of the world.

Breed: This refers to the established groups of chickens of common origin and in a class with similar characteristics of colour, body, shape and form. Distinctive differences among breeds within the class are primarily those of body, shape, size and skin colour.

Variety: This refers to a sub-division of a breed. They are largely determined by the colour of the plumage and differences in the comb.

Strain: This denotes a family name or the name of the breeder which developed the particular variety. Distinctive differences are genetic and are selected by the breeder for specific purposes.

Egg laying breeds: Good layers usually begin producing when they are about18 to 20 weeks old and continue for 12 months, laying about 260 to 300 eggs. There are two types based mainly on the colour of the egg shell;

White eggs: The most popular white-egg breed is the white leghorn. It is smaller than other breeds and produces the most eggs per unit of feed eaten. Thus it has a higher profit potential. Distinctive features are white earlobes, white shelled eggs, small body size, large and mostly single combs. They are non-broody but exhibit a nervous disposition. Females weigh about 2 kg while the males weigh about 2.7 kg by the 20th week. Other breeds in this group include the Minorca and Ancona.

Brown eggs: Rhode Island Red and New Hampshire are the two popular breeds in this group. These breeds are heavier than the white egg shell laying types. Some lay as much eggs as the white leghorn but they eat more feed per egg produced. Distinctive features are: eggs vary in colour from light beige to dark brown, ear lobes are red and feathers vary from almost white to red, brown, black or combinations. Skin and shank colour is yellow. Other breeds in this group include the

Plymouth Rock, Wyandotte and Jersey giant. Adult females weigh about 3 kg and the males weigh about 3.6 kg.

Meat Breeds: These include the Whiter Rocks, Cornish, Barred Rocks, Dorkign, Orpington and others. Present day meat strains are known as "synthetic breeds" and are as a result of crosses which may include two or more of the aforementioned breeds. Meat breeds of chicken are usually reared only for 7 to 8 weeks when they weigh about 2 to 3 kg. Meat breeds have more meat per unit of bodyweight than egg breeds. It can also be economical to use males of heavier brown egg breeds for meat production in the absence of the meat breeds.

Dual-Purpose Breeds: Generally, these are breeds used to produce eggs, and the meat obtained from them is of secondary consideration.

Important factors to consider in selecting a breed for your farm:

1. The type of product you want to market,
2. The rate of egg production or meat production as the case may be,
3. Mortality rate in the laying house (liveability),
4. Body size and vigour,
5. Egg size and quality,
6. Feed conversion efficiency, and
7. Adaptability of the breed to your particular environment.

Management of chicken

To do well with any breed type of chicken, one must understand their needs and be ready to provide the daily attention they require. Understanding the minute details in chicken management makes all the difference between profit and loss in a chicken farm establishment. Intensive system of chicken production has the highest profit potential; this means that the fowls completely rely on the farmer for all of their needs.

Chick management

Chick management schedule is divided into two parts; before the chicks arrive, and after the arrival of the chicks.

Before the arrival of the chicks: -

1. The brooder house is cleared thoroughly, this includes the floor, walls and the ceiling.
2. The brooder house is disinfected using one of the many commercial disinfectants available in the market, strictly following the manufacturers recommendation.
3. Set up, and make a trial run with brooders (heat source). This is to ensure that they are properly working. This should be done 2 to 3 days before chicks arrive.
4. Clean and disinfect all equipment such as feeders and drinkers.
5. Provide clean fresh litter on the floor to about 5 metres deep.

6. Install brooder guards which should be about 36 cm high. This keeps the chicks confined to the brooder area, thereby ensuring adequate consumption of feed and water.

After the arrival of the chicks:

1. A few hours before the chicks arrive; ensure water fountains are adequately filled with clean water. Half fill the feeders and put some feed on chick trays, papers or cardboards.
2. The temperature in the brooding area should be about 35 °C.
3. Chicks should never be without feed for more than 30 minutes at a time. Ensure the feed contains coccidiostat.
4. Spend time everyday just observing the flock. While they grow, see if they are all about the same size and are putting out feathers at about the same rate.
5. Watch out for inactive chicks (those that stand still for more than ten minutes) that are most likely to be sick.
6. Start each successive week by adjusting the heat source or height of the hover.
7. On the 3rd day, allow the chicks to finish the feed in the feeder. From then on, fill the feeders half full. If chicks are eating well, remove chick trays, papers or cardboards.
8. For the rest of the chickens' rearing period, completely change their water early in the morning and afternoon, rinsing the drinkers out as you do so. Chickens should have water available at all times.
9. On the 4th day, begin looking for signs of coccidiosis. If there is a serious outbreak, treat for coccidiosis until the flock is at least 12 weeks old.
10. On the 8th day, Infectious Bursa Disease (Gumboro) vaccination is recommended. De-crease the temperature to 31 °C and remove the brooder guard.
11. On the 14th day, lower temperature to 29.5 °C and vaccinate against Newcastle Disease.
12. On the 21st day, lower temperature to 26.5 °C. Provide larger feeders and repeat vaccination against Infectious Bursa Disease.
13. On the 28th day, lower temperature to 24°C. Give booster vaccination against New castle disease.
14. On the 35th day, lower temperature to 21 °C. If night time temperatures do not fall below this, remove the brooder. Brooder should be removed completely by 42nd day.

Meat breed management

1. Once meat birds have been vaccinated on the 28th day, they may not need any special care, until they are sold off by the 8th week.
2. If they are kept beyond this age, then they should be given booster vaccination against Newcastle Disease and other necessary vaccinations, depending on the prevailing endemic diseases in the production area.

3. Watch the flock and treat for outbreaks of intestinal worms, coccidiosis, external parasites and other health problems.
4. Remove any sick birds. If there are more than one, perform a post-mortem examination, or take the birds to a veterinary laboratory for analysis.

Egg laying breed (layers) management

1. Vaccinate for fowl pox on the 42nd day.
2. Vaccinate against Newcastle Disease on the 52nd day.
3. Increase feeders and water fountains on the 84th day and begin a lighting programme if appropriate.
4. Watch out for symptoms of worms' infestation by the 16th week, and treat birds if necessary.
5. Place nesting boxes in the house by the 19th week, so the pullets get used to them before laying starts, if rearing will continue on the floor.
6. Cull all pullets that look sick and place healthy ones in cages by the 20th week if laying will be in battery cages. Change from growers' to layers' ration when 50 % of the flock are in-lay. The main difference between layers' ration and growers' is the amount of calcium.
7. Improved breeds should begin laying by the 21st week. However, pullets might start laying 16 to 19th week if lighting programme is wrong.
8. Watch out for eggs laying outside nest boxes. Hens found laying directly on the floor should be introduced gently to a nest with an egg in it. Hens should not be unnecessarily disturbed once they begin laying. Egg production should peak at about 85 to 95 eggs per day per 100 hens and then fall gradually to about 55 to 70 eggs at the end of 12 months of lay.

Several factors influence how long a flock of layers will produce economically. These include breed type, feed prices, management and seasonal considerations. Normally, layers are kept in-lay for 12 months. However, in situations where flock replacements costs are high, it may be economical to keep them for another six months. Under good management additions, Leghorns may lay up to 18 months at an economic level and some heavier breeds up to 15 months. The time to replace a flock is determined by many factors and it is wise to consult experts before making decisions. Layers should be kept in the same house or cage during their laying year. Moving them when they are on-lay may cause them to stop laying for several weeks. Feed and water must be available continuously during daylight and ensure that their calcium and phosphorus requirements are met.

Nutrition of chicken

For every animal there is an optimum amount and balance of foods or nutrients that will produce peak physical condition, growth rate, and in the case of chickens it is important to understand that both amount and balance are important in attaining maximum productivity. Thus, proper nutrition, proper balance and control by the farmer of what the chickens consume are of paramount importance. Meeting the nutritional needs of chickens is dependent upon several factors:

1. ***Breed type:*** Improved breeds do not produce well unless the feed given them contains a proper nutrient balance.
2. ***Size of operation***: If a farmer has only 100 birds, it will probably be more costly and certainly more time consuming to mix feed than it will be to purchase from a commercial source.
3. ***Climatic conditions***: In hot climates with humid conditions, feed cannot be stored more than a month without spoilage. Vitamins deteriorate rapidly in hot climates and must be used within a few days after purchase except refrigeration is available.
4. ***Type of operation***: A broiler operation will require a steady supply of feed for only eight to ten weeks. A situation where feed ingredients may be available for short periods in line with harvest and grain milling, fishing times and other seasonal variations. Places a layer operation at a disadvantage, since feed must be available without interruption throughout the year for a successful operation.
5. ***Feed types available***: It is the protein and energy content of a diet that distinguishes what feed should be given to different ages and types of chicken.

For broiler chicken it is categorised into two:

Broiler starter diet: Fed to chicks from day old to the 4th week of age. It contains 22 to 23 % crude protein and energy level of about 3,000 to 3,200 kcal/kg diet.
Broiler finisher diet: Fed to chicks from the 4th week to finishing at about 8th week. It contains 20 to 21 % crude protein and energy level of about 2,800 to 3,000 kcal/kg diet.

For the layer breeds it is categorised into three:
Pullet chick starter diet: Fed from day old to the 8th week; it contains 19 to 21 % crude protein and energy level of about 3,000 to 3,100 kcal/kg diet.
Pullet growers' diet: Fed from about 8th to 18th week, it contains about 14 to 15 % crude protein and energy level of about 2,800 to 2,900 kcal/kg diet.
Layers' diet: Fed from about 20th week of age to end of lay; it contains about 16 to 17% crude protein and energy level of about 2,600 to 2,750 kcal/kg diet.

Nutrient Requirements of Chicken

Energy: Energy (measured in calories) is required by birds to move, eat, digest, grow, maintain body temperature and in the case of layers produce eggs. Chickens get energy from carbohydrate (grains, roots, tubers and other starchy foods and sugars), Nitrogen free extract, crude fibre (corn bran, wheat offal, etc.) and fats and oils.

Protein: Consists of various combinations of amino acids. Amino acids are essential for tissue building and body functions. Proteins for chicken come from animal sources (fish meal, blood meal, meat and bone meal, etc.), and plant sources (groundnut cake, soya bean meal, etc).

Vitamins: These are organic compounds required in extremely small quantities but are essential for normal

growth, health and productivity. Vitamins A, D, E, and K are fat soluble, while others like niacin, thiamine, pyridoxine, biotin, choline, etc. are water soluble.

Minerals: These are basic elements required for use in many life support functions. Not all the necessary minerals will be found in an otherwise balanced feed. Mineral supplements must be added. Salt will have to be added to the feed mix, and calcium and phosphorus must certainly be added in adequate quantities especially for laying hens.

Swine Breeds, Management and Nutrition

The pig is one of the oldest domesticated animals in livestock history. It is found throughout the tropical and temperate regions where no religion edict prevents it from being reared. As a result of its rapid development, based upon the fecundity of the species and its growth potential, intensive production of pig has played a significant role in the evolution of urban society and economic growth in certain tropical countries, e.g. Thailand and throughout Africa. Although the pig being a monogastric can be said to be competing with man for available food, their omnivorous nature make them to be able to utilize a wide variety of feed ranging from concentrates, forages and, agro-industrial by-products to kitchen wastes.

Breeds of pigs

Breeds of pigs that are common in Nigeria can be classified into two; indigenous and exotic.

Indigenous Breeds of Pigs: Small-scale pig farmers commonly rear the indigenous breeds under an extensive system of management. They are usually modest in size with adults reaching 100 kg maximum, with an average weight of 60 kg at the first year under the best condition of management. In general, the indigenous breeds have small body size and shorter legs than exotic type with typical unimproved conformation of a large head, well developed forequarters and relatively light hindquarters.

They are early maturing sexually, and females show their first signs of 'heat' as early as three months of age. The skin is often black, brown or occasionally spotted but rarely white. The coat is variable, usually consisting of long and thick hairs with a ridge of longer bristles along the back. The growth rate and food conversion efficiency of indigenous pigs are low when compared to exotic breeds.

Exotic Breeds of Pigs: Examples of exotic breeds commonly reared in Nigeria are Large White, Land Race, Duroc, Hampshire, and Berkshire. The Large White, Land Race and Hampshire are three of the exotic breeds commonly used on most pig farms for breeding programmes.

Large White: The large white is both a bacon and pork type. It is a white coloured, long bodied, smooth and strong framed pig with erect ears. It is highly prolific and has good mothering ability. It exhibits high feed conversion efficiency (FCE) and is fast growing. However, it is susceptible to sunburn.

Land Race: The Land Race is both a bacon and pork type. It is a long, all white pig with floppy ears. Its litter size and mothering ability are excellent. It is fast growing and sturdy. It is noted for its smoothness and length of body and a carcass that contain a high proportion of lean. The breed is highly favoured for cross breeding purposes. However, certain strains exhibit weakness of the limbs (leading to lameness) and are also susceptible to sunburn.

Hampshire: The Hampshire is a bacon type breed. It is black coloured with a white belt around the forequarters of the body. It has a long straight face with erect ears. The breed is medium sized, prolific and has good mothering ability. It has a high proportion of lean and a superior FCE relative to other breeds. Growth rate is average with a reputation of utilizing pasture well. The breed is meaty and well-muscled. Sires are excellent for use in a final cross breeding programme, especially where carcass leanness is important. However, Hampshire shows poor cleanliness characteristics under confinement conditions and some strains exhibit stress adaptability problems.

Management of pigs

Pig production and their management practices have been of various forms right from the ancient time ranging from the traditional system to the modern. There are three basic systems of pig production and management; extensive system, semi-intensive system and intensive system.

Extensive system: The extensive system is more of African way of raising their animals with the available resources largely in form of wastes and leftover, providing a little shelter for them in austere weather condition. All the classes of pigs under this system are raised out door or on semi covered floor. The pigs must be rotated to control parasite infection. Capital cost is relatively low but labour cost is high and it demands more supervision than that required in the intensive system.

Semi-intensive system: There are many varieties of the semi-intensive system. Usually the breeding pigs are raised outside on pasture and the fattening pigs are raised intensively inside the building. The most common practice is to allow the gilt and the sows to run outside with or without boars. In most areas, they are rotated around series of paddocks to control parasite infestation. The paddock should be located on a well-drained land provided with adequate shade and well fenced with chain-link. Mud wallows are centres of parasite infections and as such, if used, must be frequently cleaned and dried out in the sun. Sows and litters housed in sheds that can be rotated across pastures in this system increases labour as feed and water have to be taken to the animals, but it decreases capital expenditure. The young pigs are usually very healthy under this system and the fatteners too can be reared in the same covered yard.

Intensive System: This is the practice of completely raising the animal, providing all the feeds and housing without allowing the animals to wander at all. The advantages of this system are that it protects the animal from incidence of diseases and infections as much as possible and the animal exhibit a better yield performance compared to those raised extensively. Under the intensive systems there are separate management practices for the different classes of the animals such as the boars, the sows/gilts and the piglets.

Piglets' management

Preparation for farrowing:

1. Farrowing pens should be dry and free from draught.
2. Farrowing pens (floor and walls) should be clean and scrubbed with strong disinfectant.
3. Sows should be sprayed with any approved insecticide such as Asuntol® against mange and lice at least 10 days before the expected date of farrowing.
4. Sows should be de-wormed two weeks before farrowing.
5. Sows should be moved to farrowing pens 4 to 7 days before farrowing.
6. Plenty of straw chopped to about 10 cm in length should be provided to warm the piglets.
7. A well designed farrowing pen should have rails round the wall into which the piglets can escape. This is to prevent them from being crushed by the dam.

Heating for piglets: In cold weather, a small area can be heated with infrared lamp or 50 watts electric bulb fixed about 30 to 40 cm above the piglets. This will keep them warm and prevent them from crushing effect due to huddling and piling.

Creep feeding: Piglets from day 10 should have access to a high protein feed. The feed is put into small creep into which the sows cannot gain access. Creep feed (18 to 20 % crude protein) is good because the growing animals have a high feed conversion rate and the piglets should get used to concentrate meal because the sow milk yield decreases just as the piglets require more. An incidence of scours can be treated with antibiotics inclusion into their drinking water. The canine and premolar teeth should be cut, to prevent damage to the sow's teats, with a pair of teeth cutters within 24 hours of farrowing. The umbilical cord can be cut and dipped into iodine or a mild disinfectant within 24 hours of farrowing.

Provision of iron (Fe): An injection of iron dextran® (2ml/animal) should be administered at day 1 to the piglets to make up for their deficiency in iron.

Castration: Male piglets not designated as future breeders should be castrated within a week of farrowing.

Weaning: Piglets can be weaned from their dams as soon as they are about 3 weeks old if breeding management and feeding regime is optimum, or when they are about 6 to 8 weeks old if otherwise.

Growers' management

After about 4 to 8 days of the sows' removal from the piglets, they can be transferred to the weaning pens. By now the piglets are expected to have gotten over the 'shock' of the sows' absence. A single litter could be raised together from weaning to slaughter or breeding. Several litters can be mixed on weight basis and housed according to their weight. This will afford the smaller piglets (runts) adequate chance of survival and good development with better access to feed. Males can be separated from the females at this stage. The pigs should be weaned on to a weaners' diet (16 to18 % crude protein). They could be de-wormed at this stage or before weaning. After elimination of almost all worms, they are transferred to new pens, which have been previously cleaned and disinfected against worm eggs.

The pigs must be about 5 to 6 months old at this stage and those to be used for breeding are separated from other classes such as baconer or porker. The breeders will be given adequate water, and feed which include, proteins, vitamins and minerals for the development of all secondary reproductive organs for breeding, while the baconers and porkers will be given fattening diets.

Breeders' management

Selection of breeding gilts: Gilts to be selected for breeding should have at least 12 teats so that there will be enough teats even for a large litter. The gilts must be selected from sows that normally wean between 9 to 10 piglets/litter and which are known to be good dams. Fast growing pigs that are likely to consume less feed per unit live weight gain (feed conversion ratio) must be selected. The pigs selected should have:

a. good strong legs,
b. adequate body length,
c. strong top line, and
d. well developed hams

Selection of breeding boars: Since the male pig contributes half of the herd, it is important to select good males also. A good boar must:

a. come from a fertile mother and father whose other off-spring is satisfactory,
b. have sound feet with good fill hams,
c. have uniform curve of the back and a good length, and
d. have at least 12 functional teats to pass on to its female off-spring

Boar's management

The boar should not be allowed to 'mate' until it is over eight months of age. Mating should only be twice per week during the first two months. Subsequently, it can be used for up to six matings per week. One boar can conveniently service fifteen sows. Considerable exercise is necessary to prevent the development of leg weakness, so it may be necessary to trim the boar's feet regularly. Boar should be cleaned regularly and treated for lice and mange.

Gilt/Sow's management

Gilts and sows tend to get too fat if not allowed enough exercise. A fat sow takes longer time to come on heat and is more likely to crush her young piglets. Sexual maturing for gilts start as early as four to five months but the first mating should not be done until eight months of age, when the weight should be between 100 to 130 kg. A sow has a reproductive life of four to eight years.

Pig nutrition

Feeding: Pig feed is available commercially in the following categories;

a. Creep feed, which contains about 18 to 20 % crude protein;
b. Weaners' feed which contains about 16 to 18 % crude protein;
c. Growers and gilts' feed which contains 15 to 16 % crude protein
d. Sows' feed which contains about 13 to 15 % crude protein;
e. Boars' feed which contains about 13 to 14 % crude protein;
f. Finishers' feed which contains about 12 to 14 % crude protein.

Minerals and vitamins premixes are very important, and pig rations must contain adequate quantities of calcium, phosphorus and salt (Sodium Chloride). A sudden change in the feedstuff is not encouraged but rather should be made gradually over a period of one week or more. Energy feeds are maize, wheat, rice, barley, sorghum, oats, cassava, sweet or Irish potato, and fruit pulp. Protein feeds are oil seed meal; cotton seed cake, soybean meal, groundnut cake, blood meal, meat and bone meal, fishmeal and skim milk. Fattening pigs require low protein in their feed, while nursing sows and piglets on creep feed require higher protein concentration.

Water requirement: Some farmers provide water at all times while others prefer to give regulated amount, although this should be increased in hot priods.

Class of pig	Water requirement/kg of feed (Litres)
Fattening pigs	2.5
Lactating sows and gilts	5.0
Dry sows and gilts	3.0
Piglets	*ad libitum*

Definition of common terms in pig production

Barrow: A male pig castrated before sexual maturity

Boar: A male pig of any age

Breeder: A female or male, young or mature pig kept for breeding to produce piglets

Creep: An area near a lactating sow, accessible only to piglets

Creep feed: Piglets feed provided in the creep area, beginning at about two weeks

Colostrum: The first milk produced after farrowing, usually very high in protein, vitamin A and immunizing agents

Docking: Removal of a section of the tail by cutting or pinching

Farrow: The process of giving birth to a litter of pigs

Feeder/growing pig: A young pig after weaning and before reaching slaughter age/weight

Finishing pig: A young pig weighing more than 80kg but not yet heavy enough for slaughter

Gilt: A female pig that is yet to produce a litter

Hog: A pig of any sex, generally referring to immature gilts, barrows or boars

Piglet: A young pig before weaning

Shoat: A young pig of either sex, generally weighing less than 50 kg

Slaughter pig: A young pig ready for slaughter, usually weighing 90 to 120 kg

Sow: A female pig that has produced one or more litters

Stag: A male pig, castrated after reaching sexual maturity

Suckling pig: A young pig with its dam

Wean: Removal of piglets from their dam

Weaner: A young pig at or shortly after weaning

ANIMAL FEEDS AND FEEDSTUFFS

Sustainable animal production requires a careful balance between the animal's genetic potential and the quality and quantity of nutrients consumed. For this purpose, an adequate supply of essential nutrients is an important dietary requirement to meet the animals' need for growth, maintenance, reproduction, fattening and production of meat, eggs, milk, wool and work.

Feed represents the major cost in animal production. Even with sheep, which typically consumes more forage than other domestic species, feed may represent 55 % or higher of the total production costs; with poultry, a value of 74 to 80 % might be more appropriate; for swine it varies between 65 and 75 %; and for finishing cattle it may represent 55 % of the total production cost and 70 % for milk. Hence, it is important that feed be processed economically in such a manner as to make for maximum efficiency.

What is Feed Processing?

Feed processing refers to performing all the operations necessary to achieve the maximum potential nutritional value of a feedstuff. The process involves changing ingredients in such a manner as to maximize their natural value and the net returns from their use.

Feed processing may be accomplished by physical, chemical, thermal, bacterial or other alterations of a feed ingredient before it is fed.

Reasons for Processing Feed

To change moisture content: Moisture content of a feedstuff may need to be changed to make it safer to store, made palatable and digestible, or to process it otherwise. Grains are generally stored below 14 per cent moisture. On the other hand, it may also be desirable to add water to a finely ground meal mixture at the time of feeding in order to lessen dustiness and to increase palatability.

To alter particle size: Some feeds need to be reduced in size so that they can be consumed and are more digestible. In some cases particle size is increased (agglomerated) by pelletizing or cubing.

To change density of feed: The weight per unit volume or the bulk of the ration affects total intake. For this reason, very bulky feeds are sometimes pelletized or cubed in order to increase energy density and feed consumption. On the other hand, ruminants favour flaked grains rather than ground or pelletized to minimize digestive disturbances.

To change palatability: In most instances, feeds are processed in such a manner as to increase palatability.

To increase nutrient availability: In order to improve the palatability and nutritional value of feeds and enhance their digestibility, it is necessary to process animal feeds by various methods. Processing treatments change the structural conformation of nutrients and anti-nutrients in raw feeds in such a way that they can be digested by

digestive enzymes and their negative influences in animals eliminated.

To detoxify or remove undesirable components: Some feeds may contain toxic substances, the excess consumption of which may cause decreased nutritive value of the feeds or may injure some vital organs or even cause death.

To lessen moulds, salmonella and other harmful substances: Moulds on feeds have long been a problem. Aflatoxin is a common term used for a group of toxins produced by fungi and is common in the expeller variety of groundnut cakes. Proper harvesting, drying and storage are important factors in lessening aflatoxin contamination and toxin production. Propionic and acetic acids will inhibit mould growth. Treatment with ammonia or ammonium hydroxide will detoxify feeds. Salmonella, rod shaped bacteria are important from two distinct aspects: (a) food poisoning in man, and (b) disease in domestic animals. In meals, it is invariably present and is destroyed by pelletizing.

To reduce storage space requirement and transportation cost: Sometimes forages are processed in a certain way in order to reduce storage and transportation space.

To improve keeping qualities: Since feeds are seasonally produced, some of them must be stored for use in non-growing season. Forage may either be dried to safe levels, ranging from 25 % moisture in loose hay to 16 or 17 % for cube or preserve by ensiling at 60 to 70 % moisture content. Cubing refers to the practice of compressing long or coarsely cut hay in cubes about 1.25 inches square and 2 inches long with a bulk density of about 15 kg per cubic foot.

To make more profit: Feed efficiency can be routinely improved by as much as 10 to 15 % by changing the method of feed processing. Thus profits may be enhanced by either reducing costs, or increasing production or both.

Other reasons for processing feeds:

Feed in its natural state may not appeal to the animal due to offensive odour or bitter taste. The physical structure of the feedstuff may be too coarse and fibrous due to high structural fibre and lignin contents. If the animal succeeds in eating the feed, it may not be able to digest it due to natural constituents which are toxic and bind the animal's digestive enzymes, making them ineffective.

Processing Methods

Grains and cereals:

Grain processing methods are divided conveniently into **dry** and **wet** processes. The primary objective is to improve the availability and digestibility of starch which is present at about 70 to 80 % in grains. However, the method of accomplishing this is complicated because: (1) the type of starch varies among grains in its digestibility; and (2) availability of starch even varies from one grain variety to another.

Dry processing

1. *Grinding*: This is the process by which a feedstuff is reduced to particle size by impact, shearing or attrition. The process is most common, economical and simple. A wide variety of equipment is available with sieves that allow some control of particle size. Coarsely ground grains are preferred for ruminants while finer ground grains are more common for poultry and swine.
2. *Dry rolling or cracking*: This method refers to passing grain without steam between a closely fitted set of steel rollers which are usually grooved on the surface. It breaks the hull/seed coat and results in an end product of coarsely ground grain sometimes referred to as flaking. Cattle seem to prefer flaked grain to finely ground grain and are usually better for it.
3. *Popping*: Most readers are familiar with popped corn which is produced by the action of rapid application of dry heat, causing a sudden expansion of the grain which ruptures the endosperm. For increasing digestibility, all grains may be processed by this method, but it appears that is especially effective in processing sorghum or other Milo grains. Popped Milo requires more storage space due to its light density.
4. *Extruding*: Extruding usually involves grinding the grain, followed by heating with steam in order to soften it. The softened steamed ground grain is then forced through a machine with a spiral screw which expels the grain through a tapered head to produce a ribbon like product. Extruding animal feeds is generally confined to pet foods.
5. *Micronising*: Micronising is essentially the same as popping, except that heat is provided in the form of infrared energy.
6. *Roasting*: Roasting is accomplished by passing the grain through a flame or heating it to the desired temperature for a period of time, resulting in some expansion of the grain, which produces a palatable product. The method may be used on soya bean to destroy heat labile inhibitors and thus improve its nutritive value for poultry and swine.
7. *Pelletizing*: Pelletizing is accomplished by grinding the material and then forcing it through openings by a mechanical process. Feedstuff usually is, but not always, steamed to some extent prior to pelletizing. Pellets can be made into small chunks, or cylinders of different diameters, length and degree of hardness. The advantages of pelletizing feeds are follows:

- Feeds to be pelletized are usually ground first - the pellets so formed being appreciated by the consumer.
- Pelletizing feed to a free flowing form facilitates its handling and use in a self feeder.
- Pelletizing feeds are usually less dusty and more palatable.
- Pelletizing feed reduces storage space requirement.

However, the disadvantage of pelletizing feed is that the process involves about 10 % more cost than non-pelletized concentrates.

8. *Dehulling*: This is the process of removing the outer coat of grains, nuts and some fruits as the hulls

are high fibres and low in digestibility in swine, poultry and other monogastric animals. Today, hulls are combined with other residues from the milling of cereal grains and are marketed as by-products. The protein contents of such un-hulled (un-decorticated) oilseeds such as soya bean, cottonseeds, groundnuts, sunflowers and safflowers are relatively low.

Wet processing

1. Soaking: Hard grains soaked for 12 or 24 hours in water is a practice long in use by livestock feeders for feeding sore mouthed ruminants. Benefits are also obtained by soaking cassava and cassava by-products in water and thereby alleviating toxicity factors like hydrogen cyanide (HCN).

2. Steam rotting: Rolling refers to a process by which grains are compressed into flat particles by passing them between rollers. Steam rolling is also called crimping, and steam crimping refers to exposing grain to steam for a short period of time, usually one to eight minutes, followed by rolling. The steam softens the kernel, producing a more intact, crimped-appearing product than that produced by dry rolling. Steam rolling offers little or no advantage in feed efficiency over grinding or dry rolling. However, the product may be useful for very young animals before their teeth are fully developed or for very old animals with worn out teeth.

3. Steam flaking: Steam flaking grains are prepared in a similar manner but with relatively rigid quality controls. Grains are subjected to high moisture steam for sufficient time to raise the water content 18 to 20 % and the grains then rolled to produce a rather flat flake. Thin flakes are better as they allow more efficient rupture of starch granules whereby a more desirable texture is produced.

4. Pressure cooking: The product is very similar to steam processed flaked grain. In the case of pressure cooking, the grain is subjected to steam under pressure for a short time, such as 50 psi (pounds per square inch) for one to two minutes. Steam is injected into the cooker till the grain in the chamber reaches a temperature approaching 300°F. The grain is then expelled from the cooker at a temperature below 2000F and with 20 per cent moisture these are flaked. In comparison with steam flaking, flakes produced by pressure are less brittle.

5. Exploding: Exploding is the swelling of grain, produced by steaming under pressure followed by releasing to the air. Steam is injected into high-tensile strength steel 'bottles' to raise pressure to 250 psi. After about 20 seconds, a valve opens to let the grains escape as expanded balls with the hulls removed. Under high pressure, moisture is forced into the kernels, which when released into the air swell to several times the original size.

6. Reconstitution: Reconstituted grain is mature grain that is harvested at the normal moisture level of 10 to 14 %, following which water is added to increase the moisture level 25 to 30 %. The wet product is then stored in an upright silo (for required compaction) for 15 to 21 days prior to feeding. The grains are rolled and ground at the time of removal.

7. *Ensiling at high moisture content*: High moisture grain refers to grain harvested at a moisture level of 0 to 35 % and stored without drying in a silo. It may be ground before ensiling or ground and rolled and stored in either of the two ways.

a. It may be ensiled (fermented) in an oxygen limiting (anaerobic type) silo.

b. It may be preserved by the addition of 1 to 1.5 % propionic acid or a mixture of propionic acid with either acetic or formic acid to inhibit mould during storage. This is a particularly useful procedure when weather conditions do not allow normal drying in the field and it obviates the need to dry the grain artificially.

Roughage:

The preparation of forages normally does not increase the nutritive value of the initial product. In preparing roughages, avoid processing those with high moisture, which may lead to spontaneous combustion, and those in which there are foreign materials (wire, nails, etc).

Physical methods

Wet methods

1. *Green-chopping*: This refers to converting the green crop residues into 1 to 4 cm length pieces by chaff cutters. The main advantage is that it offers the possibility of mixing-in poor quality roughages. The chopped green materials will mask the unpalatable effects of the poor quality roughages.

2. *Soaking*: This method is not considered to be practical except possibly with chopped straw.

3. *Steam processing*: The steam treatment of forage, particularly of low quality roughages like bagasse, has been reported to cause increased voluntary intake and higher digestibility in cattle. Chemical studies indicated extensive degradation of cellulose and hemicellulose and the production of undesirable poly-phenolic compounds when bagasse was steam processed. Apart from this, the method involves extra expenditure.

Dry methods

1. *Baling*: Baling is probably the most common method used in developed countries to harvest roughage. Forage is cut and allowed to dry in the field. In areas of high humidity, a hay conditioner may be used as the hay is cut. For proper baling the moisture level must be sufficiently low (14 to 20 per cent) at the time of baling. Since bales are packages or bundles of convenient sizes of dry roughages, these may be of square or round type. Round bales, however, will shed rain and thus may be left in the field for extended periods without serious damage to the hay. Bales vary in size from about 20 to 120kg. In undeveloped and developing countries, the use of any sort of machine will be a costly affair. Moreover the baling machines will have to be imported.

2. *Grinding hays and straw*: It is not necessary to grind good quality hay to realize its effective use. Grinding coarse, stemmy hays will encourage total

consumption by livestock but will not improve their digestibility. However, for making the complete ration for livestock, the entire hay must be ground. The coarser the hay that is ground, the more it will retain its bulk value.

3. *Pelletizing of roughages*: Hay and straw must be ground prior to pelletizing. Thus, pelletizing takes care of most of the disadvantages of grinding. The method reduces the space requirement for storage by as much as 75 %. Pellêtizing of hay and straws increases consumption and performances in beef cattle. It also reduces dustiness. The process when applied to roughages will cost twice as much as pelletizing concentrates. Pelletized high quality roughages will produce performance (gain in weight) in young cattle or lambs almost comparable to high grain feeding.

4. *Cubing*: Cubes are nothing more than large pellets. These may be of square or round shape having the diameters and length between 2 to 3 inches and 1 to 4 inches respectively. Grinding before cubing is not required, but usually water is sprayed on the dry hay and straw as they are cubed. Although cubes have an advantage, as they can be fed on the ground in clean pastures and no troughs are needed, it is difficult to detect (visually) low quality roughages in them, and besides the method is costly.

5. *Drying of roughages*: Drying entails removal of excess moisture from green crop residues (14 to 15 %) either by natural or by artificial heat. In tropical countries, sun drying is the only feasible method. However, in some developed countries where sunshine is not plentiful, artificial drying is used. This involves a process, in which forage is cut by a hay chopper or silage cutter immediately after harvest and dried in large drum driers of different sizes. The process is helpful to ensure utilization of green forages during periods of scarcity. Large amounts of fodders can be stored in a comparatively smaller storage spaces. However, there are usually losses of some of the leaves and other finer and more nutritious parts while drying is taking place. Also more energy is required by the animals to chew dry hay and have it pass through the digestive tract than with green forages.

6. *Irradiation*: Improvement in the digestibility of wheat straw by high voltage X-rays has been found to be due to breaking of cellulose and hemicellulose bonds, resulting in the formation of oligosaccharides, which can be utilized by rumen organisms. Forage lignin on the other hand resists irradiation. Upon irradiation, ergosterol, a plant sterol, yields calciferols, commonly known as vitamin D_2. The method involves high cost and technology.

Chemical methods

1. *Alkali treatment*: Treating straw with alkali can give a product of considerable nutritive value. It reduces the strength of the intermolecular hydrogen bonds which bind the cellulose fibres without affecting much of the cell wall. It has been suggested that alkali saponifies uronic acid and acetic acid esters. This would perhaps

account for the solubilisation of silica and hemicelluloses.

The usual method requires large quantities of water and is impracticable in areas where water supplies are limited. The process consists of soaking the straw in 10 times its weight of 1.5 % Sodium hydroxide solution for about 24 hours. The liquid is then drained off and can be used for succeeding batches of straw. The straw is washed after treatment until freed from the alkali. Unfortunately the total yield of the organic matter is reduced due to heavy leaching of 20 % organic matter. To eliminate leaching losses, low concentration of alkali sprayed on the chopped straw should be used (4 kg NaOH/160kg of straw). In this method only 30 % of water is used when compared to the earlier method, but there remains a high amount of residual alkali in the straw.

2. *Ammonia treatment*: Treatment of straw with anhydrous ammonia will add nitrogen to the straw which can be used by rumen microorganisms. The ammoniation of straw will improve significantly the degradability of its fibrous constituents which will result in the production of more energy in the form of volatile fatty acids (VFAs). The crude protein content of rice straw has been shown to increase from 2.71 to 8.85 % on 3 % ammonia treatment along with an increase of degradability of cellulose from 48 to 60 %. The ammonia method requires that a stack of straw be covered so that the ammonia does not escape.

3. *Lime Treatment*: Calcium hydroxide generated from lime may prove to be the cheapest alkali available for the effective treatment of coarse roughages. Both wet and dry methods of treatment have been used. In the wet method, 1.25 % of commercial grade lime is used and straw is soaked in the lime solution for several days. The digestibility has been shown to increase by 24 to 30 %. In the dry method, 4 % lime is dusted on moist straw and stacked for reaction. The higher concentration of lime in the dry method is used to compensate the slow reaction and low solubility of lime.

4. *Urea-generated ammonia treatment*: Although scientifically very sound, the method of treatment of straw with anhydrous or liquid ammonia directly is full of practical difficulties particularly the handling problems at farmers' level. A more practical approach is storing urea treated (3 to 5 %) straw for about four weeks to allow the release of ammonia of which attacks the ligno -cellulosic bonds in a similar manner as anhydrous or aqueous ammonia does in the direct treatment. It has been reported that such urea-treated straw was as good as the green sorghum and could support a growth rate of 300 g/day in cross, breed heifers with only 1 kg/day of concentrates. It has been further reported that the replacement of untreated straw with urea-treated stacked straw in diets consisting of elephant grass-maize straw resulted in an increase of 2 to 3 litres of milk/day in cross breed cows, despite a decrease in the daily allowance of concentrate.

5. *Urine treatment*: Animal urine can also be used as a source of urea which can generate ammonia to have a similar effect on improving the degradability of fibrous constituents of coarse fodders. Although urine treatment can also have an added advantage of minerals like calcium and phosphorus to some extent, it adds a very small amount of urea in relation to water content. If the moisture in the treated straw has to be kept at a low level, urine should be essentially fortified with urea to have optimum results.

6. *Addition of urea to dry roughages*: Addition of urea molasses to straw has become popular for increasing nutritive value. A solution of 10 kg molasses and 2 kg urea in 10 kg of water is spread by a sprayer on straws in 100 kg lots and spread evenly under the sun over an area of 20x20 ft. The treated straws can form maintenance ration when supplied along with proper amount of 2 % mineral and 1 % salt and vitamin A and D_3 mixture.

7. *Urea mixed with silage*: Another way of feeding urea to cattle, especially dairy is through the addition of urea to crops which is being ensiled. If chopped, the whole maize plant is ensiled at 35 to 40 % dry matter. Urea is then added at a level of 0.5 % of wet material.

Biological treatments

Use of selected bacterial and fungal culture in roughages has been considered during the past few years to increase the nutritive value of roughages over chemical treatments. Since plant residues constitute a good quantity of cellulosic materials including cellulose, hemicellulose and lignin, the biological treatment causes simplification of these compounds by releasing appropriate enzymes from microbes so that the materials ultimately become easily digestible upon intake by ruminants. The fast growth rate of these microbes results in enriching the roughages in protein values also.

REFERENCES

Ensminger, M. E. (1971). *Poultry Science.* Interstate Printer and Publishers, Danville, Illinois.

Oluyemi, J. A. and Roberts, A. A. (1979). *Poultry Production in the Warm Wet Climate.* Macmillan Press, London.

Williamson, G. and Payne, W. 1. A. (1984). An *Introduction to Animal Husbandry* in the Tropics. ELBS, Longman.

5

CROP PROTECTION, PESTICIDE APPLICATION AND SAFETY TIPS FOR PEST MANAGEMENT

Adebayo A. Omoloye

Introduction

The agricultural enterprise is constrained by biotic and abiotic factors of the environment. The factors, biotic (otherwise called pests) and the abiotic, adversely affect total productivity of crops. Protection is a vital component of the crop production business. Generally, pests' attack alongside a shortage of all or some components of the abiotic factors like the climate, physiographic and soil (edaphic) characteristics can cause total crop failure. The importance of crop protection is paramount to the extent that if all efforts were made at ensuring very good site selection and land preparation, planting of healthy seeds, optimum environmental conditions and general farm maintenance without protection measure would be an exercise in futility. This is because the menace of pests can upturn an expected bumper yield. Such pest challenges often require the application of a pest control measure. There are several methods used in pest management such as biological, cultural, mechanical and chemical methods but the most popular and most abused is the chemical method through the use of pesticides (Omoloye, 2009). The purpose of this lecture is to guide users of pesticides and all who may use or come into direct or indirect contact with pesticides on safe application as they affect production and storage of crops.

Pest and Pesticides

A pest is any biological factor in nature, which possesses and expresses noxious attributes that interfere with or affect man and/or his interest (such as his crops and animals) negatively within a given period or circumstance which result in economic damage (Omoloye, 2008). A pest, therefore, may be a plant (otherwise called weed), animals or group of animals such as invertebrates (insects, nematodes, mollusks) or vertebrates (rodents, monkeys; reptiles, birds) and pathogens (fungi, bacteria and viruses). Attacks by pests always warrant the application of protection measures. Needful to state that application of control measure does not increase yield physically but it helps crops to produce at their maximum potential. Therefore, in order to ensure

protection of crops against pests in the field and in store, man has learnt over the years to apply agricultural chemicals (agro-chemicals) otherwise called Pesticides (Omoloye, 2008; 2009).

Use of Pesticides for Pest Management

The application of pesticides in the field or store to bring down damaging pest population to levels at which they cannot cause economic damage is described as chemical control. When a pesticide is applied, many other organisms are affected too. Pesticides are toxic chemical substances or poisons that are applied deliberately to kill or reduce pest population and they are the chief weapon used by man to control pests. Pesticides have been abused greatly and there had been adverse effects from this abuse. Different kinds of hazard and degradation have been caused in the environment and this is why it is important for everyone to know.

Problems Associated with Pesticide Usage

Heavy dependence on pesticides has resulted in the following problems in the Environment:

Pest resistance to insecticide- this is the ability of the pest to survive and adapt to the pesticide after continuous or repeated usage of the same or different pesticides to treat the pest. This creates a situation in which the pesticide is no longer able to control the pest.

Pest resurgence – this is a condition in which the pest develops and re-infests the crop after treatment. This results from ineffective application of a pesticide or wrong dosage application.

Deleterious effects on non-target organisms – this is the lethal effects of the pesticides on other organisms, especially the beneficial organisms such as predators and parasitoids in the environment.

Problems of secondary pest outbreak – this is the condition in which innocuous pests, those which were not pests before but had the potential to become one suddenly become a serious problem. This occurs when the natural enemies of such secondary pest have been removed and they are now free to cause problem.

Food contamination and poisoning – this is a major problem created when pesticides comes into direct contact with food items served to man or livestock. This usually occurs as result of poor handling of pesticides.

Direct toxicity to man and livestock – During application, some pesticides spill and pour on the person applying the pesticides. Sometimes some livestock graze on treated forage.

What is an ideal pesticide?

An ideal pesticide should possess most or all of the following qualities. It must be:

- ***Relatively persistent*** to stay at the place of application throughout its active period;
- ***Toxic to the particular or target pest*** but harmless to other non-target organisms including man;
- ***Easy to use*** or ***handle*** in terms of mode of application; and

- ***Biodegradable into harmless product in the environment*** within a reasonable time and must be cheap to produce.

Composition of an Insecticide

Pesticides are made up of two principal components- the *technical grade materials* and the *Carrier*. The technical grade material consists of the active chemical substance that forms the active principle of the pesticide. The carrier is usually an inert material which serves to ensure preservation of the effectiveness and safe handling of the pesticide. Pesticides are formulated in a way to ensure safe handling. All pesticides are marketed as formulated products. Thus, a formulated product consists of an active ingredient (a.i.) that has been proportionately combined with other materials to produce a product that is useable upon dilution to the field strength; stable in the environment over specific period and safe for application.

Pesticides Toxicity to Man and Livestock

Pesticides are toxic materials that we use for our benefits but they must be used and handled with great care. A lot of damage can result from pesticide abuse or misuse. The toxicity of a particular pesticide depends on its **chemical nature, target organisms and mode of application**. Pesticide toxicity may be described in two ways based on the timing of its effectives and effects on the applicator as follows.

Chronic Toxicity is the effect on humans; of small non-lethal doses of the pesticide received over a long time, which often result in cancer, brain, liver or kidney damage.

Acute toxicity is the immediate toxic effect or poisoning that results from a single dose of the toxicant often resulting in nausea, nervous symptoms and eventually, death.

Measures of Pesticide Toxicity

The Acute Toxicity of a pesticide is usually measured in terms of is Lethal Dosage (LD_{50}) value. The LD_{50} is the amount of the toxicant that is required to kill half of a randomly selected population of the test animals such as rats. The unit of measuring LD_{50} is milligrammes per kilogramme body weight (mg/kg) of the test animal. To ensure safety, the LD_{50} a value of any pesticide is always quoted either on the pesticide label along with a description of the method of application or on the pesticide *container.*

Pesticide Formulation

The mode of application of a pesticide depends on its formulation whether as liquid (spray) or solid (powder or dust or granules). The formulated product is the form in which a pesticide product is sold to the farmer.

Table 1: Common examples of pesticide formulations

Solid or Dry formulations	Sprayable or Wet formulations
Dusts, e.g. Actellic 2%D[R],	*Emulsifiable Concentrate,* e.g. Actellic 25 E.C[R]
Granules, e.g Furadan 5G, Wormforce *3G*	*Soluble Concentrate in* Water, e.g. Nuvacron 40SCW[R]etc.
Wettable Powder, e.g. Dimilin 25% W.P.[R],	
Fumigants, e.g. Phostoxin, Quickphos	

General Classification of Pesticides

Pesticides are classified in different ways as follows. They may be classified on the basis of:

- **Target organisms to control**: For example, insecticides are used for the control of insects, nematicides for control of nematodes, rodenticides for control of rodents, herbicides for control of weeds or herbs, fungicides for control of fungal pathogens, etc.
- **Origin of the pesticide,** e.g. natural (botanical) or synthetic pesticides.
- **Chemical nature of the pesticide** such as or-ganic or inorganic pesticides.
- **Intended use,** e.g. Selective and non- selective or broad spectrum pesticides, pre-emergence, emergence and post emergence pesticides
- **Level of hazard to the person** who is applying the pesticide, e.g. extremely, highly, moderately or slightly toxic.
- **Mode of application**, e.g. stomach poison, fumigant, contact or attractant.

Classification of Pesticide Toxicity on the basis of mode of Entry into man

The type of pesticide formulation determines whether the pesticide will be hazardous to humans or livestock by oral, dermal or inhalation toxicity.

Oral toxicity occurs in man or livestock when exposure to the pesticide is through the mouth. This is found usually in pesticides that have been applied as stomach poison for leaf feeding insects. Therefore, do not eat or drink during or immediately after application of a pesticide without first cleaning up thoroughly. Do not even chew kola nut or chewing gum.

Dermal toxicity occurs in man or livestock when exposure is through the skin. This problem is higher when applying insecticides that are active by contact such as Gamalin 20[R], Apron plus[R], Nuvacron 40SCW[R] among others. Always wear safety devices such as gloves, protective clothing and boots during applications of such pesticides.

Inhalation toxicity occurs in man or livestock when exposure is through the respiratory channel. This problem is aggravated when applying aerosols such as Shelltox[R], Raid[R], Baygon[R], among others; fumigants, e.g. Quick-phos[R], Phostoxin[R], and dusts such as AIdrex T[R], and Femansan D[R]. Therefore wear or put on safety devices such as gloves, face and nose masks during application of such pesticides.

Table 2: Classification and LD_{50} (mg/kg) thresholds of oral and dermal toxicity

Class	Toxicity	Oral Toxicity		Dermal Toxicity	
		Solid	Liquid	Solid	Liquid
A	Extremely toxic	<5	>20	<10	<40
B	Highly toxic	5-50	20-200	10-100	40-400
C	Moderately toxic	50-500	200-2000	100-1000	400-4000
D	Slightly toxic	>500	>5000	>1000	>4000

Different types of pesticide based on mode of action in the target organism

There are different types of pesticides based on their mode of action in the target organism as follows:

Stomach poison: This type of pesticide is required to be swallowed by the target pest. They are usually applied on leaf surface as sprays or baits for rodents. An example is *Klerat* for rats.

Contact insecticide: These are chemicals that are absorbed through the cuticle or spiracle of the target pest to be active and effective. An example is Endosulfan.

Systemic insecticides: These are applied on plants and translocated to the plant parts such that any pest that feed on the plant parts is poisoned. These are particularly useful for control of sucking insects or internal stem feeders or stem borers. An example is Cabofuran (Furadan).

Fumigants: These are chemicals that are volatile at ordinary room temperature but give off poisonous vapor that are toxic to the target pest. They could be in solid phase or other forms, e.g. Phostoxin tablets, Quick-phos (Solids) or Methyl bromide (Liquid), etc. Fumigation is usually done in warehouses, cargo planes, food stores, etc.

Repellents: These are chemicals that are volatile whose vapour drives or keeps away insects primarily by their actions on the olfactory senses of the insects. An example is *Odomus.*

Attractants: These are chemical stimuli released into the environment that cause the target pest to move

towards the chemical source or another killing agent. These volatile chemical stimuli could be natural or synthetic in origin. An example is *Trimedlure*

Pesticide Application and Equipment

Depending on the type of formulation, insecticides are applied with specially made equipment (Matthews, 1982). Notably, pesticide formulations for household application always come in handy, easy to use equipment. For instance, aerosols such as Raid[R], Sheltox[R] and Baygon[R] come in handy sprayers. Similarly, powdered formulations always come in plastic containers with pointed tip to control discharge of the content to the target area such as *Pif-paf*[R], and permethrin powder, while dust formulations usually come in sachets such as Aldrex T[R] and Apron plus[R], or in plastic or metal cans such as Actellic 2% Dust[R]. However, for field applications, spray application requires the most specialized types of equipment and they are classified according to the amount of liquid applied (l/ha) to the crop as follows:

- High volume (>600) : These are otherwise called boom sprays,
- Medium volume (200-600),
- Low volume (5-200),
- Ultra low volume (ULV) (<5).

Types of sprayer

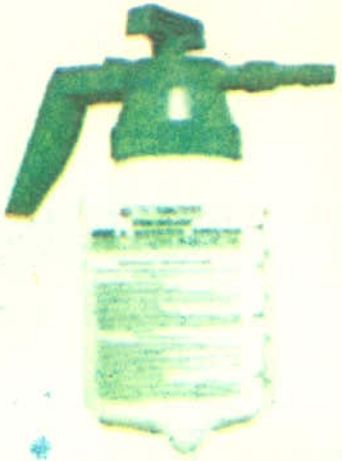
There are different types of sprayer that are commonly used for small-scale farming. Sprayers that are used for large volume sprays which release large molecules of spray particles are called **boom sprayers** while those that release tiny molecules of spray particles are called **Mist sprayers**. An example of Boom sprayer is the knapsack sprayer while an example of the Mist Sprayer is the Ultra low volume sprayer and the Electrodyne sprayer as described below.

I. Knapsack sprayers. These have been improved greatly and can be distinguished into the manual and the motorized knapsack sprayers.

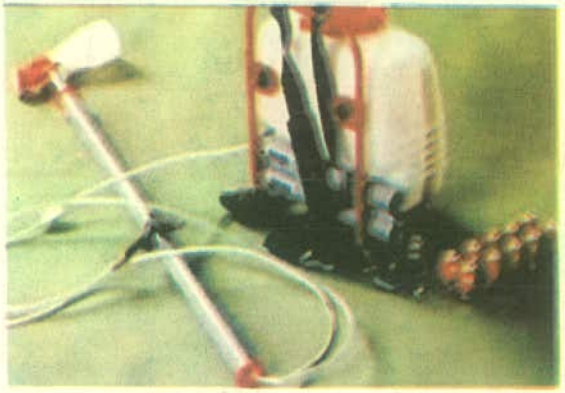
a. A manual knapsack sprayer

b. A motorized knapsack sprayer

2. **Simple Hand Sprayers.** These are usually hand held commonly used for garden sprays



2. **Ultra Low Volume sprayer.** These have also become improved as they come in different shapes and sizes. They are otherwise called mist blowers.



Safety Precautions Guiding Pesticide Application

It is important to ensure that appropriate safety precautions are observed before, during and after pesticide application. This is needful so that the applicator, bystanders, and the surrounding environment are protected from harm. Note that each pesticide is unique with different mode of action and, therefore, can affect people and the environment differently. Some pesticides pose more hazards than others and so it is important to always check the label to see if there is any special precaution needed to be observed for the pesticide being applied.

Before applying a pesticide:

1. Always read the label first and follow the directions to the letter, including all precautions and restrictions.
2. Don't use products for pests that are not indicated on the label.
3. Don't used expired or adulterated pesticide; buy from reputable dealers.
4. Don't use more pesticide than is indicated or directed by the label for the pest. Don't think that twice the amount will do twice the job.
5. If you hire a commercial applicator or pest control outfit, ask for information about potential risks and safety precautions to take.
6. Identify any nearby sensitive areas or items that can be damaged or affected such as crops or livestock or other animals in adjacent fields, streams or other

nearby water bodies, adjacent vegetation, adjacent fields with workers, schools, hospitals, or houses, bus stops, especially where children wait for the school bus, yards with toys, pet dishes, laundry or even roadways and sidewalks, trails, or walkways

7. Don't assume you know how to apply the pesticide, read and follow label directions as details on pesticides labels are easily forgotten and often change. Look out for special precautions to protect applicators and sensitive areas.
8. Cover or remove animal food and water containers near the treatment area.
9. Tell someone on the farm, what pesticides you are applying, where you are working, and when you will return. Ask them to contact you if you do not report back.
10. Make sure the area to be treated is clear of people and animals.
11. Do not drink alcoholic beverages before working with pesticides.
12. If hiring a pest control company, make sure the applicator has a valid pesticide applicator certificate and the company has a valid Pest Control Service License.

During application:

1. Put on protective measures when handling pesticides as directed by the label, such as wearing impermeable gloves, long pants, and long-sleeve shirts. Generally it is expected that the applicator must wear boot, overall coat, nose masks, eye goggles and gloves.
2. Don't spray outdoors on windy or rainy days. Take precautions to keep the pesticide from drifting or running off into the vegetable garden, fish pond or pool.
3. Remove totally or cover all food items during indoor applications including when using aerosols like Raid, Sheltox or Baygon.
4. Use the appropriate pesticide dosage as prescribed on the pesticide label. Increasing the application rate may leave high residues on the crop or it may harm the crop. However, decreasing the rate may result in poor pest control or it may contribute to the development of pesticide resistance.
5. Use application equipment that is calibrated, properly maintained, and adjusted for the crop being treated. Don't use damaged or leaking qquipment
6. Use separate equipment for applying herbicides and insecticides. For example, Herbicide residues left in the sprayer may kill plants to be protected if the the same sprayer is used.
7. Wear gloves when you are to replace or clean plugged nozzles. Do not blowout a plugged nozzle or screen with your mouth. Use a soft brush or toothpick.
8. Spray when human activity nearby is unlikely. For example, do not spray near a school while children are on the grounds.
9. Do not work alone when handling very toxic pesticides.

10. Avoid eating, drinking and touching your face during pesticide application.
11. Wash before eating, drinking or using the toilet.
12. Have fresh water readily available in case of emergencies.
13. Prevent pesticides from contaminating non-target areas. Leave a buffer zone or untreated area around lakes, streams, ditches and wells.
14. Spray when the wind is blowing away from sensitive areas. Prevent or minimize drift as much as possible (Box 1).
15. Ensure that the pesticides for chemigation are registered before they are applied through irrigation systems. Also, the pesticide label must have specific instructions for chemigation and this should be followed strictly during application.

Box 1: Ways to minimize pesticide drift

Pesticide drift can be minimized by:

- Spraying only when winds are less than 5-8 km/hr. There is usually less wind in the early morning and late evening.
- Not spraying when temperatures are greater than 30C.
- Using boom sprayers with as low pressure as possible, the correct nozzles, large volumes of water, and setting the boom near to the ground as possible to still get uniform coverage.
- Using a drift control agent.
- Using drift guard or other specialty nozzles that reduce drift.
- Using a shrouded sprayer.

After application:

1. It is important to observe personal hygiene and carefully carry out the pesticide application process, ensuring that there are no accidental spills or discharge nor undue exposure to fumes especially during opening or closing the pesticide can or canister or container.
2. Remove the protective wears carefully; clean yourself, the personal protective equipment, and sprayer.
3. Change clothes and wash your hands immediately after applying pesticides.
4. Wash yourself after application and before eating or drinking anything or using the toilet.
5. Mount or Paste post spraying warning signs to keep people out of treated areas.
6. Do not wade through treated farms; wait till the required restricted entry interval before entering the treated area.
7. Only allow people with the proper protective clothing into treated areas during the restricted

entry intervals.

8. More importantly, wait and ensure that the required pre-harvest interval is past before harvesting the crop. Thus is to prevent pesticide poisoning from the treated crop.

General First -Aid Guidelines in Case of Accidents with Pesticides

The following are guidelines to follow in case of accidental splashes or spills of pesticides (Plestine, 1986). If the problem is indicated as:

- **Swallowed poison.** Induce vomiting but this depends **ONLY if the emergency personnel on the phone tells you to do so.** This will depend on what type of pesticide has been swallowed.

- **Poison in eye.** Eye damage can occur, within minutes with some types of pesticide. If pesticide splashes into an eye, hold the eyelid open and wash quickly and gently with clean, running water from the tap or a gentle stream from a hose for at least 15 minutes. Do not use eye drops or place chemicals or drugs in the wash water.

- **Poison on skin.** If pesticide spills or splashes on the skin, drench area with water and remove the contaminated clothing. Wash the affected part of the skin and hair thoroughly with soap and water. Later, discard contaminated clothing or thoroughly wash it separately from other laundry.

- **Inhaled poison.** Carry or drag the victim to fresh air immediately. If you are unable to get to the victim because of fumes, immediately contact the Fire Department. Loosen victim's tight clothing. If the victim has stopped breathing, give artificial respiration (if you know how) and call rescue service for help. Open doors and windows so no one else will be poisoned by fumes.

Pesticide Application and Pest Damage

An organism does not constitute a pest unless it occurs in such a relatively large population that will cause economic damage. This implies that a single organism such as a housefly or cockroach is not a pest until such a time when its population has risen to the point of damaging the yield of crop. Economic damage is defined as the amount of damage done to a crop either in the field or store that will justify the cost of artificial control measures such as pesticide.

Selected Pests of Crops and their Chemical Control in the Field or Store

The growth of crops in the field can be categorized into different phenological stages such as vegetative, flowering podding and harvesting. Specific pests attack each of these stages and more than one insect may attack one stage. Of those that may attack a stage, however, some are particularly more common than others, occurring frequently and causing more damage to the crop. These commonly occurring and persistent pests are called major pests and they form the focus of

attention for control. Examples of such majors pests are presented for selected crops in table 2 (Cowpea), table 3 (maize) and table 4 (cassava) below (Schwab et al., 1995; Ekpo and Omoloye, 2003).

Table 2: Chemical Control of Pests of Cowpea, Vigna unguiculata

Phonological stage of crop	**pests**	**Damage symptoms**	**Control**
1. Pre-flowering stage	Nematodes, e.g. *Meloidogyne* sp.	Stunted growth, diseased plant,	Systemic pesticide, e.g. carbofuran
	Aphids-*Aphis craccivora,* Leaf hoppers-*Empoasca dochili,* Foliage beetles-*Ootheca Mutabilis*	Stunted growth, Hopper burn Defoliation by adult beetle	Periodic spray 3-4 times with any of the following insecticides. Monocrotophos, e.g. Nuvacron 40SCW^{R}, Cypermethrin (Cymbush^{R}), Dimethoate (Rogor^{R}), Sherper plus^{R}. To get very good results, use resistant varieties as planting materials.
2.Flowering stage	Flower thrips- *Megalurothips sjostedti,* pod borer-Maruca vitrata	Flower abortion and dropping, Webbing of pods and creating holes	
3. Podding stage	Pod sucking bugs-*Clavigralla tomentosicollis, Anoplocnemis curvipes, Riptotus dentipes,* Seed beetle, *Callosobruchus maculates*	Pod constriction, Shrivelling of pods and Seed wrinkling, Carved exit holes on seeds	

Table 3: Chemical Control of Pests of Cassava, Manihot esculenta

Phenological stage of crop	*Insect pests*	*Damage symptoms*	Control
Vegetative stage	Grasshopper- Zonocerus *variesgatus, Cassava* mealybug- *Phenacoccus manihoti,* Green spider mite- *Mononychellus tanajoa*	Defoliation Bunchy top/Candle stick appearance Chlorosis and reduced younger leaves	Use of insecticides such as rogor, monocrotophos to stem cuttings at planting to control mealy bugs and mites

Table 4: Chemical Control of Pests of Maize, Zea mays

Phonological stage of crop	*Insect pests*	*Demage symptoms*	Control
Vegetative stage	Stem borers- *Busseola fusca, Sessamia calamistis,* Corn ear worm-Helicover- *pa sea, Mussidia nigrivenella Armyworm,* *Spodoptera exempta* Field to store pest- *Sitophilus zeam*	Window pane effects and dead heart Holes in maturing seeds Webbed together, Sporadic defoliation Holes in dry seeds	Spray with systemic foliar insecticides or apply systemic granular insecticide, e.g. Carbofuran to foliage insects and stem borers respectively.

Note that most soil pests such as nematodes; stem borers and other sucking insects like aphids and whiteflies are controlled by application of nematicides and systemic insecticides like granular cabofuran (*Furadan*^{R} and *Wormforce*^{R}).

Conclusion

No doubt, chemical pesticides are quick acting and usually very effective; nonetheless, they cause serious damage to the ecosystem. Chemical pesticides are toxic and potentially dangerous. Efforts, therefore, should be made to deliberately reduce the use and reliance on chemical pesticides. Natural pesticides are biologically active compounds; usually of plant origin that are used for pest control. They constitute fewer problems to the agroecosystem because they are easily biodegradable; leaving no toxic residues in the environment after application. They are also relatively affordable, adjudged safe and easily adoptable by farmers and housewives. Examples of plants that have been found useful as botanical pesticides include the neem plant, *Azordirachla indica, Piper guineense* and pepper *Capsicum sp*.

REFERENCES

Ekpo, J. A. and Omoloye A.A. (2003). *Principles and Practice of Plant Protection.* Ibadan. Distance Learning Centre. University of Ibadan, Nigeria. 136pp.

Kumar, R. (1984). *Insect Pest Control with Special Reference to African Agriculture.* London: Edward Arnold 298pp.

Matthews, G.A. (1982). *Pesticide Application Methods.* London: Longman. 336p.

Omoloye, A. A. (2008). *Fundamentals of Insect Pest Management.* Corporate Publishers: Lagos. Nigeria. 256pp.

Omoloye, A. A. (2009). *Insect Pest Management: Strategies and Methods.* Corporate Publishers: Lagos. Nigeria. 196pp.

Omoloye, A. A. and Fadina O. O. (2003). *Introduction to Plant Protection.* Ibadan. Distance Learning Centre. University of Ibadan, Nigeria. 125pp.

Plestine, R. (1986). *Prevention, Diagnosis and Treatment of Insecticide Poisoning.* Geneva: WHO, VBC/84.889.

Schwab, A; Jager-Mischke, I; Stoll. G.; Gorgen, R. and Prexler Schwab, A. (1995). *Pesticide in Tropical Agriculture: Hazards And Alternatives.* CTA, Margraf. PAN. 282pp.

Youdeowei, A. and Fadare, T.A. 1975. *Pesticide Usage in Nigeria.* Entomological Society of Nigeria; Occasional Publication No. 17. 99pp.

6

FISHERY MANAGEMENT

Bamidele Oluwarotimi Omitoyin and Adetola Jenyo-Oni

Fishery management is the rational exploitation of aquatic resources in such a way that they are maintained on a sustainable yield basis. Generally, a **fishery** is an entity engaged in raising or harvesting fish. According to the FAO, a fishery is typically defined in terms of the "people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, and purpose of the activities or a combination of the foregoing features".

Fisheries management draws on fisheries science in order to find ways to protect fishery resources so sustainable exploitation is possible. Modern fisheries management is often referred to as a governmental system of appropriate management rules based on defined objectives and a mix of management means to implement the rules, which are put in place by a system of monitoring control and surveillance. According to the FAO, there are "no clear and generally accepted definitions of fisheries management" However, the working definition used by the FAO and much quoted elsewhere is: *The integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives.*

Managing fisheries is about managing people and businesses, and not about managing fish. Fish populations are managed by regulating the actions of people (Hilborn, 2007).

Importance of Fishery to the Nigeria Economy

- It provides the cheapest source of animal protein for Nigerians.
- It provides employment opportunities for those who engage in some aspects of fisheries activities.
- It provides sources of foreign exchange earnings to the country through exploitation of fish and fish products.
- It provides opportunity for recreation (i.e. sport fishing) and raw materials for food manufacturing and livestock industries.

Fish Production in Nigeria

The sources of fish production in Nigeria can be broadly divided into capture and culture fisheries.

i. Capture Fishery

This is the catching of fish from open water. It is more of hunting than stock raising. This sector can be divided into Artisanal fishery, which includes coastal and brackish water fishery; and Industrial fishery, which includes onshore and offshore fishery.

ii. Culture Fishery

This is the rearing of aquatic organism in controlled or semi-controlled environment. It is more of stock raising than fish hunting. Another name for culture fishery is aquaculture, which is the rational rearing of fish including notably, the control of growth and breeding.

Types of Aquatic Environment

Nigeria is blessed with three types of aquatic environments and these are marine, brackish and freshwater. The distinguishing factor between these aquatic environments is their level of salinity (saltiness). In marine environment, salinity is greater or equal to 35 parts per thousand (examples are sea and ocean). Marine ecosystems cover approximately 71% of the Earth's surface and contain approximately 97% of the planet's water. Brackish water salinity is between 1 - 34 parts per thousand (examples are estuaries and lagoon), while freshwater environment salinity is less than 1 part per thousand (examples are lakes, rivers, streams and springs). Freshwater ecosystems cover 0.80% of the Earth's surface and inhabit 0.009% of its total water. They generate nearly 3% of its net primary production. Freshwater ecosystems contain 41% of the world's known fish species.

Culture system

Fish culture permits the supervision and regulation of reproduction, feeding, quantitative growth and control of the size of the fish as well as the stocking and maintenance of fish ponds. Fish culture system in Nigeria includes monoculture, polyculture, integrated aquaculture and cage culture.

Monoculture

This is the culture of a single species of fish. For example the culture of *Clarias* or Tilapia or Common carp only. The advantage of this culture system is that it helps the farmer to feed the fish well to meet their nutrient requirement. It helps the farmer to get familiar with the fish better. For non-carnivorous species like Tilapia, mono-culture enables the farmer to stock fish of different sizes, ages and sex together. The farmer can also selectively harvest his fish all year round, thereby keeping his fish pond operational.

The disadvantage of this system is that if there is an outbreak of disease the entire fish population can die.

Polyculture

This is the culture of more than one specie of fish in a pond. For example the culture of Tilapia with Catfish; or Tilapia, Catfish and Common carp in the same pond. This culture system better utilises the natural food produced in the pond since each of the fish feed at different trophic levels. Fish are more resistant to disease outbreak in this system than in monoculture. Farmers should, however, make sure that fish that are compatable are stocked under this system in order to maximise yield.

Integrated Aquaculture

This is the rearing of fish alongside other forms of agriculture. It is a semi-intensive farming system where resources are efficiently utilized and recycled in order to have higher production than would have been obtained from a single production system.

The advantages of this system are:

- Optimal utilization of resources;
- Higher return on investment;
- Reduction of cost of production as waste generated from livestock or farm produce are recycled to feed fish, while waste water and site from fish ponds are-used to irrigate and fertilize crops. It also helps to reduce environmental pollution since wastes are recycled.

There are various types of integrated aquaculture system practiced in Nigeria. It ranges from very simple system such as fish with one kind of domestic animals or crops to complex one like fish, poultry, pigs, sheep, goat, cattle and crops.

Cage culture

This is the rearing of fish in cages in open waters such as rivers, lake reservoirs and large ponds. Cages can be stocked at higher densities greater than ponds. The water exchange rate, availability of good feed and other inputs determine the density at which fish are stocked. The major problems of raising fish in cages are that fish can easily be stolen while water where cages are rigged can also be easily polluted particularly in open rivers.

Cultivable fish species in Nigeria

The following are some of the fish species that have been identified to be cultivable in Nigeria. They are:

S/N	Scientific Names	Common Names
1.	*Clarias gariepinus*	African catfish
2.	*Heterobranchus bidorsalis*	African Catfish
3.	*Heterobranchus longifilis* .	African Catfish
4.	*Heterotis niloticus*	Bony tongue fish
5.	*Oreochromis niloticus*	Nile Tilapia
6.	*Sarotherodon galilaeus*	Mango Tilapia
7.	*Gymnarchus niloticus*	Trunk fish /Aba
8.	*Liza falcipinnis*	Sicklefin mullet
9.	*Liza grandisquamis*	Largescaled mullet
10.	*Elops lazeta*	West African Lady fish
11.	*Tilapia melanopleura*	Tilapia
12.	*Chrysichthys nigrodigitatus*	Silver catfish
13.	*Macrobrachium macrobranchion*	Giant River Prawn
14.	*Macrobrachium vollenhoveni*	Fresh water Shrimp

Levels of aquacultural practices

Aquacultural practices can be classified into seven levels. The criteria for classification are based on the level of feed input, stocking density and water management. They include.

Extensive fertilization
Intensive fertilization
Extensive feeding
Intensive feeding
Hyper - intensive
Ultra-hyper intensive
Recirculatory Aquaculture System (RAS)

Conditions for selecting site suitable for aquaculture.

For a site to be considered suitable for fish farming, it must satisfy the following conditions.

- It must have good quality water in sufficient quantity.
- The soil must retain water preferably silty clay.
- The topography of the land should be gently sloping.
- Choose a location where drainage from domestic sewage; polluted water from industrial wastes and chemicals used from agricultural purpose will not drain into ponds.
- Construct ponds where there will be easy access to motorable road.
- Avoid heavily wooded vegetation to reduce cost of construction.

Conditions for selecting fish suitable for culture

Fish to be raised for aquacultural purpose must satisfy the following conditions:

- The fish must be able to reproduce under culture condition.
- The fish must be temperature tolerant.
- The fish must accept artificial feed.
- The fish must be resistant to disease.
- It must be accepted by consumers.
- It must have a fast growth rate and reach market size at a short time.
- It must be compatible with other species.

After meeting the necessary conditions it is important to note that there are factors responsible for the growth of fish: Internal and external factors.

External Factors:	**Internal Factors:**
Temperature	Heredity
Quantity and quality of food	Ability to benefit from food (feed conversion ratio)
Water quality	Resistance to diseases
Necessary amount of space	

Problems of Aquaculture Development in Nigeria

The major problems of aquaculture development in Nigeria are:

- Insufficient quality fish seed and cost effective fish feed,.
- Inadequate genetically improved fish feed,
- Inadequate cost effective fish feed,
- There is faulty process of data collection,
- Inadequate environmental impact consideration,
- Insufficient formal dialogue between the stakeholders in aquaculture,
- Poor marketing structure, and
- Poaching.

Fishing Gears

Fishing gears are implements used for catching fish. It can be classified into passive and active gears.

Passive Gears

These are gears which are not moved about during fishing operation. They assume fixed position and fishes move into them voluntarily. Examples

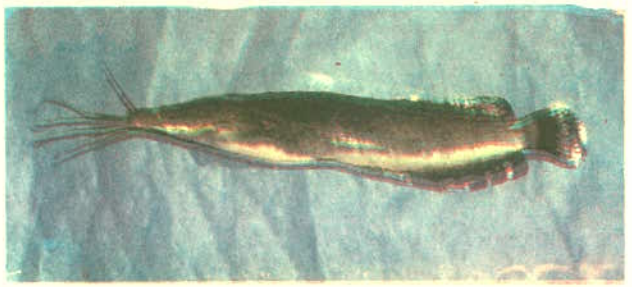
- Traps
- Gill nets
- Drift nets
- Hooks and lines
- Trammel nets
- Pole and lines
- Cast nets
- Clap nets
- Beach seine
- Drag nets
- Trawl nets - attached to trawlers for catching shrimps and other demersal fishes.

Active Gears

These are gears that are moved about during operation. They do not assume fixed position and fish do not have to move into them voluntarily. Examples are:

S/N	Scientific Names	African bony tongue fish
1.	*Heterotis niloticus*	Cassava Croaker
2.	*Pseudotolithus Senegalensis*	Rough head sea catfish
3.	*Arius gigas*	Sompat Grunt
4.	*Pomadasys jubelini*	Bigeye grunter
5.	*Brachydeuterus auritus*	Great barracuda
6.	*Sphyraena barracuda*	Bonga shad
7.	*Ethmalosa fimbriata*	West African Ilisha
8.	*Ilisha africana*	African catfish
9.	*Clarias gariepinus*	Bagrid Catfish
10.	*Chrysichthys nigrodigitatus*	Elephant snout fish
11.	*Mormyrus rume*	Niger or Nile perch
12.	*Lates niloticus*	Tiger fish
13.	*Hydrocyanus vittatus*	River pike
14.	*Hepsetus odoe*	Moonfish
15.	*Citharinus citherus*	Bayad
16.	*Bagrus bajad*	African Catfish
17.	*Heterobranchus bidorsalis*	African Catfish
18.	*Heterobranchus longifilis*	Trunk fish/Aba
19.	*Gymnarchus niloticus*	Nile Tilapia
20.	*Oreochromis niloticus*	Mango Tilapia

21.	*Sarotherodon galilaeus*	Southern Pink Shrimp
22.	*Farfantepenaeus notialis*	Guinea Shrimp
23.	*Parapenaeopsis atlantica*	Giant River Prawn
24.	*Macrobrachium macrobranchion*	**Giant Freshwater Prawn**
25.	*Macrobrachium rosenbergii*	Tarpon
26.	*Megalops atlantica*	Red Snapper
27.	*Lutjanus goreensis*	Lady fish
28.	*Elops lacerta*	



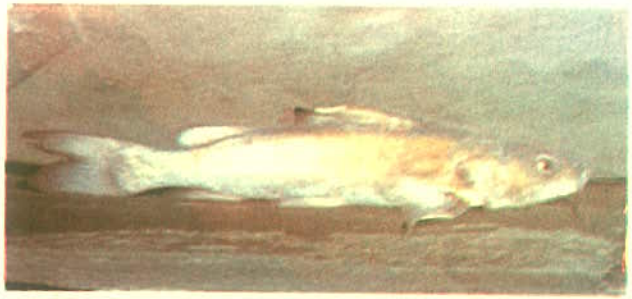


Plate 5: *Gymnarchus niloticus*

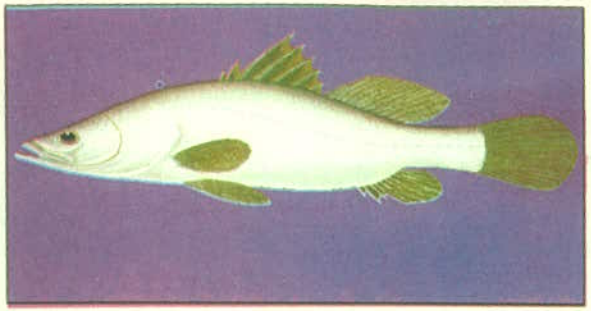


Plate 6: Picture of *Lates niloticus*

Plate 7: Picture of *Heterotis niloticus*

Plate 8: *Oreochromis niloticus*

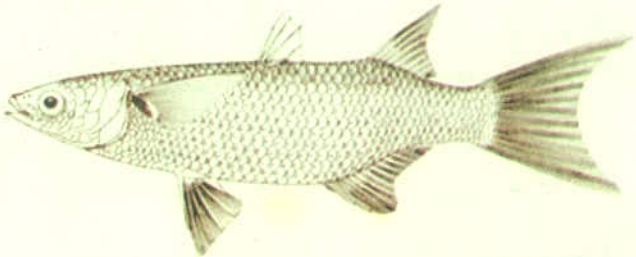


Plate 9: *Liza falcipinnis*

Plate 10: *Megalops atlanticus*

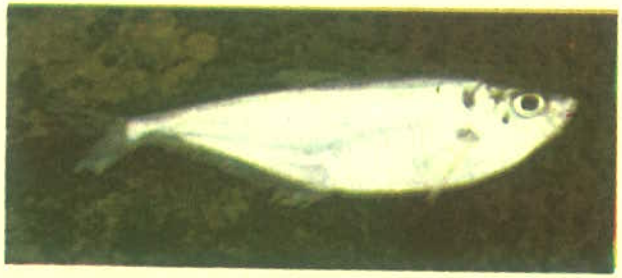


Plate 11: *Ilisha africana*

Methods of Fish Processing and Preservation.

Fish Processing

Fish processing is anything that can be done to the fish which will result in change of texture, taste, and physical appearance so that deterioration is slowed or halted. Fish processing usually involves high temperature and are called curing techniques.

The principle behind this is to make fish unfavourable for bacteria, microbial and insect activities thus rendering fish concentrated by loss of moisture. Processing impacts flavor, taste, texture and appearance on fish which are acceptable by the consumer. These four impacted characteristics are called organoleptic characteristics.

Examples of processing methods are:

Smoking	Salting
Canning	Drying
Frying	Fish protein concentrate
Fish meal	Fish silage

Fish Preservation

Fish preservation is a means by which fish can be maintained in its fresh state without any change in its fresh state such as in the texture, taste and physical appearance. Methods of fish preservation include:

Icing

Freezing

REFERENCES

FAO (1997): Fisheries Management Section 1.2, Technical Guidelines for Responsible Fisheries. FAO, Rome. 7-15.

Hilborn, R. (2007): "Managing Fisheries is Managing People: What has been Learned?". *Fish and Fisheries* **8** (4): 285–296.

Huet, M. (1972): *Textbook of Fish Culture, Breeding and Cultivation of* Fish. Fishing News Books Ltd. Farnham. Survey, England 436pp.

Holden, M. and Reed, W. (1978): *West African Freshwater Fish.* West AFrican Nature Handbooks, Longman Group Ltd. London p 68.

Omitoyin, B. O. (1999): Intensive Fish Farming. An invited Technical Paper Delivered at the intensive Agriculture Training Workshop Organised by Nigeria. Institute for Oceanography and Marine Research (NIOMR) Victoria Island Lagos. 1 October 1999. 9pp.

Otubusin, S. O. (1994): A Review of Integrated Fish Farming and a Highlight of the Nigeria Scenario. A Paper Presented at the National Workshop of

Aquaculture Development. Fish Seed Production and Post-harvest Technology, NFFRI New-BussalFAU, Abuja, 20-23 Sept. 1994.

Schwatz, C., Davidson, G., Seaton A. and Tebbit, V. (2000): Chambers English Dictionary. Chambers Cambridge imprint. 536p

Tobor J.G. (1990): *The Fishing Industry in Nigeria. Status and Potential for Self-Sufficiency in Fish Production.* NIOMR Tech. Pap. No. 54.

7

TROPICAL FOREST RESOURCES AND SUSTAINABLE DEVELOPMENT

L.A. Adebisi

Introduction

Tropical forests are all vegetation type of evergreen forests of most tropical low lands, the less luxuriant evergreen deciduous forests found at low and moderate altitude or tropical mountains, and the evergreen deciduous forests of oceanic subtropical climates found in various parts of the world. The trees therein are luxuriant and are at least 30m high; the vegetation is woody rich in lanes as well as herbaceous epiphytes.

The tropical forest is generally said to be an outstanding example of a complex biological community with an unparalleled diversity and interdependence of its component members, especially the flora and the fauna. The diversity of the vegetation in the floristic composition is of high degree (Amakiri, 1990). Malaysia has about 2000 different tree species, while Nigeria has about 560.

Within the forests are found the materials or products that could be economically utilized for the welfare of man. These could be classified as forest resources which in turn could be major or minor products from the economic point of view. This classification is relatively subjective, minor product of a place may be the major product in another area. For instance, gum arabic is a minor forest product in Nigeria while it is a major forest product and Non-Timber Forest Product (NTFP).

Tropical Forest: Distribution, Formation and Structure

The global distribution of the tropical forest is virtually impossible mainly because of the inadequacy of available information on the territorial spread of this formation type. Bada (1984) says that the tropical forest generally occurs in the broad inter-tropical zone, more or less forming a continuous belt around the earth between latitude 24°S and latitude 24°N through the northern and southern boundaries are not rigid especially in parts of Indo-China and Australia. The tropical forest belt is somewhat divided unequally by the Equator such that more of the vegetation lies in the northern than in the southern hemisphere.

The tropical forests could be grouped into four regions, namely:

1. **The African Tropical Forest Region:** This embraces the *Congo* Basin, West Africa, and parts of East Africa, Seychelles, Mauritius, Madagascar and a few other islands.
2. **The American Tropical Forest Region:** This includes parts of South and Central America, South America in the Amazon and Orinoco lowlands and Central America, Mexico, the Caribbean and Hawaii islands.
3. **The Indo-Malaysian Tropical Forest Region:** This includes parts of India, Burma, Malaysia, Peninsula and the Southeast Asian Islands.
4. **The Australian Tropical Forest Region:** This region embraces Eastern Australia (Queensland), New Zealand and the Pacific Islands.

The above listed areas are potential areas that could carry tropical forest animals under normal conditions. These areas, however, might have carried tropical forest some long years ago. It may be highly assumptious to give the impression that these areas at present carry tropical forest because of socio-economic and political factors. These factors have reduced the effective area of the tropical forest in the last 50 years because of forest clearing for agriculture, urbanisation and road development. It is noted by Bada (1984) that in the last 30-40 years, the rate of forest conversion has increased by more than 300% because of the increasing demand for land for cultivation, oil pipelines, as well as the improved technology of 'working' the forest which has considerably reduced or totally eliminated the minimum allowable girth for exploitation. For instance, the multinational JARRI project in the Amazon is an example of a massive assault on the tropical forest.

In Nigeria, the situation is worsened by the fact that the tropical forest is the climatic climax only in the southern parts of the country. This little belt has been subjected to persistent pressures from shifting cultivation, cash-crop farming and urban and infrastructural development. Also, the government policy of large-scale conversion of the high forest into plantations of a selected number of fast-growing exotic tree species has militated against the conservation of the national forest. In general, tropical forests are over exploited and if these trends continue, the remaining relics of tropical forest may be completely exploited before the year 2000 A.D. (Kio 1978, Myers 1983).

Tropical High Forest in Nigeria

Physiographic and climatic factors are major factors influencing the vegetation type distribution of a place. In Nigeria, physiographic features do not have direct influence but indirect influence on vegetation distribution. Physiographic features have some appreciable influence on the local annual rainfall and its distribution. Climatic factors have direct influence on the vegetation types and their distribution.

The two prevailing winds that determine the seasons of the year in Nigeria are:

1. The North-East trade winds which are cold and dust-laden and blow from the Sahara Desert. These bring harmattan, and dry season.
2. The South -Westerly winds that blow from the Atlantic Ocean. They are moisture-laden and warm, and they bring rain and wet season.

These winds influence the vegetation types and their distribution. The longer a place is under any of these winds, the more distinct the vegetation of the place. The Northern parts of Nigeria under the influence of the North-East trade winds have savannah vegetation while the Southern parts of the country under the influence of Southwesterly winds are clad with tropical high forest. The more the influence of South-Westerly winds decreases northwards the less luxuriant the forest trees become.

Indeed, the general rainfall pattern makes the rain forest of Nigeria a climatic climax (in the Southern Nigeria, the annual rainfall is 1400mm or more). In the North, the annual rainfall is less than 1000mm. The main tropical high forest types are:

a. Mangrove forest and coastal vegetation,
b. Fresh water swamp forest, and
c. Lowland rain forest.

The mangrove forest and coastal vegetation extend right to the sea. It is common in all the coastal areas which are inundated with brackish water. The major tree species in this vegetation type is red mangrove *(Rhizophora racemosa)* whose bark is a source of tannin. The latter is useful in leather and plywood industries. White mangrove *(Avicennia africana)* succeeds red mangrove in the plant succession. Their breathing roots (pheumatophores) enhance their ability to reclaim the coastal land (forming chikoko soil).

The fresh water swamp forest is formed immediately after the mangrove vegetation, a little inland particularly around lagoons and estuaries with fresh water. The predominant tree "species in this vegetation types are *Mitragyna ciliata, Brachystegid spp, Raphv spp, Uapaca spp, Cleistaphois patens,* etc. Some of them are good timber trees.

The lowland rain forest is the third type of vegetation from the coast. It forms a continuous belt about 250-300km wide from the west to the south-east. This forms the bulk of the forest wealth of Nigeria. The forest is with diversified tree species, rich in climbers and with uneven, distribution of economically desirable tree species.

The tropical high forest occupies only about 2% of the total land area of the country. It accounts for more than 90% of the total timber supply of the country. Kio (1978) said that over 80% of the timber produced in Nigeria for export and internal use, up to 1976 were extracted from the high forest of South-Western Nigeria. In 1971 alone (after the civil war) roundwood equivalent to sawn timber production in the country was about 2.8 million m^3.

The tropical high forest could be stratified into four or three storeys; emergent, upper canopy, middle storey and lower stratum trees. The emergent trees tower over

the upper canopy trees that form the general- upper layer of the forest. The emergent never form a continuous layer, their canopy is broken. In this category could be found trees like *Lophira alata, Pitadeniastrum africanum, Khaya spp, Entandrophrgana spp, Cylicodiscus gabonensis, Gossweileracendron balsamiferum* to mention a few. These trees could be as high as over 50m. Bada (1984) and Richards (1966) noted that *Entancbcohraguna cylindricum* has been recorded to be as high as 59m, and girth as big as 17m.

The height of over 30m could be recorded for the trees in the upper canopy. They form close canopy and in their class could be found species like *Holoptelea grandis, Triplochiton scleroxylon, Guarea cedrata,* G *Thempsoni, Khaya ivorensis, Lovoa trich ilo ides, Sterculia rhinopetala,* etc.

In the middle storey, trees of 10 -15m height could be found. These trees are made up of the young regrowths of upper canopy species, small trees and shrubs while the lower stratum comprises shrubs, young seedlings of the big trees and herbaceous plants.

Forest Contribution to National Economy and Development

Forest has served mankind right from the time of creation in a number of ways. Forest was a place of abode and source of food to early man. It is still the major source of materials for economic development of the people in rural communities.

Forest provides tangible, intangible materials and essential benefits because of their biodiversity. Forest products are converted into forms that are useful in human economy and arts. Tangible forest products include wood for timber, poles, and panels, pulp for paper making; fuel, chemicals and animals. Animal products are converted after exploitation from the area of production.

In the pre-independence years timber exploitation contributed to the foreign earning of Nigeria. Species like *Triplochton seleoxylon* was exported for manufacture of Packages while *Milicia excelsa,* and mahoganies were sent abroad for furniture. Internally, for match stick production, several species have been tried and such tree species like *Triplochiton scleroxylon* and *Pterygota macrocarpa* have been found useful for the manufacture of match sticks. Many Nigerian hardwood tree species are being used in the wood based industries either as composite wood or sawn planks in the areas of plywood, particle boards, chipboard, and panels production.

In the round form, forest products are consumed as fuelwood. This is the most important wood item consumed in the Tropical Africa which accounts for more than 90% of the total volume of wood utilized. This wood energy is used for cooking, space warming and in local brewing and baking industries. In the rural communities, the fuel used is fire-wood which is used for processing of agricultural products treating tobacco, smoking fish, bakeries, potteries. Wood is also used for

charcoal production. Poles are converted into pit-prop, forming electric and telegraphic posts. Strong wood is converted to railway slippers and culvert, and building beams.

In the paper industries, many tree species in Nigeria are found useful and they could be utilized any time from now. Species like *Musanga ceropioides* and *Sterculia setigera* were tested and found to possess long fibre. Nigerian Jebba Paper Mills has embarked on the establishment of plantations of *Sterculia setigera.* These species could be used for pulp production, thereby saving our foreign exchange.

The minor forest products NTFP - latex such as rubber, essential oil, resins, gums, incense, spices, medicinal extracts, and tannins for leather industries could be obtained from the forest.

Environmental Conservation and Anti-desertification

Tropical forests have unique climate (micro-climate) where weather elements have their shortest possible ranges. For instance, in the tropical forest, temperature is generally high from 27°C to 30°C (mean annual temperature with small range). Mean annual rainfall ranges between 2000mm and 2500mm, relative humidity is not below 70% in the morning and 60% in the afternoon. The soil-moisture regime is of the equatorial type in which large water surplus are generated in most months of the year. Consequently, these prevailing conditions support the development of luxuriant vegetation which is delicately balanced. Any mistake to upset this condition of equilibrium will lead to a devastating destruction either by clear felling for farming or other development construction.

With vegetation cover, soil erosion is prevented by converting rain drops to intercepted water and stem flow, which when getting to the forest floor, flows slowly along the soil surface unlike through fall that is capable of loosening the soil particles and eroding the soil in the process. The litter formation at the forest floor also prevents the carrying away of the soil particles.

In the water shed management, the forest cover is essential for the prevention of soil erosion and consequent siltation of the dam which could reduce the potential volume of water that the dam could retain. At the same time prevention of siltation of the dam enhances the purity of the water and consequently reduces the quantity of chemicals used for treating the water for human consumption. .

Forest cover which reduces the amount of erosion through fall water improves the seepage of the water in the soil and thereby maintains the water table in the soil. These conditions enhance the activities of soil organisms like bacteria and earth worms that aid the formation of humus soil, aeration of the soil and soil porosity.

Against desertification, artificial forest belts are established in the region to serve as wind breaks, and to ameliorate the weather condition of the place. With careful choice of the species that could thrive well in

dry SITE, shade could be provided for human habitation while the farmland could be reconditioned for productive farming. The species that could be used for shelter belt include *Eucalyptus* species, *Acadiracta indica,* and *Acacia nilotica.*

Agro forestry

This is a farming system in which an agriculturist practices side by side with a silviculturist or pasturalist on a piece of land without one necessarily quitting for the other at a later date of the system. . is not a new concept. Trees, arable crops and animals have traditionally been raised together on small farms throughout the world. "Farm forestry" used to be a required course at many U.S. forestry schools and still is at a few.

The demise of this concept in the temperate zone seems to have followed the demise of the small "family farm", as the trees, crops and animals have become separately managed at large scales in "modern" agriculture and forestry. Interest and expertise have waned as practitioners, scientists and educators focus on their own specific commodity and research area - (Gholz, 1987).

The resurgence of the concept derives primarily from the recognized failure of large agriculture and forestry monocultures in the lesser developed world, mainly in the tropics. Also, the rate of tropical forest destruction and loss of the multitude of natural products they yield have raised an alarm world wide. It is most unlikely that mixed cultures will replace highly productive and profitable monocultures anywhere in the world as long as fossil fuel energy is abundant. Nevertheless, in areas where fossil fuel subsidies are not possible, where soils are marginal or have been degraded, or where trees are now absent and their products sorely missed, increasing reliance or tree/crop/animal mixtures is inevitable.

Agroforestry is capable of being repeated with success around the world and under various environmental conditions. Within the system, production of food with other agricultural crops and wood with forest services are ascertained.

The escapement adopted by the silviculturist should not be the type that will send the agriculturist or pastoralist packing at the canopy closure of the forest trees. At the same time, the choice of agricultural crops or livestock should not be inimical to the good development of forest stand. In fact, the activities of both parties should complement one another.

There are various types of agro forestry, namely: Agro-silviculture, pastoral-silviculture, agro-pastoral or the combination of three disciplines in as much as there is no conflict on operation.

REFERENCES

Amakiri, M. A. 1990. Tropical Forest National Plantations: Introduction to Agriculture (GES 105) External Studies 47-51. The Department of Adult Education, University of Ibadan.

Bada, S.O. 1984. Growth Patterns in an Untreated Tropical Rain Forest Ecosystem. Ph.D Thesis 254pp. Faculty of Agriculture and Forestry, University of Ibadan.

Gholz, H.L. 1987. *Agroforestry: Realities, Possibilities and Potentials.* Published by Martinus Nijhoff Publishers in Cooperation with ICRAF. Pp-227.

Kio, P. R. O. 1978. Stand Development in Naturally Regénerated Forest in South-Western Nigeria. Ph.D. Thesis 594pp.

Myers, N. 1983. Tropical Moist Forest: Over-Exploited and Underutilized. *Forest Ecology and Management* 6: 59-79.

8

WILDLIFE AND RANGE MANAGEMENT

G A. Lameed

Introduction

Giles (2000) defined wildlife management, as "the science and art of changing the characteristics and interactions of habitats, wild animal populations, and men in order to achieve human goals by means of the wild life resource." The study of the characteristics of man as a social animal has been described as "the study of history, development, organization, and problems of people living together as social groups." Obviously, man, apart from the rest of the living world, is a perilous delusion, and without delusion and consideration of the many vagaries of man is folly.

Nearly a quarter of a century ago Shea (1948) pointed out that wildlife management has been working on the edges of the human-relations problem, recognizing that the human element is always more difficult to handle than the management of wild creatures. As a social scientist, Shea indicated that methods and tools were available, or being forged, to change certain types of human behaviour and social patterns. During the past two decades, we have seen how these methods and tools have been used by psychologists and sociologists in the business worlds to promote sales of various products. Motivational research has been an effective tool in convincing persons that they needed all sorts of commodities many originally not wanted, not needed, or even not good for them. Wildlife managers and administrators, however, have not availed themselves of the full potential of the methods of the social sciences to achieve the goals of wildlife husbandry.

Aside from isolated studies, the dearth of socio-wildlife research indicated that, despite early recognition of the importance of people management, this aspect has been largely overlooked since wildlife management became recognized as a profession in the early 1930's. Mair (1960), in the critique of the 25th North American Wildlife Conference has this to say "I am disturbed too at the apparent complete lack of research into the social and cultural aspects of the wildlife now and plan to spend much more in the future... But there has been at this conference no mention of research into the mores of our people, their motivation and their real needs."

Definitions with Relevant Annotations

Wildlife Management as an aspect of natural science "is replete with terms and terminologies. It will be gainful and most rewarding to define certain terms before further exegesis (Onadeko 2004).

- ***Wildlife or wild animal species*** refers to all living things, plants, invertebrates and vertebrates outside the direct control of man (that is, all non-cultivated plants and non-domesticated animals). It embraces all animals in their natural habitats. They are undomesticated animals which may be small organisms only visible to humans if seen through a microscope or as big as the whale. Wildlife includes but is not limited to insects, spiders and birds, reptiles, fish, amphibians, and mammals if not domesticated (NCF, 1994).

Biodiversity or biological diversity refers to the total variability of living organisms on the planet (UNEP, 1995). It is defined in terms of genes, species, and ecosystem which are the outcome of over 3,000 million years of evolution. As a biological concept, biodiversity is an essential or a necessary tool for human survival. Biodiversity is the totality of genes, species, and ecosystems in a region. In another term biological diversity is the total heritable variation or differences in characteristics that exist in all living things, individuals and their species in different parts of the earth. It consists of all the heritable variation caused by the presence of genes or units of hereditary information which organism can transmit to their offspring from one generation to another in different climatic and vegetation zones of the earth, in ground or atmosphere.

- ***Wildlife management*** has been defined as the combination and application of business methods and ecological knowledge to manipulate undomesticated fauna and flora (wild animal and plant) resources in a way that ensures their products and services will be sustained. The application of ecological principles and knowledge to the management of wildlife entails certain basic approaches viz:

- ***Preservation*** of wild species and allowing nature to follow a balance, devoid of any human intervention
  - Direct or indirect manipulations of wild fauna population such as through cropping, culling, habitat alteration and other habitat management tool so as not to exceed carrying capacity.
  - Maintenance of useful and desirable species.
  - Sustained-yield management through limiting consumptive utilization to annual production capacity (Eltrimgham, 1984; Afolayan, 1987; Ayodele *eta/.*, 1999).

- ***Conservation*** is the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspiration of future generations. Conservation as rendered involves preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment.

- ***Consumptive utilization*** is the extraction of resources for the production of consumer goods and services. Apart from providing food, other types of consumptive uses of wildlife include products such as skins and hides, materials for arts and crafts, or ceremonial uses, oils and medicines, live animal trades, sport, hunting, stock resources for domestication or improvement of domesticated breeds, farming activities and mineral resources exploitation. All activities directed towards production of goods and services which often lead to the degradation of the environment.

- ***Non-consumptive utilization*** is defined as the provision of natural amenities and services for recreational use such as game viewing, nature trail, swimming, boating and other water related recreational activities in lake, and waterfall. It includes spiritual and religious values, values due to the willingness of local and international user-public (tourists) to pay to see living and non-living resources in the natural setting .

- ***Sustainable use*** is the rate of harvest within the capacity of species and their habitats to maintain them. Sustainable use can be non-consumptive or consumptive in nature.

- ***Commercial use*** is defined as the management of native wildlife for profit. The terms utilization and commercial use are interchangeable.

- ***Extinct -Species*** is no longer existing or living.

- ***Ecological extinction*** is defined as the reduction of a species to such low abundance that though it is still present in the community, it no longer interacts significantly with other species.
- ***Extirpation*** - Species is not extinct, but no longer occurring in a wild state or no longer exhibiting patterns of use.
- ***Endangered*** - Any native species in immense danger of extirpation or extinction.
- ***Threatened*** - Any native species likely to become an endangered species within the foreseeable future.
- ***Special Concern*** - Any native species for which welfare concern or risk of endangerment has been documented.
- ***Biosphere*** - That is the thin layer of the earth surface and atmosphere inhabited by living organisms.

The Philosophy and Policy of Wildlife: The main national wildlife management philosophy and policy (FDF 1982) are:

(1) Bush meat production: to increase national animal protein production and intake.
(2) Preservation of national heritage
(3) Promotion of recreation and tourism.

To achieve the above policies and philosophy in wildlife management, the following are the objectives set aside to approach the proposed action plan. (Ajayi, 1979).

(i) Total preservation of the endangered species for national heritage at least for the next decade to ensure recovery from the possibility of extinction.
(ii) Conservation of other wildlife species in schedule 11 and those in any schedule, where possible, for bush meat production to enhance national protein intake especially in the rural areas.
(iii) Rational exploitation on a sustained basis for exportation of wildlife trophies.
(iv) Conservation for education, research and for the ecological diversity, stability of gene pool and ecological system.

Major Problems Militating Against Wildlife Management in the Country are:

(i) Inadequate funding of wildlife programmes by the various tiers of government in the country.
(ii) Scarcity of professionally trained manpower at all levels.
(iii) Poaching or illegal hunting and exploitation of wildlife resources.
(iv) Competition with other land users.
(v) Lack of necessary equipment and field facilities, viz : stethoscope, binocular, GPS (Global Positioning System), compass, ranging-pole, zoom lence camera, data-sheet, etc.

Some Factors Influencing Wildlife

There is much interesting speculation regarding man's behaviour towards wildlife resources as influenced by religion, culture and tradition, politics, economics, and the individual's sex, age, occupation, and education. This aspect considers examples of the many possible relationships and problems dealing with people and wildlife.

Religion

The hunter, said the ancients, is not the one who will be found wanting in due reverence to the gods. The Bible records hunting as an acceptable practice. The Mosaic Law provides some of the most practical advice on wildlife management and hygiene found anywhere in the literature. Some religions prohibit killing or eating of certain, or all, species of wildlife.

This "reverence for all life" religion is more than casually embraced by may individuals in North America. Clark (1958) cited the example of Albert Scheitzer in his discussion of this topic. Schweitzer apparently believed that man should tear no leaf from a tree, break no flower, and take care not to crush any insect as he walked. Death, as a fundamental part of life, was apparently not recognized. On the other hand, some religions consider wildlife as "God-given" for many to enjoy. Further, man has been charged to exercise scientific wildlife husbandry, and the stewardship to leave the land more alive and fruitful than he found it. The true hunter, in the words of the old European hunter's pledge, "honours the Maker in His handwork." Both of these religious viewpoints will, in some degree, be felt by those responsible for wildlife management programs.

Culture and Tradition

In most areas of our own culture and in most primitive cultures, the "chase" is an integral part of life where true harmony between man and nature exists (Clarke, 1958). For example, the rural landscape, with its hedges and copses (thikets) and beautiful managed fields, is basically a sporting landscape. Without fox hunting, the hedges would come down; without pheasant shooting, the copses would disappear. The historical waterfowl wetlands of the Central Valley of Wetland sites would probably be drained and plowed for rice and safflower if it weren't for the private duck hunting clubs.

Some psychologists feel that hunting and fishing have their roots in man's old and harmonious relationship with nature, for wildlife is as truly his prey as it is that of any other predator. Furthermore, the role of all predators, including man, is still vital in the harmonious functioning of the natural community. The hunter and fisherman often becomes the alternate of disease and starvation.

Down through history, each nation, race, or culture has acquired certain values about wildlife. How these values were formed and what it would take to change them are questions yet to be answered. A case in point is the wholesale killing of songbirds in America, before and at the turn of the century, by alien immigrants from Southern Europe and "by the negroes and poor whites of the South" (Hornaday, 1913). Southern Europeans have trapped, netted, and shot song and insectivorous birds for centuries for use as food. Hornaday felt the way to discourage this practice was to "prohibit the use of forearms in hunting by any naturalized alien from Southern Europe until after a 10 years' residence in America." How he determined it would take 10 years to change tradition that "killing song birds for food is right" is not clear. It may be speculated that the killing of songbirds by negroes and poor whites in the south was a matter of survival of low income groups or possibly just a handy source of recreation.

Habitat destruction, not uncontrolled hunting, was the primary reason for reduction of wildlife populations 50 to 100 years ago. Hunting was a factor, however, and as a result public indignation mounted to the boiling point in opposition to some forms of hunting. Conservation organizations, schools, churches, and other groups began promoting "preservation" of wildlife resources. Leading conservation organizations adopted a drastic code of ethics. One such tenet was so well "sold" that it plagues wildlife managers till today. It reads: "The killing of a female hoofed animal, save for special preservation, is to be regarded as incompatible with the highest sportsmanship; and it should everywhere be prohibited by stringent laws" (Hornaday, 1913: 385). This ode has been so deeply inculcated in the minds of many people that it has been difficult to obtain adequate, and necessary, big game harvests in many areas.

Why don't people change their attitudes when confronted with sound scientific evidence? Psychologists tell us that people are "selective readers" and often pay little attention to materials which conflict with their preconceptions. When they do read something that they disagree with, they will not remember facts contrary to their opinion. This is called "selective retention".

Even semantics play an important part in prohibiting wise wildlife programs. A case in point is associated with the deer controversy in California. Somehow through the years, the term "deer management" has acquired the meaning to many people of killing female deer. When biologists try to sell "deer management", individuals with this limited mental image of the term will not listen to biological facts although "deer management" may properly require any number of management techniques, from closed seasons to liberal killing of both sexes of deer. University of California scientists have found that where the term "deer husbandry" is substituted, most people will listen. Understanding what makes hunters "tick" becomes more difficult when we probe deeper. Why is it that hunters will accept doe shooting as a routine game management tool in one state and reject the idea in an adjoining one? Or, why do many hunters who will not shoot female deer prefer killing cow elk?

Still another hunting paradox exists in some areas. Many hunters enjoy hunting both sexes of quail, grouse, doves, ducks, and geese but reject the killing of hen pheasants. Does color have something to do with this phenomenon, or is it all right to kill a female if you don't know it is one?

The problem of polarization in people's attitudes is a social one and, in the wildlife field, the hunter is at one end and the preservationist at the other, each with his rigid attitudes which often are based to a large extent on misunderstandings or ignorance.

The Yellowstone elk herd controversy is a good example of a situation where the biological facts were clear, yet the attitudes of people for a long time prevented the implementation of recommendations based on biological findings, simply because they were opposed to "slaughter" of the elk on the National Park. Other people were opposed to killing the elk at all, and were completely unwilling to recognize the limitations of carrying capacity and that the habitat was being severely damaged.

Clarke (1958) is convinced that the interest in hunting is established before adolescence. It would appear that opportunity to hunt and fish in early years has a profound influence on an individual's activities and preferences in these sports. It is the opinion of many wildlife authorities that we are raising a new generation of urbanities and subordinates who do not hunt and fish, and do not understand the ecological necessity of wildlife harvests by man.

Political Aspects

Political expediency is often a greater influence than biological facts when dealing with wildlife. Wildlife

management is inextricably involved in and influenced by local, state, and federal politics. Conservation agency administrators and biologists that ignore this fact cannot promulgate necessary programs. Education programs designed for only portions of interested segments of the public are not adequate.

Cain (1960) cites the Michigan deer herb problem as an example. As was true in so many areas of North America, deer herds in Michigan made fantastic recovery in the 1930's and 40's until starvation, disease, and depredations of roving dogs accounted for thousands of deaths each winter. Persistent educational programs in the 1950's were so successful that by 1960 nearly two-thirds of the hunters understood the necessity and agreed to hunting does and fawns in some parts of the state. In spite of the hunter's opinion, the State Legislature had apparently not been exposed to similar information on deer management and called for a "moratorium on killing mothers and babies.

At the local community level, Shea (1948) identified two groups of leaders which need to be enlisted and convinced of the worthiness of a news program before the community as a whole will accept it. These two groups are "leaders of opinion" and "action leaders." Leaders of opinion are prominent persons with reputations made, usually middle aged or older. These are the "gate-keepers" to community acceptance, but it takes the second group, "action leaders" to get action. People in the community have learned by experience that "action leaders" are usually right in their judgment and will carry things through to a successful conclusion.

Sociologists have found that people oppose any program or idea, real or imaginary that threatens their security. Threat to security may be financial or a threat to a traditional community leadership role. An example would be the person who for many years had led the valiant battle to "bring the local deer herds back from near extinction. This man has established himself as the deer authority in the community because the deer herds have come back, although the change in deer habitat probably was a greater influence on increased deer populations than the restrictive hunting seasons advocated by him. It would be good public relations, psychology, game management, and politics to enlist the leadership of this man in any new deer management program. Remember, it is human nature to believe peers in preference to outsiders.

Although wildlife supplies considerable numbers of man-days of recreation, it contributes an increasingly smaller proportion of the nation's recreational activity. There could possibly come a time when management of wildlife, from a recreational viewpoint only, may invoke the question, "Why has wildlife for the enjoyment of so few". It is not wise to wait and have to take the defensive on such issues, but rather generate an offensive to prevent damaging confrontations. Ammunition for this type of action will not come entirely from biological research but also from a better understanding of society itself, which may ask the questions and which can permit wildlife resources to live or die.

Wildlife Values

Wild living resources represent a natural resource of great significance for most forest and savannah-dwelling human communities as well as for those living in many other rural contexts (Table 1). In terms of direct benefits to humans, wildlife animals provide a major source of the human protein in the diets of rural, sub-urban and even urban people in the many developing countries of the world.

Several authors have reported varying percentage contributions (20 - 90%) of wildlife to animal protein in the average human diet in Benin Republic, Cameroon, Ghana, Ivory Coast, Liberia, Zaire, Nigeria, Sub - Saharan Africa and Latin America (Ajayi 1971, 1974; Asibey, 1974; Devos, 1977; Von Richter, 1979; Sale, 1981; Prescott - Alien and Prescott - Allen, 1982) . Irrespective of the percentage contribution, it is certain that there is a shortfall in the per caput protein contribution in many countries ameliorated by wildlife sources. The wild species being used include insects, caterpillars, maggots, snails, rodents, monitor lizard, birds and various antelopes and primates (Defoliart, 1989; Redford *et al.*, 1995).

Wild animals are also valued for products that are needful for subsistence such as clothing, tools, medicine, materials for handcrafts and art. Many other animal products (such as elephant tusk,(ivory), musk from musk deer, rhino horn, tiger body parts, skins and fur, pelts, etc.) have attracted significant commercial values in local, national and international markets (Redford *et al.*, 1995; Eltringham, 1984; Asibey, 1974; Afolayan, 1987; Onadeko *et al.*, 1989).

Table1. The roles of wildlife in food security in Africa and other values

DIRECT CONTRIBUTION		**INDIRECT CONTRIBUTION**	
Food from wild animals		**Household income**	
Bushmeat	Smoked Fresh Salted Bitong	Employment	Hunters/ Traders; Helpers Shop bar workers Services linked to the Tourist industry Craft workers Wildlife officers

Eggs	Birds, turtles	Macro-economy	
			Tourist Industry Sport hunting, game Viewing Local (hunting permits/ taxes)Export trade (live animals) Export trade (skins, hides, trophy
nsects:			
Adults; **Larvae**			
	Roasted **Dried** **Boiled**		
Honey		**Influence on Health**	
Flavouring			Wild animals' parts/products medicines; Use of wild animals in drug development; Spiritual & Mental health; cultural & religious values.
		Influence of Agricultural Systems	
			Seed dispersal, Pollination, manure pests, As pests - Massive defoliators - Devastation of farm crops (destructive raids) Marauding and rogue species, pathogen reservoirs.

Several wildlife species throughout history have been valued in religious customs, mythology and folklores and in almost all communities of the world, their central roles still remain. Of much application to us is the African tortoise of the Yoruba homestead fables. In particular beloved *Yonnibo* will always be remembered with nostalgia of the old school days.

Wild animal species have a number of advantages over and above domestic animals such as high consumer preference, high percentage of dressed carcass weight, and richness in protein and mineral contents, (Tables 2 and 3) and adaptation to local conditions of climate and diseases, and ability to efficiently utilize available key species of plants that constitute their food.

Other Values of Wildlife

Socio-cultural Values	Religions, customs, mythology and folklores
Socio-economic values	Products for subsistence: clothing, tools, medicine, materials for handcrafts, trade, income and foreign exchange
Ecological values	Pollination, seed dispersal, decomposition, herbivory, predation, habitat structure
Educational values	Tourism and recreation: science club, field laboratory
Research and scientific values	Natural History Ecology. Immunological specimens
Gene bank	For improvement and diversity of resources

SOURCE OF FOOD

Animal Protein Production. The most important aspect of wildlife utilization is meat product. Since all the present day domestic animals were once wild animals, wildlife has been from time immemorial, man's main source of animal protein.

Wildlife today is still an important source of meat in Africa especially for people in the rural areas (Ajayi 1976). The term 'bushmeat' is used to describe the flesh of wild animals in West Africa and it constitutes a large proportion of the animal protein consumed by the rural communities of the tropics.

In Nigeria, 'bushmeat' has been contributing immensely to the eradication of protein deficiency and malnutrition in the rural areas. Several writers including Riney (1965), Asibey (1972), Charter (1970), and Ajayi (1978) have stressed the important role the bushmeat is playing in the diet of rural communities in Nigeria, most especially in the coastal regions where cattle do not thrive well because of the tse-tse fly infestation and other diseases of humid environment.

Ajayi (1978) has estimated that wildlife meat which includes various insects, caterpillars, maggots, snails, snakes, rodents, monitor lizard and various antelopes accounts for between 20-90% of animal protein consumed by people living in the coastal regions of West Africa. Though the contribution of bushmeat to Nigerian diet is substantial, it is higher in other West African countries such as Cameroun, Ghana, Ivory Coast and Liberia.

In Ghana, wildlife is the source of 65% of the protein consumed in rural areas (FAO, 1969), in Botswana 60% of the animal protein consumed annually is derived from wildlife (FAO, 1969). Many different species of wildlife are exploited as source of food, providing a variety of dietary essentials such as proteins, fats and oils.

Among the mammals utilized are whales which have provided feed for human consumption, the edible oil is used in the preparation of margarine and cooking fats. The solid remains of bone and meat are dried and ground up to form meal which is used to augment animal foodstuffs. Eggs of sea and fresh water turtles are all consumed by local people and exploited as a source of income (Redford and Robinson, 1991).

The giant land snail is eaten on a large scale in West Africa and is immensely popular with people in Central Ghana and in parts of Nigeria and Cameroun. A fresh sample of edible portion is 74% protein (dry weight basis) or 16-19% for beef. Snail meat contains a considerably greater percentage of certain amino acid, notably arginine and lysine than whole chicken's egg (Sale, 1981).

Bee and Wasp breed are eaten by many indigenous people and are highly nutritious. Honey produced by bee is priced as one of the most accepted insects products. Beetles are eaten both as larva and adults and can be brought live from markets (Watanabe and Satarawana, 1984).

Termites are also widely eaten seasonally in many areas and analysis shows them to be unusually high in both protein 36% and fat 44% (Sale, 1981). The seasonal abundance of certain species make them especially important at times of year when other resources may be lacking. Many species which are agricultural pests are also used as food resources in some part of their range or have the potential to be utilized as palm grubs (weevil larvae) which are pest to coconuts and oil palm throughout the tropics are considered a delicacy by indigenous people.

GAME RANCHING

It is an aspect of wildlife utilization whereby wildlife especially the larger herbivores are tamed and managed like cattle, goats, and sheep under extensive system of management. The objective of game ranching includes the search for suitable alternative species to the present conventional domestic animals, in terms of performance and adaptation to survive and utilize the semi-arid habitats of Africa better than the conventional domestic animals.

WILDLIFE DOMESTICATION

Domestication is the ultimate result of the contact between man and animal (Eltringham, 1984). Domestication of game is also an important conservation process in the retention of wild population of the original parent stock, strains and gene pool of particular species of animal for the future generation (Ayeni and Okaeme, 1989).

Man has domesticated some animals as hunting partners, this enhanced his hunting success. Dog is the most familiar in this respect, as a beast of burden, as source of food and as pets. Now that animal protein is scarce, the cost of production of conventional domestic livestock has risen considerably. In recent years, Africa is now compelled more than ever before to domesticate some of its fast breeding and socially acceptable wild mammals (Ajayi, 1983).

According to Ajayi (1983) considerable researches have been coordinated on the suitability of the cane rat (grass-cutter) and giant rat respectively as for domestication. He pointed out that giant rat meat has a low fat and high protein content and a high dressing out percentage (51.5%) compared to domesticated species bred for meat. The same holds for almost all wild mammals investigated for their meat production potential.

AESTHETIC UTILIZATION

Wildlife has recreational and aesthetic values in different forms (Atanda, 1984). In the National Parks and Wildlife Reserves of the World, it is often the aesthetic appeal of wildlife that attracts people. People come for the purpose of seeing or photographing wild animals in their natural surroundings. If wildlife has no other value and were of economic detriment, it would still be worth preserving for its sheer beauty and appeal to human spirit (Dasmann, 1964). Worldwide aesthetic utilization of wildlife has become more important and provides an economic justification for marine reserves National Parks and Wildlife refuges. It is important to note that the utilization of wild animals as pets is because of its aesthetic value. According to Eltringham (1984) most pets belong to only a few species – dogs, cats, rabbits, rats and mice amongst the mammals, budgerigars and canaries amongst birds, tortoise and gold fish. Wildlife products are valued for their ornamental, decorative or ceremonial purposes. Elephant, tortoise shell and furs command great value. Reptile skin and bird feathers are also used as items of adornment in many parts of the world, often being incorporated into traditional dress to indicate status.

COMMERCIAL UTILIZATION

The most generally recognized value of wildlife in terms of utilization is commercial, by directly contributing materials that are sold in the market place (Atanda, 1984). Even today, apart from meat, wild animals provided people with skins and fur for clothing, sinews for rope and thread, fat for fuel, antler for tools, horns for drinking vessels and musical instruments.

Ecological health

Another critical issue relating to the home on the range is the increased risk of human exposure to new animal borne diseases or to existing diseases transmitted in new ways. Considerable negative health implications are already being connected with the processing and consumption of wildlife. Hunting, collecting, dressing and eating bushmeat according to BCTF (2003) places people at increased risk of contacting animal borne diseases.

The disease which has made the greatest and loudest global impact in recent times is the Acquired Immune Deficiency Syndrome (AIDS). In Cameroon, serological analysis of some 800 monkeys sampled from hunters' returns for sale in markets showed that 17% of the monkeys were infected by one of the Simian Immune Deficiency Viruses (SIV) as well as 13 monkey species out of 16. The diversity and distribution of the virus also made it possible to isolate five new strains and to highlight the risks for 30 monkey species. The survey indicated the likelihood of the appearance of a new HIV 3 of AIDS. It is clear, that both the hunting and eating of certain bush-meat species represent a high risk of exposure of human to lethal zoonotic viruses from SIV through chimpanzee for HIV1 and Mangabe for HIV2.

Also several species of rodents make up a sizeable proportion of the bush-meat trade in Africa as most of the larger animals have been hunted to low numbers. Rodents such as giant rats, grasscutters, multi-mammate rat, porcupine, squirrels are regularly consumed. Rodent consumption as food has been associated with health risks in recent times. The multi-mammate rats of the genus Mastomys is generally known as the reservoir of the Lassa virus. Lassa virus fever, an acute virus illness has been a serious problem in the last few years in tropical Africa.

According to NEST (1991) one of the invisible but ubiquitous and particularly insidious and infamous environmental pollutants in Nigeria is a group of biocides known as chlorinated hydrocarbon pesticides. The residues of these pesticides remain in the soil after use and these are transported to the plants, animals and man at the top of the food chain (Osibanjo, 1990). Osibanjo observed that wildlife species face high risk from exposure to untreated industrial and domestic waste. The adverse effects in the soil include phytotoxicity, mortality of beneficial insects and wildlife, loss of reproductive contaminations. Ecotoxicological and environmental pollution disaster problems worldwide is beyond expectation (Osibanjo, 1990).

TRADE IN MEAT PRODUCTS

In all its nutritional forms, wildlife has great economic value to local people. Thus, it is calculated that the annual replacement value of wild animal protein (inclusive of bushmeat, wild fowl and fish) used in Nigeria totalled some 30 million pounds which at the time was approximately equal to 40% of Nigeria's gross domestic product.

Many wild animals are also traded in local markets, providing direct revenue for hunters and traders alike. Around Kisangani (Zaire) the village hunters take the higher value carcass especially duikers to towns for sale, while the rodents and other smaller animals are mostly consumed by the hunters and their families (Colyn et al, 1988).

Worldwide the commercial trade in wild plants and animals was valued by Kemley (1988) at US$5 billion. Many African countries derived substantial revenue from export of wild animals and wildlife products. Annual revenue derived from unmanaged wildlife in Nigeria and Ghana was about N38.6 million and N6 million respectively (Ajayi 1973).

ETHICAL UTILIZATION

The ethical value of wildlife is well known throughout the world because almost all the religions do show some degree of reverence (Atanda, 1994). Akindele (1992) reported that "man is the most superior of all creation; a trustee of nature and has the duty to foster the survival of other species as a rational being and possibly responsible for the extinction of other species that share the planet with him". Eltringham (1984) has the opinion that one way in which animals should be treated have much in common with religious belief. Just as we try to respect other people's religion without necessarily accepting them, we should try to develop a similar tolerance to each other's attitude towards animals.

MEDICINAL AND SCIENTIFIC UTILIZATION OF ANIMAL PRODUCTS

Animal products are widely utilized in both western medicine and traditional medicine worldwide. Their importance in this domain has been stressed by Asibey (1974). Ajayi (1978) offers a good deal of information on the use of wildlife products in primitive and curative medicine. In most cases, various parts are used for preparing concoction for curing ailments in children or for acquiring protection against enemies and witches. Levy (1978), has described 181 animal based remedies used by the Hausa tribe, in Niger Republic, most of which was derived from wild species. In local market in Brazil, dried lizards of several species, the genital of dolphins, fox fur and many other parts of wild animals are sold for medicinal and magical purposes (Redford and Robinson 1997).

Some spectacular uses are as follows:

(a) Kob skin is used in preparing medicine for people to secure riches, while snails have been discovered to be capable of improving the tones of singers if taken regularly as stressed by Ayodele 1988).
(b) Leopard skin when mixed with black soap is said to provide extra strength for wrestlers and boxers.
(c) The skin of red-patas monkey is used to prepare talisman that enables one to disappear during mishaps, accidents and wars.
(d) Python teeth when mixed with other ingredients is said to cure snake bites

(e) Bush-buck bone is used in preparing the concoction that cures dizziness in children
(f) The Tail of squirrel is used by wrestlers in preparing talisman that preventing them from being floored during wrestling.

Wildlife has made a charming contribution to medical research in the world. Most of the advances in research have come through the studies of wild or formerly wild species of animals. Ayodele (1988) stated that most of the studies in biomedical fields are as a result of wildlife in the parks.

According to Ayeni (1992) medical laboratories make use of the living animals including a large number of rats and primates for the study of pathogens, new drugs are first tested on primates because their physiological processes are close to human (Ajayi 1979). Rhesus monkey has contributed towards an understanding of the human blood chemistry 1 group and the prevention of disease (Ayodele 1988).

Zeng (1985) also reported the use of the stomach, skin and bile juice of giant savamanda as tonics. Horse shoe – crabs have been used in fundamental research into vision and its clothing property is exploited in human blood testing.

Studies of animal behaviours reveal new insight into several knots encountered by psychologists in their study of the human mind (Dasmann, 1964). Studies on the territorial behaviour of wild animals in their natural surroundings have revealed useful information on studies of human population and aggression.

THE UTILIZATION PATTERN OF WILDLIFE RESOURCES

Utilization pattern and average prices of wildlife resources in Nigeria.

Description	Price/kg	Parts used	Main uses
Flying squirrels *Anomalurus beecrofti*	=N=2,000	Meat and Skin	Food and ornament.
Cane-rat *Thyronomys swinderianus*	=N=4,500	Fur, skin, whole, fresh carcass	Traditional medicine and food.
Bat *Eidolon helvam*	=N=600	Meat, claws and the whole	Traditional medicine and food

Tortoise *Testudo gigantiae*	=N=1,112	Meat, shell and the blood	Food, ornament and traditional medicine
Ground Pangolin *Manis gigantica*	=N=2,500	Scale and meat	Traditional medicine and food.
Tree Pangolin *Manis tricuspis*	=N=3,500	Whole and meat Meat	Traditional medicine and food
Bush baby *G. senegalensis*	=N=2,200	Fur and tail and meat	Food
Giant forest squirrels *Protoxeryx sp*	=N=4,115	Whiskers , feet and meat	Traditional medicine and food
Tree hyrax *Dendropyrax spp*	=N=950	Skull and skin and meat	Traditional medicine and food
Civet cat *Viverra civeta*	=N=6,110	Meat	Food
Genet cat *Geneta* sp	=N=5,100	Meat	Food
Sita tunga *Tragelaphus spekel*	=N=6,300	Intestine, head, gall skin and meat	Food
Python *Python sebae*	=N=80,000	Whole	Traditional medicine and food
Palm Squirrels *Expecerus ebil*	=N= 2,100	Teeth, fat, hair, and meat	Food
Warthog *Phacochoerus aethiopicus*	=N=15,150	Whole, fur, tail, teeth, skin and meat	Traditional medicine and food
Giant rat *Crycetomys gambianus*	=N=2,140	Skin and horn and meat	Traditional medicine and food
Hartebeest *Alcelaphus buselaphus*	=N=25,500	Skin, skull and gall meat	Traditional medicine and food
Chimpanzee *Pan troglodytes*	=N=100,000	Skin, and skull, meat	Traditional medicine and food

Mongoose *Ichneumia albicauda*	=N=15,000	Skull, skin, tail and meat	Traditional medicine
Mangabey monkey *Cerocebus torguates*	=N=10,000	Skull, skin, tail and meat	Traditional medicine and food
Red Patas monkey *Erythrocebus patas*	=N=25,000	Skull, skin, tail and meat	Traditional medicine, ornament and food
Mona monkey *Cercopthecus mona*	=N=21,000	Skull, skin, tail and meat	Traditional medicine, ornament and food
Green monkey *Cercopithecus aethipium*	=N=10,000	Skin, head, hind leg, skin and horn	Traditional medicine, ornament and food
Yellow backed duiker *Cephalophus sylvicultor*	=N=6,180	Skin, head, hind leg, skin and horn	Traditional medicine, ornament, food and making local drum
Maxwell duiker *Cephalophus maxiwelli*	=N=6,180	Skin, head, hind leg, skin and horn	Traditional medicine, ornament, food and making local drum
Red-flanked duiker *Cephalophus fufilates*	=N=6,180	Fat and gall meat	Traditional medicine, ornament, food and making local drum
Red river-hog *Potamochoerus porcus*	=N=10,150	Skin, and head/horn meat, skin and horn	Traditional medicine and food
Bush duiker *Traglopus scriptus*	=N=6,180	Skin, and head/horn meat, skin and horn	Traditional medicine, ornamentl, food and making local drum
Black duiker *Cephalophus niger*	=N=5,180	Skin, mucus, excreta, hoofs and horns meat	Traditional medicine, ornament, food and making local drum
Bufallo *Syncerus caffer*	=N=180,165	Bone, teeth, tusk and skin, bone excreta, and meat	Traditional medicine, ornament, and food
Elephant *Loxodonta Africana*	=N=190,000	Fluid, whole, meat shell	Traditional medicine, ornament, and food
African giant snail *Achatina sp*	=N=320	Skin, horn, and meat	Traditional medicine, ornament, and food

Kob *Kobus kob kob*	=N=5,160	Meat and eggs feathers	divination, ornamental and food
Guinea fowl *Numbea meleagris*	=N=2,250	Meat fur and skin	ornamental, food
Hare	=N= 1,150	Fat, whiskers, nails, fat meat gall skin.	ornamental, food
Leopard *Panther pardus*	=N=280,00	Feather, eggs, egg shell and meat	Traditional medicine, ornamental,
Francolin *Francolinus sp*	=N=1,200	Whole	For ornament, food, traditional medicine application tool.
Cat fish *Clarias* sp	=N=500	Whole	Traditional medicine and food
Electric fish *Malapterurs electricus*	=N=1,200		Traditional medicine and food

Some other significant uses of wildlife are as follows:

S/N	ORDER	SPECIES	PART USED	MEDICINE USE
1	Primates	Gorilla	Bone	Ingredient in concoction against diseases and witchcraft.
2	Proboscides	Elephant	Meat	Ingredient in medicine for immunity against diseases
			Bone	Good luck
3	Carnivore	Leopard	Bone	Protection against witches
			Skin	Witches use it for a respectful personality
4	Artiodactyla	Bush-pig	Head	Medicine for good luck
			Bone	Medicine to prevent illness in children when growing milk teeth
5	Insectivora	Pangolin	Spine	Medicine to effect safe delivery in pregnant woman
6	Rodentia	Gross cutter	Hair	In concoction for healing wound.
			Skin & Intestine	Mixed with black soap to bathe children against illness

CAUSES AND LOSS OF WILDLIFE SPECIES IN NIGERIA

Foreign Debt Servicing: The high levels of foreign debt has put pressure on governments to engage in a variety of agricultural and industrial practices which involve harvesting resources at unsustainable rate, with inevitable subsequent ecosystem devastation.

Over-Harvesting Intense harvesting can result in extremely rapid decline in species population. for example, over-harvesting of black rhinocerous, which is less that 20 years has been reduced from 70,000 to about 3,500 individuals.

Culture The influence of people's culture on the wildlife resources cannot be overemphasized. Eltringham (1984) reported that a man will only be allowed to marry after he must have killed a lion with spear in Masai tribe of East Africa. The effect that this would have on the population of the lion is better imagined.

Government Policies and Legislation: Ajayi (1994) reported that the alleviation of African from their wildlife, backed by repressive legislation with no respect for chiefs, rural communities and their traditional and cultural values has cut into the heart of long-held traditions and customs that were an integral part of African existence and, according to Muenya (FAO 1990), it dismembered the entire holistic philosophy underlying the structure of African life. Deprivation thus evoked a strong sense of injustice among the African rural communities who lived closest to wildlife to the extent that they resorted to poaching.

Total Ban on Exploitation One approach to elephant and rhinoceros conservation in Africa today is a total ban on exploiting these two species in order to suppress or eliminate trade in ivory and rhinoceros horns. The trade has resulted in the loss of 56 to 78 per cent of elephant population in East Africa and central Africa mainly to poachers (Ajayi 1994). He (Ajayi, 1994) reported that despite the total ban on wildlife exploitation, the more lucrative business of poaching is such a powerful incentive that the very government officials charged with the primary responsibility of protecting the wildlife sometimes become the worst criminals.

There are two principal arguments in support of the conservation of Biodiversity. Firstly, from a moral perspective, mankind has control of the renewable resources and should treat these resources wisely and with respect. Secondly, because these resources make numerous and valuable contributions to the well being of man, it is essential for mankind health and survival that we maintain them in a healthy condition. It is essential that governments, industry, commerce and people alike, all recognize that the destruction of Biodiversity (Species and ecosystems) has human and economic costs. Therefore, Steele (1994) suggested that our role should be that of a trustee who must ensure

that he does not pass onto future generations less than he has inherited.

Wildlife Conservation

Wildlife conservation is the sustainable utilization of the natural resources for the present generation maintained at national level for the future. The main aim of wildlife conservation is, therefore, to achieve three main objectives (NCF 1990).

(1) Maintenance of essential processes and life support system.
(2) Preservation of genetic diversity.
(3) Ensuring the sustainable utilization of species and ecosystem

Traditional conservation method

In the African setting, every locality or community has sets of traditional conservation laws and regulations commonly known as taboos. The floristic richness of a sacred grove at Ikere- ile (Nigeria) with farmlands (arable and tree crops) demonstrate the influence of traditional conservation methods aimed at allowing the earth to continually replenish itself. For example in some areas, forest groves were set aside by various communities for religious and other traditional rites. Many activities such as hunting, fishing, fuel wood gathering, etc were forbidden in such groves. Hagan (1997) listed seven traditional laws for the sustainable use of bio-systems as follows:

- Laws of exclusion prohibited entry in forests, lakes or rivers except at period of severe scarcity and critical needs.
- Laws of selective extraction protected certain species or prohibited the destruction and use of immature animals; pregnant animals were generally not killed for consumption.
- Laws for diversification of use are found in clan or community dietary taboos, so that whole communities might not over-exploit one or two crops or animals.
- Laws regulating exploitation, enforced by rites for closing and opening rivers, lakes and forest under constant use, enabled species varieties, ecosystems to regenerate and reproduce.
- Laws communizing "firing of land" in preparation for farming ensured that possible fire hazards can be contained.
- Laws protecting special species of plants and animals from misuse (certain trees could not be cut for fire wood) ensure high stock levels.
- Laws enforcing rites for felling of big trees and animals ensured the protection of big trees and animals and made the ecosystems around them safe; for several kinds of plants and animals that lived close to or around them to survive and thrive.

Many of these measures, have, however, now broken down. Under the impact of modern civilization and technological breakthrough, the strong bonds and linkages that exist between human life and the other living

creatures are breaking apart. The cultural bonds and linkages are demystified and demythologized. The direct bond between the societies and the sacred forests and groves are broken because the cultural forest and groves are no longer seen as necessary for survival. The sacred groves and mystical authorities of the traditional enforcement agents are treated with contempt (Hagan, 1997).

There are two forms of new wildlife conservation methods. These are Ex –situ conservation and In-situ conservation.

***Ex -situ* conservation** of wildlife is the management of plants and animals in a situation removed from their normal habitat. These are: zoological garden, gene bank, botanical garden, plant orchard, semen bank, ova banks or embryo banks.

***In-situ* conservation** is the management of live wild animal population in their adaptive environment or as close to it as is practically possible. Examples of such conservation areas are: National parks, game reserves, forest reserves, birds' sanctuaries.

PROBLEMS OF WILDLIFE CONSERVATION

- Problem of ownership and land tenure right and decree
- Hunting pressure and illegal poaching activity.
- Land use system and techniques, grazing, road construction industries, oil exploration.
- Illegal settlement and uses of resources.
- Lack of manpower.
- Suggested strategies of conservation.
- Creation of wildlife management services to review, and streamline the existing wildlife legislation
- Inventory of wildlife resources in the country.
- Encouragement of domestication
- Capturing, rearing of endangered species.
- Educative propaganda for appreciation for value of conservation of wildlife.
- Determination of ecological viability of existing and potential reserve.

Conservation of wildlife in Nigeria started formerly in 1916 when the Eastern Nigerian Government game law was created (Anadu, 1987). The subsequent game laws enacted by Western and Northern Regional Governments in 1928 and 1963 respectively were the preservation of the abundant wild animals for posterity. But the idea of creating game reserve in Nigeria was first suggested in 1932 at the end of surveys of wildlife resources in Nigeria and a few other West African Countries.

Nigeria's first Game reserve, Yankari was established in Bauchi province (now Bauchi State) in 1956, followed by the Borgu (now Kanji LNP) in 1959 in Niger State. Latest statistics revealed that there are 7 National Parks, 2 Wildlife Sanctuaries, 1 Game Sanctuary, 1 Water fowl sanctuary and 31 Game Reserves in Nigeria (NNPS. 1999).

Latest statistics revealed that there are 8 national parks, 2 wildlife sanctuaries, 1 game sanctuary, 1 water fowl sanctuary and 31 Game reserves in Nigeria. (NNPS. 1999)

Table 1: Protected Areas, Gazetted and Proposed in Nigeria

Project area	Area (ha)	Location	Year gazetted	State
1. Kainji Lake National park	534,082	9° 4°- 10° 3°'N $ 3° 30'- 5° 51'E	1975	Niger
2. Gashaka- Gumti National Park	630,300	6° 4°'n-80 20'N$ 1110'N-12° 10'E	1975	Gongola Adamawa andTaraba
3. Chard Basin National Park	228,000	13° 20' $ 14°00'E	1978	Borno
4. Cross River National park				
a) Northern sector	72,000	6° 20'N $ 9° 15'E	1991	Cross River
(Boshi/Okwangwo)	374,255	7° 45'N $ 4° 007'E	1991	Cross River
b)Southern sector (Oban Hills)				
5. Old Oyo National Park	251,200	8°44'N $ 3° 44'E	1991	Oyo
6. Yankari National Park	224,000	9° 30'N-10° 00'N $ 10°00'- 11° 00'E	1957	Bauchi
7. Orle River Game Reserve	110,000	0° 50' N $ 6° 36E	1960	Edo
8. Kwale Game Reserve	1,340	5° 43'N $ 6° 27'E	1960	Delta
9. Gilli Gilli Game Reserve	36,300	6° °5'N $ 5°20'E	1960	Edo
10. Falgore Game Reserve	92,000	11° 00'-11° 20'N $ 8° 33'- 8° 45'E	1969	Kano
11. Kambari Game Reserve	41,400	8° 48'N $ 10° 38'E	1969	Plateau
12. Dagida Game Reserve	29,400	9° 20'N $ 5° 31'E	1971	Niger

13. Alawa Game Reserve	29,600	10° 20'N S 6° 38'E	1971	Sokoto
14.Kwaiambana Game Reserve	261,400	10° 50'- 11° 50'N S 6° 00' 7° 00'E	1971	Sokoto
15 Pandam Wildlife Park	22,400	8° 31'-8° 40'N S 7° 50'-9° 00'E	1972	Plateau
16. Pai River Game Reserve	248,600	8° 09'N S 2° 50'E	1972	Plateau
17. Wase Game Sanctuary	186,500	9° 40'N S 10° 00'E	1972	Plateau
18. Ibi Game Reserve	158,000	8° 20'N S 10° 38'E	1972	Plateau
19. Nasarawa Game Reserve	190,000	8° 32'N S 7° 43'E	1972	Plateau
20. Lame-Burra Game Reserve	205,767	10° 27'N S 9° 75'E	1972	Bauchi
21. Wase Rock Bird Sanctuary	93	9° 04'N S 9° 58'E	1972	Plateau
22. Opara Game Reserve	248, 600	8° 09'N S 9° 53'E	1973	Oyo
23. Kashimbia Game Reserve	139,600	6° 40'N -8° 20'NS 11° 10'- 12° 10'E	1977	Gongola
24. Sambisa Game Reserve	68,600	11° 00'-11° 30' S 13° 30'-14° 30'E	1978	Borno
25. HadejiaBaturiya Wet lands	29,700	12° 27'N S 10° 13'N	1976	KanoUigawa
26. Okomu National Park	11.200	6° 21'N S 10° 13'E	1985	Edo
27. Kamuka National Park	120,000	10° 48 S 6° 18'E		Kaduna
28. Anambra Game Reserve	35,400	7° 16'-7° 24'E		Anambra
29. Ifon Game Reserve	28,200	6° 59'-7° 13'N $ 5° 43'-5° 53'E		Ondo
30. Meko Game Reserve	96,610	-° 27'N $ 2° 51'E		Ogun
31. Ebbe Ikempe Game reserve	11,730	8° 15'N $ 6° 00'E		Kwara
32. Jos Wildlife park	800	9°55'N $ 8° 45'E		Plateau
33. Omo Biospere Reserve	460	6° 30'N $ 4° 15'E	1949	Ogun

Factors Affecting Wildlife (animal) Population (Happold, 1987)

- Natality
- Mortality
- Weather
- Predation
- Parasite and diseases
- Competition.

Factors Influencing Numbers of Wild animals

- Food resources
- Shelter or cover (vegetation)
- Water
- Soil
- Salt licks
- Grazing
- Diseases
- Parasites
- Predation

Wildlife Ecology

Wildlife species are greatly influenced by the presence or absence of suitable habitats. The main types of habitat associated with the principal ecological zones in Nigeria are:

- Mangrove, High Forest, Low Forest, Derived Savannah, Guinea Savanna, Sudan Savanna, Sahel Savanna and Mountainous Zone (Hopkins, 1987).

(1) **Estimation of Wild Animal Abundance**

(a) Ground survey

(b) Aerial survey

(a) Ground survey - Total count over whole area.
- Total count on sample plots.

(b) Aerial survey- sampling by aircraft (i.e. Aeroplane or Helicopter)
- Aerial photograph with the aid of Satellite Imagery (SI) and Global Information System (GIS)

The methods used by wildlife scientists to carry out the above survey methods are:

(a) King census method
(b) Line or fixed transect method
(c) Stop check method
(d) Capture and recapture method
(e) Point Catered Quartered method
(f) Total count method

Indirect methods like spoor rates signs such as burrow, nests, droppings, dead individual, song, calls, foot prints and other significant presence of species within the ecosystem.

(2) **Absolute density/Relative density**

(a) Food Studies
(b) Watching wild animals feeding
(c) Raising game animals as pet in captivity
(d) By examining the food eaten after the animal has been killed.

Population of each species.
Relative density = Pi = Di
Ri x Ti
Di = Mean sample
R = Spoor rate per day
Ti = No of days.
Where Di = Ndi
Absolute density = P = AZ.
ZxY
P = Total population
A = Total area
Z = Number of animal seen,
X = Sighting distance
Y = Length of transact line.

Status of Wild animal

Every species and sub-species is recorded according to the new system of classification by IUCN (1996). Threatened; endangered; vulnerable; and extinct species. Other organizations responsible for wildlife management are:

IUCN - International Union for Conservation of Nature and Natural Resources for Flora and Fauna,
WWF - World Wide Fund for Nature,
NCF - Nigerian Conservation Foundation.
GEMS- Global Environmental Monitoring System
FORMECU- Forestry Monitoring Evaluation and Coordination Unit
FEPA- Federal Environmental Protection Agency
SEPA- State Environmental Protection Agencies
NRCC- Natural Resources Conservation Council
NEST- Nigeria Environmental Study/ Action Team
UNEP- United Nations Environment Program
UNCED- United Nations Conference on Environment and Development
TNC- The Nature Conservancy
SCB- Society of Conservation Biology
SER- Society for Ecological Restoration
WCU- World Conservation Union
NAEP- Natural Association of Environmental Professional
ISEE- International Society for Ecological Economics
UNDP- United Nations Development Programe
CAN - Conservation Action Network.

STATUS

Extinct

↓

Extinct in the Wild

Threatened

Endangered | Critically Endangered

——— | Vulnerable

Lower risk |

\- —— Conservation dependant

Near threatened

Least concern

Adequate data

Data Deficient

Evaluated

Not Evaluated

Common and Abundant

Domestication

Some domesticable species in the Tropics according to Amubode (1988) are as follows:

Cane rat	-	*Thryonomys swindarianus*
Giant rat	-	*Cricetomys gambianus*
Guinea fowl	-	*Numedia meleagris*
Duiker	-	*Cephalophus sp.*
Kob	-	Kobus kob
Snail	-	*Acharchatine achatina and Achartina maginata, etc.*

Some factors considered for domesticating a species are:

- Cultural attitude
- Religious acceptance
- Social norms and response
- Cost benefit analysis for domestication
- Ethological response like timid, aggressive and isolation
- Ecological parameters like home range, food, feeding habit, and population structure of species.

↓

FIELDS OF SPECIALIZATION IN WILDLIFE

1. Ecology
2. Ornithology
3. Herpetology
4. Eco-tourism
5. Protected Area Management
6. Extension Education
7. Wildlife Environmental Impact
8. Game Ranching and Domestication

REFERENCES

Anadu P.A. (1987) Progress in the conservation of Nigerias Wildlife *Biolo. Conservation 41,* PP237 - 252.

Cain, S.A. 1960. *Wildlife Management and the Customer.* Trans. N. Amer. Wild. Conf. 25: 472-481.

Clarke, C. H. D 1958. Autumn Thoughts of a Hunter. J. Wildl. *Manage*. 22(4): 420-427.

FDF (1982) A National Conservation Strategy for Nigeria 75pp. Ajayi, SS (1979) *Utilization of Forest Wildlife in West Africa* FAO Rome FO Misc. /79/26:76

Hagan, G. P. 1997 Traditional Laws and Methods of Conservation and Sustainable Use of Biodiversity. In: *Biodiversity Conservation*. Proc. Of the 3rd UNESCO / MAB on Biospher for Biodiversity: Anilalo, Atsiatome, L. D. and Fiati. C Eds E.P.A. 1998.

Hornaday, W.T. 1913. Our Vanishing Wildlife. New York Zoological Society, New York 411 p.

Longhurts, W.M. 1957. The effectiveness of hunting in Controlling Big.Game Populations in North America. *Trans. N. Amer. Wildl. Conf.* 22:544-569.

Lonnie, L. W, and Richard, D.T (1990) *The Role of Social Sciences In Wildlife Management* 1st Edition U.K Press PP 34 – 37

Mair, W.W. 1960. Natural Resources and American Citizenship: A Critique of the 25th North American Wildlife and Natural Resources Conference. *Trans. N. Amer. Wildl. Conf.* 25:487-496.

NCF (1990) Nigerian Conservation Foundation *News Letter for Publication and Relation Office V4 No 12 1990* PP 32 .

NNPS (1999) Nigerian National Park Service, Official Diary and Bulletin 1999-2000 release

Onadeko S. A. (2004) Home on the Range: Crises, Consequences and Consolations. Inaugural Lecture delivered at UNAAB; Series No 17, On behalf of Department of Forestry and Wildlife Management, College of Environmental Resources Management (COLERM) 2004. pp86.

Packard, V. 1957. The Hidden Persuaders. Pocket Books, New York.

Peterle, T.J. 1961. The Hunter Who is he? *Trans. N. Amer. Wildl. Conf.* 26:254-266.

Shea, J. P. 1948. A new approach to farmer-sportsmen cooperation. *Trans N. Amer. Wild. Conf.* 13:163-169.

Swank, W.G. 1966. Our Hunting Heritage, Part 1. *Wildlife Views,* Arizona Game and Fish Dept. 13 (2):8-9.

Tillett, P. 1963. *Doe Day: the Antlerless Deer Controversy* in New Jersey, Rutgers University Press, New Brunswik, New Jersey 126p.

9

PRINCIPLES OF LIVESTOCK, FISHERIES DISEASE PREVENTION, CONTROL AND PUBLIC HEALTH

Adedeji O.B., Olatoye I.O., Adetunji V.O., Eyarefe O.D. and Lasis O.T.

Introduction

The word disease refers to any structural or functional deviation from the normal in the system of an animal. Livestock diseases have direct and indirect impacts on health, socioeconomic and wellbeing of humans. Diseases reduce the amount of livestock products available as animal protein which can lead to malnutrition (kwashiorkor and marasmus) while some animal diseases are also transmissible to human beings via direct contact or their food products (zoonoses). Livestock producers, pets owners, veterinarians, processors, retailers and consumers of food of animal origin are all crucial in the surveillance efforts of these diseases. More so, in this age of globalization, most diseases do not respect geographical boundry (transboundary animal diseases) and hence the national and global surveillance efforts of World Health Organization (WHO), *Office des Internationalle Epizooties* (OIE) and Food and Agriculture Organization (FAO).

Basic Definitions of Disease Terminologies

a. *Communicable disease*

This is an illness due to a specific infectious agent or its toxic product which arises through transmission of that agent or its products from a reservoir to a susceptible host either directly as from an infected person or animal, or indirectly through the agency of an intermediate plant or animal host, vector or the inanimate environment.

b. *Allergen*

This is any specific substance that, if inhaled or got in contact with the body, will cause hypersensitivity (allergy); e.g. inhalation of hay or other plants, pollens, dog or cat hair particle, horse, cow or sheep dandruff, etc. Allergy shows itself in some ways through swelling appearing all over the body or face, fever, watery nose and eyes, sneezing, etc.

c. *Communicable period*

The time or times during which the infectious agent may be transferred directly from an infected person to another person from an infected animal to man, or from an infected man to animal is called the communicable period.

d. ***Incubation period***

This is the period between the time one contacts a disease agent and the time the disease shows itself clinically. (Note that contacting a disease agent does not necessarily result in clinical manifestation of the disease or infection)

e. ***Epizootiology***

This is the study of the occurrence and spread of a disease in populations in order to control it. Population is the complete collection of individuals that have some particular characteristics in common.

f. ***Case fatality rate***

This refers to the number of people that died per 100 cases of a disease.

g. ***Carrier***

A carrier is an infected person (or animal) that harbours a specific infectious agent in the absence of discernible clinical disease and serves as a potential source of infection for man. The carrier state may occur in an individual with an infection unapparent throughout its course (commonly known as health carrier) or during the incubation period convalescence and post-convalescence of an individual with a clinically recognizable disease (commonly known as incubatory carrier or convalescent carrier). Under either circumstance, the carrier state may be of short duration - temporary carrier) or long duration (chronic carrier).

h. ***Antigen***

This is a substance that is capable of inducing specific immune response, e.g. Yellow fever vaccine.

i. ***Reservoir of Infectious Agents***

This refers to any human beings, animals, arthropods plants, soil or inanimate matter in which an infectious agent normally lives and multiplies and on which it depends primarily for survival, reproducing itself in such manner that it can be transmitted to a susceptible host.

j. ***Fomites***

These are inanimate objects or personal articles, e.g. handkerchief, drinking glass, clothing, toy, your pen and pencil.

k. ***Isolation***

The separation for the period of communicability of infected persons or animals from others in such places and under such conditions as will prevent the direct or indirect conveyance of the infectious agent from those infected.

l. ***Cyclicity***

Seasonal recurrent alterations in the frequency of disease implying a link between the activity of the underlying cause and some aspect of season, e.g increase in respiratory diseases in winter or during rainy season.

m. ***Etiology***

This is the study of the causes of a disease

n. ***Prognosis***

This refers to the outlook with regard to the outcome of an illness, e.g complete recovery, partial recovery or death.

o. ***Pathogenic***

This is an agent, usually infectious, and capable of causing disease.

p. ***Herd immunity***

This is the resistance of a group to invasion and spread of an infectious agent based on the immunity of a high proportion of individual members of the group.

q. ***Complete quarantine***

This is the limitation of freedom of the movement of such persons or domestic animals that have been exposed to a communicable disease for a time not longer that the longest usual incubation period of the disease, in such manner as to prevent effective contact with those who had not been exposed to such communicable disease.

r. ***Prophylaxis***

The prevention or preventive actions taken prior to the onset of disease is known as prophylaxis.

s. ***Chemotherapy***

This is the use of a chemical to cure a clinically recognizable infectious disease or to limit its further progress.

t. ***Chemoprophylaxis***

The administration of a chemical, including antibiotics to prevent the development of an infection or the progression of an infection to actively manifest infectious disease.

u. ***Infestation***

For persons or animals, the lodgement, development and reproduction of arthropods on the surface of the body or in the clothing. Infested articles or premises are those, which harbour or give shelter to animal forms, especially arthropods and rodents.

v. ***Immune Individual***

A person or animal that has specific protective antibodies or cellular immunity as a result of previous infection or immunization, or is so conditioned by such previous specific experience as to respond adequately to prevent infection and/or clinical illness following exposure to a specific infectious agent. Immunity is relative: An ordinarily effective protection may be overwhelmed by an excessive dose of the infectious agent or by exposure through an unusual portal or entry; it may also be impaired by immunosuppressive drug therapy, concurrent disease, or the aging process.

w. ***Infected Individual***

A person or animal that harbours an infectious agent and who has either manifest disease or in apparent infection is an infected person. An infectious person or animal is the one from whom the infectious agent can be naturally acquired.

w. ***Infection***

Infection refers to the entry and development and multiplication of an infectious agent in the body of man and animal. The result may be inapparent (sub-clinical) or manifested (clinical).

x. ***Contamination***

The presence of an infectious agent on a body surface; also on or in clothes, bedding, toys, surgical instruments or dressings, or other inanimate articles or substances including water and food. Contamination on a body surface does not imply a carrier state.

Disease Prevention, Control and Eradication

The application of the various measures to exclude diseases from an unaffected population is known as **disease prevention**. It is the first line of defense against disease. While measures directed in reducing the frequency of existing disease to a level where the infection no is of no significant public health or economic consequences are

termed **disease control**, efforts directed at eliminating the disease agents from a geographical area are termed as **disease eradication**. These measures are usually applied either at the individual animal level or at population level; and can also be at local (e.g. farm), national or global levels. The general features of a disease that enable appropriate intervention include; (a) the existence of sufficient detriment that eradication is considered economically justifiable, (b) the existence of features that enhance easy detection and surveillance and (c) the existence of at least one tool that is effective in altering disease transmission.

Reasons for disease prevention and control

(i) Mortality: Disease may cause premature death of animals and this can have devastating effects both on individual families and on the entire country, especially when such animals are of high mortality during their peak of production.

(ii) Reduced Productivity: The presence of a disease causes reduction in yield and quality of products and thereby leads to decreased availability of animal products, decreased availability of animals for transport, for games, for companion in the case of pets such as dogs and cats and for clothing (in some parts of the world).

(iii) **Disruption of herd structure and productivity** (population dynamics). When a disease results in high rate of premature death or involuntary culling, the herd will often have a lower productivity and economic returns. In a dairy herd, this may have negative effects on productivity because diseased animals will not remain in the herd long enough to adequately achieve their full genetic production potential which occurs at approximately the fifth lactation. Another effect of culling is increased demand for and hence high cost of replacement animals as well as increased risk of introducing disease to the farm.

(iv) Public Health: Diseases of animals affect human and animal welfare. Zoonotic diseases such as rabies, tuberculosis and trypanosomiasis can directly affect human health. The health of animals particularly if they are pets can have significant impact on the mental and physical health of man. In addition, using various chemicals to combat animal pests and diseases can result in residue in edible animal products such as meat, milk, eggs or the environment that may directly affect human health by causing anaphylactic reaction in man to antimicrobial agents or indirectly by causing increased resistance to antibiotics. Antibiotic resistance is a major global health concern due to misuse in both humans and animals.

Transmission of Diseases

The three common methods of transmission of infectious agents to animals are by contact, vehicle, and vector. The understanding of these methods is crucial to the adoption of appropriate strategies for the prevention, control and eradication of diseases.

(i) Contact transmission - Direct contact denotes physical contact between the infected and susceptible individual whereas indirect contact transmission denotes a contact between the infected and susceptible individual by means of fresh secretions, e.g. Leptospiral organism in

urine, contaminating drinking water or by means of aerosol droplets resulting from coughing or sneezing. Contact with recently infected litter in poultry is usually a more important means of transmitting coccidiosis and Newcastle diseases.

(ii) Vehicle transmission - It involves inanimate substances, e.g feed, water, dust and equipment. Vehicular transfers can be mechanical or biological. Mechanical transmission involves physical medium of transfer to the host, e.g. truck tyres contaminated with Foot and Mouth disease virus and poultry feathers contaminated with Newcastle disease virus, while in biological vehicle the agents undergo further development or multiplication in the medium. An example would be the transmission of bacterial in milk.

(iii) Vector transmission - It denotes invertebrate animal carrying infectious agents between vertebrates. Such transmission can be purely mechanical, e.g. the transmission of equine encephalitis virus by mosquitoes; or biological, e.g. the development of the larva stages of the dog earthworms *Dirofilaria imitisin by* Culex species of mosquitoes which must occur for the larvae to become infective to animals or man.

Disease prevention and control strategies

Several factors contribute to the occurrence, distribution and spread of diseases. Hence, there is more than one approach to prevent or control a disease. Common disease prevention and control measures are aimed essentially at some or all of the following: (a) destruction or removal' of disease-causing organisms or condition (e.g. nutrition) in the environment; (b) interference with the possible transmission of disease agents to susceptible animal hosts; and (c) making the animal hosts to be resistant to disease-causing agents. Strategies employed in disease prevention and control include;

(i) ***Management and husbandry***

Good husbandry and management practices are the primary and crucial aspects of disease prevention. Sound husbandry practices reduce stress on the animals, thereby reducing possible host susceptibility to infections. Good husbandry practices include:

(a) stocking of the foundation and replacement animals that are free from genetic abnormalities or vertically transmitted infections;
(b) isolation of all newly purchased animals separate for some days under veterinary supervision before they are mixed with the old stocks;
(c) adequate ventilation and consistent temperature and avoiding draft and excessive humidity; and
(d) avoiding overstocking by allowing adequate floor space per animal.

ii. ***Reduction of contact***

Disease prevention and control can also be achieved by reducing or preventing physical contact between infected and non-infected animals via aerosol, physically barriers (solid partitions pens or by building separate facilities). All-in and all-our system of husbandry in poultry, swine, feedlot cattle and fish production ensures that new stock does not have any contact with the old and possibly diseased stock. Adequate ventilation in the building is necessary to reduce aerosol transmission in intensively housed poultry, swine and cattle systems.

iii. ***Modification of host resistance***

The resistance of the host to infection may be modified by increasing genetic resistance, e.g. selecting strains of poultry resistant to Mareks disease; and transfer of passive immunity, e.g. ensuring that all newborn animals are fed the colostrum within the first three days of their delivery - stimulating acquired resistance, e.g. through mass vaccination.

Vaccination in modern usage is synonymous with immunization. Immunization is the art inoculation of an animal with living or dead antigenic preparations in order to protect it against attacks of some specific diseases. Vaccination programs are developed for different animal species to offer protection during their lifetime against prevalent or emerging diseases. Table 1 shows examples of such programs.

Disease	Route of vaccination	When to vaccinate
Cattle		
Rinderpest	Sub-cutaneous	Annual but immunity May last 5 years
CBPP	Sub-cutaneous	Annual
Anthrax	Sub-cutaneous	Annual
Black quarter	Same	Annual
Haemorrhagic Septicaemia	Same	Annual
Sheep and goats		
Kata	Intramuscular	Annual
Poultry		
Newcastle	intra-occular and in drinking	Day old and Lasota on 8-10
Mareks	sub-cutaneous or intra-Booster	days and Lasota
	Muscular	28-30 days. Day old
Gumboro	In drinking water	8-10th day and 4th week
Fowl cholera	Sub-cutaneous	10th week
Fowl typhoid water	Sub-cutaneous	12th week
Fish	Vaccination of fish could	Varies
Bacteria cold water Disease	be by immersion, or through	
Vibriosis	intra-peritoneal or	
Enteric Redmouth and other entero-	sub-cutaneous injection. bacterial infection	

iv. Quarantine of suspected animals

This is the enforced physical separation from the healthy population of infected or potentially infected animals, their products or items that they have contaminated. For example imported cattle are usually placed in quarantine stations for a defined period prior to being released to the owner to ensure that through clinical and or serologic monitoring, they are not infected with such diseases as rinderpest, contagious bovine pleuro-pneumonia and foot and mouth disease. Similarly, dogs are usually quarantined for a period to ensure that they are free of rabies before admitting them into most countries. To be effective, the period of quarantine must exceed the usual incubation periods of important diseases for the species.

v. Use of chemical

Disinfection may be used to reduce risk of transmission of infectious agents, e.g. the use of formaldehyde between batches of eggs in hatcheries. Pesticides may be used to reduce or eliminate vector populations and hence aid in the control of disease, e.g. dipping of cattle into arsenic or organophosphate compound against tick and fleas. Drugs such as sulphonamides applied to drinking water of poultry prevent or control coccidiosis, anthelmintic drugs are also administered to eliminate intestinal worms in animals; while antibiotic therapy using Chloramphenicol, furpirinol, oxytetracyline, sulphamerazme are efficacious in treating diseases in animals and fish. Malachite green, copper sulphate, prydylmercuricacetate (PMA) and potassium permanganate are anti-parasitic agents that are common chemicals used in fish pond management against diseases.

Safety precautions are required for administration of chemicals and drugs usually under the prescription and supervision of veterinarians to prevent toxicity to the animals, resistance by the disease agents, drug residues in meat, egg and milk as well as human health dangers to people handling the chemicals.

vi. Environment health, sanitation and hygiene

Most diseases result from an ecological imbalance between the host and its environment. If the environment can be altered to reduce the severity or likelihood of such imbalances, the result will be a reduced level of disease.

Examples of such measures include improving the ventilation and lighting in an animal house. Environmental hygiene also includes the physical cleaning of animals and their environment which may be combined with the use of disinfectants. It also includes such management schemes as pasture rotation.

The aquatic environment also plays a vital role in disease prevention and control in fish husbandry since the host and the parasites are both found in the same environment. The water must be free of pollution, with the physico-chemical and biological characteristics such as temperature, dissolved oxygen, nitrite concentration, turbidity, alkalinity and carbon dioxide concentration that may affect the survival, growth and reproduction remaining at the normal range. The control of such diseases as fin rot, vibriosis and columnaris disease is best achieved by routine pond management such as the

maintenance of water quality, low dissolved oxygen and high ammonia levels, good husbandry and low stocking densities.

vii. ***Slaughter of infected or suspected animals***

This is the deliberate killing of infected, susceptible, or contact animals in an attempt to stamp out disease and prevent it from spreading to a healthy population. This can be done selectively (on an individual animal basis) or by complete depopulation (on a herd/flock or area basis). Selective slaughter has been used in a number of campaigns against animal disease. This involves a method of case finding, usually by means of an immunological screening test, and then the killing of test-positive animals; hence the name test and slaughter, e.g in the recent case of Mad cow disease in Europe. The main disadvantages of this approach include high cost as well as the risk of environmental pollution since the carcasses are either burnt or buried very deep with at least six feet of soil above the carcass.

viii. ***Biological Control***

This control method utilizes living things that are considered to be reasonably nondetrimental to control disease causing agents. The measures may be aimed directly at agents of disease, or indirectly via control of vectors or reservoir populations. Example includes the use of sterile male flies to control screwworm disease in cattle in the southern United States. Male flies are grown in large numbers in captivity, sterilized by irradiation and then released to alter the reproductive cycle of the fly. Since the females mate only once, mating with an irradiated male leads to no offspring and hence a subsequent reduction in numbers of adult flies.

The incidence of Columnaris disease of fish might even be reduced by adding significant number of competitive bacteria like *C. freundi* to susceptible fishponds.

ix. ***Extension education***

Enlightenment of livestock farmers and the public in general on the need for disease recognition and the various ways to prevent or control them begins with their notification of appropriate animal health experts and authorities. Education of the public usually through veterinary extension services should, therefore, be an integral part of disease prevention, control and eradication efforts. Extension education helps to drastically reduce the economic and social impact of epidemic diseases especially the zoonotic infections. In veterinary practice, there are several classic examples where educational programmes have been integral parts of disease control programs. These include the campaign to eradicate rinderpest in 1962-72, rabies in 1982, recent efforts against African swine fever in 1999- 2000 and avian influenza in 2006.

Common Ruminant Diseases: Causes, Prevention and Treatment

A. Simple Indigestion in Cattle: This is caused by a sudden change of diet, consumption of excessive quantities of finely chopped straw or indigestible food.

The condition is characterized by immobility of gastrointestinal tract, which is manifested, often by lack of defecation. Avoiding excessive finely chopped straw or sudden change of food could prevent this condition. The veterinarian should be contacted whenever the condition occurs.

B. Mastitis in Cattle, Sheep and Goats: This is the inflammation of the mammary gland. Many infectious agents like *Streptococcus beris, S. dysgalactiae* and *Coryrebacterium pyogenes* in cattle cause it.

In sheep, some infective agents implicated *include Pasteurella haemolytica Escherichia colt* and *Staphylococcus aureus.*

Mycoplasma agalactiae and Streptococcus agalactiae.

Features of the disease include; discoloration of milk in form of bloodstained or a wateriness accompanied by clots of flakes.

This condition can be prevented and controlled by:

- Treating all affected cows at dry off period.
- Treating all clinical cases as they occur.
- Culling chronically affected animals.
- Dipping the teats of animals after each milking especially in cattle.
- General hygiene of all milking utensils and personnel.

C. Tetanus: This disease is cause by *Clostridium tetani.* It is manifested as limb stiffness which is followed by muscle tremor, lockjaw, prolapse of third eye lid, marked hyperesthesia, bloat and wide stance. Prevention can be achieved by:

Proper skin and instrument disinfection at castration, docking and shearing time. These operations are supposed to be carried out in clean surroundings. Actively immunizing all susceptible animals in enzootic areas, vaccinating newborn lambs.

D. Salmonellosis: This is a disease caused by various infectious agents such as *Salmonella dublin, S. typhimurium and S. abortus ovis.* It is characterized by inflammation of the gastrointestinal tract, which is followed by dysentery with whole blood being passed in large clots and lack of milk in lactating ruminants. There is also abdominal pain, rolling and groaning. Prevention is by:

Preventing carrier animals from entering the farm. Avoiding contaminated foodstuffs, especially, feeds of animal origin. Emphasizing vigorous disinfections of the farm. Supplying water in troughs without faecal contamination.

E. Liver Fluke Disease: Members of worms called Fascioloides and Dicrocoelium generally cause this condition. In Nigeria, the commonest causative agent is Fasciola gigantica. There are three forms of this disease: acute, sub-acute and chronic type. Features include death without clinical signs, dullness, weakness, lack of appetite, weight loss, submandibular oedema (bottle jaw) and shedding of wool. Prevention can be

achieved by: Provision of balanced nutrition. Vaccination of all animals in enzootic areas. Control of the host snails in the environment.

F. Pimply Gut Disease: This condition is caused by the infestation of animals with worms of *Oesophagostomum* species. In cattle, the worm is O. *radiatum* or O. *venulosum*. In sheep and goats the worms are O. columbianum, O. *venulosum* and O. *asperum*. This condition is seen in affected animals as emaciation and the passage of soft stool with lots of mucus. The major losses are caused by failure to thrive. The damage done to intestines of affected animals, by the presence of necrotic nodules, renders them unsuitable for use as sausage casings.

G. Hook Worm Disease: This is a disease caused by infestations with hookworms, which are usually small reddish roundworms, which inhabit the small intestine of their hosts. In cattle, *Bunostomum phlebotomum* is the most important hookworm. In sheep and goats *Bunostomum trigonocephalum* and *Gaigeria pachyscelis* are important hookworms.
The worms cause poor growth and blood loss manifested by anemia and generalized mild abdominal pain, prostration and death in 2-3 days. Prevention of this condition is always by avoiding wet surroundings in pastures, yards, and barns. Also, pens should be cleansed frequently and ample bedding provided. Avoid heavy stocking of sheep and calves in small pens.

H. Haemonchosis: This disease causes heavy death losses, poor growth and decrease production in ruminants. In sheep, losses occur mostly in lambs, especially those recently weaned, but matured sheep may also be affected. Poor growth in lambs results from a heavy infestation with the worms.
Haemoncus contortus is the most common species in sheep and goats. However, in cattle H. *placae* is the most common. This organism inhabits the abomasum. In acute form of the disease, lambs and young sheep are found dead without premonitory signs. Other signs observed include lethargy and muscular weakness, pallor of conjuctivae, and generalized oedema especially under the lower jaw and vertical abdomen. Most cases have (constipation rather than diarrheoa).
Prevention is by: Avoidance of pasture contamination by affected animals and Improved plan of nutrition for young and adult animals on the farm.

I. Foot and Mouth Disease: This is a disease characterized by fever and vesicular eruptions in the mouth and on the foot. It is an extremely contagious, disease of cloven B footed animals. The causative organism is a virus with many strains differing from one geographical location to the other. Cattle are the most susceptible species while sheep are not. Clinically, the onset of infection is heralded by a fall in milk production and a high fever. There is also dejection and loss of appetite followed by pain due to the inflammation in the mouth. Hence the animal salivates profusely. Also simultaneously, vesicles appear on the feet.

Consequently, there may be abortion in female animals. Prevention of this condition is by: Vaccination using the killed trivalent vaccines for all animals in the affected farm.

Slaughter policy may be applied to the farm where the disease has been diagnosed to prevent spread to other farms. A complete embargo may be placed on the importation of animals and animal products from the countries where the disease is enzootic. Control the movement of personnel from other farms to your farm.

J. Rinderpest: The causative organism of this disease is a morbilli virus. The condition is an acute, highly contagious disease characterized by high fever and erosion of the mucosa of the alimentary tract. Historically, rinderpest has been one of the most devastating diseases of cattle. Loss of appetite, a drop in milk yield, lacrimation and a starring hair coat, nasal discharges and diarrhea are some of the clinical features of the disease.

Prevention of this condition can be achieved by:

Periodic vaccinations of all susceptible livestocks.

Complete elimination of all affected animals.

Treatment is not advisable, to avoid danger of disseminating the disease.

K. Viral Diarrhoea of Calves, Lambs and Kids: The disease is marked by a sudden onset of profuse diarrhoea with pale yellow, mucoid faeces. The most commonly involved viruses are rotavirus and Corona virus. Recovery may occur in a few days. The prevention is by: Minimizing the degree of exposure of the newborn to infection agents by adequate management of pregnant animals at the time of parturition, avoiding overcrowding of pen, Maintenance of good sanitation, andVaccination of the newborn, and dams during pregnancy.

There is no specific therapy for this disease. Veterinarians can be contacted to treat possible presence or occurrence of enteric and systemic bacterial infections.

L. Orf Disease of Sheep and Goats: This is a highly infectious viral disease, which is manifested by the development of pustules and scabby lesions on the muzzle and lips.

This disease also occurs in humans working among infected sheep and among a battoir worker.

Prevention of this disease is by isolation and treatment of affected animal and vaccination of the remaining ones.

M. Kata of Goats and Sheep: This is an acute, highly contagious viral disease manifested by fever, loss of appetite, nasal discharge and respiratory distress. The clinical disease resembles what is observed in rinderpest disease of cattle except that severe respiratory distress is very common in Kata. Prevention could be affected by:

-Prevention of new stock from being introduced to existing stocks especially when the new animals are just purchased from a livestock market.

-By vaccination.

N. Diseases caused by trypanosome: Trypanosomes are protozoa parasites transmitted principally by Glossina species of tsetsely.

The disease is caused by: *Trypanosoma brucei, Tcongolence, Tvirax* and *Tsimiae; evansi; T. equipadum,* and *T cruzi,* in ruminants and pigs, horses and camels, and in dogs and humans respectively! Intermittent fever, dullness and visibly swollen lymph nodes characterize the disease. Prevention of trypanosomosis in enzootic regions involves control of tsetse fly population, prophylactic treatment of susceptible animal and use of trypano-tolerant animals.

Diseases of Poultry

Avian Influenza
Newcastle Disease
Gumboro Disease
Avian Salmonellosis
Coccidiosis

Diseases of Pigs

A. Porcine Salmonellosis

This is a disease caused by a bacterium called *Salmonella cholera suis.* A dark red to purple discoloration of the skin is evident especially on the abdomen and ears and subcutaneous petechial hemorrhages may also be visible. Nervous signs including tremor, weakness, paralysis and convulsions may be prominent and occur in a large proportion of affected pigs.

Prevention of this condition requires:

Avoidance of dealer yards, sale yards and public transport.

Ensure that the farm origin is free of salmonellosis.

Introduce only those pigs guaranteed not to be carriers.

And if possible, purchase animals when they are older.

The treatment causative organism in this condition is *Pasteurella multicida.* Affected pigs have fever, lose appetite and appear dull. They show significant respiratory distress with laboured respiration, often breathing through the mouth.

Vaccination has no proven efficacy to prevent this condition.

Transmission requires close pig to pig contact. If transmission can be prevented, it is possible to limit or even eradicate the disease from a herd.

Pests Control in Farm Animals and Stored Animals Products

A pest includes animals and insects that are extremely hurtful, annoying, troublesome, harmful or destructive to man and his environment. Pests are of economic importance to man because they are destructive. Pests are also of public health importance because they spread diseases to man and his animals, and also reduce the productivity and aesthetic values of farm animals and stored animal products. The various types of pests include rodents, flies and other insects, birds, ticks and fleas.

Rodents (rats and mice)

Rodents are a big problem in pest control and constitute a serious hazard to man and animal. Examples are (i) Brown rats, (ii) Grey rat (Root rat), (iii) Black rat *(Rattus rattus) and* (iv) House mouse *(Mus mitsculus)*. A rodent borne disease, the bobonic plague, has killed more human beings than all the wars in history. The plague of 142 A. D. killed 100 million people. That of 1346 A. D. claimed 25million lives and the third pandemic plague 1898 -1948 killed more than 12 million people in India alone. Other effects of rodents are:

(a) They are reservoir of many diseases, which are spread to man and animals, and they also help in the spread of lice, fleas, tick and mites, which by the bites on man and animals, spread diseases.

(b) They damage buildings and start fires by damaging electric wires.

(c) They eat or spoil farm grains. A mature rat may eat about 45kg of grains and spoil or waste about 70kg of grains annually.

(d) Rodents will kill baby chicks or even mature birds.

(e) Rodents, e.g rat are highly prolific. They mate at 3 months of age and have a gestation period of 21 -23 days. The litter size is between 6 -12 young and is weaned at 4 - 6 weeks. Their high numbers due to high proliferation constitute a nuisance in the environment.

Public Health Importance of Rodents (Diseases Spread by Rats)

a) Rat-bite fever: This is primarily an infection of rats caused by *Streptobacillus moniliformis (Streptobacillosis) and Spirillum minus/minor (spirillosis).*

b) Food poisoning: Food spoiled by rats is always potentially dangerous to human or animals consuming it. Rat faeces, urine and hair contains microorganisms capable of causing disease in man and animals

c) Lassa fever: Caused by lassa virus. The multimammate mouse *(Mastromys natalensis)* is the reservoir of this lassa virus.

d) Murine typhus: This disease is transmitted from rat to man by means of the rat flea *(Xenopsylla cheopts).*

e) Tularemfa: Is a zoonotic bacteria disease caused by *Pasteurella tularensis.* Rats may contaminate community water with the organism.

f) Leptospirosis: Primarily a disease of dogs. The notable reservoirs are rats. It is characterized by sudden onset of fever, headache, chills and conjuctival suffusion.

g) Plague: A serious disease of man caused by *Pasteurella pestis* transmitted from rats and other rodents to humans by means of infected fleas.

Control of Rodents

The best means of control of the pests is to prevent breeding through sanitation. In attempting to control rats and mice in a place, a survey of the infested premises or building is paramount to assess the extent and size of infestation, breeding places, openings whereby the rats enter the building and the species concerned. All this information will determine the method of control to be employed. This information can be determined by:

(i) Trapping and catching the rodents to verify the type.
(ii) Examination of droppings (faeces) - faeces of roof (black) rat is in small firm masses while that of brown rat is longer and bigger with blunt ends.
(iii) Locating runways and tracks, which are travel routes for rodents. Laying of patches of powder may help to find the tell-tale footprints and tail marks.
(iv) Identifying the mode of gnawing - mouse eats food item from the middle while rats eat from one end. Fresh gnawed surfaces can be used to estimate the time of appearance,
(v) Others - rat odour and use of cats and dogs to probe the area are other means of survey.

The several methods of rodents control are: Sanitation (bush clearing and proper cleaning), Physical methods (rat-proof construction and trapping), Biological control (cats, dogs, ferrets, etc are effective in destroying rodents), Electric devices (the use of ultrasonic sound to distract rats) and chemical (the use of pesticides or rodenticides)

Flies and Other Insects

Flies belonging to the order Diptera, a large complex order of insects. Most members of the order have two wings as adults. Flies are a nuisance and a problem in almost every part of the world and serve as vectors of diseases to both man and animals. Flies are attracted to meat and meaty smells, hence the need for their control in and around our premises. Examples of flies and insects include Housefly *(Musca domestica),* Tsetse fly *(Glossina spp)* Mosquitoes *(Aedes africans; and Anophelis spp)* fleas (Pulex irritans), Cockroaches *(Periplaneta spp)* Ham and Hide Settles *(Pioptila easel; Dermestes ater).*

Importance of Flies and Insects to Animals,

Housefly *(Musca domestica)* -Transmits diseases to farm animals. Solids are dissolved by saliva, which the fly ejects into food. The saliva will contain bacteria and other microorganisms from a previous meal and hence it will contaminate food.

Tsetse fly *(Colossina spp)*- Transmits *Trypanosoma gambiense* and *Trypanosoma brucei,* causing sleeping sickness to man and *trypanosomiasis* to farm animals.
Fleas *(Pulex irritans)* - Fleas suck blood of animals and poultry, and also transmit diseases.

Cockroaches *(Periplaneta spp)* - Destroy food and water supplies and contaminate them with disease agents like Salmonella, Clostridia and Staphylococci that may lead to serious outbreaks of food poisoning.

Ham and Hide bettles (Pioptila easel; Dermestes ater) - Lay tiny white eggs over the surface of exposed meats (cured or smoked pork). Cheese may also be infected. The holes created in meat lowers the economic value. The adult fly has been shown to carry *Clostridium botulinum* spores to contaminate food. The *Dermestes spp* lay eggs on dried meat and fish to spoil them.

Myiasis

The migration of larvae of flies in subcutaneous tissues of the skin or organs/ tissue produces a condition called myiasis. There are two types of myiasis based on degree of host dependence

(i) Facultative myiasis - The fly larvae are free living (do not depend on host)
(ii) Obligatory myiasis - The fly larvae are dependent on host i.e. complete parasitic dependence on host to complete the life cycle.

Based on areas of body attached, myiasis can be divided into 3 types

(i) Cutaneous myiasis
(ii) Myiasis in cavities of the body
(iii) Tissue myiasis

Insect Control

(1) Breeding sites of flies (insects) should be destroyed, i.e. burn vegetation, bury rubbish, cover drains etc.
(2) Control of fly entry into premises building by putting screens on doors and windows and using bait traps to attract and destroy flies in the environment. Darken doorways should be lighted with light trays or electricity; self-closing doors and air curtains can also be used.
(3) Control of flies inside buildings by avoiding small crevices for pests like cockroaches. Use of air curtains, electrocuters (should be mounted high and away from meat cutting area) and the use of approved insecticides.
(4) The application of chemical insecticides is one of the most common ways of fly control.
(5) Biological control:

Chemical control of flies and insects involve the use of insecticides that are classified as;

(A) Non-Residual insecticide-Ideal for edible processing areas.
(a) Pyrethrium (plant extract) - Have a good knockdown effect and its safe.
(b) Allethrin (synthetic type of pyrethrium) Inferior in action to pyrethrium in controlling crawling insects.
(c) Residual insecticides - These are used for other areas including the outside of building, drains and garbage breeding sites. They include Chlorinated Hydrocarbons, D.D.T. (outdated in advanced countries), B.H.C. (Lindane), Chloridane, Aldrin and Dieldrin

(B) Organic-phosphate

a) Diazinon - useful, but resistance by insects is developing
b) D.D. V.P. - short life with high vapour pressure (evaporate quickly). Useful in specific circumstances, e.g. Bird mites.

c) Malathion - Apply as spray or dust to waste areas at 2 - 5% solution.
d) Fenitrothion - Use as spray at 20% for general pest control work.

Birds (*hawks, owls, eagles, sparrow, quella birds and starling*)

Much of the adverse interactions of birds is prompted by the activities of man, for he encroaches on the natural habitat of birds. The damage done by birds includes:

(1) Consumption or destruction of foodstuffs – carry away household poultry and small animals and grains.
(2) Cause economic loss – woodpeckers' damage telephone and power poles.
(3) Carriers of diseases affecting man and animals, e.g. Ornithosis by parrots.
(4) Indirectly affect man's comfort, cause short circuit power failure, aesthetic and sporting values.
(5) Birds act as predators. Hawks and owls feed on poultry. Herons and egret attack fish. Golden eagles predate on sheep and goat especially the newly born animal.

Control of bird

a) Proper husbandry techniques -Rear poultry and animals in sheds and houses.
b) Trapping and shooting of large birds
c) Aerial spraying of birds using chemical poisons.

Useful in controlling swarms of sparrow and quella birds eating grains on the stock.

Table 2:

Insecticide	Amount
Pyrethrin solution	0.009-0.18%
Malathion solution	0.025-0.125%
solution Pyrethrium dust per 900cm3 sack	0,2-l.Ogm
Common salt solution	8.18
Potassium sorbate solution (against all fungi infestations)	5 – 10

Public Health Impact of Animal Diseases (Zoonoses)

In the last 100 years, scientific and technological progress in the field of veterinary public health has thrown more light on the epizootiology of livestock disease, which are transmissible to man. These diseases of livestock and those of other lower vertebrate animals like monkeys, dogs, cats, rabbits, etc. are commonly referred to as zoonoses, or zoonotic diseases. Some diseases, which were not thought to be very important in the past, are now emerging as serious zoonotic diseases. For example in 1988, a 7-year old girl was reported as having ascending motor (neurological) paralysis and speech difficulties. She was diagnosed as having tick paralysis. Tick, which was found to have transmitted this disease to the girl, is not a vertebrate animal but a parasite of dogs, cats, cattle, and other livestock from which the tick itself was infected before biting and transmitting the disease to the girl. Also in

2006, a woman was reported to have died of Avian Influenza in Nigeria.

According to FAO/WHO (Food and Agricultural Organisation / World Health Organisation), "Zoonoses are defined as those diseases and infections which are naturally transmitted between vertebrate animals and man". From the above example, *zoonoses* include not only infections and diseases acquired by human beings from lower animals (whether vertebrate or non-vertebrate), but also such diseases induced by non-infective agents like toxins and poisons from foods of animal origin e.g. clostridium or salmonella poison from eggs and meat. Thus tick paralysis is one of the emerging zoonosis. Over 80% of human infections are traceable or suspected to be zoonotic. Many more zoonoses are still being discovered as emerging and re-emerging zoonoses.

Classification

Zoonoses could be classified using the following criteria:

1. Aetiology: a. Viral; b. bacterial; c, parasite; d, rickettsal, and e; fungal
2. Reservoir Host

a) Anthropozoonoses
b) Zooanthroponoses
c) Amphixenoses

3. Infectious cycle and Prospect for Control

a) Direct *Zoonoses:* Transmission is by contact or vehicle and biologically requires a single vertebrate reservoir species to maintain the infectious cycle e.g. rabies, brucellosis and trichinosis.

b) Cyclozoonoses: Biologically require at least two species of vertebrate animals to complete their infectious cycles, e.g the taeniases and hydatid diseases

c) Metazoonoses: Transmitted to vertebrate hosts by invertebrates and depend upon invertebrate vector intermediate hosts for the completion of their infectious cycles, e.g. arborviral infections, fasioliasis, plague etc.

d) Saprozoonoses: They require organic or other inanimate matter as a reservoir, e.g cutaneous larva migrant.

Why Do We Study Zoonoses?

1) Man and animals are in direct competition for food and water, e.g rodent.
2) Man consumes vertebrate host; several bacterial diseases are spread via this process.
3) Man keeps vertebrate host as pets, e.g. rabies.
4) Common ancestor: we all evolved from the single cell organism about 3 billion years ago
5) Primarily to improve public health

Some Bacterial Zoonoses

1. *Brucellosis*

Synonymus: Undulant fever, Gillbrata fever, Bang's disease (in cattle), contagious abortion (in cattle), Mediterranean fever (in man), Malta fever.

Etiology: Brucella abortus (from cattle) Brucella melitensis (from goat) Brucellosis is a worldwide systemic disease of cattle, goat, sheep, swine, etc. that

causes storm of abortions particularly in cattle. It is also a systemic infection (involving blood system) in man, which is characterized by fever of variable duration, headache, weakness, profuse sweating, chills and general body aches. It may also cause non-purulent meningitis and penumonitis in man. The disease may last from several weeks to several years in a patient that is not diagnosed correctly and treated in time. In chronic sufferers, the patients, if male, shows swollen inflamed testicles (Orchitis) and bone diseases problems (Osteomyelitis).

The reservoirs of *B. abortus* are cattle and other wild ruminants while the reservoirs of B. melitensis are the goats. It is from these sources that human beings get infected. Infections can be by drinking the milk of infected cows or goats that are not properly pasteurized (boiled). We can also be infected by contact with tissues, blood, urine, and vaginal discharges of aborted animals that are also infected.

Control is by ensuring good hygiene practices at dairy farms. Boil fresh milk of cattle if not pasteurized before drinking it. The veterinaries vaccinate animals against this disease and effect control of spread. No immunization of man is necessary and the disease is curable if diagnosis is correctly made.

2. *Anthrax*

Synonyms: Malignant pustule, malignant edema, Woolsorters' disease, Charbon

Etiology: Bacillus anthracis

Anthrax is primarily a bacterial disease of livestock, cattle, sheep and goats in particular. It also occurs in wild and zoo animals. The disease is infective to human beings who work particularly with cattle and in establishments where wool and hides are stored. It occurs also among industrial workers in plants that process wool, goatskins and other hides. In man there are three clinical forms of anthrax namely: the cutaneous (skin form), pulmonary or respiratory (affecting the lungs) and the gastro-intestinal form (affecting the stomach and intestines). Of these, the cutaneous form is the most common and accounts for more that 90% of human anthrax. The initial lesion is a vesicle (a small blister) which develops into a black painless or slightly painful swelling. People that die from untreated cutaneous anthrax are about 5-20%.

The pulmonary form of anthrax is contacted by inhalation of spores of B. anthracis. At the onset of the disease the patient suffers mild symptoms of common upper respiratory tract infections. Some 3-5 days later, symptoms become more acute, with fever, shock and death, tile mortality rate in this form of anthrax is very high. The gastrointestinal anthrax is contracted when contaminated meat is eaten. This is followed by severe gastro-enteritis with vomiting and blood in the stools. Mortality is also very high.

Anthrax is found worldwide. There is no true reservoir host for this bacterium. Animals that contact the disease before they infect people do so by consuming garbage or drinking water that had been contaminated

with spores of B. anthracis especially in places where anthrax infected animals have died.

Anthrax is treatable in hospitals provided early diagnosis is made. The veterinarians who will routinely vaccinate susceptible cows in endemic areas or use drugs to treat clinically ill animals also control it. Veterinary public health doctors also prevent innocent members of the public from being infected by condemning anthrax suspect animals at the abattoirs.

3. Tuberculosis

This is a worldwide disease of man caused by Mycobacterium tuberculosis. Tuberculosis can also be caused by M. bovis (TB of cow and M. avium TB of birds). Human beings contract the disease either by drinking the organism in contaminated milk or eating infected meat that has not been properly cooked or from a sufferer.

In the past people thought that bovine (cattle) type of tuberculosis M. bovis was an extra-pulmonary (i.e. found outside the lungs) but today it is known that it can also cause generalized tuberculosis. Again people thought mat avian tuberculosis would not affect human beings. But now it is also known that it does affect them. The only difference is that they do not occur in the same frequency as the human type of tuberculosis caused by M. tuberculosis.

In countries where raw and unpasteurised milk is drunk and people have extra-pulmonary tuberculosis, such clinical signs like cervical adentities, (inflammation of back bone) do occur. This may lead to bending of the -backbone hump. There may also be an infection of the intestine and bladder, leading to difficulty in digestion and urinating.

In order to control tuberculosis, the sufferer should go to the hospital. Veterinary public health officers also prevent human infections by condemning tuberculosis cows. There are many other bacterial zoonoses like tularemia caused by Francisella (Pasteruella) Tularensis, Shigellosis caused by Shigella, Dysenteric, Salmonellosis (enteric) caused by Salmonella.

4. Botulism

Synonyms: AHantiasis, Limbemeck

Etiology: Clostridiun botulinum

Botulism is a toxin producing bacterial organism, which rarely affects human being, but when it does so, death is often the result. Thetoxin (not an infection) produced by mis-organism is a serious food poisoning which when eaten by man is often characterized by extreme dryness of the mouth, weakness and other serious nervous system problems. Vision is blurred or one sees double images of an object, vomiting and diarrhea may follow constipation. One-third of patients who are poisoned by this toxin usually die within 3 to 7 days as a result of respiratory or other nervous system failure. Intestinal tracts of domestic animals including fish are the reservoir areas of clostridium species. They are also found in soils, water and in canned food products. Human beings contact the disease when they

ingest the toxins by eating contaminated foods, vegetables, fruits, sardine, meatballs, jams, and corn-beef.

Control is by careful examination of what one eats. Watch the tin foods bought. For example sardine tins that are swollen up may be as a result of gas produced by the bacteria. This may be poisonous if eaten. Adequate cooking or boiling destroys many pathogens and toxins. Housewives, especially, must be educated on the processing and preparations of commercial canned and preserved foods.

5. Campylobacteriosis (Campylobacter enteritis, Vibrionic enteritis)

This is an enteric bacterial infection of man caused by Campylobacter jejune or C. fetus. It causes severe abdominal or stomachache with diarrhea fever like feelings, vomiting and weakness. It is easily mistaken for typhoid fever disease.

The disease is found worldwide, Cattle, sheep, pigs, cats, dogs and even chicken can be reservoirs of this disease. Human beings contact it through food when not properly cooked or if food is contaminated after cooking and through unpasteurized milk. If livestock are sick and they are not well taken care of by qualified veterinary doctors such livestock become chronic carriers of the disease. They then remain as primary source of human infections. The disease in livestock is, therefore, best controlled and eradicated by veterinarians. Human beings that are sick should go to human hospital for care.

Section III

Viral Zoonoses

Some examples of viral zoonoses are Cow.pox, Monkey pox, Western and Eastern equine encephalitis, Food and Mouth disease, Non-human primate hepatitis (contacted from monkeys) influenza, Lassafecer, Yellow fever, Rift valley fever, Rabies etc. However we will discuss only a few of them.

1. Rabies (Hydrophobia Lyssa)

Rabies is primarily the disease of warm-blooded animals caused by rubies virus, a rhadovirus of the genus lyssa-virus. The organism is bullet shaped. Rabies related viruses that exist in Africa (Mokola and Duvenhage) have been associated rarely with fatal rabies like human illness. Infected dog in particular is the commonly known animal that transmits rabies to man through biting. Infected cats, cows, donkeys and mules can also infect man usually by biting.

The disease occurs worldwide with an estimated 30,000 deaths a year, almost all in developing countries. The only areas free of rabies in the animal population at present include Australia, New Zealand, New Guinea, Japan, Hawaii, Taiwan and Pacific islands, the UK, Ireland mainland Norway, Sweden, Portugal and some of the West Indies and Atlantic Island. Dogs transmit urban (or canine) rabies whereas sylvatic rabies is a disease of wild carnivores and bats (vampire, frugivorous and insectivorous), with sporadic spillover to dogs, cats, and livestock.

Rabies transmission occurs when virus-laden saliva of a rabid animal is introduced by a bite or a scratch (very rarely, into a fresh break in the skin or rarely through intact mucous membranes). The incubation period is usually 2 to 8 weeks, occasionally as short as 5 days, or as long as a year or more. The incubation period depends on the severity of the wound, site of the wound in relation to the richness of the nerve supply and its distance from the brain, amount of virus introduced, protection provided by clothing and other factors.

Period of communicability: in dogs and cats, for 3 to 10 days before onset of clinical signs (for rarely over 3 days) and throughout the course of the disease.

Methods of Rabies Control

A. Preventive measures

1. Register, license and vaccinate all dog; collect and destroy ownerless animals and strays as indicated. Vaccinate all cats as prevention. Educate pet owners and the public.
2. Detain and clinically observe for 10 days any healthy-appearing dog or cat known to have bitten a person, dogs and cats showing suspicious signs of rabies should be sacrificed and tested for rabies.
3. Destroy immediately unvaccinated dogs and cats bitten by known rabid animals; if detention is elected, hold the animal in an approved pound or kennel for at least 6 months under veterinary supervision and vaccinated against rabies 30 days before release. Individuals at high risk should receive pre-exposure immunization.
4. Prevention of rabies after animal bites ("post exposure prophylaxis") consists of all:

a) Physical removal of the virus by proper cleansing of the bite wound and
b) Specific immunologic protection.

B. Control of Patient Contacts and the Immediate Environment

1. Report to local health authority
2. Isolation: Contact isolation for respiratory secretions for duration of the illness
3. Concurrent disinfection: Of saliva and articles soiled therewith.
4. Immunization of contact: contacts that have an open wound or mucous membrane exposure to the patient's saliva should receive anti-rabies specific treatment.
5. Investigation of contacts and source of infection.
6. Specific treatment for clinical rabies, intensive supportive medical care.

C. Epizootic measures

Applicable only to animals. A sporadic disease in man.

D. Disaster implications

A potential problem if the disease is freshly introduced or enzootic in an area where there are many stray dogs or wild reservoir animals.

E. International measures

(i) Strict compliance by common carriers and travellers with national law and regulations requiring quarantine, vaccination of animals, certificates of health and origin, etc.

(ii) WHO collaboration centres.

2. *Yellow Fever*

There are two types of yellow fevers. One is called the Cosmopolitan Yellow Fever, CYF, the other is Jungle Yellow Fever (JYF). The first one CYF is relatively harmless but the JYF is very dangerous. It is the type that has been causing the epidemics and deaths in Nigeria. An RNA virus causes the Jungle Yellow Fever and it is transmitted by a bite of an infected mosquito. How does mosquito itself get it? This virus exists naturally in Ibrtst monkeys and it is circulating there in the jungle between monkeys and mosquitoes. It is when an unvaccinated man that goes into the jungle is bitten by an infected mosquito that he becomes infected. When this man returns to the village or town and he is bitten by another mosquito, that mosquito now becomes infected and it bites other people who then may come down with yellow fever.

The disease starts by causing cold and chills. It later damages the liver which leads on to jaundice (yellow eye balls, pale hands and face) weakness and death. Some patients may be paralyzed for some time and later they get well.

Control is by people having a protective vaccination. Prevention of mosquito bite is very essential. Breeding water container for mosquitoes like sardine tins, broken pots, used cans, useless plastic bowls etc. should be destroyed. Insecticide can also be used.

3. *Lassa fever*

This is another deadly viral zoonosis, which was first discovered in Nigeria. Lassa is the name of a village in one of the northern Nigeria states. The disease is characterized by serious fever-like symptoms. An RNA virus also causes it. The disease is found also in Liberia, Sierra Leone, Ivory Coast, Mali, Central Africa Republic and Senegal. Human beings contract this disease not by mosquito bite but by contamination of the environment by the reservoir host-a multimamate rat that is found in houses and fields. The infected rats excrete the virus through faces and urine. If food is so contaminated and eaten, then lassa fever may occur. Control is by controlling rats in our houses, keep foods covered, clean drinking cups and eating plates before use.

4. *Monkey Pox & Cow Pox*

Both Cow pox and Monkey pox cause a disease similar to small pox in human beings. There is also rabbit pox and mouse pox *(ectromelia)* that could also affect man. However, all these poxes cause mild infections which do not usually result in death. Nevertheless, they can predispose an infected person to other secondary bacterial infections.

The mode of transmission to man is by direct contact with infected animals. The disease affects all age groups, but children under 10 years are at the highest

risk. However, transmission from man to man is rare. Control small pox vaccination is protective to some of these poxes.

5. Avian Influenza

Section IV

Parasitic Zoonoses

Some of the parasitic zoonoses of importance in our environment are: *Trypanosomiasis, Babesiosis,* Malaria of non-human primates, *Toxoplasmosis, Cutaneous and Visceral Ueshmaniasis.*

1. *African Trypanosomiasis*

This disease is called sleeping sickness in man. It is caused by *Trypansoma gambiesnse* in West African regions while sleeping sickness in East Africa region is caused by T. *rhodesiens.* They are both transmitted to man by the bite of an infected fly called glossina. The mechanism of fly bite is simple. When a fly lands on the skin, it pierces the skin with its sharp mouth parts. It then deposits saliva into the surrounding, waits for sometime and then sucks it back. In this process, parasites of the trypanosomes resident in the gut of the fly go into the blood stream. The bitten man then may become infected. Flies get the infection from infected cows, and other wild ruminants. The disease can be transmitted to many people at the same time. Thus we have an epidemic outbreak. The disease manifests in man first by causing sleeplessness (insomnia), difficult breathing, altered vision, anaemia, muscular pain, joint and abdominal pains. Later it progresses to weakness and sleeping sickness, which if not cured in time will lead to coma and death.

Control: Controlling fillies, protecting oneself when one goes to the bush. Sick people should go to hospital in time.

2. *Malaria of non-human primates*

Malaria is a common blood parasite that people are familiar with. It is caused by *Plasmodium vivax, P. malaria or P. falciparum.* Mosquitoes transmit this disease to man. However, non-human primate malaria are those, which have monkeys, apes, baboons, etc as their hosts. There are about 20 species of this type of plasmodium and they can infect man also. They are transmitted by vector mosquitoes called *anopheline.*

Many of the non-human primate malaria cause low-grade fevers. However, much work is still required in the pathogenesis of this type of human malaria and the vectors.

Control is similar to the control of human malaria and the vectors.

3. *Babesiosis*

This disease is primarily a blood parasite of ruminants e.g. cows caused by *Babesia bigemina* or 16 other species. They infect red blood cells of the ruminants inside which they divided by binary fission, i.e. divide into two parts each of which becomes adult. When ticks bite to suck blood from an infected cow, the tick also becomes infected. It is the infected tick that transmits

the disease to man by bite also. The spleen easily protects most infected humans. However any person that has got his spleen removed because of one problem or the other stands nearly 100% chance of death if infected by *Babesiosis.* The disease is treatable if diagnosed in time. Control is by preventing tick bites.

4. *Toxoplasmosis*

This is another dangerous parasitic zoonosis, which can affect human beings through ingestion of the eggs from contaminated food. Cats in particular when infected serve as the final or definitive host. The adult worm called *Toxoplasma gondii* develops to maturity in cats from where the eggs are shed in the cat's faeces to the outside environment.

Infection is very common in man but very rarely does an infected man show clinical disease before the.eggs are destroyed. However in a pregnant woman, the eggs can develop into larval stage, which can migrate (Larval migrants) to the foetus and cause abortion. It can also cause deformities like blindness and deafness in newborn babies.

Control is by taking pet cats to veterinary clinics for periodic check up. If one prevents cats from going into the bush to kill rats, the cat would not have it. Prevent food from being contaminated with cat's faeces. Pigs can also have *toxoplasmosi;* so good cooking is required before eating infected pork.

Other Zoonoses

There are other zoonoses like tapeworms and hookworms, *chlamydial* agents like psittacosis and omtithosis Q-fever, etc. All of these can infect human beings. Man can be infected with the following by eating raw or undercooked fish: *Clonorchis sinensis* (Chinese fluke). *Heterophyes, Paragonismus westermani, Diphyllobothrium latum, Angiostrong us cantonensis.* Education and prevention are the best ways of control.

REFERENCES

Abrams, S. Benenson (1995) *Control of Communicable Diseases Manual* (16th ed). Published by American Public Health Association. NW Washington, DC 2005,577pp.

Adams, M. R. and Moss, M.O. (1999) *Food Microbiology.* The Royal Society of Chemistry Thomas Gaham House, Science park, Cambridge CB4 (3rd ed) 398pp.

Alonge, D. O. (2001) *Meat and Milk Hygiene* Farmcoe Publications Ibadan. (2nd ed) 240pp.

Aoki, T. (1992) Past, Present and Future Problems Concerning the Development of Resistance in Aquaculture. In: Proceedings of OIE Symposium on Problems of Chemotherapy in Aquaculture held at Paris, 12 - March 1 991 , pp 256 - 264.

Bushland, R. C. and Smith C.N(1962) *Pest Control: in Milkhygiene* Monograph Publication of FAO/ WHO Geneva. 158-182pp *Fundamental of*

Agriculture (1993). Afrika Link Books Ibadan. 182pp.

Doherty, T. Mulriple J. P(1995) W.B.S Aunders Company, Philadelphia? - Diagnosed and treatment of large animal disease.

Fujihara, M. R. and Nakatani, R. E. (1971) *Antibody Production and Immune Responses of Rainbow Trout and Coho Salmon to Chondrococcus Columnaris*. Fisheries Research Board of Canada, 28:1253-1258.

Martin, S.W., Meek, A.H. and Willeberg, P. (1987) *Veterinary Epidemiology: Principles and Methods*. Iowa State University Press, Ames.343p.

Radosis, O. M, Blood, D. C and Gay, C.C. (1995). *Veterinary Medicine, A Textbook of the Diseases of Cattle, Sheep pigs, Goats and Horses (8th* ed.)

Scbwabe, C.W., 1969. *Veterinary Medicine and Human Health,* The William & Wilkin Co. 713pp.

Venglovsky. J. Petrovsky. M. Pacajova. Z., Placha. I. J., Sasakova. N., Harichva. D., Greserva. G (2003) Monitoring Fly Resistance to Insecticide in Slovakia in 2001 - 2002. Proceedings of the XI International Congress in *Animal Hygiene* Feb. 23 - 27, 2003 Mexico city Vol. 2; 761 – 764.

Wood, J. W. (1974) *Diseases of Pacific Salmon: Their Prevention and Treatment* (2nd ed). Published by Department of Fisheries, Washington State, 82p.

10

ANIMAL HEALTH MANAGEMENT: PRINCIPLES AND PRACTICE

O.D. Eyarefe and Lasisi O.T.

Introduction

Health, according to *Dorland Dictionary of Medical Science,* is a state of complete physical, mental and social well-being rather than mere absence of disease and infirmity. Animals' health issues are daily becoming of greater concern since animals co-exist with man in the same ecosystem and share from common natural sources of food and water. One of the ways, therefore, to guarantee human health is to facilitate and ensure animal health. The present compaign of "one health, one medicine" has this as its philosophy. Viewed from the economic, social and nutritional angles, animal health is important for the following reasons:

1. Diseases of animals are transmissible to man (zoonotic diseases) . These zoonoses which may be viral, bacterial, protozoan or parasitic can only be stemmed as adequate attention is paid to health issues of concerned animal species. Examples of such diseases include: rabies, cow pox, tuberculosis, brucellosis, trypanosomosis etc.
2. Animals and their products are sources of income to their owners, and foreign exchange to nations. Animal products like tusk of Elephant, hide and skin, beef, and milk from cattle including poultry products are popular for industrial as well as nutritional values and their revenue generation potentials.
3. Animals like dogs and cats are good companion animals that contribute to man's social well-being.
4. Animals such as mice, rats, guinea pigs, etc. are fundamental species in scientific investigations and biomedical research. For instance, the effects of some synthetic foods and drugs on human beings were deduced from the responses of animals to such foods and drugs.
5. Some animal products are sources of food and dietary supplements to man. Examples include Eggs, Butter, oils (Cod liver oil), etc.
6. Some ancient and modern games, such as polo game, horse race, horse dance , chicken fight , dog race, to mention a few, have animals as key players, and contribute immensely to man's social

satisfaction. In some traditional setting, the horse is a symbol of royalty, and it is adorned for the king and nobles as part of their royal dignity. Due to the close human contact, the health of such animals cannot be downplayed.

7. Modern security outfits have evolved in recent times with trained dogs of diverse breeds playing prominent roles in tracking and hunting of criminals as well as in discovering of prohibited drugs and their peddlers.

Trivializing animals' health issues, therefore, is inimical to human health, existence and progress in a world of rapid social and scientific advancement.

Factors Affecting Animal Health in Nigeria

Nigeria is a developing country with unique social, religious and traditional diversities with reference to values and attitude to animal species existence and health. A society's attitude to animal health is influenced by her level of awareness of the importance of animals to the economic, social and nutritional well-being of the society.

The following factors affect animal health in Nigeria:

1. Disease:

A disease is any process, which disrupts an animal's normal function (Hunter, 1996). Animal disease may result from the following factors:

(a) ***Infectious organisms***: These include viruses, bacteria, fungi, protozoa and parasites (ecto , endo, and haemo-parasite).

(b) ***Neoplasia*** (tumors): these are growths caused by complex processes of uncontrolled proliferation of cells to form tissues (lump), which may spread to other organs of the body (malignant), or exist solitarily (benign).

(a) ***Mechanical or thermal injuries***: These include burns; trauma (gunshot injuries, fracture, luxations or sprain).

(b) ***Chemicals***: Chemical poisoning may result from ingestion of heavy metals (lead poisoning), herbicides, acaricides and petroleum products (engine oil, gasoline or kerosene).

(c) ***Metabolic diseases***: Ketosis, Monday morning disease (Horses), pregnancy toxemia (sheep), and milk fever (cattle).

(d) ***Digestive diseases***: bloat, diarrhea, constipation, colic, impactions.

(e) ***Congenital diseases***: Atresia ani, freemartinism, and hermaphrodism.

2. Nutrition: This is a major factor affecting animal health because most people in Nigeria live below poverty level which by extension affects the animal welfare. Good and balanced dietary nutrient is relevant in promoting good health in the following ways:

(a) Maintenance of reproductive functions, e.g. Good libido, pregnancy, lactation, nursing care and growth of neonates.

(b) Resistance to diseases through boosting of body immune system.
(c) Prevention of deficiency syndrome, e.g. mineral, vitamin and protein deficiency syndrome.
(d) Maintenance of daily activities.

Factors that could hamper good dietary utilization include:

I. Conditions such as diarrhea, obstructions and congenital anomaly.
II. Parasitic competition, e.g. gastrointestinal parasite (*Toxocara canis* in dogs).
III. Loss of appetite: This may be due to bad management or disease.

3. Religious Taboos

In places where religious belief prevents the eating of any particular species of animal, outbreak of diseases among such species could be very devastating, because funds for quick interventions are withheld by stakeholders who are opposed to the rearing of the forbidden species of animal. The recent outbreak of African swine fever in southwest in Nigeria is a good example.

4. Veterinary Medical Care

Animal health care facilities are non-existent in many villages, towns and cities, making livestock farmers to suffer untold hardship in the process of disease management. Besides, there are few extension officers to disseminate research information on proven methods of disease prevention through husbandry and vaccination to farmers; as a result, the wealth of information available for the health and maintenance of their animals are not within their reach.

5. Environment and Husbandry Factors

These are factors in the environment as well as rearing and raising methods that predispose animals to diseases.

i. Unhygienic animal houses: These may predispose animals to infectious diseases.
ii. Bushy environment: This could predispose animals to snakes and scorpion bites .
iii. Feeding on contaminated food and water: This could predispose animals to food and water-borne diseases, and death.
iv. Use of faulty drinkers and feeders may predispose to starvation, oral injuries and anorexia.

Recognition of Signs of Health and Ill Health among Animals

Disease recognition and treatment in animals are complex tasks, which require adequate veterinary training. Obvious animal disease symptoms, including abnormal behaviours should be referred to veterinary doctors. Nevertheless, recognition of basic signs of ill health by livestock farmers, animal handlers or care giver is important as this could enhance the alert process or movement of the animal to the animal health centre for appropriate care. Familiarity with signs of health through daily observation and interaction is a rule of thumb in recognizing signs of diseases in animals. The table below is aimed at this objective.

Signs	Normal (Health)	Abnormal (ill health)
Death	In old age Of natural cause and may involve just one animal.	- Involve two or more animals .- Involve animals of various ages. - Suspicions of a predator or disease causing agent
General body features	Sleek appearance of coat. Well-muscled body with less ribs and hipbones prominence. Well-rounded hindquarters.	- Dry and rough coat appearance. - Prominent ribs and hipbones. - Asymmetrical abdomen.
Head	- Clear bright and moist eyes. - Slightly moistened and cool muzzle or nasal plenum. Wet oral cavity without gum or tongue ulcers or blisters	- Sunken eyes, unilateral or bilateral ocular discharges, which may be serous, mucoid or mucopurulent. - Bilateral nasal discharge. - Drooping of copious saliva, with or without gum or tongue ulcers and dental injuries.
Skin	Slack, smooth, loose and glossy and well aligned with the body.	Skin is dry, scaly, with soars and heavy skin parasite; such as lies, ticks, mites.
Visible mucous membrane	Mucous membrane of the mouth (gums), nostrils, eyelids (conjunctiva) vaginal, prepuce and rectum are normal (pink).	Mucous membrane of the eyes, gums, vagina, anus and prepuce may be yellow, cyanotic, paper white, cherry or red in colour.
Posture in movement or standing position	- Walking in a balanced stable fashion - Walking with swaying head and nodding slightly. - Stand alert and confident. Raise limbs with ease	- Walking with staggering gaits. - Limping or carefully carrying limbs, with obvious signs of discomfort. - Last among flock. - Sleepy while standing.

Urination/Urine colour	- Urinate with ease. - Urine in straw or slightly yellow in colour without blood tint.	- Urinate with obvious signs of discomfort. - Urine is red or deep yellow with some bloodstain.
Respiration	- Breathing is quiet and barely noticeable in resting position. - Only fast after physical exertion .- The number of breath in resting position per minute (respiratory rate) is normal Horses 8 – 12 Cattle 12 – 16 Pigs 10 – 16 Sheep/goat 12 – 15	- Breathing is with difficulty and irregular .- Obvious sounds, e.g. whistling crackles, coughing .- Abnormal respiratory rate.
Body temperature	- Able to maintain constant body temperature even in extreme environment conditions.· Horses 38.0^{0}C· Cattle 38.0^{0}C· Pigs 37.5- 39..0^{0}C· Sheep/Goat 38.0 – 39.5^{0}C· Dog 37.5-39^{0}C	- Shivering - Have abnormal temperature
Faeces	-Is of normal constituency (well formed) and colour depends on the diet.- There may be a change in constituency if diet is changed	- Watery faeces -Hindquarter is stained with feaces.
Reproduction	-Animal cycles regularly after puberty except when pregnant. -The duration of pregnancy (gestation period) is normal for the breed/species	-Animal may not cycle at all. -Not able to become pregnant after mating.

Enhancing Animal Health Through Husbandry Practice and Immunity

The best way to ensure the health of animals is to ensure that they are subjected to a good level of husbandry. Animals that are given balanced diet, provided with clean and adequate water, with good shelter coupled with good veterinary care (immunization) are better equipped to overcome disease challenges thus enhancing productivity.

Health -Fostered Husbandry Practices

Health fostered husbandry practice could be promoted through the following measures:

1) **Nutrition:** Balanced dietary formulations for different species of animals as well as animals of different ages have the potentials of boosting animals' health and productivity. Good pasture management is important for grazing animals to ensure nourishing forages, prevention of ingestible eggs and larvae of worms, and the growths of poisonous plants. Accidental ingestion of poisons or poisonous plants, however, should be reported to the nearest veterinary centre for quick intervention.

2) **Provision of shelter**: Provision of shelter is necessary especially for animals under intensive system. Excessive heat or cold reduces the immunity of animals (immunosuppression), which could result in ill-health. Some diseases are also associated with direct sunlight (e.g squamous cell carcinoma). Provision of shade from trees and tents have been found relevant to animals reared under extensive or semi-intensive system.

3) **Hygiene**: Good hygiene through washing, disinfections and flaming animal house of farm equipment, thorough cleaning of feeders and drinkers are effective ways of killing and reducing microbial load to ensure health of animals.

Disinfectants are chemicals that either kill or prevent multiplication of pathogenic micro-organism. They include

a) ***Oxidizing Agents***: such as Hydrogen peroxide and potassium permanganate.

b) ***Halogens***: such as sodium hypochloride and iodine (iodine compounds).

c) ***Reducing agents***: such as formaldehyde, phenolic compounds and cresol (e.g. Lysol).

Disinfectants, however, should be used with caution, and the manufacturer's instructions must be followed to avoid health hazards.

4) **Regular grooming/trimming of hoof/nails**: Regular grooming of the hair coat ensures good aeration and circulation of blood to the skin. It also helps to improve coat aesthetics as well as eliminating coat debris and ectoparasites. Trimming of hooves and nails helps to prevent overgrown hooves and nails, thereby minimizing lameness.

5) **Monitoring of puberty, estrus cycle and gestation period**: Knowledge of time of heat (estrus)

should enable a timely provision of a proven sire (male) to mate the female animals. Information on gestation period also ensures the breeders' availability for appropriate care during delivery (parturition).

6) **Vaccination and treatment of sick animals**: To ensure a healthy flock of animals, adequate immunization should be done especially against existing (endemic) diseases in the area. The assistance of the Veterinary doctor may be needed to administer vaccines and treat the sick animals.

Disease Prevention through Immunity

Animal bodies possess natural occurring defense systems that protect them from infectious diseases. These factors are innate qualities of the species. Exposure to a particular infectious agent, either deliberate (vaccination) or accidental (infection) results in antibody productions against the infectious organism. However, some mechanical barriers and physiological factors exist in animals to prevent disease occurrence. These include:

- **Intact skin**: The skin coat is the first line of defense. Maintenance of animal skin coat will ensure good immunity.
- **Secretions from skins** (sebaceous gland): The skins of animal contain oily glands, which have anti microbial factors (fatty acid and low pH). Most bacteria, viral and fungi agents are susceptible to low concentrations of organic acids.
- **Flushing action of lachrymal, saliva and urine**: The lachrymal glands and saliva contain anti microbial properties that inactivate microbes.
- **Cilia of the respiratory system**: The movement of these structures inhibits bacteria movement and expose them to inactivation by the mucous secreted by the global cells of the tract.
- **Sneezing/ Cough reflex**: This reflex action dislodges and expels mucous blanket.
- **Mucous membrane of the respiratory tract**: This traps bacteria and inactivates such through lysosomal enzyme activities.
- **Body Temperature**: Most animals possess body temperatures of between 37° and 39° centigrade that encourages poor growth of disease causing organisms.

Defense cells: Animal possesses a very complex system of cells that function to recognize and destroy invading disease causing organisms, These cells include:

a. ***Neutrophils***: These are inflammatory with relatively shorter life span. They phagocytose harmful bacteria in the tissue.

b. Monocyte: These are capable of migrating into the tissue to phagocytose bacteria or become larger, become more active and effective (***Macrophages***) against viruses, bacteria, protozoan, etc.

c. Lymphocytes: These immune cells act to recognize invading micro-organism and parasite, and destroy them through production of antibodies. Two types exist: T – (thymus derived) and B– (Bone marrow derived) lymphocytes. The B-type may be activated to plasma cells, which produces antibodies against the invading organism.

These confer immunity on the animals through the development of "memory" against the organism following subsequent invasion. This ability of immune cells to react promptly against the invading disease-causing organisms is called immunity.

Vaccines and Vaccinations

Vaccines are preparations containing weakened or dead microbes of the kind that cause disease, administered to stimulate the immune system to produce antibodies against that disease

This is achieved by altering the organisms in some way before inoculation, with the aim of stimulating a humoral or cellular immunity without producing the disease effects of the organism. Existing types of vaccines include:

a. **Attenuated vaccines**: These are based on organisms that have been altered by passaging (transferring of the organism through a series of animals or laboratory culture to reduce the virulence of the organisms).

b. **Inactivated vaccines**: These are organisms that have been killed by chemicals, heat or radiation.

c. **Toxoids**: These are exotoxins of bacteria, which have been rendered non-toxic, and introduced into animal bodies to protect them against specific bacteria exotoxins.

More types of vaccines are presently available which are as a result of recent advances in molecular biology, immunology and genetic engineering.

Active and Passive Immunity

Immunity resulting from recovering from infection or from vaccines is called **acquired or active immunity.** However, antibodies from a humoral response of mothers can protect their young ones naturally during pregnancy. Newborn animals do not possess a mature immune system, but they receive antibodies from their mother either through the placenta before birth, or from the first milk called colostrums. This immunity is sufficient to protect the young ones within few months of life until their own immune system is developed. This type of immunity is called **passive immunity**.

ANIMAL DISEASES AND VACCINATION

DISEASES OF CATTLE

S/N	DISEASE	AETIOLOGY	VACCINE
		BACTERIAL DISEASES	
1	Anthrax	Bacillus anthracis	Anthrax spore vaccine
2	Blackquarter	Clostridium chauvoei	Blackquarter vaccine
3	Malignant oedema	Chlostridium septicum	Clostridium septicum [Malignant oedema] vaccine
4	Botulism	Clostridium botulinum [type C and D]	Clostridium botulinum type C and D vaccine
5	Tetanus	Clostridium tetani	Tetanus vaccine
6	Actinomycosis	Coorynebacterium pyogenes	Corynebacterium pyogenes vaccine
7	Brucellosis	Brucelle abortus	Brucella S19 vaccine for cattle
8	Calf paratyphoid	Salmonella dublin, S. typhimurium, S. morficans	Salmonella Dublin vaccine
9	Vibriosis	Campylobacter fetus [veneralis]	Campylobacter[vibrio] fetus vaccine
10	Collibacillosis	Escherichia coli	E. coli oil emulsion vaccine for cattle and sheep
11	Pasteurellosis	Mannheimia haemolytica	Pasteurella vaccine for cattle
		VIRAL DISEASES	
12	Lumpy skin disease	Poxvirus[Neethling]	Lumpy skin disease vaccine
13	Rift valley fever	Virus in Bunyanviridea family	Inactivated RVF vaccines
		PROTOZOAN DISEASES	
14	Anaplasmosis	Anaplasma marginale, A. central	Frozen Anaplamosis vaccine for cattle
15	Babesiosis[red water]	Babesia bigemina, B. bovis	Frozen Asiatic red water vaccine for cattle, Frozen African redwater vaccine for cattle.
16	Heartwater	Cowdria ruminantum	Heartwater infective blood

DISEASES OF SHEEP

S/N	DISEASES	AETIOLOGY	VACCINE
	BACTERIA DISEASES		
1	Anthrax	Bacillus anthracis.	Anthrax spore vaccine
2	Malignant oedema	Clostridium septicum	Clostridium septicum vaccine
3	Botulinum	Clostridium botulinum type C and D	Clostridium botulinum type C and D vaccine
4	Tetanus	Clostridium tetani	Clostridium tetani vaccine
5	Lamb dysentery	Clostridium perfringes type B	Lamb dysentery vaccine
6	Swelled head	Clostridium novyi	Swelled head vaccine
7	Caseous Lymphadenitis	Corynebacterium ovis	Corynebacterium ovis vaccine
8	Brucellosis [sheep and goat]	Brucella ovis and B. melitensis	Brucella Rev.1 vaccine for sheep and goat
9	Collibacillosis	Escherichia coli	Escherichia coli oil- emultion vaccine for cattle and sheep
10	Pasteurellosis	Pasteurella hymolytica	Pasteurella vaccine for sheep and goat
11	Blue udder	Pasteurella hymolitica, Staphylococcus aureus	Blue udder vaccine for sheep
	VIRAL DISEASES		
12	Bluetongue	Orbivirus	Bluetongue A, B and C vaccine
13	Rift valley disease	Virus in bunyanviridea family	Live rift valley fever vaccine[inactivated], Live rift valley fever vaccine[live]
14	Orf	Paravaccinia[poxvirus]	Orf suspension vaccine
	PROTOZOAN DISEASE		
15	Heartwater	Cowdria ruminantium	Heartwater- infective blood

DISEASES OF GOATS

S/N	DISEASES	AETIOLOGY	VACCINE
		BACTERIA DISEASES	
1	Anthrax	Bacillus anthracis	Anthrax spore vaccine
2	Botulism	Clostridium botulinum type C dan D	Clostridium botulinum type C and D vaccine
3	Tetanus	Clostridium tetani	Tetanus vaccine
4	Caseous lymphadenitis	Corynebacterium pseudotubrculosis, C. ovis	Corynebacterium ovis vaccine
5	Brucellosis	Brucella abortus	Brucella S19 vaccine for cattle
6	Pasteurellosis	Pasteurella multicida, P. hemolytica	Pasteurella vaccine for sheep and goat
7	Collibacillosis	Eschrechia coli	Escherechia coli oil emulsion vaccine for cattle and sheep
8	Rift valley fever	Rift valley fever virus [Bunyanviridea]	Live rift virus fever vaccine Live rift valley virus fever[Inactivated]

DISEASES OF HORSE

S/N	DISEASE	AETIOLOGY	VACCINE
		BACTERIA DISEASES	
1	Tetanus	Clostridium tetani	Tetanus toxoid
2	Strangles	Streptococcus equi	Vaccine available
3	Salmonellosis	Salmonella species	
4	Anthrax	Bacillus anthracis	Anthrax spore vaccine
5	Dermatophilosis	Dermatophilus congolensis	
6	Brucellosis	Brucella canis	Brucella S19 vaccine
7	Leptospirosis	Leptospiral interrogans	DHLPP vaccine
		VIRAL DISEASES	
8	Equine infectious anemia[EAI]	EAI-virus	No vaccine
9	Equine encephalomyelitis[EE]	Western EE virus and Eastern EE virus	Bivalent vaccine containing WEE and EEE virus
10	Equine influenza	Equine influenza virus	Vaccine available
11	Rhinopneumonitis	Equine herpesvirus-1[HPV-1], and HPV-4	HPV-1 vaccine
12	Rabies	Rabies virus	Rabies virus vaccine
13	Western Nile infection	Western Nile virus	
		PROTOZOAN DISEASE	
14	Equine monocytic ehrlichiosis [potomac horse fever]	Neoricketsia risticii	Potomac horse fever vaccine
15	Equine protozoan myeloencephalitis	Sarcocystis neurona	
16	Cryptosporidiosis	Cryptospprodium species	

COMMON DISEASES OF DOG

S/N	DISEASE	AETIOLOGY	VACCINE
		BACTERIAL DISEASE	
1	Brucellosis	Brucella canis	Brucella S19 vaccine
2	Leptospirosis	Leptospiral interrogans	DHLPP
3	Canine monocytic ehrlichiosis	Ehrlichia canis	
		VIRAL DISEASE	
1	Canine parvovirus infection	Canine parvovirus [DNA virus]	DHLPP
2	Canine distemper	Canine distemper virus [RNA virus]	DHLPP
3	Canine adenovirus [CAV] infection	CAV-1 and CAV-2	DHLPP
4	Rabies	Rabies virus	Antirabies vaccine
		PROTOZOAN DISEASES	
1	Toxoplasmosis	Toxoplasma gondi	
2	Giardiasis	Giardia lamblia	
3	Hepatozoonosis	Hepaatozoon canis	
4	Canine trypanosomiasis	Trypanosome brucei, T. cruzei, T. congolensis	

S/N	DISEASES	AETIOLOGY	VACCINE
		BACTERIA DISAESES	
1	Pullorum disease	Salmonella pullorum	No vaccine
2	Fowl typhoid	Salmonella gallinarum	Fowl typhoid vaccine
3	Paratyphoid infection	Salmonella enteritidis	
4	Haemophilus Coryza	Haemophilus paragallinarum	Hemophillus coryza vaccie
5	Fowl cholera	Pasteurella multocida	Fowl cholera vaccine
6	Pseudotuberculosis	Yersinia pseudotuberculosis rodentium	
7	Avian tuberculosis	Mycobacterium avium	
		VIRAL DISEASES	
8	Newcastle disease	NDV/avian pneumovirus-1	HB, clone, lasota, komorov roakin, R2B
9	Avian influenza	Type-A influenza virus	
10	Avian encephalomyelitis	Enterovirus in the family picornavirus	
11	Fowl pox	Poxvirus[avipox]	Poxvirus vaccine
12	Infectious bursal disease	IBD virus	Gumboro live vaccine
13	Marek disease	Lymphotropic herpesvirus	Attenuated serotype 1 MD vaccine, Naturally avirulent serotype 2 MD vaccine, HVT serotype 3
		PROTOZOAN DISEASES	
14	Coccidiosis	Eimeria species	Coccidiostat
15	Histomoniasis	Histomonas meleagridis	
16	Leucocytozoonosis	Leucocytozoon simondi	
17	Toxoplasmosis	Toxoplasma gondii	

REFERECES

Archie Hunter (1996) *The Tropical Agriculturist; General Principles of Animal Health* volume 1, I.C.T.A, MACMILLAN.

Keith H. Hoopes and Richard N. Thwaits Williams and Wilkins (1997). *Principles of Veterinary Science.* Vol 1

Richard M. Hyde and Robert A. *Patriode Immunology.*

IAN R. TIZARD (1996) *Veterinary Immunology, An Introduction.*

T. Doherty and J. P Mulriple (1995) *Diagnosis and Treatment of Large Animal Disease* W. B. Saunders Company, Philadelphia .

Veterinary Medicine, A textbook of the diseases of cattle Sheep Pigs, Goats and Horses (8th ed) O. M. Radosis, D. C. Blood and C.C Gay (1995).