

Tamilnadu Agricultural University
Department of Animal Husbandry
Fundamentals of Livestock and Poultry Production (2 +1)

THEORY- Internet Class Notes: B.Sc., (Agriculture)

Class 1: Prelusion-Significance of livestock and poultry in Indian economy-Livestock and Poultry census - role of livestock and poultry in Indian agriculture.

Livestock farming is an integral part of crop farming and contributes substantially to household nutritional security and poverty alleviation through increased household income. The returns from livestock especially dairying and mixed farming in small and medium holdings are larger and highly sustainable. The progress in this sector results in more balanced development of the rural economy and improvement in economic status of poor people associated with livestock. Indian agriculture is an economic symbiosis of crop and livestock production with cattle as the foundation. Dairy animals produce milk by converting the crop residues and by products from crops which otherwise would be wasted. Dairy sector contributes by way of cash income, draught power and manure. Livestock provides for human needs by way of 1. Food 2. fibre. 3. Fuel. 4. Fertilizer. 5.. Skin and 6. Traction. It is a living bank providing flexible finance in time of emergencies and also serves as insurance against crop failure for survival. If Agriculture is the foundation of our national economy Animal husbandry constitutes the sheet anchor of agriculture. Indian agriculture marches on the patient back of the bullock.

70 percent of the livestock are owned by 67 percent of small and marginal farmers.

76 percent of the milk is produced by weaker sections of society.

One fifth of the worlds livestock population is present in India .

India has nearly 57 % of the worlds buffalo population, 16% of the cattle population, 20% of goat population and 5 % of sheep population although India constitutes less than 3 % of the worlds total land area.

Population of livestock and poultry in India and Tamilnadu

CATTLE	–	209.08 MILLION & 9.10 MILLION
Buffaloes	–	92.19 Million & 2.93 Million
Goat	–	120.60 Million & 5.87 Million
Sheep	–	56.47 Million & 5.61 Million
Pig	–	15.42 Million & 0.60 Million
Poultry	–	3430 Million & 240 Million.

The production Parameters are

Milk – 81 Million tonnes (00 –01) – I in the world (contributing 14% of the world milk production)

32.4 Billion eggs – 5th in the world

47.6 million kgs of wool

4.7 million tonnes of meat

Per capita Milk availability is 221 gms / day (00 –01) whereas the requirement is 280 gms / day

Per capita egg availability is 33 eggs/ year whereas the requirement is 180 eggs

Per capita availability of poultry meat is 700 gms/ annum whereas the requirement is 10 kgs/ annum.

It is estimated that about 18 million people are employed in the livestock sector in principle or subsidiary status. Export earnings from livestock sector and related products are progressively rising. Finished leather accounted for 50 % (Rs.1745 crore) and meat and meat products accounted for 42 %(Rs1457 crore) of the total export from the livestock sector during 2000-01. The contribution of livestock sector to the total Gross domestic product (GDP) was 5.9% in 00-01, accounting for 27 % of total agricultural output.

Though the cattle wealth is quite abundant in terms of population the production from these animals is very poor viz., 987 kgs per lactation whereas the world average is 2038 kgs per lactation. The main reasons for this shortcoming is the abundant population of nondescript cows, chronic shortage of feed and fodder, poor nutritive value of the available feed and fodder, low fertility rates, destruction of grazing land, increasing human population and competition between animals and man for the available feed resources.

To satisfy the nutrient requirement for the huge population of livestock the options are 1.to reduce the unproductive/ low productive animals. 2. feeding of non conventional feed stuffs – among these are the horticultural by products like agriculture by products, vegetable wastes and horticulture industrial wastes.

First step that bridges livestock and agriculture is the efficient utilization of agriculture/horticulture waste to feed animals and convert to high quality meat, milk, wool, egg etc., Second linkage is through application of organic fertilizers to crops.

The third application is the usage of draught animal power for ploughing of land.

Nutrient content of animal and poultry manure

Nutrient	Nutrient content of manure (mg g dry weight ⁻¹)				
	Cattle	Sheep	Pig	Horse	Poultry
Nitrogen	25-40	20-45	20-45	17-30	28-62
Phosphorus	4-10	4-11	6-12	3-7	9-29
Potassium	7-25	20-29	15-48	15-18	8-29
Calcium	5-8	8-19	3-20	7-29	17-69
Magnesium	5-8	3-6	2-3	3-5	3-8
Sulphur	3-4	2-3	3-5	1-3	4-7

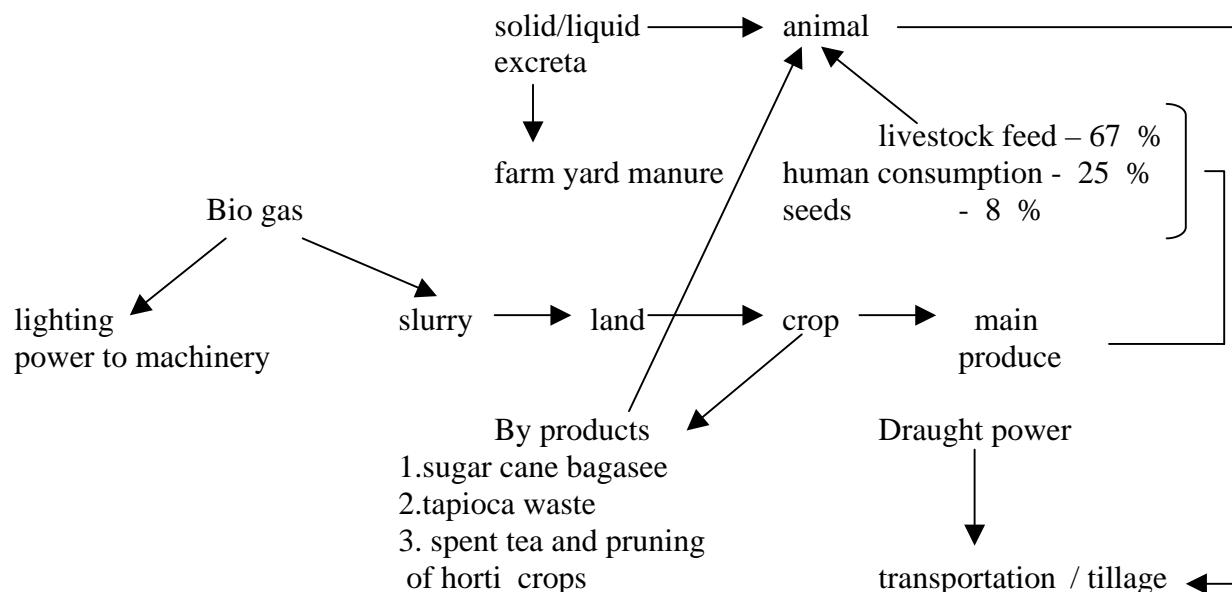
Apart from manurial value biogas can be produced from livestock dung and poultry droppings. 32 kg of cow dung/20 kgs of pig faeces/12 kgs of poultry droppings can produce 1 m³ – 34 cft of bio gas. the calorific value of bio gas –500 to 700 BTU per cft in comparison to Natural gas – 850 BTU/cft.

1 m³ of slurry fed to biogas plant produces on an average 0.15 to 0.20 m³ of biogas daily. Based on equivalent effective heat produced 2 m³ biogas plant replaces in a month fuel equivalent of 26 kgs of LPG contained in standard gas cylinder or 37 litres of kerosene or 88 kgs of charcoal or 210 kgs of fuel wood or 740 kgs of animal dung.

1. 83 million draught animals
2. The power generated from 83 million draught animals is equivalent to 30,000 million watts in terms of electric power

3. 0.33 ha area of land is cultivated by the animals. The power rating of a full grown bullock a pure Indian draught breed is 0.70 HP average is 0.5 Hp only. A35 Hp tractor can plough about 2.5ha of land in an eight hour shift and consume about 5l diesel / hr.
4. Animal power is also utilised for transport.

25,000 million tonnes km of freight per year which saves 6 million tonnes of diesel /petrol worth Rs.4000 crores



Cow is taken as the basal unit and all other types of animals are equated to have a common platform

cow	1.0	example: if the goat population is is 120 million it means it is equivalent to 24 million cows $120 \times 0.2 = 24.0$
bullock	1.2	
young stock	0.6	
buffalo	1.2	
sheep and goat	0.2	

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Calcium	5-8	8-19	3-20	7-29	17-69
Magnesium	5-8	3-6	2-3	3-5	3-8
Sulphur	3-4	2-3	3-5	1-3	4-7

Livestock and Poultry Production

Introduction : Importance of Livestock and Poultry in Indian Agricultural livestock and poultry census and its role in Indian Economy.

1. India owns nearly 23% of the world livestock population.
2. Agriculture is the back bone of Indian Economy and within agriculture livestock plays an importance role in providing sustainable income to farmers throughout the year.
3. Failure of monsoon, pest infestation, floods etc – when crop husbandry fails next alternate is livestock and poultry industry.

Animal Husbandry – important steps are -Breeding, Feeding, Weeding and Heeding

Importance of livestock in Agriculture

1. Income from livestock and poultry enterprises contribute as high as 10% of the total national income and nearly 50% of agricultural sector income.
2. Effective utilization of labour – family labour is effectively utilized in animal husbandry.
3. Soil fertility : organic manure – promotes and maintain soil fertility.
4. Effective utilization- cow produces 8 tonnes of farm yard manure per year and farm biomass farm products which includes fodder, feed, edible weed, tree fodder, bund grass are better utilized – and converted to Edible products like – Milk, Meat and Egg.
5. Effective utilization of agri industrial by products
By products obtained from grain processing (bran), oil seed process (oil cakes), pulses processing (gram, husk) and molasses.
6. Better standard of living : family income from livestock and poultry - 'Bankers cheque'
7. Inter relationship

Man, animal plant interrelation is interdependent (one cannot survive without the help of other) Man not only depends on plants and animals for food but also for income and other needs. He co-ordinates activities of the crop and other husbandry by proper planing.

Main objectives of livestock census

1. To assess the growth rate of the livestock
2. It helps to assess/improve the quality/production performance
3. It helps to reduce the uneconomical livestock by culling.

Class 2: Various systems of livestock production-extensive - semi intensive- intensive- mixed.

Systems of Livestock Production

Extensive : Semi intensive- specialized - Intensive – Tethering .

Extensive:

- i. Oldest method**
- ii. Requires extensive land**
- iii. Grazing – dry – housed – night**
- iv. Availability of fodder varies with season so variation in intake.**
- v. Cost of feeding – Nil, Negligible**
- vi. Currently – Not followed – except in**

Reason : a) Reduction in grazing land

b) Tremendous pressure on cultivable land

High yielding animal – not suitable

i) Temperature ii. Loss of energy iii. Average fodder

Semi intensive 1. few months grazing

2. Daily / everyday – grazing

During cropping season – confined/other times let loose.

Exercise for the animal : Milch animal : Fat % : Absences of leg problem – over grown Hoof. Feed cost comparison – less Vs. intensive system, Identification – heat, ailing animals

Dis Adv. : High yielding animal not suitable :

Intensive : Total confinement to shed throughout the year and fed. Restricted movement – energy conservation, management easy. Number of animals can be maintained under direct supervision, space requirement less when compared with. Ext or SI system.

Demerits : over grown hoof ; lack of exercise. Leg problem : improperly maintained disease outbreak – severe – Economical loss – high.

Mixed Farming : Along with crop Husbandry one or more component of livestock or poultry maintained. mixed farming is the economical rearing of different types of Livestock&Poultry in the farm along with

(a) making use of farm Produce.

b)Utilization of unconventional feed and fodder

c)better utilization of farm by products.

Recycling : Farm Yard Manure – Dung – Gas – Slurry – Soil fertility

Bring constant income to the family throughout the year

Indirectly enhances standard of living.

Drawbacks :

- i. No planning**
- ii. No Scientific approach.**
- iii. No correlation between land availability and number of head of animal maintained.**
- iv. Improper planning –over utilization/ under utilized.**

Integrated farming system – (IFS)

In the integrated farming system the defects of mixed farming is overcome by proper planning, monitoring and execution of work according to size of the farm, farm resources, Agro climatic etc.

In this type, the type of livestock species or poultry enterprises are selected based on the availability of feed, fodder, water resources of the farm.

Quantity – Availability : No. of animals maintained

Specialized farm

- i. Sole income is derived from one species – Cattle, Buffalo, goat, pig or poultry
- ii. Feed mixture procured
- iii. Specialized farm – Fodder procured, Accomplish partly.
- iv. Location- various with production of fodder, availability of land ; cost , etc.

If located close to town – Advantageous i. Reduce transport cost ii. Marketing easy since avenues more.

Village : Cost of land cheap : investment on feed and fodder less.

Specialized Farm

1. White cattle
2. Black cattle
3. Sheep
4. Goat
5. Poultry

Pure Breed

- i. Breeding policy
- ii. Income from sale of breeding bulls.
(eg.) Work Bullock (Kangayam)

Grading – upgrading local stock

- i. Production of market milk
- ii. Poor producers - disposed
- iii. New stock purchased
(Eg.) Murrah and local buffalo

Non descript

- i. No specified breeding policy
- ii. No specific breed maintained

- i. Sole Income from Livestock or poultry
- ii. Farm which neither produces feed or fodder
- iii. Fodder alone raised – depending on – availability of land
- iv. Location of farm varies :

Close to urban –

Feed & fodder purchase-Transport cost increased

Rural areas

- | | |
|--|--|
| 1. Production of feed and fodder | 1. Transport cost |
| 2. Production cost feed and fodder | 2. Cost of Feed and Fodder |
| 3. Quality feed and fodder assured | 3. Quality not assured |
| 4. Green fodder available through out the season | 4. Cost fluctuating |
| | 5. Availability of green fodder during summer. |

**CLASS 3: INTEGRATED FARMING SYSTEMS- ROLE OF LIVESTOCK AND POULTRY, MANURE
MANAGEMENT METHODS, DUCK/FISH/RICE CULTURE.**

Integrated Farming system

E A S T A S I A A N D P A C I F I C

REGIONAL SETTING

Characteristics of the region

The East Asia and Pacific region¹ contains 836 million² people (just over one-third of all the inhabitants of developing countries), of which 62 percent (1124 million) are directly involved in agriculture. Considerable variation exists among countries in terms of size and density of population, and the overall proportion living in rural areas. Most people are concentrated in just two countries: China (with 1278 million inhabitants or 68 percent of the region) and Indonesia (with 205 million inhabitants); respectively the first and fourth most populous countries in the world. Very high population densities occur in some rural areas, for example in Eastern China and the islands of Java and Bali in Indonesia.

The total land area of the region is 1639 million ha. Forest cover is estimated at 380 million ha (23 percent of land area), of which 170 million ha are considered as dense forest. Cultivated land is estimated at 232 million ha (15 percent of land area) and the remainder consists of grasslands, wastelands, mountains, urban areas and waterbodies.

Some 278 million people³ (15 percent of the total regional population) are living in extreme poverty, with daily incomes of less than US\$1. A quarter of these impoverished people live in China, but significant numbers are found in almost all countries in the region. About 240 million people⁴ (13 percent of the total population) are undernourished. Poverty in rural areas is approximately twice as high as in urban areas⁵. The incidence of rural poverty ranges from 4.6 percent in China to 57.2 percent in Vietnam. With the exception of China and the Republic of Korea, the economies of the region are strongly agrarian. Although the average contribution of the agricultural sector to total GDP is 13 percent, this figure is heavily influenced by China (17 percent)⁶. In the Republic of Korea, the agricultural sector's added value is only 5 percent, while in Laos, Myanmar and Cambodia it is over 50 percent.

Major farming systems in South Asia and Pacific- MAP

Major farming systems in East Asia and Pacific

Eleven broad farming systems have been identified⁷, based on criteria discussed in Chapter 1. They are listed in Table 6.1 and their geographical location is indicated in the accompanying Map.

Lowland Rice Farming System

This farming system is found in both humid and moist subhumid agro-ecological zones in well-watered mainly flat landscapes⁸. It covers an estimated 197 million ha and, with an agricultural population of 474 million, it is the most populous system in the region. Cultivated area is 71 million ha, of which about 45 percent are irrigated. Large areas of this system are found in Thailand, Vietnam, Myanmar, South and Central East China, Philippines and Indonesia. Smaller areas are located in Cambodia, Korea DPR, Republic of Korea, Laos DPR and Malaysia. The farming system is dominantly rice-based, with cropping intensity dependent on rainfall distribution, length of growing

season and the availability of supplementary irrigation. Important subsidiary crops include oilseeds, maize, root crops, soybeans, sugarcane, cotton, vegetables and fruits in all areas, while wheat is significant in Central East China. Both livestock and off-farm income contribute to household livelihoods. Regional food security depends upon the production from this system. The prevalence of poverty is moderate overall, although it is extensive in Myanmar and Cambodia.

Tree Crop Mixed Farming System

This farming system is found mainly in the humid agro-ecological zone, but also extends into moist subhumid areas, principally on flat to undulating landscapes with poor soils where paddy rice cannot be intensively produced. Total system area is 85 million ha, with an agricultural population of 30 million. Cultivated area is estimated at 18 million ha, of which little more than 12 percent are irrigated. Significant areas of this system are found in Malaysia, Indonesia, Thailand, Cambodia, Philippines, Vietnam, Southern China and Papua New Guinea. Major industrial crops include rubber, oil palm, coconut, coffee, tea and cocoa, with some other associated crops such as pepper and other spices. Tree crops are grown under both large private estate and smallholder management systems. Smallholders also grow food and cash crops, raise a considerable number of large livestock, and supplement their livelihoods with off-farm income. Coconut plantations are widespread throughout most Asia and Pacific countries. The system has been a traditional source of export earnings in Indonesia and Malaysia, and also a target for substantial private and public investment. The prevalence of poverty is moderate.

Root-Tuber Farming System

This farming system is found in humid and moist subhumid agro-ecological zones in both plain and hill landscapes, typically in areas with low population density. Total system area is 25 million ha, with an agricultural population of approximately 1.5 million. Cultivated area is about 1.2 million ha, less than one percent of total area - no irrigated area is recorded. The system is found in Papua New Guinea and the Pacific Islands generally, and often merges into the Coastal Artisanal Fishing System towards the coastline. Although of minor significance on a regional level, it is the dominant farming system in many Pacific countries. It is based on the use of root food crops (yams, taro, sweet potato), vegetables and fruits (particularly banana), coconut and livestock, supplemented by hunting and gathering in the forest. There is relatively limited poverty in this system.

Upland Intensive Mixed Farming System

This farming system is found in upland and hill landscapes of moderate altitude and slope, in humid and subhumid agro-ecological zones. Total system area is 314 million ha, with an agricultural population of 310 million - the second most populous system, after Lowland Rice, in the region. Cultivated area is 75 million ha of which just under one quarter are irrigated. This is the most widespread and most heterogeneous farming system in the region (even including some remnant shifting cultivation), with major areas located in all countries of East and Southeast Asia. The system is characterised by the cultivation of a wide range of mostly permanent crops, but the specific crops preferred depend on geographic area, agro-climatic conditions, slope, terracing and water regime. A significant crop area - mainly rice - is irrigated from local streams and rivers. Livestock production is an important component of most farm livelihoods (there are 52 million large ruminants and 49 million small ruminants in this system) and contributes draught power, meat, cash income and savings. Off-farm work is an important source of income for many poor households. Poverty is extensive, varying in severity from moderate to very severe.

Major Farming Systems in East Asia and Pacific				
Farming Systems	Land Area (% of region)	Agric. Popn. (% of region)	Principal Livelihoods	Prevalence of Poverty
Lowland Rice	12	42	Rice, maize, pulses, sugarcane, oil seeds, vegetables, livestock, aquaculture, off-farm work	Moderate
Tree Crop Mixed	5	3	Rubber, oil palm, coconuts, coffee, tea, cocoa, spices, rice, livestock, off-farm work	Moderate
Root-Tuber	2	<1	Root crops (yam, taro, sweet potato), vegetables, fruits, livestock (pigs and cattle), off-farm work	Limited
Upland Intensive Mixed	19	27	Rice, pulses, maize, sugarcane, oil seeds, fruits, vegetables, livestock, off-farm work	Extensive
Highland Extensive Mixed	5	4	Upland rice, pulses, maize, oil seeds, fruits, forest products, livestock, off-farm work	Moderate
Temperate Mixed	6	14	Wheat, maize, pulses, oil crops, livestock, off-farm work	Moderate
Pastoral	20	4	Livestock with irrigated crops in local suitable areas	Extensive, especially drought induced
Sparse (Forest)	10	1	Hunting, gathering, off-farm work	Moderate
Sparse (Arid)	20	2	Local grazing where water available, off-farm work	Extensive
Coastal	1	2	Fishing, coconut, mixed	Moderate

Artisanal Fishing			cropping, off-farm work	
Urban Based	<1	1	Horticulture, dairy, poultry, other work	Limited
Source: FAO data and expert knowledge. Note: Prevalence of poverty refers to number in poverty, not depth of poverty, and is a relative assessment for this region.				

Highland Extensive Mixed Farming System

This farming system is found in hill and mountain landscapes of high altitude and steep slopes, in both humid and moist subhumid agro-ecological zones. It often lies above the Upland Intensive Mixed Farming System, but with poorer resources and lower population density. Total system area is 89 million ha with an agricultural population of only 47 million. Cultivated area is 8 million ha, of which about one fifth is irrigated. Extensive forested areas occur within the system, some of which have little human habitation and are similar to the Sparse (Forest) System delineated below, but provide grazing to some of the 16 million large ruminants. Major areas are located in Laos, Central and North Vietnam, Northern Thailand, Northern and Eastern Myanmar, Southwestern China, the Philippines and parts of Indonesia. The farming system can be subdivided into permanent and shifting cultivation sub-types. Both sub-types produce crops (including perennial crops such as fruit trees), livestock and forest products. This system provides the principal base for a number of tribal (indigenous) groups. Poverty is moderate to severe.

Temperate Mixed Farming System

This farming system is found in moist and dry subhumid agro-ecological zones in Central-Northern China and restricted areas of Mongolia. Total system area is 99 million ha, with an agricultural population of 162 million. Cultivated area is 31 million ha, of which about one-third is irrigated. The transitional boundary between this system and the Lowland Rice Farming System in Central-Eastern China is not easily defined, and the system also blends into the Extensive Cereal-Livestock Farming System of Southern Siberia and parts of Central Asia (in the Eastern Europe and Central Asia region - see Chapter 4). Major crops are wheat and maize, with smaller areas of rice, cotton, soybeans, sweet potato and rape - depending on local temperature and water conditions - as well as citrus and some temperate fruits. Livestock are important, particularly cattle, pigs and poultry. The prevalence of poverty is moderate.

Pastoral Farming System

This farming system is found in semiarid and arid temperate agro-ecological zones (with less than 120 growing days per annum) in both plain and hill landscapes. The system is extensive in Western China and much of Central and Northern Mongolia. Total area is 321 million ha, but with no more than 42 million people classed as agricultural, cultivated area is just over 12 million ha of which some 20 percent is irrigated in dispersed zones. The farming system is dominated by transhumant pastoralism and characterised by mixed herds of camels, cattle, sheep and goats extensively grazing native pasture. Irrigated crops include cotton, barley, wheat, pulses, peas, broad beans, potatoes and grapes, while sericulture is sometimes practised. Severe poverty, often triggered by drought or severe winters - with consequent loss of livestock - is common in both pastoral and irrigated areas.

Sparse (Forest) Farming System

Although vast in area, the sparse agriculture systems (both forest and arid) are of limited economic importance. The Sparse (Forest) System occurs at moderate to high altitudes to the north and west of the main areas of the Highland Extensive Farming System in Western China and Northern Myanmar, in Northern Mongolia - where it comprises part of the extensive Siberian Sparse (Forest) System - and in the major islands of Indonesia, excluding Java, and Papua New Guinea. The system covers an area of 172 million ha with a population of 23 million people, of whom 15 million are classified as agricultural. On the mainland of Asia small, scattered settlements depend on potatoes and buckwheat, plus cattle and yak herds. In the dense tropical forests of Malaysia, Indonesia and Papua New Guinea, small, scattered settlements (mainly tribal) depend on upland rice, root crops and small and large ruminants, supplemented by gathering wild plants and hunting animals. There are nearly 10 million ha of scattered cultivation, while 14 million bovines and 20 million sheep and goats are also supported. The prevalence of poverty is moderate.

Sparse (Arid) Farming System

The total area of the Sparse (Arid) Farming System, located in Western China and Southern Mongolia, is estimated at 322 million ha, supporting an estimated 9 million cattle and 59 million small ruminants. Only a little over one percent (less than 4 million ha) is cultivated, of which about two-thirds are under irrigation. Two types of irrigation are practised - some large-scale irrigation areas concentrated in the west; and scattered small areas of irrigation used by pastoralists to supplement their livelihoods. There is a population of 24 million people, 17 million of whom are classified as pastoral or agricultural. Apart from these arable areas, the dominant arid areas are utilised for opportunistic grazing. Poverty is extensive and, especially after droughts, severe in this system.

Coastal Artisanal Fishing Farming System

Along the narrow coastal strips in many countries of the region and in many islands (an estimated area of 38 million ha), around 28 million people supplement artisanal, inshore fishing with food production - rice from Java to China and root crops in the Pacific countries - and cash-oriented enterprises such as coconuts and livestock. Cultivated area is estimated at three million ha. The location of the system is not separately mapped. There is a moderate incidence of poverty.

Urban Based Farming System

In most large towns and cities throughout the region, the intensive production of perishable, high value commodities, such as milk and fresh vegetables, has expanded and now employs an estimated seven million people. This farming system - which is also not mapped - is generally characterised as a high external input, commercial system with well-functioning links to the surrounding rural areas for livestock, feed and fodder supplies. Because of the availability of other employment, poverty is generally limited.

Region-wide trends in East Asia and Pacific

This section describes the most important region-wide trends in terms of: population, hunger and poverty; natural resources and climate; science and technology; trade liberalisation and market development; policies institutions and public goods; and, information and human capital. At the end of the section, four of the regional farming systems described in the previous section of the Chapter are selected for further description and analysis.

Population, hunger and poverty

The region has been settled for many thousands of years but has experienced rapid population growth in the last century, resulting in high population densities in many areas. In response to overpopulation, many governments have introduced birth control programmes that are contributing to falling population growth rates. This trend will continue, although there will be significant variations in the rate of decline among countries. Overall, the population in the region is projected to grow at 0.9 percent per annum to 2.13 billion by 2015, and thereafter at 0.5 percent per annum to reach 2.31 billion by 2030. The degree of urbanisation is expected to increase from the current 37 percent to 53 percent by 2030. However, in many of the developing countries in the region, a large proportion of the total population, and the majority of rural people, will continue to be employed in the agricultural sector. Nonetheless, the rural population will age gradually as younger people migrate to cities for jobs. This has adverse implications for socio-economic conditions as well as labour quality and availability in rural areas.

The rapid economic growth experienced over much of the region during the last two decades has resulted in major and widespread socio-economic gains in many countries, but these gains have generally been strongly biased in favour of the urban population. Yet, with the exception of China and Republic of Korea, the regional economies remain strongly agrarian. GDP has been steadily decreasing as a proportion of national GDP, but still remains significant. This trend can be expected to continue in all countries, but a majority of the population will still remain dependent on the agricultural sector by 2030. Socio-economic indicators (household income, poverty, health, literacy, infant mortality, morbidity, longevity, etc.) of the rural population, while gradually improving in most countries, are usually significantly lower than for the urban population. Rural incomes have only increased slowly - and perhaps not at all in real terms - and in almost all countries there is a growing disparity between rural and urban incomes.

Average per capita GDP is about US\$1000 (US\$3500 at parity purchasing power)¹¹, which is low compared to other developing regions. There are 278 million people (15 percent of the total population) who are considered to be living in extreme (or dollar) poverty, with daily incomes of less than US\$1 per day - approximately twice as many in rural areas as in urban areas. A quarter of these people live in China, but significant numbers are found in almost all countries in the region. Furthermore, the rural population remains relatively poorly educated, with significant illiteracy and low school attainment levels in a number of countries. This has an adverse effect on the knowledge and learning skills of farmers. Figure 1.3 in Chapter 1 shows the dramatic reduction in poverty in the region during the period 1978-1987. While some improvements in these factors may occur, it is anticipated that rural/urban disparities will increase in many countries by 2030 unless governments undertake active policy initiatives and make specific plans to redress this imbalance.

The current average food intake is estimated at about 2780 kcal per person per day; 6 percent higher than the average for all developing countries. However, cereals (rice and wheat) contribute a very high proportion of total calorie intake. In the last two decades, the diet in the region has improved significantly, with a 30 percent increase in average total calorie intake, resulting in significant reductions in undernourishment in most countries. By 2015 and 2030, the food intake is forecast to increase to 3020 kcal and 3170 kcal, respectively. In China, the proportion of the undernourished population decreased from 30 percent in 1979-1981 to 13 percent in 1995-1997, and in Indonesia from 26 percent to six percent¹². Undernourishment increased in only two countries - Mongolia (from 27 percent in 1979-1981 to 48 percent in 1995-1997) and Korea DPR (19 percent to 48 percent) - in the same period. However, a number of other countries still have higher proportions of under-nourished people than the developing world average (18 percent), including Cambodia (33 percent), Lao PDR (33 percent), Thailand (24 percent), and Papua New Guinea (24 percent). Overall, the number of

undernourished people in the region has halved in the quarter century leading up to 1995-1997; from 504 million to 240 million (see Figure 1.2 in Chapter 1).

Natural Resources and Climate

Total cultivated land is estimated at 231 million ha, of which 134 million ha are found in China. This is less than 15 percent of the total regional land area. However, only a marginal net increase in cultivated land is expected by 2030, due to the large areas occupied by desert, mountains and other areas unsuitable for cultivation - as well as the loss of productive land to urbanisation. In particular, net cultivated land in China has actually decreased over the last two decades and is forecast to continue to decrease gradually over the period to 2030, as urbanisation reduces cropping area faster than new land can be brought into cultivation. Unfortunately, urbanisation removes some of the most productive land, while the newly cultivated tends to be more fragile, less fertile, steeper, more drought-prone and with less soil depth. In the other countries in the region, however, a gradual net increase in cultivated land area is projected up to 2030.

Agriculture is currently smallholder-based with widespread subsistence production. Average farm size has been declining for many decades in most countries. In only few countries has the absolute number of the rural-based population decreased - so allowing larger average farm sizes - as happened decades ago in industrialised countries. By 2030, therefore, it is anticipated that most farms in the region will remain as traditional smallholdings, although the proportion of semi-commercial and commercial farms will increase. The region's renewable water resources account for 32 percent of the total in the developing world. The current irrigation efficiency is low at 38 percent and is expected to increase only slowly to 42 percent by 2030 - still lower than the projected developing world average of 50 percent in that year. Cultivated land under irrigation is projected to expand from the current 71 million ha (30 percent of the total cultivated land) to 85 million ha (35 percent) in 2030. China alone irrigated 51 million ha in 1995-1997 and is expected to bring another nine million ha under irrigation by 2030.

Forest cover¹³ is estimated at 380 million ha (23 percent of land area), of which 170 million ha (10 percent of land area) remain dense forest. This area decreased by 0.8 percent per annum (three million ha) between 1990 to 1995, due to unsustainable logging practices, and is expected to diminish further, with little reforestation of natural forests and limited establishment of forest plantations.

With so many low-lying coastal areas on the mainland and the numerous islands, the Asia and Pacific region is particularly vulnerable to floods and maritime storms. The frequency and severity of storms is expected to intensify as a consequence of global warming. In addition, rising sea levels may threaten some islands during the course of the coming century.

Science and technology

Mainly as a result of the adoption of better technologies generated by the CGIAR and national research systems, overall crop production in the region has been increasing at three percent per annum during 1980s - but the rate of increase has been diminishing. Crop yields increased by 3.6 percent per annum during the period 1967-1997, and are projected to grow only at about one-third of this historic rate during the period until 2030. Since little increase is expected in cultivated land area, future growth in crop production will be achieved through higher cropping intensity and higher crop yield per unit area. However, considerable variation can be noted in growth projections for various crops. While production of paddy rice, the main crop in the region, increased at about 2.2 percent per annum from 1970 to 2000 (see Table 6.2) to reach 345 million tons (200 million tons in China), this rate of growth

was lower than that for South Asia. Paddy rice production is projected to increase slowly over the period to 2030.

Wheat has been the fastest growing of the cereal crops, with production expanding by over four percent per annum over the last 30 years, almost all of it due to yield increases. Output is expected to continue to increase during the period 2000 to 2015. The region now produces 100 million tons of wheat per annum compared to only 30 million tons in 1970; almost all of it in China. Substantial increases in the production of maize and barley are also expected, but little increase is anticipated for millet, sorghum, cassava, and pulses. The output of oil crops, such as rape, soybean, maize, sesame, sunflower and oil palm, and fruits and vegetables - already one of the fastest growing crop categories in the region, averaging almost six percent production increases per annum since 1970 - is projected to increase substantially by 2030. The production of cotton is expected to grow moderately, while the output of other fibre crops is forecast to stagnate. The production of beverages, tea and coffee, is also expected to increase significantly. Natural rubber output has grown at an annual rate of 2.7 percent in the past, doubling from 1961 to 5.6 million tons by 1999 and is projected to double again during the next 30 years. Vegetables and fruits have shown very strong growth over the last 30 years, and this is expected to continue.

Over the period 1961-1997, the use of fertiliser increased rapidly at an annual rate of 8.9 percent. As a result, fertiliser application is high, at 147 kg per ha, compared to the developing world average of 90 kg per ha. However, the relatively high level of regional fertiliser consumption is due principally to massive use in China, as the average for the rest of the region is only 93 kg per ha. China consumes 73 percent of all the fertiliser in the region and has twice the application rate of the average in other regional countries. The pace of increase is expected to decline from 2000 to 2030, when average consumption is projected to be 180 kg per ha. Excluding China, the projected annual rate of increase in other countries will be slow, leading to an average consumption will be 106 kg per ha by the year 2030.

Both total and per capita meat and milk consumption have increased rapidly in the last twenty years. Between 1983 and 1993, per capita per annum meat consumption increased from 16 to 33 kg in China and from 11 to 15 kg in Southeast Asia countries, while per capita milk consumption increased from 3 to 7 kg in China and from 10 to 11 kg in Southeast Asia countries.

Most of the strong historical growth in livestock production has been driven by the rapid expansion of the livestock sector in China. Numbers of pigs and poultry in the region increased at high annual rates over the last three decades to reach over 500 and 6000 million head respectively (see Table 6.3). At present, more than 50 percent of the pigs and 36 percent of chickens and fowls of the world are found in the region. During the period 2000 to 2030, the pace of increase in China will slow down. However, this will still create huge increases in demand for animal feed supplies in China. These extra supplies are expected to come from the conversion of substantial areas of rice and wheat to maize production (as well as an acceleration of maize imports). The scope for increased livestock numbers and meat production in other countries in the region is mostly limited to pigs and poultry, as there is little potential for strong growth in the supply of ruminant meats (see below). The increased production of poultry and pigs will entail greater competition between livestock and humans for cereal grains.

Ruminant livestock are an important source of draught power, meat, savings and income in farming systems throughout the region. Total populations of cattle and buffalo, specialised dairy animals, and sheep and goats, are estimated at 190, 3, and 338 million respectively. While the growth in buffalo numbers in recent decades has been slow - largely due to the expansion of mechanisation -

cattle and small ruminant populations have shown strong growth, with annual rates of increases of 1.9 and 2.8 percent respectively for the last three decades.

The projected future growth, for the period 2000 to 2030, is moderate for both types of livestock. However, the limited potential for increasing the supply of ruminant feedstuffs is anticipated to be a significant constraint in most countries. Little opportunity exists for improving and expanding native pastures, forages, and sown pastures. Ruminant feed supplies are expected to be mostly dependent on cultivated forages and native pastures rather than grains and concentrates.

Table 6.2 Trends in Crop Area, Yield and Output in East Asia and Pacific, 1970-2000						
Crop	Harvested 2000 (m ha)	Yield 2000 (t/ha)	Production 2000 (m tons)	Average Annual Change Area 1970-2000 (%)		
				Area	Yield	Production
Rice	74	4.6	344	0.4	1.8	2.2
Wheat	27	3.7	100	0.1	4.0	4.1
Maize	31	4.1	127	1.0	2.7	3.8
Other Cereals	7	2.1	15	-3.5	1.4	-2.2
Oilcrops	47	0.9	41	2.2	3.7	5.8
Roots & Tubers	15	16.3	239	0.1	1.2	1.3
Vegetables	18	17.2	313	4.4	1.5	6.0
Fruits	13	8.4	105	4.7	1.2	5.9
Source:FAOSTAT.						

Trade liberalisation and market development

The region currently accounts for a major proportion of world trade in a number of agricultural commodities, including, oil palm (Malaysia, Indonesia, China, Papua New Guinea and Solomon Islands), rubber (Thailand, Malaysia and Indonesia) and rice (Thailand, Vietnam and Philippines). Countries with a strong positive balance of trade in agricultural products include Thailand, Malaysia and Vietnam, while China, Republic of Korea, Korea DPR and the Philippines have a strong negative balance of trade. Market liberalisation is expected to encourage farm diversification - production and trade of higher-value products - in all farming systems. Growing urban markets and higher per capita incomes will lead to increased internal trade in most countries, with urban and peri-urban agriculture expected to expand and intensify to meet the increasing demand for vegetables and fruits and meat and dairy products.

Policies, institutions and public goods

Many countries in the region are governed under communist-derived regimes (China, Cambodia, Laos, North Korea and Vietnam) or military leaders (Myanmar). In these countries, the political regime has had a marked effect on government policies, laws and regulations, thereby affecting the environment in which businesses and farming have had to operate. Restrictions on trade and prices, rent-seeking practices and the persistence of inefficient government enterprises, all adversely effect the provision of goods and services to farming and private enterprise businesses. In other countries, restrictive and inefficient government bureaucratic practices, and widespread corruption have also had a negative effect on the growth, productivity and profitability of the agricultural sector. Despite these collective shortcomings, policy reforms have been implemented in recent years to improve market liberalisation, government efficiency and good governance, as well as to diminish corruption in the public service. However, it is proving to be a considerable challenge to implement these policy reforms.

Most countries, usually through donor assisted projects, have introduced changes to strengthen their agricultural extension and research systems. While the knowledge, skills and capacity of these services have been upgraded, there is still a need for further strengthening. Whilst the degree of importance given by governments to the protection and management of natural resources (land, water, flora and fauna) and the environment has increased, there is still a need for further upgrading of government institutions concerned with natural resource policy, planning and management. There also needs to be a closer linkage between government agencies concerned with agricultural production and natural resources management.

Information and human capital

Recent advances in information technology have almost exclusively benefited urban, educated populations. Traditionally, agricultural information dissemination to farmers has been delivered by public extension services. This has been through the usual mechanisms of formal and informal farmer training, radio and television presentations, provision of leaflets, field days, etc. In recent years, some countries have introduced computer-based management information systems (MIS), and geographic information systems (GIS), within agencies focused on rural issues. They have also started to develop some basic information programmes on research and extension themes, and even introduced farm decision programmes. Internet based information delivery has the potential to revolutionise service provision to agriculture. However, these developments are only in their infancy and have not reached the general farming public to any extent.

Selection of farming systems for analysis

Four of the farming systems outlined in the previous section have been selected for analysis, using criteria based upon agricultural population, the incidence of poverty, and apparent potential for agricultural growth and poverty reduction in the coming 30 years:

- Lowland Rice Farming System;
- Tree Crop Mixed Farming System;
- Temperate Mixed Farming System; and
- Upland Intensive Mixed Farming System.

These four farming systems contain most of the agricultural poor in the region and also produce more than three-quarters of the GADP. They are described in more detail in the following sections of the Chapter.

LOWLAND RICE FARMING SYSTEM

Characteristics of the system

The Lowland Rice Farming System is the single most important farming system in East Asia in economic and demographic terms, covering some 197 million ha (12 percent of the land area of the region) and containing 825 million people or over one quarter of the region's agricultural population (474 million) - see Box 6.1. It covers both humid (270 to 365 growing days) and moist subhumid (180 to 269 growing days) tropical environment in mainly flat landscapes. Large areas of this system are found in Thailand, Vietnam, Myanmar, South and Central-Eastern China, Philippines and Indonesia. Smaller areas are located in Cambodia, Korea DPR, Republic of Korea, Laos DPR and Malaysia.

Average household incomes are low and poverty is extensive and severe in many areas. Land ownership is secured under traditional or - less frequently - freehold tenure. Traditional rights are not recognised as legal ownership in many countries, but usually ensure long-term use of land. The system is generally well serviced by roads, communications, community, goods and support services.

Table 6.3 Trends in Livestock Populations and Output in East Asia and Pacific, 1970-2000		
Species	Million Head 2000	Ave Annual Change 1970-2000 (%)
Cattle	38	1.9
Buffalo	152	0.3
Small Ruminants	338	2.8
Pigs	501	3.0
Poultry	6 073	5.6
Product	Output 2000 (million tons)	Annual Change 1970-2000 (%)
Total Meat	74	6.9
Total Milk	16	6.1
Total Wool	0.3	2.8
Total Eggs	26	7.7
Source:FAOSTAT.		

About 71 million ha, or almost one third of the total area of the system, are estimated to be cultivated. There is considerable variation in intensity of farm production. More intensive production systems are found in areas with higher population density and smaller farm size, for example in China. While

cultivated area per farm household can reach as much as several hectares in central Thailand, in the Red River Delta it is only 0.24 ha (see Box 6.2). Other locations tend to have sizes between 0.5 and 1 ha (e.g. the Mekong River Delta averages 0.79 ha cultivated area, while in Southeast China it is estimated at 0.67 ha). Average farm household size varies from six persons in the Mekong River Delta to four persons in Jiangsu Province, China.

As its name implies, the farming system is predominantly rice-based, with from one to three harvests per annum depending on rainfall distribution, length of growing season and the availability of supplementary irrigation. Total irrigated area is around 33 million ha, or 45 percent of the arable area in the farming system. This constitutes almost half of the entire irrigated area of the region. The total annual area of rice is estimated at 96 million ha. The second most important crop is wheat (21 million ha), which is sown as a winter crop, mainly in the northern part of this farming system in Central-Eastern China. Other crops, in descending order of importance by area, are vegetables, oilseeds, maize, root crops, soybeans, sugarcane, cotton and fruits. Large and small ruminants, pigs and poultry are a minor but important source of income generation.

Rice is mostly grown on puddled lowland soils under both rainfed and irrigated conditions. Soils are heavy and inherently more fertile than other cropped soils, but natural fertility is declining under conditions of continuous cropping with inadequate or unbalanced nutrient inputs. The average yield of paddy is 3.1 t/ha across the region, but it is heavily skewed by the higher yields obtained in China (up to 8.1 t/ha in Jiangsu Province). High-yielding varieties are used in all countries, but some still have significant areas of lower yielding, traditional varieties because of their perceived higher grain quality and acceptability. Fertiliser use is moderate to high, including the use of both inorganic and organic types. High inputs of organic and inorganic fertiliser combined with the universal use of high-yielding varieties are the main determinant of high yields in China. Rice is mostly transplanted, but germinated seed or seedlings are broadcast in some countries (Thailand and some areas of China) where serious labour shortages occur. Triple cropping only occurs where transplanting is used and there is a continuous supply of water during the year.

Livestock are important for draught power, meat, income and savings purposes. About 29 percent (52 million head) of the total large ruminants (cattle and buffalo) of the region are found in this farming system. Buffalo are very important for draught power in the lower, wetter landscapes with cattle used more commonly in slightly higher parts. Sheep are unimportant, but there are an estimated 36 million goats (12 percent of the regional total). Ruminant livestock graze under extensive conditions and animal health services are generally poorly developed. Pigs and poultry are important for household consumption and sale. In the more extensive areas within the system, animals mostly scavenge during the day with some supplementary feeding. Buffalo will probably decline in importance and numbers in the future, as mechanisation increases. More intensive production systems for pigs and poultry are found in China where a more intensive farming system is generally practised. Animals are usually housed, and productivity levels are higher as a result of better feeding, husbandry and animal health practices.

On-farm fish production is an important source of food and income in this farming system. Fish are cultivated in association with wetland rice fields and in ponds. Rice cultivation has been further diversified in coastal areas in China where rice culture has been combined with other fisheries products, such as crabs, shrimps and pearls. This type of farm diversification has numerous benefits; including improved pest control, nutrient cycling and a higher cash income that can be used to purchase crop production inputs.

The majority of farm households in this system are food secure and sell surplus rice, cash crops, livestock and fish. However, at a national level, most countries are barely able to meet domestic demand; only Thailand and Vietnam are significant exporters of rice. Until the present time, livestock and fish have only been marketed domestically, however small quantities of some other crops are traded internationally.

Trends and issues in Lowland Rice System

The rate of production growth of the Lowland Rice Farming System is expected to decline in the coming years due to the limited capacity for expansion of cultivated area, as well as an expected reduction of the historical rate of crop yield increases. Although production intensification will be important, poverty reduction is expected to derive primarily from increased diversification of cropping, as well as non-crop activities such as intensive livestock production and small-scale on-farm aquaculture (fishponds, rice-fish culture, shrimps, crabs, etc.). Rice production may actually decline in some areas as other activities offering higher returns to land use become popular. An increasing proportion of the agricultural population will also obtain a greater percentage of their income from off-farm activities - whether this involves agro-processing, service provision or seasonal migration to urban areas (e.g. construction work). In addition to increased production and incomes, technology changes will emphasise improved sustainability of the natural resource base. Efficiency of irrigation use is also expected to increase, with some expansion of irrigation area.

Box 6.1 Basic Data: Lowland Rice Farming System	
Total population (m)	825
Agricultural population (m)	474
Total area (m ha)	197
Agro-ecological zone	Moist subhumid
Cultivated area (m ha)	71
Irrigated area (m ha)	33
Bovine population (m)	52

Specific issues that will have to be addressed if the Lowland Rice Farming System is to achieve significant progress in reducing poverty include: land fragmentation; unbalanced fertiliser use; inefficient use of water resources; inferior seed quality; poor post-harvest management; limited farm diversification; and, the absence of adequate local capacity for agricultural product processing.

Increasing fragmentation of farmland has resulted from a growing agricultural population and the absence of primogeniture to maintain the integrity of holdings. In many instances farm sizes are now uneconomic, and even with the adoption of best practices would still only be marginal in terms of livelihood. If this trend is not reversed, an increasing proportion of farmers will be unable to rely on agriculture to ensure adequate food security and income levels. As a consequence, on-farm employment, and even complete exit from the system (e.g. permanent migration to urban areas), is likely to occur on a much larger scale.

The adoption of intensive methods of crop production, based on high levels of inorganic fertilisers and pesticides, has in many cases lowered the quality of soil and water resources. Continuous rice cultivation, using unbalanced mineral fertilisers and only low inputs of organic manure, is in some situations seriously deteriorating the physical and chemical properties of the soil with adverse consequences on crop yields. On-farm deterioration in the quality of rice for sale, due to poor post-harvest management practices and inadequate storage conditions, is very significant in many areas and leads to reduced revenues from crop sales. There is limited scope for further expansion of irrigation systems. Only a few countries are in the fortunate position of under-exploiting their water resources. In some areas, serious shortages of irrigation water occur in the dry season. However, water use efficiencies are often low.

In most countries, seed is generally of poor quality and not necessarily of the most recently recommended variety, because most farmers retain their own seed for replanting for many seed generations. While research services and private companies have developed new crop varieties - including hybrids - with higher yield potential and better local adaptability, they are often unavailable to the majority of farmers or are unsuited to their production practices. Production of seed of improved rice varieties is undertaken in many countries by government services, but quantities are generally much less than required by farmers. This situation has a serious adverse effect on crop yield and overall crop production.

Box 6.2 A Typical Household of the Lowland Rice Farming System

A typical rice farm household in Thai Binh Province, Red River Delta, Vietnam illustrates very intensive rice farming (in contrast to the larger farm sizes in Southeast Asian countries). The family of four cultivates a total area of 0.24 ha with a cropping intensity of 190 percent. Two transplanted rice crops (89 percent of the total cropped area of the farm) are followed by small areas of sweet potatoes, maize and soybeans. Modern rice varieties are transplanted in both seasons, producing 2.5 tons per annum of paddy rice (equivalent to 6.5 t/ha for spring paddy and 5.8 t/ha for winter paddy). The yields of the three other crops are 14.6 t/ha for sweet potatoes, 4 t/ha for maize and 1.7 t/ha for soybeans. Total annual household production of these four main crops would total approximately 2.8 t (0.7 t per capita). Power tillers are used for primary tillage, and additional income is earned through provision of transportation services. The household maintains a small piggery. The household income, which has risen rapidly during the past 20 years, is only now reaching the international poverty line.

Historical trends in farm production patterns have been towards the development of rice monoculture systems in lowland areas. The more recent reversal of this trend, towards a more diversified form of production - introducing field crops, vegetables, small livestock and fish into the farming system - has generated both increased incomes and improved family diets. However, opportunities for farm diversification are often location-specific; depending upon markets, infrastructure and other factors, and hence need to be identified on a zone-by-zone basis. In many areas, the productivity of livestock within the Lowland Rice Farming System is low because of extensive management practices. Opportunities to intensify small animal production enterprises need to be identified in relation to the resource situation and market circumstances.

Off-farm income is already a significant part of total household income in many areas. Further opportunities for increasing the value of products need to be identified. In some countries, government agencies still maintain monopolies on the supply of production inputs and also control the price and sale of crop products. Policies and actions need to be adopted to privatise the supply of production inputs and liberalise the marketing of products.

Priorities for Lowland Rice System

The central strategic priorities for improving the farming system relate to: (i) enterprise diversification; (ii) strengthened linkages to the non-farm economy to boost off-farm income; (iii) improved resource management to maintain and even increase current high levels of productivity; (iv) land consolidation to increase field sizes; and (v) an improved level of farm management concentrated on better control of soil nutrients, weeds and pests.

Demonstration, active learning and formal training programmes can catalyse the diversification of farm production (field crops, annual fruits, vegetables, small livestock and fisheries) in order to increase incomes, minimise and spread risks, enhance natural resources and the environment, and improve the diet of farm families (see Box 6.3). Programmes would aim to promote the cultivation of new, higher value, crops with good market prospects. Intensification of village-based, small livestock-production (chickens, ducks, pigs, etc.) should be promoted through effective animal health services, better feeding, better animal husbandry practices and breed improvement. Local feed processing should be promoted by using crop by-products and the cultivation of specific feed crops. Small pond culture, rice-fish culture, and rice-shrimp and crab systems should also be promoted where local conditions are suitable. Diversification is likely to be accompanied by gradual increases in the productivity of existing crops and livestock.

A further high priority area is the introduction of improved post-harvest management practices, processing and storage conditions to reduce losses of crop products - in terms of both quality and quantity. These measures should be accompanied by government divestment to the private sector of responsibility for the production, distribution and sale of improved seeds and planting materials, so as to replace the generally inefficient and inadequate government seed and seedling production services. Reforms need to be accompanied by improvements in marketing systems, through provision of market information, assistance and market facilities in order to prevent product losses and to increase farmers' share of the consumer price.

Development of financial mechanisms to facilitate the use of local resources and gradually expand financial services, is extremely important. In marginal areas, support to local Self-Help Groups (SHGs), to enable them to mobilise savings and to give small short-term loans, may constitute a good starting point. Linking SHGs with formal financial institutions and the use of micro-lending technologies broadens the outreach as well as the sustainability of financial services.

Improved management of natural resources can be achieved through implementation of programmes of integrated soil nutrient management to promote increased use of organic manures, crop rotations that include leguminous crops; plus balanced fertilisation to improve sustainability of soil fertility and thereby crop yields. These actions should be accompanied by the implementation of training programmes and demonstrations that emphasise improved efficiency of water use, avoidance of pollution of water resources, communal operation and management, and cost recovery of irrigation systems and efficient drainage systems.

Improved resource management will be facilitated by land aggregation and consolidation, leading to a gradual increase in field sizes and, over time, average farm size. These policy initiatives need to include: (i) issuing of land titles; (ii) development of land markets; (iii) land leasing; (iv) establishment of land banks; and (v) the use of land as collateral to finance purchase of additional land and investment in farm production activities. In addition, governments need to undertake initiatives to provide alternative employment to agricultural workers in rural areas through promotion and development of locally-based industries in order to enhance exit opportunities of farmers and farm workers. This would promote land consolidation, as well as providing off-farm income for households that remain in farming.

A more holistic, integrated form of participatory research and extension should be developed and promoted, with less emphasis on single-crop research. This type of work would place greater emphasis on benefiting from synergies between productive activities, and would consider the whole-farm production system - including the sustainability of natural resources and the protection of the environment. Specific support should be given to the development of research resources, both equipment and human resources, to take advantage of new techniques in biotechnology and genetic engineering. At the same time, there is a need to develop the skills of farmers and extension staff in participatory of farming systems and identification of development opportunities, combined with a farmer field school approach to promoting new technologies. These measures should be associated with improvements in the linkages between research and extension to ensure more effective information availability, dissemination and technology development.

TREE CROP MIXED FARMING SYSTEM

Characteristics of the system

This system covers 85 million ha, mainly in Thailand, Malaysia and Indonesia, with smaller areas in Cambodia, Philippines, Vietnam, South-ern China and Papua New Guinea, and contains a total population of 49 million with an agricultural population of 30 million (see Box 6.4). The tropical environment of this zone is mostly humid (270 to 365 growing days), with some extension into moist subhumid (180 to 269 growing days) areas. Tree crops have been established under plantation or estate crop systems for the provision of industrial products, beverages and condiments. They are cultivated principally on flat to undulating landscapes on acid soils of low inherent fertility.

The total cultivated area is estimated at 18 million ha and there are only about 2 million ha of irrigation. During the 19th century, extensive areas of tree crops were developed as large private sector estates, particularly rubber and later oil palm in Malaysia and Indonesia. Today, however, there are also significant areas under smallholder ownership and management. Smallholder plantation crop areas are usually a maximum of 2 or 3 ha in size, depending on crop type. Coconut plantations are more widespread throughout most Southeast Asia and Pacific countries and are now mostly smallholder operations.

Coffee and tea plantations are confined to specific agro-ecological areas with higher elevation. Cocoa is usually grown as an intercrop at low elevations under humid tropical conditions. Condiments, cloves, pepper, etc., are usually smallholder crops. While tree crops are the dominant production system, small farms without tree crops are scattered throughout the system, producing food (rice and maize), cash crops (soybeans) and livestock (see Box 6.5). Although large livestock are not very important in this farming system, considerable numbers of small ruminants co-exist with the tree crop plantations in many areas. Incomes of smallholders are moderate and little poverty exists. Where it does exist, poverty is higher among small farmers and landless farm labourers.

Governments in a number of countries have established specialised commodity research stations or institutes for improvement of tree crops, while government operated research extension services have supported smallholder farmers. Crop yields have been rising through the introduction of improved varieties developed by government research or in some cases by large multi-national companies involved in the plantation industry. New higher-yielding dwarf varieties of oil palm and coconut have been developed in recent years that are significantly increasing yields for these crops. Regular applications of fertilisers combined with effective weed control measures are used in productive, well-managed plantations. All these crops require intensive labour inputs for harvesting and processing and therefore profitability is determined by local labour costs. In some countries, such as Malaysia, rising labour costs are now seriously affecting the profitability of rubber plantations and there has been a strategic shift to oil palm cultivation.

Private companies and governments have established large factories, with high investment requirements, to process crops such as rubber, oil palm, tea and coffee. Smallholders supply raw materials or partly processed products to these factories. Smallholder co-operatives are not usually well developed and individual farmers often have no alternative but to accept whatever prices are offered by middlemen or factories for their raw products. Some intercropping is undertaken to increase and diversify incomes, both in the early years of establishment of new plantations and in mature plantations. In some tree crop systems (rubber and coconut plantations) industrial crop production has been combined with livestock production. In more recent times there has been a move to develop alternative products in order to diversify and add to incomes from some plantation crops, for example wooden products from rubber and coconut trees available when old stands are cut and replanted.

Trends and issues in Tree Crop Mixed System

The major factors influencing the future of the tree crop sector will be concerned with: international demand and prices for industrial crop products; replacement of labour-intensive and costly harvesting and processing practices through mechanisation for some crops such as rubber, oil palm and tea; development and adoption of improved production technologies; planting of much higher yielding clones; and, the extent to which there is any significant change in proportion of private companies and smallholder producers. Although world population growth is expected to decline in the future, there will continue to be a strong demand for industrial crop products (plant oils, rubber, beverages, natural fibres, condiments, etc.). However, the price of those products that compete with oil-based synthetic products will be greatly determined by future petroleum prices.

Box 6.3 Intensive Development of the Rice-Based Farming System¹⁴

The Lowland Rice Farming System in East Asia underpins the food security of several countries in the region. There are considerable productivity gaps between farms, between provinces and between countries. Very high sustained yields have been achieved in some high-performance systems such as in Zhejiang Province, China. However, a high level of management is required, with special attention to soil resources, complemented by continuous refinement of technology through strong production support services. Although rice is still the main crop in lowland areas, diversification is increasing towards high value crops such as oil seeds and vegetables, and other profitable enterprises such as fish production. Current trends suggest that total farm productivity will continue to grow in the coming decade.

Given the large reported area of immature trees within the system, the tree crop sector is expected to continue its moderate expansion. Prospective annual production increases to 2030 are estimated at 3.4 percent for oil palm, 2.8 percent for rubber, 3.4 percent for coconut, 1.8 percent for coffee and 3.8 percent for tea. It is anticipated that these production increases will come from both area expansion and increasing yields. The extent to which the major private estates will increase their size will depend on overall profitability, but it is anticipated that the smallholder sector will remain important, at least in the medium term. Some plantation (industrial) crops will continue to be grown mainly by smallholders.

The subsequent discussion of issues facing the Tree Crop Mixed Farming System is confined to the smallholder sector. The key issues that have to be addressed in advancing the productivity and income generation of smallholder plantations include: low yield; lack of alternative enterprises; inadequate farmer skills; enhancement in technologies and crop husbandry; primary product processing; and, marketing mechanisms.

Yield improvement has been dependent on government and private research and extension services developing higher-yielding clones with increased disease and pest resistance. However, this research and extension support has been mainly directed to rubber and oil palm and in general, insufficient support has been given to production improvement of other tree crops. Government policies are aimed at assisting smallholder plantation crop production, but government support for expansion of tree crop area must be based on an in-depth analysis of future product demand in order to avoid oversupply and low prices.

Prices for industrial crop products are subject to the considerable variation that occurs in the international marketplace. Many countries have established commodity boards to stabilise prices; generally with very poor results. At the local level, smallholder farmers generally have to accept prices below those ruling in the market because of their immediate need for cash. Returns to smallholders can be increased through improved on-farm processing and collective marketing of products by smallholders' associations. Governments have tried to establish farmer co-operatives for smallholders engaged in many plantation industries. These generally have been weak or have failed altogether as a result of farmers not receiving any material advantage from their operation. Nonetheless, large financial advantages can be obtained from collective purchase of inputs and joint collection, delivery and marketing of products. Alternative modalities still need to be defined for the operation of co-operatives, or farmers' associations or small business companies.

Box 6.4 Basic Data: Tree Crop Mixed Farming System	
Total population (m)	49
Agricultural population (m)	30
Total area (m ha)	85
Agro-ecological zone	Humid - subhumid
Cultivated area (m ha)	18
Irrigated area (m ha)	2
Bovine population (m)	19

Development of the skills of farmers involved in industrial crop production is usually weak. In many instances, there is inadequate participatory identification of problems, constraints and opportunities for product development and only limited support from government extension and specialised research services. Linkages between government research and extension in information dissemination and technology development are also generally inadequate. There is usually also very little technology transfer to smallholders from private (multinational) companies, even though they often have their own research and extension services directed towards plantation tree crops.

Priorities for Tree Crop Mixed System

The strategic options for the smallholder sector include increased productivity, diversification of enterprise activities and group organization for business development. Related interventions that would enable significant advancement of the smallholder Tree Crop Farming System include measures to increase production in smallholder plantation systems (rubber, oil palm, coconut, etc.) where considerable scope exists through the introduction of modern clonal materials. As stated above, new clonal materials with very high yield potential have already been developed in some crops, such as oil palm and coconut, and new rubber clones are also being continually developed in commodity institutes. There should be a progressively accelerated replacement of old clonal materials with new, more high-yielding clones.

Regeneration of old plantations must take advantage of intercropping in the early establishment years so as to give an immediate income. Emphasis should be given to local value-adding processing of both product and wood materials. Opportunities also exist for expansion of intercropping in mature plantations to stabilise incomes and reduce risks from price fluctuations; and for households to grow small areas of food crops and keep small stock such as goats, utilising surplus feed and fodder produced around the plantations. Research programmes should be broadened to include more research on the minor tree crops. Research capacity needs to be increased to take advantage of advances in biotechnology and genetic engineering to improve yields and disease and pest resistance.

The establishment of business co-operatives, associations or companies should follow a gradual approach to avoid overloading fragile institutions with multiple functions. Thus it is preferable to start with one main business, e.g. input or output marketing. Once marketing channels and a reliable client base are developed, diversification into other business areas, such as interlocking input supply and credit with output marketing, can be considered. Assistance is required to broaden the outreach of financial services provided by both formal and informal financial institutions to farmers. Business co-operatives, farmers' associations or small companies could gradually expand their activities towards financial intermediation and play an important role in savings mobilisation as a source of funds for credit supply.

In many countries, the government has given insufficient emphasis to extension and research support for industrial crop producers. Consideration needs to be given to the development of private extension support services for smallholder farmers; these could be financed by the smallholder business co-operatives. Skills enhancement of smallholders should not only include training in all aspects of crop production, but also methodologies and practises in post-harvest management and processing of products to maximise quality and price. A farmer field school approach to promoting new technologies should be used, as well as the provision of technical training programmes for farmers.

Box 6.5 A Typical Household of the Tree Crop Mixed Farming System

A typical smallholder rubber producer has 0.75 ha of land under rubber, assigned by the nucleus estate. The management of the rubber is closely supervised by estate personnel. The rubber is the principal source of household income. In addition, the household grows food crops, including upland rice and maize on a further 0.9 ha. No fertiliser is used on the food crops, so yields are low and the family purchases additional rice. The family of seven also has a perkarangan (multi-storied) homestead garden with a variety of fruit trees, herbs, spices and vegetables, which supplements household food supplies and improves the nutritional quality of the diet, as well as providing a surplus of fruit for cash sale. The household keeps two cattle plus followers, six goats and a dozen free range poultry - the sale of animals also generates small amounts of additional cash income. Vulnerability is relatively low from the point of view of climate, but the system is under pressure because of declining world commodity prices.

UPLAND INTENSIVE MIXED FARMING SYSTEM

Characteristics of the system

This system covers some 314 million ha and is the most widespread and diverse farming system in the region with major areas located in all countries of East and Southeast Asia (see Box 6.5). The system contains a total population of 530 million with an agricultural population of 310 million. It is characterised by similar topography, but considerable ecological variation exists. The system is found in humid and subhumid tropical, subtropical, and temperate environments in upland and hill landscapes of moderate altitude and moderate to steep slope. Soils are generally of low fertility, shallow and susceptible to erosion. Some 75 million ha are cultivated within the system, encompassing a wide range of crops, depending on geographic area, landscape slope, terracing and water regime - see Box 6.6 for a description of a typical farm household system.

Some forested areas are scattered throughout the system, but these have generally been depleted as a result of unsustainable logging practices. Deterioration of natural resources, biodiversity and the overall environment has occurred in many areas. This is a result of high population densities, leading to the extensive cultivation of fragile slopes without the adoption of appropriate soil and water management practices. As a consequence, households are vulnerable to natural disasters and crop failures. Local infrastructure is generally poorly developed. Because most of the population lives in remote areas, links to markets and other systems are scarce. Moderate to severe poverty is found in this system, but with potential to further increase production and incomes there is some opportunity to reduce poverty in the future.

Most agricultural production occurs under rainfed conditions, but about a quarter of cultivated area (18 million ha), much of it terraced, is irrigated from local streams and rivers. In some areas, for example in the Philippines and Indonesia, substantial terraces have been constructed for rice cultivation, but in most cases only simple terracing has been developed (e.g. bunding for rice cultivation) and soil and water conservation structures are completely absent. Crops include paddy and some upland rice, wheat, maize, sugarcane, cotton, leguminous pulses, oilseeds, fruits and vegetables. Rice is the staple crop in tropical and sub-tropical areas, being replaced by wheat in more northern latitudes. Both tropical and temperate fruits and vegetables are grown, depending on climatic location. While there are some more extensive areas of commercial fruit and vegetable production, home gardens are widely used for vegetable and fruit production for household consumption and sale of products.

Livestock production is an important component of the system. Livestock are used for draught power, meat production, cash income and as movable assets. Some 52 million cattle and buffalo (28 percent of the regional total), and 49 million goats and sheep (14 percent of the regional total) are found in this system. Pig and poultry production is also very important for meat and cash income. Livestock growth rates and production are generally low, however, because in many countries animals are raised under extensive conditions using poor animal husbandry and animal health practices. More intensive production systems are found in China, particularly for pig and poultry. Where water resources are available, aquaculture is practised, usually combined with rice production. On-farm forestry is limited.

Considerable variation exists in the intensity of crop and farm production within this system, with highest production intensities found in Southern China. In areas of more extensive crop production, many farms operate semi-subsistence production systems with only limited sales of products to meet livelihood needs. Thus, average incomes are low, creating significant poverty and food insecurity. Rural credit is rarely available. Households are vulnerable to the consequences of natural disasters, crop failures and ill health. Rural infrastructure is often poorly developed, particularly in more remote areas, and access to goods and services is poor.

Shifting cultivation is practised in some hill and mountain areas, especially in Southeast Asia, but is mainly confined to the Highland Extensive Mixed Farming System, a subsistence agriculture system characterised by widespread poverty and food insecurity.

Trends and issues in Upland Intensive Mixed System

The major factors influencing future changes in the Upland Intensive Mixed Farming System are expected to be concerned with: (i) preservation of the natural resource base; (ii) improvement of technologies for both crop production and watershed management; (iii) diversification into higher-value products; (iv) expansion and intensification of livestock production; (v) development of the rural financial system; (vi) increasing opportunities for improved marketing and off-farm income; and (vii) more responsive agricultural support services.

Major changes in agricultural production are expected to come from intensification and diversification of crop production with little expansion of overall cropped area, and from improved productivity of livestock and tree crops. The trend will be towards agricultural products with higher value, as this system is generally not competitive for the production of cereals for market. Increasing diversification would include an expansion of perennial crops and annual cash crops - as opposed to food crops - and intensification of livestock production. The particular higher-value crops selected for cultivation will depend on local agro-climatic conditions and access to markets; crops which are bulky and perishable will be grown close to larger markets while those with less bulk and longer shelf-life would be cultivated at more remote locations.

Livestock numbers are increasing under very extensive and low input production systems, but productivity and off-take remain low. If present patterns continue, only small increases in livestock numbers can be anticipated because of shortages of feed supplies. However, some intensification of livestock production is expected as a result of an improvement in general incomes and consequent increased demand for livestock products. These changes would increase household incomes and reduce poverty.

A key issue facing the future development of the Upland Intensive Mixed Farming system is the increasing population in hill and mountain areas that is exerting growing pressure on natural resources (soil, water, flora and fauna). Widespread, severe natural resource degradation in many areas has given

rise to substantial local costs in the form of lowered yields, mudslides and scarcity of water in the dry season. There are also large downstream costs from siltation of rivers and flooding. The highest priority of farmers is to produce annual food crops to sustain their families. Increasing population pressure has also caused annual crop cultivation to increase on more fragile landscapes and has resulted in a decreased length of the fallow period in shifting cultivation systems. Furthermore, because farmers are poor they are extremely reluctant to invest in field structures to control soil erosion. Collectively, these factors have an adverse effect on farm production and on natural resources. If the majority of families remain in semi-subsistence farming there will be an increasing pressure on natural resources stability in the future, unless considerable new opportunities can be opened up for off-farm employment or exit from the system.

A further critical development issue in highland areas in many countries is lack of security of land tenure. Many governments, because of their political system, are reluctant to give farmers legal ownership of these lands, yet farmers are generally unwilling to invest resources in development without secure land tenure or ownership. Land tenure, land leasing and land markets are policy issues that have to be reviewed in order to promote development in upland and mountain areas.

Government agencies and large timber companies have been responsible for widespread and unsustainable logging of natural forests throughout the system. The area of natural forest has decreased enormously in all East Asia countries in the last two to three decades. Little has been done to replant logged areas or to develop systems of sustainable natural forest management, and the establishment of tree plantations has been limited. The management of village forest resources by communities and the promotion of on-farm agro-forestry systems are important development issues. However, governments have generally been very reluctant to accord responsibility to local communities for managing local forest resources.

Technology development in the past has tended to be focused on specific commodities, rather than on integrated development of a system that is productive, economically attractive, not too complex to manage and that provides a range of land use options in varying agro-ecological circumstances. Because of this single commodity focus, very few technologies have been developed that are economically viable and attractive to farmers while at the same time contributing to environmental and resource regeneration.

Box 6.6 Basic Data: Upland Intensive Mixed Farming System	
Total population (m)	530
Agricultural population (m)	310
Total area (m ha)	314
Agro-ecological zone	Various
Cultivated area (m ha)	75
Irrigated area (m ha)	18
Bovine population (m)	52

Livestock products are a very important source of household cash income in the system and there is considerable potential for expansion of livestock production. However, as in the case of crops, little emphasis has been given to the development of improved integrated livestock production systems - where improvements in feeds, genetic material and husbandry practices are related to other farm activities - and the provision of effective animal health services.

The generally poor development of rural infrastructure in upland areas has seriously affected marketing of products because of very bad communication and transport networks. With a few exceptions, the Upland Intensive Mixed Farming System has received a low priority in government policymaking, and this has aggravated the natural constraints to development that are inherent in these upland areas.

Box 6.7 A Typical Household of the Upland Intensive Mixed Farming System

A typical farm household of five members in Yunnan Province, China, cultivates an area of 0.94 ha (21 percent being irrigated), with a cropping intensity of 84 percent. The main crops grown and their yields are: maize (21 percent of the total cropped area, with a yield of 4 t/ha), rice (16.5 percent of the area, yielding 6.1 t/ha) and wheat (13.2 percent of the area, 2.2 t/ha). Annual farm household production for these three main crops totals is 1.7 t/year; equivalent to 337 kg per capita. Few external production inputs are used. The household has a pig, some poultry and one goat for fattening. The household is food insecure, and has an annual per capita income of only US\$166 per annum; considerably below the international poverty line.

Priorities for Upland Intensive Mixed System

Whilst increasing off-farm income represents the most important household strategy for the reduction of poverty, closely followed by exit from the farming system, there are also prospects for intensification and diversification. Other improvements to the system centre on sustainable natural resource management and more effective agricultural services. Future programmes of assistance should emphasise improved watershed management, conservation farming, water harvesting and introduction of appropriate technologies (see Box 6.7). A holistic approach is essential in micro-watershed management. Experience shows that such programmes must be strongly community-based, with full participation and involvement in management and use of the natural resources. Soil and water management practices and techniques should be promoted as an important means of stabilising yields, ensuring maintenance of soil productivity and increasing crop production. Water-harvesting technology should be promoted where natural circumstances permit interception of surface water flows. Technologies that are introduced and promoted must be holistic, and must provide short-term, medium-term and long-term economic benefits.

The forested areas that are scattered throughout this system mainly occur at higher elevations. Where relevant, future development programmes should strongly promote community management of forests as this has positive effects on environmental management, as well as providing important sources of building materials, income and food for local communities. Furthermore, on steeper lands, agro-forestry systems should be promoted, with contour planting of suitable tree species - for production of fruits, timber, fuelwood and non-timber forest products - to act as conservation barriers and provide additional income generation.

Future programmes of assistance must address the policy issues of land tenure, land leasing and land markets, which are fundamental in promoting development of upland areas. Key priorities would include the establishment of functioning land markets through the establishment or acceleration of cadastral and land titling procedures, and establishment or strengthening financial markets to support purchase and sale of land.

Development and introduction of improved technologies should include: (i) improved cropping patterns using crops that contribute to food and cash income; (ii) soil and water conservation and fertility building; (iii) contour planting of trees and shrubs (for timber, forage, fruits and food grains); (iv) mulching and other soil conservation techniques; (v) higher-value agricultural products; and (vi) feeds for livestock. Livestock development is a priority for this system. Advantage should be taken of any opportunities for intensification of village-based, small livestock (chickens, ducks, pigs, etc.) production, as well as large ruminant production. Technologies introduced should provide improved animal health, better animal feeding, improved animal husbandry practices and breed improvement. Effective extension and support services will be needed as well as an established animal health service. In some situations technologies can be introduced to improve forage and pasture production for cattle feeding.

General lack of capital is constraining investment in productive activities and rural development in general. Donor assistance should be focused on the improvement of rural financial services and the improvement of farmer access to these services; setting-up community-managed funds etc., with a view to introducing the agricultural community to the use of commercial financial services.

Because of the remoteness of much of this farming system from markets, plus the poor communication and transport networks, the emphasis in agricultural production has to be on low weight and high value products that are easily transported, have a long shelf-life and can be processed locally to add market value. In addition, the development of good rural infrastructure must be actively promoted, not only as a pre-requisite to agricultural development in these areas, but also as a means of creating opportunities for increased off-farm employment, particularly in eco-tourism. Although external assistance may help in building the infrastructure, this will not be sustainable unless the beneficiaries and local institutions participate in planning and construction, as well as contributing to the cost and management of their operation and maintenance.

The Upland Intensive Mixed Farming System has received less attention and benefits from government research and extension services than lowland farming systems for many reasons - remoteness, complexity of system, lack of water resources, a lack of perception of their importance, etc. However, the system represents an important part of the agriculture sector in most countries of the region. The strategic priorities for the future must be to strengthen the capacity of governments to undertake participatory identification of problems, constraints and opportunities for farm development and to provide the necessary support by government or privatised extension and research services in these areas. The complexity and diversity of the system demands that the future priority is for a more holistic, integrated form of research and extension. This should be strongly linked to farmers and be based upon their active participation and should take greater advantage of synergies, consider the whole farm situation and emphasise the conservation of natural resources and protection of the environment.

Skills, knowledge and educational development of farmers are crucial to agricultural development. Programmes of assistance must emphasise participatory analysis of farming systems and opportunity identification, combined with a farmers' field school approach to promoting new technologies that have been shown to result in greater agricultural production and family incomes. Skills and knowledge

building must be promoted as an essential component of future development assistance. This must be combined with much improved systems for information dissemination to and access by farmers, particularly because of the remoteness of this system from sources of information.

TEMPERATE MIXED FARMING SYSTEM

Characteristics of the system

The Temperate Mixed Farming System covers some 99 million ha in Central-Eastern and Northeastern China, with smaller areas in Korea DPR and Mongolia (see Box 6.9). It contains a total population of 247 million, of which 162 million are classified as agricultural. The climate of the zone is mainly dry subhumid (120 to 179 growing days). The transitional boundary between this system and lowland rice-based system is not easily defined in Central China. Throughout the system, average incomes are low with modest poverty levels. Some 31 million ha are under cultivation, with wheat being the dominant crop. Other major crops include rice, maize, soybeans, sweet potato and rape, as well as citrus and some temperate fruits. Irrigation covers about 12 million ha within the system. The preferred food staple throughout the region is wheat noodles.

There are two main sub-systems: the Loess Plateau Sub-System, involving mixed farming of both summer and winter crops; and the Northern Sub-System, in Northeast China, Korea DPR and restricted parts of Mongolia where the climate only permits cropping during the summer. Both are characterised by rainfall being concentrated in the summer months and by severe frosts in winter, particularly in the northern areas. Average farm size ranges from as little as 0.3 ha in the Loess Plateau of China to several hectares further north, where it gradually blends into the Pastoral Farming System. Average household size is approximately four to five persons.

In the Loess Plateau of China, wheat and rape are the main winter crops; while maize with rice, cotton, soybeans and sweet potato are the main summer crops. Cropping intensity is about 150 percent. Crops are grown under both irrigated and rainfed conditions. Wheat yields averaged about four t/ha in 1999. Yields have risen dramatically since 1970 and even in the last decade have achieved 2.7 percent annual growth.

In the Northern Sub-System (Northeastern China, Korea DPR and Mongolia), because cropping is possible only during the summer, wheat (0.5 m ha in Korea DPR and Mongolia) and other cereals are grown concurrently and compete for cultivated land. Yields are lower in these zones due to adverse climatic conditions, and cereals may be supplemented by cold-resistant crops such as potatoes and cabbage. The higher yields in China are due to crops being grown with high organic and inorganic fertiliser inputs and intensive pest control practices. In this system, overall cropping intensity is high and scope for expansion of land area is limited.

Livestock are also an important component of the system: particularly cattle for draught power, and pigs, small ruminants and poultry for meat. Some 11 million cattle and 35 million sheep and goats are located in this system and pigs and poultry are widespread. Livestock are reared and managed under extensive conditions in most countries. More intensive production systems are found in China, however, especially for pigs and poultry. In this country, pigs are mostly housed and fed supplementary grain and concentrates.

Trends and issues in Temperate Mixed System

Wheat areas have been declining for the last decade in all countries and this decline is expected to continue in the future. In contrast, wheat yields have been increasing rapidly and overall wheat

production is expected to increase, more than offsetting the declining crop area. Areas of maize, however, have been expanding and are projected to increase substantially in the future, provided that production can maintain competitiveness with imported supplies. In the southern part of the system any increase in maize will likely be at the expense of rice production. Overall, maize production is expected to double by 2030 as a result of both increased area and yields. This increase will be a direct consequence of a greater demand for animal feeds. Fattening of store cattle for local markets, using treated cereal straw, is becoming more common, especially in the southern part of the system.

Several specific issues have to be addressed to reduce poverty levels in the Temperate Mixed Farming System. The high crop yields obtained in the intensive production system in China have resulted from very high applications of nitrogen and phosphorus. Further yield increases from increased use of inorganic fertiliser will require a more balanced use of nutrients. Potassium is now a significant limiting factor, but potash fertiliser is fully imported and much more expensive than the locally produced nitrogenous and phosphatic fertilisers. About 40 percent of the crop area in this system is currently irrigated. Some scope exists to expand the existing irrigation systems by increasing the use of surface water and extraction of groundwater from shallow aquifers. However, in some areas over-exploitation of shallow aquifers is already evident from recorded increases in pumping depth.

The system is strongly crop-based and market demand for meat, vegetables and fruits is increasing as urban incomes rise. Farms are expected to diversify to meet this shift in food demand, and this change may be accelerated if world prices for cereals continue to decline. Some conflict is expected in choice of crops based on the competing demands human food and the rising demand for animal feed.

Low population growth rates and migration to cities in China has created labour shortages at crucial times in the farming calendar. This trend is expected to continue. The need for small-scale farm mechanisation is becoming a more important issue. Because of small farm size, family income is low. Farmers will need to grow higher-value crops and increase farm size to increase disposable farm incomes significantly, as well as to expand off-farm income sources.

Box 6.8 Transforming Shifting Cultivation in Laos¹⁵

Shifting cultivation is practised mainly in the highland farming systems through a wide swathe of East Asia, including Vietnam, China, Laos, Thailand and Myanmar, and involves burning small areas of forest to clear land for planting, control weed species and release minerals into the soil. Traditionally, several years of cultivation are followed by long periods in which the land is left to allow natural regeneration of the vegetative cover. However, throughout Asia, shifting cultivation is coming under increasing population and, in some instances, market pressure, resulting in shortened fallow cycles and resulting resource degradation.

A newly implemented Asia Development Bank funded project in Houaphanh province in the northeast of Laos aims to resolve this problem, assisting farm households to replace shifting cultivation with sedentary farming systems. At present one family cultivates about one ha of upland rice annually and over a 10 year period the farmer cuts down 10 ha of forest. The new system aims to replace the 10 ha used for shifting cultivation with 4 to 5 ha of mainly perennial agricultural production, returning 5 to 6 ha to permanent forest. Food security is being enhanced by increasing rice production through expansion of paddy areas in valleys, adoption of improved production

technologies, improvement of water diversion structures, construction of small ponds or reservoirs, and installation of small pump systems. Alternative agricultural activities to provide additional sources of income include: (i) improvement of livestock production using better feeds and veterinary support; (ii) expansion of fish ponds; (iii) improving cash crop production, particularly crops with relatively short production cycles such as ginger, chili, sesame, soybeans, peanuts, and garlic; and (iv) sustainable production and extraction of non-timber forest products.

The transformation is expected to double production of wetland rice and increase ginger, fruit, beef, chicken and fish production even more. Both household food security and cash income of farmers will increase substantially. Natural forestry resources will also be expanded and improved on steeper and more fragile landscapes. It is expected that the lessons from implementation can be extended to the development of other areas of shifting cultivation in neighbouring provinces of Laos and other countries.

Priorities for Temperate Mixed System

Increasing off-farm income represents the most important household strategy for the reduction of rural poverty; with substantial development of agro-processing and other off-farm employment sources. This particular household strategy would be closely followed by diversification and exit from the farming system. There are, however, some prospects for the expansion and intensification of maize production for animal feed. While an 18 percent expansion of irrigated area by 2030 is anticipated in China, the more important future priority, both there and in other countries, is to institute programmes to improve the effectiveness of existing irrigation systems and the efficiency of water use at field level.

Further intensification of crop production will occur as a result of promotion of higher-yielding varieties - particularly hybrid varieties - better balanced use of fertilisers, increased water availability and more efficient water use. It is uncertain to what extent the supply of future production inputs will come from the private or the public sector. Future assistance should promote farm mechanisation and the development of the private sector for provision of goods and services.

Greater emphasis should be given to small-scale intensive livestock production - mainly pigs - and to growing vegetables and fruits, as market demand for these higher-value products will increase with rising urban incomes. Cattle have already been successfully fattened on a diet based on treated cereal straw, but government research and extension services will need to provide the appropriate technical advice and support for this changes in the production system.

STRATEGIC PRIORITIES FOR EAST ASIA AND PACIFIC

The strong economic growth and steady reduction in poverty in China and other regional countries during recent decades is noteworthy. Nevertheless, poor socio-economic indicators in many countries continue to reflect the results of: (i) lack of opportunities for intensification and diversification of farm production; (ii) lack of opportunity for off-farm employment and income for many farm households; (iii) lack of access to financial resources; and (iv) small farm size. This situation is dictated by underlying factors that include: (i) overpopulation; (ii) land fragmentation; (iii) absence of secure land ownership; (iv) deterioration of natural resources; (v) unavailability of information and lack of knowledge; (vi) lack of credit and inadequate supplies of production inputs; and (vii) poor marketing prospects (remote distance, poor infrastructure, small local market demand). Further substantial

reduction of poverty can be anticipated if the enabling factors, needed to catalyse rural communities and households to invest their labour, capital and physical resources in agricultural development, are created.

Table 6.4 reflects expert judgement as to the relative importance of each of the five household strategies to reduce poverty within individual farming systems in East Asia and Pacific during the coming decades. As can be seen, the importance of different pathways varies significantly from system to system. In broad terms, lower potential systems are expected to derive a greater proportion of poverty reduction from migration to cities or other areas than do higher potential systems, which are believed to benefit more from diversification and increased productivity. Increased off-farm income is an important pathway for poverty reduction in all systems.

The widespread possibility of gaining access to off-farm income makes this the most important pathway for escape from poverty overall within the region. Approximately 40 percent of poverty reduction expected to derive from this strategy. Diversification of agricultural activities on-farm is the second most important strategy and, together with off-farm income, probably accounts for 70 percent of all development potential on a regional basis.

The specific strategic priorities required to create the enabling environment for strong agricultural growth and further poverty reduction in the region include:

Box 6.9 Basic Data: Temperate Mixed Farming System	
Total population (m)	247
Agricultural population (m)	162
Total area (m ha)	99
Agro-ecological zone	Dry subhumid
Cultivated area (m ha)	31
Irrigated area (m ha)	12
Bovine population (m)	11

Policies, institutions and public goods

The economies of many countries in the region (China, Vietnam, Laos, Cambodia and Myanmar) are still, to a significant degree, under state-managed control. These countries in particular still have many policies, regulations and practices that constitute disincentives to the growth of particular commodities, to investment in soil and water resource enhancement, or to higher agricultural input use in general. Future emphasis in assistance will have to be more strongly directed to the adjustment of policies that still cause serious distortions in the macro-economy in general and the agricultural sector in particular, and create disincentives for farmers considering whether to invest in agricultural development. Infrastructure is an important driving force for farming systems development, especially when related to water resources management, soil management, transport and markets. An enabling environment for the development of vigorous decentralised government and effective support service industries (such as seed, machinery and agro-processing) needs to be created.

Donor institutions have generally been reluctant to deal with the issue of poor access to credit for individual farmers. Rural banking services and credit institutions are badly in need of restructuring and refinancing. Assistance is critically needed from donors to create greater access by farmers to formal financial services, to improve the functioning of rural financial markets, to stimulate rural savings and community-managed funds, as well as preparing farmers to use commercial financial mechanisms.

Trade liberalisation and market development

Potential and Relative Importance of Household Strategies for Poverty Reduction in East Asia and Pacific							
			Strategies for poverty reduction				
Farming System	Potential for agricultural growth	Potential for poverty reduction	Intensification	Diversification	Increase d Farm Size	Increase d off-farm Income	Exit from Agriculture
Lowland Rice	Moderate	Moderate	1.5	3.5	1	3	1
Tree Crop Mixed	High	High	2	3	1	3	1
Root-Tuber	Moderate	Moderate	3	2	1	2	2
Upland Intensive	Moderate	Moderate	1	3	0.5	3.5	2
Mixed							
Highland Extensive	Low	Moderate	0	2	0	3	5
Mixed							
Temperate Mixed	Low	Low	1	3	0.5	3.5	2
Pastoral	Moderate	Good	0	1	1	3	5
Sparse (Forest)	Low	Low	0	1	0	3	6
Sparse (Arid)	Low	Moderate	0	1	0	3	6

Coastal Artisanal	Moderate	Low	1	2	0	5	2
Fishing							
Urban Based	Low	Moderate	1	2	2	5	0
Average for Region			1.1	3.0	0.7	3.3	1.9
Source:Expert judgement. Note:Total score for each farming system equals 10. Assessments refer to poor farmers only. Average for region weighted by agricultural populations of systems derived from Table 6.1.							

Agricultural development must exploit local and international comparative advantages in a more globalised future economy. The region is already a major exporter of oil palm, rubber and rice, as well as of industrial products. As infrastructure improves, many producers are being exposed to international prices for a wider range of commodities and may well face declining prices for cereals such as wheat and maize as imports become more accessible. Governments must identify and promote production systems that benefit local farmers through exploitation of agro-ecological, and locational, resource advantages. Furthermore, improving per capita incomes are likely to accelerate changes in diet and to increase demand for higher value products (milk, meat, fruits, vegetables, etc.). Diversification into higher value products and adding value to farm produce would increase the overall level and stability of household income. Training and demonstrations of new technologies are required to improve production, post-harvest management, packaging and marketing of these products.

It is generally recognised that agro-industrialisation of rural areas in Asia is an important factor in growth and poverty alleviation. The majority of smallholder agricultural produce is sold through domestic markets, to consumers in rural or urban areas. Opportunities for local level agro-processing should also be promoted to add value to agricultural products, and to create off-farm employment. Thus, in most areas, policies that encourage the development of local entrepreneurs in processing and trade will improve farmers' incomes. This linkage will be particularly important for the Highland Extensive Mixed and Upland Intensive Farming Systems. In these systems, where transport infrastructure is often poor, comparative advantage is likely to be associated with commodities that have a high value to weight ratio.

Information and human capital

Skills, knowledge and educational development of farmers are a key to agricultural development. Farmers are typically poorly educated, with significant levels of illiteracy in some countries. Most governments do not have strong educational programmes for farmers and access to information is difficult and limited. Skills and knowledge building must be promoted as an essential component of future development assistance, combined with improved systems for dissemination and access of farmers to information. Modern information technology development (computerised networks, local accessing of computer based information, etc.) will become a key component of agricultural development in the future.

The challenge for the future is for government agencies to develop, in participation with the private sector and target communities, computer-based systems for information transfer. This necessarily involves focusing on three major aspects: (i) information generation; (ii) information transfer systems; and (iii) local information access systems. Some interesting initiatives have already been taken in the region to develop information transfer to remote communities without the benefits of basic infrastructure like electricity and telecommunications. Lack of education and literacy amongst villagers in remote locations also provides some impediment to information exchange, but is not insurmountable.

Given the importance of off-farm income as a probable pathway from poverty within the region, and as an engine for rural economic growth, the education of young people should stress the acquisition of vocational skills of value in agro-processing, light manufacture and services such as tourism.

Science and technology

Diversification into higher-value products and adding value by processing, increases overall household incomes and improves income stability. Training and demonstrations of new technologies are required to improve production, post-harvest management, packaging and marketing of these products. Opportunities for local agro-processing should also be promoted in order to add value to agricultural products.

Public-private partnerships could provide the foundation much agricultural research in the future. While the private sector is expected to increase its provision of goods and services to farmers, it is anticipated that governments will still have to provide certain essential support and services to poor small farmers. The strategic priorities for the future should be to strengthen the capacity of governments to undertake participatory identification of problems, constraints and opportunities for farm development. Based on this knowledge, governments should provide the necessary enabling framework for effective extension and research services in partnership with the private sector.

Government research that must keep abreast of private research developments in terms of quality and relevance. The applications of biotechnology in its broadest sense, and genetic engineering specifically, must be evaluated and used where appropriate. Several Asian countries, particularly China, are already important sources of research and knowledge in this area, and this strength should be built upon - albeit with adequate attention to associated risks (see the accompanying case study on biotechnology). Future research must also be more integrated with extension; take greater advantage of synergies; consider the whole farm situation and integrated technologies; and, emphasise efficient and sustainable use of natural resources. The latent potential of farmers for experimentation, adaptation of technologies and farmer-to-farmer extension needs to be more fully exploited. The strategic priorities for agricultural research in the region include better use of water, improved management of soil structure and fertility, and restoring productivity growth in cereals.

Box 6.10 A Typical Household of the Temperate Mixed Farming System

A typical wheat farm household with four family members cultivates 0.55 ha of land (60 percent being irrigated) in Shandong Province, China, with a cropping intensity of 140 percent. The land is partially irrigated but the water table is dropping as irrigation for cash crops is expanded. The area, production and yields of the main crops are: wheat (36 percent of the total

cropped area, 1.45 tons per annum with a yield of 5.3 t/ha) and maize (25 percent of the area, 1.1 tons per annum with a yield of 5.6 t/ha). Annual production of this farm household for these two main crops totals 2.5 tons; equivalent to 630 kg per capita. Power tillers are used for primary tillage, and additional income is earned through provision of transportation services. The household usually keeps a pig, a goat and some poultry. It has a per capita income of about US\$280, which has risen rapidly during the past 20 years, but still remains under the poverty level.

Natural resources and climate

The basic problem of low incomes rural household in the region is that too many people have only limited access to resources for agricultural production. Technology advances that offer increased efficiency can barely keep pace with diminishing resources as population increases and land fragmentation continue. In this scenario, the socio-economic situation of individual rural households stagnates although overall agricultural output increases. The majority of farmers are quasi-subsistence producers on farms with uneconomically low-volume, low-value production oriented farm units.

Furthermore, in those countries under state-managed control, lack of secure land tenure or ownership is an additional obstacle to agricultural growth. With the land being owned by the state, or allocated on some form of short-term lease, farmers are reluctant to invest in land development. Moreover, without land title, farmers are unable to use land as collateral to access credit and it is not possible to develop an effective land market - a necessary ingredient in land aggregation. Future support is required to assist governments in developing programmes to provide land title and ownership of rural lands to individuals; establish functioning land markets; remove obstacles to land aggregation for fragmented and extremely small holdings; and create local part-time and full-time off-farm employment for farmers on sub-marginal units and for those displaced from the land.

A considerable proportion of the significantly degraded agricultural resource base of the region can be recovered through better management - improved soil management, better utilisation of scarce water resources, and sustainable forest management represent three major thrusts. Along with improved resource management, existing agricultural production needs to be intensified in a sustainable fashion in order to maintain and increase household incomes in the face of declining terms of trade for cereals.

Conclusions

The East Asia and Pacific region is the most populous of the six developing regions. Despite strong economic growth accompanied by a steady reduction in poverty in some countries, considerable hunger and poverty persist. The foregoing analysis has shown that rural development in the region should concentrate on the basic determinants of economic performance, particularly farm and off-farm rural economic growth. While many policies that emphasise social issues are extremely important, the resolution of these issues in rural areas depends critically on agricultural growth. Strong agricultural and off-farm economic growth, as well as improved household food security, are dependent on a set of enabling factors that create commercial farming systems where surpluses of agricultural products are produced for sale.

Poor members of rural communities require opportunities to increase their labour productivity in farming and to utilise surplus labour in the off-farm sector. Agricultural growth, if equitable, will create beneficial opportunities for all - including opportunities for disadvantaged rural households to become involved in off-farm income generation as suppliers of goods and services, or as primary

processors of raw products. Within this overall framework, specific actions directed at poverty-stricken, food insecure and disadvantaged families are necessary.

Although it is impossible, based on the foregoing regional analysis, to prescribe specific national actions, the overall challenge of reducing hunger and poverty in the region demands four inter-linked strategic initiatives:

Increased small farm competitiveness. Increasing the competitiveness of small and poor farmers provides a basis for successful diversification into new higher-value agricultural activities. Components include: improved marketing; better processing; strengthened product standards; expanded access to finance; and integrated technologies for sustainable productivity increases in high value enterprises, as well as traditional staple crops (especially rice, wheat and commodity tree crops).

Improved resource access. Smallholder land consolidation creates larger fields that are better suited to improved technologies and mechanisation to support intensification and diversification. Components include: improved land policies; land titling; land leasing arrangements; and rural credit.

Enabling environment for off-farm employment. Non-farm employment opportunities provide the most important potential for escape from rural poverty in the region. Components include the creation of a favourable environment for off-farm employment in rural areas, the enactment of appropriate policies - with particular emphasis on processing, assembly and tourism - and attention to infrastructure improvement in many systems.

Enhanced human resources. If gains in recent decades are to be carried forward into the future, it is vital that members of small farm households increase their knowledge base and capacity to respond to both changing agricultural requirements and off-farm income generating and employment opportunities. Components include: information and knowledge networks; farmer capacity building; support to entrepreneurship; and training for the younger segments of the population in vocational skills.

Animal Husbandry and Dairying sector contributes about 23 percent of the value of the output from total Agriculture and allied sector.

Employment (1993-94) in animal husbandry sector was 9.8 million in principle status and 8.6 million in subsidiary status.

Women constitute 71 % of the labour force in livestock farming in dairying, 75 million women are engaged as against 15 million men, while in case of small ruminants, the sharing of work with men is almost equal.

1.0 Executive Summary

Tenth Plan: Animal Husbandry and Dairying

1.1 Livestock sector plays a crucial role in rural economy and livelihood. This is the sector where the poor contribute to growth directly instead of getting benefit from growth generated elsewhere. The overall growth rate in livestock sector is steady and is around 6% and this has been achieved despite of fact that investment in this sector was not substantial. The rural women play a significant role in animal husbandry and are directly involved in major operations like feeding, breeding, management

and health care. As the ownership of livestock is more evenly distributed with landless laborers, and marginal farmers, the progress in this sector will result in a more balanced development of the rural economy, particularly in the reduction of poverty ratio. Even many small & medium farmers who derive yearly savings from agriculture are dependant on livestock especially dairy & poultry for daily subsistence.

1.2 In India food consumption basket is being diversified gradually in favour of non-food grain items like milk, meat and egg. The consumption of animal origin food is however small in compared to ICMR norms and income increases would make people consume more of these items resulting in improved overall nutrition. The gradual changes in the diets of millions of people will create a massive increase in demand for food of animal origin, which could provide income growth opportunities for many rural poor. But such demand driven growth will stretch the capacity of existing production and distribution systems. Rapid advances in feed improvement and genetic and reproductive technologies offer scope for overcoming many of the technical problems posed by increased livestock production. Productivity is the key to growth. We have no option but to raise the productivity of our livestock through scientific breeding, feeding and management. The goal is no longer the farmers share of the consumers rupees, it is significant and sustained increase in farmer's income and employment. Governments and industry must prepare themselves for long-term policies and investments that will satisfy consumer demand, improve nutrition, direct income growth and opportunities to those who need them most, and alleviate environmental and public health stress.

1.3 Review of Ninth Plan

1.3.1 Milk production in India more or less remained stagnant from 1950 to 1970 when the production grew at the rate of a mere 1 per cent per annum. Thereafter, it increased rapidly, reaching 81 million tones in 2000-01(anticipated).

India is currently the largest producer of milk in the world.

India ranks 4th in Egg production and 19th in Broiler production in in the World

Rinderpest, a dreadful disease of ruminants has been eradicated from the Country

The per capita availability of milk increased from 112 gm per day in 1970-71 to about 214 gm per day in 2000-01. However, it is still below the world average of 285 gm per day. Poultry, which was considered as a backyard venture in the early 60's has now been transformed into a strong agro-based farming activity. It is estimated that the egg production in the country is about 32.5 billion (2000-01). Meat production was estimated at 4.6 million tones (1998) with annual growth rate of 4.1%. Wool production has increased from 43.3 million kg in 1996-97 to 47.4 million kg in 2000-01. Notwithstanding all the major livestock products showed an increasing growth rate during Ninth Plan, but the target for milk (96.49 million tones), egg (35 billion) and wool (540 lakh kg) is difficult to achieve.

Average Annual Growth rate of Milk and Egg Production 1950-51 to 1998-99

Year	Milk (%)	Eggs (%)
1950-51 to 1960-61	1.64	4.63
1960-61 to 1970-71	1.15	7.91
1970-71 to 1980-81	4.51	3.79
1980-81 to 1990-91	5.50	7.70
1990-91 TO 1998-99	4.14	4.59

1.3.2 Two schemes viz. I) Extension of Frozen Semen Technology and Progeny Testing Programme and II) National Bull Production Programme was continuing up to October 2000 when they were merged into a comprehensive scheme 'National Project for Cattle and Buffalo Breeding'. During the first four years of the Ninth Plan, the Department was able to spend only 59% of budget allocation under these schemes. Further one-third of the fund released to the States remained unspent indicating that this important and crucial scheme has not gained momentum. Broad frame-work of cattle and buffalo breeding policy recommended for the country since mid-sixties envisaged selective breeding of indigenous breeds in their breeding tracts and use of such improved breeds for upgrading of the non-descript stock. While the States accepted the framework, appropriate implementation of the same through field level programme could not be done. Lack of interest in promoting Breed Organization/Societies and related farmers' bodies contributed to gradual deterioration of indigenous breeds. That there had been large deviation from the laid breeding policy is quite obvious from the fact that crossbreeding which was to be taken up in a restricted manner and in areas of low producing cattle has now spread indiscriminately all over the country including in the breeding tracts of some of the established indigenous cattle breeds.

1.3.3 Investment in the dairy sector has been reduced drastically in the Ninth Plan. In compare to 8th Plan investment of Rs. 821.43 (against the plan outlay of Rs. 900 crore), the maximum investment during 9th Plan would be 130.93 crore against the plan outlay of Rs. 469.52 crore. After the completion of Operation Flood Programme in April 1996, the two major programmes for dairy development are I) Integrated Dairy Development Programme (IDDP) in Non-Operation Flood, Hilly and Backward areas and II) Assistance to Cooperatives. The utilization of fund under the IDDP scheme during 9th Plan is not satisfactory; against the budgetary allocation of Rs. 135.1 crore (Plan outlay Rs.250 crore), only Rs. 94.62 would be spent. The scheme Assistance to Cooperatives has been approved in January 2000 for providing assistance in the form of grants for rehabilitation of loss-making district milk co-operative unions. Out of 168 Milk Unions, 119 Milk Unions (70.8%) were running in loss as on 31.3.1998. So far, the Government policy in dairy sector has been to give preference to the establishment of milk processing plants selling liquid milk particularly in urban areas. This policy was guided by an overall shortage of milk and the national milk production falling short of nutritional requirement during the earlier years of planning era. But the scenario has changed from a milk shortage environment to conducive environment that will enhance demand so that growth rate of milk production is stimulated. No policy measures were undertaken so far to give a fillip to the unorganized sector involved in the production of Indian dairy products (like ghee, paneer, channa, khoa etc.), which have tremendous potentiality for export market in Asian and African countries.

1.3.4 Since second plan the efforts were provided to control diseases namely, Rinderpest, Foot & Mouth Disease, Hemorrhagic Septicemia, Black quarter and Anthrax. Although Rinderpest has been eradicated from the country but other diseases are still continuing as the major problem in the animal production programme in spite of the fact that good vaccine against these diseases are available. Some of the emerging diseases like Peste des petits ruminants (PPR), Bluetongue, Sheep pox and Goat Pox, Classical Swine Fever, Contagious Bovine Pleuropneumonia, New Castle Disease (Ranikhet Disease)

are causing substantial economic losses. Under the scheme National Project on Rinderpest Eradication, contingency plan is being implemented for surveillance of diseases and early warning system for Border States but the performance is not satisfactory. In the Assistance to State for Control of Animal Disease Scheme the Department would be able to spend only Rs. 40.60 crore against the budgetary allocation of Rs. 67 crore; the reason might be that many State Governments are unable to contribute their share due to financial crunch. Directorate of Animal Health, a Central Sector Scheme, spent only Rs.6.98 crore against the budget allocation of Rs. 21.25 crore during the first four year of the Ninth Plan. The situation is alarming because this scheme has the important components like Animal Quarantine and Certification Services, National Veterinary Biological Products Quality Control and Disease Diagnostic Referrer Laboratories. There seems to be not more than 5 technical posts at Head quarter for animal health that have the responsibilities to manage India's animal disease control and certification system. Presently the Department of Animal Husbandry and Dairying is not well equipped with necessary infrastructure and qualified technical manpower to execute the programme and perform its mandatory duties and responsibilities.

1.3.5 In India, meat production is largely a byproduct system of livestock production utilizing spent animals at the end of their productive life. Cattle and buffaloes, which contribute about 60 % of total meat production, are primarily reared for milk and draught purpose and in the end utilized for meat purpose subject to many limitations. India has over 2000 animal markets where livestock are traded which are not developed on scientific lines. Market facilities are generally inadequate and if available are poorly maintained. There are 2702 slaughterhouses in the country, which are recognized or authorized by local bodies. In addition a considerable number of animals are slaughtered in unauthorized places. A rough estimate indicates up to 50 percent of animals slaughtered in any urban center are from unauthorized slaughter. Condition of many of the urban slaughterhouses is far from satisfactory. Under the CSS scheme Assistance to States for Improvement/Modernization of Abattoirs and Carcass Utilization Centers, assistance as grants in aid is provided to the State Govts to improve / upgrade the existing slaughter houses and to establish carcass utilization centers. Implementation of schemes has not been satisfactory; projects sanctioned during the 7th and 8th Plans in are still to be completed.

1.3.6 Central Sponsored Schemes related to small animals are National Ram/Buck Production Programme and Assistance to States for Integrated Piggery Development. The total expenditure in the two schemes would be Rs.22.62 crores against the total outlay of Rs.65.05 crore. Although small animals are reared by the poorest of the poor, this sector is being neglected since First Five Year Plan. Despite the least attention from the planners, goat population in India during last two decades has increased at fastest rate among all major livestock species. In spite of the fact that nearly 41 percent of goats are slaughtered annually with about 15.5 percent natural death in the rural areas. About 36% of the total sheep population is slaughtered every year for meat purposes. During last 4 decades there has not been much increase in sheep population. The fine wool production in the country is around 4 million kg and the demand from the industry is around 35 to 40 million kg of fine wool, which is mainly imported from countries like Australia. Pig husbandry is the most important activity in the Animal Husbandry sector in North Eastern Region inhabited by tribal people. The region also has a substantial pig population, which constitutes around 25% of the country's pig population. The bulk of the population is however indigenous type whose growth and productivity is very low.

1.3.7 The Indian poultry industry has come a long way – from a backyard activity to an organized, scientific and vibrant industry. The significant step in poultry development has come from the initiatives taken up by the private sector for commercial pure-line breeding in the country. Government intervention by way of various support mechanisms is now directed towards promotion of poultry in

rural areas. Central Sponsored scheme 'Assistance to State Poultry/Duck Farms had been cleared during 1999-2000 for strengthening the infrastructure facilities of one or two existing State Poultry Farms in each state for multiplication and dissemination of chicks. Initially, the scheme is being implemented on pilot basis in North Eastern States, with 100% grant in aid. The anticipated expenditure in the project during current plan would be Rs. 9.90 crore against the play outlay of Rs.16.20 crore.

1.3.8 Export earnings from livestock sector and related products rose from Rs. 1241 crores in 1993-94 to Rs. 2073 crore in 1998-99 showing an average annual growth of about 10.8 per cent. Leather and leather products accounted for as high as 54 per cent and meat and meat products for 37 per cent of the total export. Exports of milk and milk products accounted for less than 1 per cent. Although the potentiality for export of livestock products is immense but it is not realized because India is unable to adjust effectively to the open trade regime under the WTO particularly SPS regime.

1.4 Tenth Plan Focus and strategy

1.4.1 Animal husbandry and dairying will receive a high priority in the efforts for generating wealth and employment, increasing animal protein availability in the food basket and for generating exportable surpluses. A sustainable and financially viable livestock and poultry farming, which will generate wealth and self - employment through entrepreneurship, is need of the day.

A sustainable and financially viable livestock and poultry farming.

Technology support is imperative not only for enhancement of productivity but also for reduction of per unit cost

All licensing control for processing of livestock products / bye-products should be repealed and all restrictions on the export of livestock and its products need to be removed.

The overall focus will be on the four broad pillars viz. (i) removing policy distortions that is hindering the natural growth of livestock production; (ii) building participatory institutions of collective action for small scale farmers that allow them to get vertically integrated with livestock processors and input suppliers; (iii) creating the environment in which farmers will increase investment in ways to improve productivity in the livestock sector; and (iv) promoting effective regulatory institutions to deal with the threat of environmental and health crises stemming from livestock.

1.4.2 Use of technological and marketing interventions in production, processing, and distribution of livestock products will be central theme of any future programme for livestock development. Technology support is imperative not only for enhancement of productivity but also for reduction of per unit cost. Generation and dissemination of appropriate technologies in the field of animal production as also health care to enhance production and productivity levels will be given greater attention.

1.4.3 External markets are an extremely important source of demand and these should be tapped much more aggressively. In order to encourage exports, all licensing control for processing of livestock products/bye-products should be repealed and all restrictions on the export of livestock and its products need to be removed. The immediate focus should on export of Indian dairy products, buffalo meat and poultry products to Asian and African countries. The minimum requirements for sustainable export are creation of disease free zone, organic farming and potable water; these should be made available in selected areas having large marketable surplus.

1.4.4 Sustainable rapid growth and development in this sector can only be ensured if the livestock owners, service providers, veterinarians and planners become knowledge based and acquire the ability to absorb, assimilate and adopt the spectacular development in the veterinary sciences and related technologies. A massive programme encompassing village schools, veterinary colleges and universities should be taken up in collaboration with ICAR to improve the skills and competence of all the stakeholders.

1.4.5 Besides the Ministry of Agriculture, schemes relating to animal husbandry and dairying are also being implemented by other ministries viz. Ministry of Rural development, Ministry of Non-conventional Energy Resources, Ministry of Culture (Animal Welfare Department) etc. Many schemes operated by these ministries have similar and overlapping objectives targeting the same population. Generic components like extension, training, and infrastructure get repeated in most of such schemes and are not complementary. Thus, there is a need for consolidation and convergence of all such activities, schemes and funds. Department of Animal Husbandry & Dairying being the nodal department should address all the issues in totality.

1.4.6 Most of the livestock services like A.I, vaccination, deworming etc. are time sensitive which Government institutions at times are not able to deliver due to financial as well as bureaucratic constraints. This necessitates the need for providing efficient and effective decentralized services in tune with demands emanating from users. Such services should be delivered at farmers door and linked with cost recovery for economic viability. However limited Government involvement should be continued for people below poverty line who are vulnerable, illiterate and unable to integrate with the mainstream.

1.4.7 The Department of Animal Husbandry and Dairying should play a role of regulatory authority rather than disbursement of central kitty, which is the current focus. It should have legal authority for certification and enforcement of quality / standards of veterinary biological, feeds, pharmaceutical products and livestock and livestock products.

1.4.8 Capacity of the Department of AH&D to do effective monitoring of central schemes (both CS and CSS), which are highly technical in nature is limited and often does not exist. In view of the fact that entire sector programmes are needed to be handled by the technical person from inception to monitoring, the present staffing pattern is highly distorted and ineffective. Declaring the Department of Animal Husbandry and Dairying as a Science Department and dovetailing the Animal Research Institutes of ICAR with the Department would not only improve its efficiency but also provide a effective delivery machinery to the Department enabling it to work as a regulatory body in post-liberalized era. These agendas of reform in governance should be taken on priority basis if we have to achieve 8% growth rate in this sector.

1.4.9 A national livestock breeding strategy needs to be evolved to meet the requirements of milk, meat, egg and other livestock products and transport. Major thrust will be on genetic up gradation of indigenous/native cattle and buffaloes using proven semen and high quality pedigreed bulls and by expanding artificial insemination network to provide services at the farmer's level.

4.10 Since animal disease eradication and quarantine is critical to exports, animal health system will be strengthened and disease free zones created.

Conservations of threatened livestock breeds and improvement of draught animals.

Immunization programme against important animal diseases and creation of disease

free zones.

Feed and fodder production enhancement and improvement of common property resources.

Building infrastructure for animal husbandry extension network (service providers)

After the successful eradication of rinderpest disease, the major thrust will now be to adopt a National Immunization Programme against most prevalent animal disease (e.g. Hemorrhagic Septicaemia and Black Quarter in large ruminants, PPR and Poxes in small ruminants, Swine fever in pigs, Ranikhet in poultry).

1.4.11. Conservation of threatened breeds of livestock and improvement of breeds used for draught animal and pack should be the major goal of the Tenth Plan. It should be a national priority to maintain diversity of breeds and preserve those showing decline in number or facing extinction.

1.4.12 The importance of feed and fodder in livestock production hardly needs to be emphasized. Attention is needed for cultivation of fodder crops and fodder trees to improve animal nutrition. The area under permanent pasture and grazing land has been estimated at 11.06 million ha. However, actual availability appears to be much less. An integrated approach for regeneration of the grazing lands needs to be evolved. Due to improper management of common property resources and lack of coordination between different agencies involved, the productivity as well as carrying capacity of the present public and forestland are decreasing. This problem needs to be addressed on priority for sustainable and economic livestock production

1.4.13 Livestock extension is presently a part of agriculture extension. But livestock extension, which is primarily based on providing services and goods, needs to be treated differently from crop related extension activities that based on transfer of knowledge. Animal husbandry extension worker is basically a service provider. Panchayats, Cooperatives and NGO'S should play a leading role in generating dedicated band of service providers at the farmers doorstep in their respective areas.

1.4.14 Public sector lending in livestock sector is abysmally low and such inadequate

National Animal Health and production information system for generation of reliable and timely database.

Development of marketing infrastructure for all types livestock products

Dairy / poultry Credit Card and Venture Capital Fund to meet the credit need of farmers and entrepreneurs.

Specific funding to solve field oriented problems through R & D.

Livestock care and well being, relief during natural disasters and calamities.

credit support leads to poor capital formation. As the organized financial sector is unwilling to finance livestock programme that are not in their interest especially after the initiation of financial sector reform, the livestock farmers are mainly dependent on the financial intermediaries and they end up bearing a higher interest rate than that would be available otherwise. NABARD should ensure that at least 20% of the total agriculture sector lending is reserved for Animal Husbandry and Dairying Sector for both short term and long term capital requirement. Financing should be done against model projects that have demonstrated their economic viability. A conducive climate is to be created through

favourable price and trade regime to promote farmer's own investment as well as private sector investment.

1.4.15 The country needs a computer based 'National Animal Health and Production Information System' with active involvement of Institutions, Government Departments, Private industries, Cooperative, and NGO's.

1.4.16 Priority attention should also be given to improve the processing, marketing and transport facilities, with emphasis on modernization of abattoirs, carcass utilization and value addition thereon. Incentives for livestock production activities should be brought at par with incentives for crop production. Development of marketing network and remunerative price support to the producers will be a great incentive for higher animal productivity both in quantity and quality. Creation of a permanent institution, which will estimate the cost of production of various livestock products and suggest remunerative price is needed so that farmers are not exploited.

1.4.17 Issue of animal management and welfare during natural calamities and disaster will require attention and suitable programme need to be developed since such asset loss can drive the poor into destitution. Animal welfare is also related directly with the productivity of the animal. The well being of animal is hampered during management under intensive production system, in the animal market, during handling and transportation in animal market, rearing of newly born male calves in urban areas etc. There is a great deal of wastage and losses, as well as animal suffering due to ill designed agri-implements, carts and implements attached to animal. Veterinary universities/ colleges and other institutions like veterinary hospital, dispensary, NGOs working on livestock care system need to be strengthened so that they can ensure and promote animal care and well-being.

1.4.18 In India poultry neither enjoys the status of agriculture nor does it enjoy the status of industry. This uncertainty does not auger well for consistent development of the sector. Poultry establishments having less than 10,000 birds should be treated as agricultural activity for the benefit of the poultry farmer and extend the same benefit/incentives/concessions to this sector, as applicable to agriculture; for units having capacity greater than 10,000 birds it should be treated as industry with all the benefits as extended to industry

1.4.19 Quality and safety of livestock products depend upon quality and safety assurance system for which legislation is an obligatory mechanism for setting up standards, which should correspond to Codex standard. These do not exist nor is there any method for reviewing and rationalizing the quality and safety guidelines. Enforcement of the legislation would also be one of the important areas of action. For these, infrastructure facilities for testing food quality and safety need to be harmonized with OIE and SPS system. It is needed to establish a permanent Directorate/ Regulatory agency in DAHD supported by an Expert Committee for review of WTO/SPS related issues, regulatory requirement vis-à-vis Indian Legislation, control of import if necessary, counter measures against unjustified/arbitrary WTO/SPS measures adopted by other nations, helping export of livestock products and matters related to trade of livestock and its product on a regular basis

1.4.20 Livestock farming is a major player in dry lands and hill regions. But the focus of investment and developmental strategy is on crop agriculture. The focus in these regions should have been on livestock production as more than 70% of family income is derived from livestock. This will help to alleviate poverty and increase the family income of those who are poorest of poor.

1.4.21 Ever since draught power was allocated to Ministry of Non-Conventional Energy Sources ((MNES), very little developmental work has been done. For the development and efficient utilization

of draught animal power in the country, the Ministry of Agriculture should work as a nodal ministry. A National Center for Animal Energy Development can be established under the Department of Animal husbandry and Dairying as a Central Sector Scheme to coordinate all the activities related to the efficient utilization of DAP in collaboration with other Ministries/Departments. A new programme focused exclusively on improvement and conservation of draught breeds of livestock may be initiated during Xth Plan.

1.4.22 Remove the present restriction on establishing new milk processing capacity under MMPO. Rules and regulation regarding registration of milk plants as practiced globally should be framed. MMPO should concentrate on quality and food safety only. To enable the dairy and poultry cooperatives to compete with private companies, it is necessary that cooperatives are free of shackles of archaic laws and bureaucratic interference. Time has come to bring about structural changes in the unorganized sector; programme should be designed and implemented to.

1.4.23 Government should recognize that culling and utilization of surplus animals is an established norm for animal production and improvement. Animal preservation acts of the states need to be reviewed so that constraints, if any, affecting proper utilization of livestock could be removed. Registration of the all slaughterhouses in the city/town is must for clean meat production and protection of the environment. Establishing Rural Based Abattoirs (RBA) in animal tracts would drastically reduce the need for transportation of live animals to urban areas for slaughter.

1.4.24 The Livestock Census Scheme suffers from timeliness and quantitative as well as qualitative problems. Livestock census should be based on cent percent coverage of all households in the country on a specific date through the State Animal Husbandry Directorate and the Department of Animal Husbandry & Dairying at the Central level..

1.5 Resource Mobilizations

1.5.1 The Government should endeavor to create a favorable economic environment for increasing capital formation and private investment by removing distortions in the incentive regime for livestock production and bringing about external and domestic market reforms and backed by rationalization of tax structure. Resource Mobilization has to come through, institutional financing, capital market and private investments, which are to be tapped as a major drive to put the infrastructure in place.

1.5.2 This export surplus should be used to develop the infrastructure. Presently, country is exporting leather and leather goods worth Rs.17,000 crores a year. None of these are ploughed back into improvements of livestock so that quality skins and hides are produced nor in creating environmental friendly carcass utilization centers for dead and fallen animals. Similarly, country exports carpets worth Rs.1,500 crores a year and none of these goes back to growth of indigenous sheep industry. A cess on leather, leather goods and carpet should be imposed and this would be ploughed back to improve the related industries at the level of farmers. The delivery and input cost of all the services provided by State Veterinary Department should be recovered on commercial basis except for those farmers who are identified as being below the poverty line.

1.5.3 The venture capital fund should be created in the Department of Animal Husbandry and Dairying (in collaboration with NABARD) for establishment of infrastructure by private entrepreneurs like veterinary hospitals, vaccine production units, feed plants, fodder seed production facilities, processing plants for western and indigenous dairy, meat and egg products, semen production units including bull mother farms and network for delivery of semen to the farmers. These activities should also get credit

under the head of Priority Sector Lending from commercial and co-operative banks. The concept of working capital loan is not in operation in the livestock sector. Like in small-scale sector, this sector requires a provision of working capital loan to enable the entrepreneurs to use it judiciously. Such provision will help the entrepreneur to avoid rushing to the bank for further financial help and make a long wait by which time the activity might suffer irreparable loss. Introduction of Dairy and Poultry Farmers Credit Card (Like Kisan Credit Card) would solve the problem of working capital. Under this programme the farmer will get credit against the future production and he will be free to purchase the inputs at a competitive price from his selected shop. Government should come out with a margin money scheme on the lines of KVIC's Margin Money Scheme where entrepreneurs are required to contribute only a sum equal to 5 or 10% of the cost of the project from their own sources. Alternatively, a soft loan scheme with concessional rate of interest to meet the margin money should be formulated with the help of NABARD.

1.5.4 The perception of bankers is that the financing of animal husbandry activities is a risky proposition and many loans are likely to become bad. It is this factor, which forces the financial institutions to go in for collateral security either in the form of mortgage of land or third party guarantee. Such units will be security oriented rather than commercially designed. In case of commercial units, where technology plays an important role and the size of land holding need not be large, the collateral becomes insufficient in the bankers perception. Removal of collateral security wherever warranted will prove to be of great help to qualified and skilled entrepreneurs to establish financially viable units.

1.5.5 The share of animal husbandry and dairying sector was only 5.7% of total ground level credit offered through NABARD for agriculture and allied activities during 1999-2000. Only term loan to the tune of Rs.2366 crore was given to animal Husbandry and dairying; no production credit or short-term credit was given. NABARD should ensure that at least 20 percent of the total ground level credit becomes available to animal husbandry sector. Financing should be done against model projects that have demonstrated their economic viability. A reasonable unit size depending upon the capacity of an individual is to be determined and necessary schematic lending has to be provided to establish the same.

1.5.6 Besides the funding by Department of Animal Husbandry and Dairying, a minimum portion of the budget (10% of the budget or Rs.3000 crore per annum) of Ministry of Rural Development should be earmarked for animal husbandry and dairying activities as a legitimate share of rural development.

Animal Husbandry & Dairy Development

Animal Husbandry sector has played a significant role in the socio-economic development of the rural community. This sector also contributes significantly in supplementing family incomes and in generating gainful employment in the rural sector.

India has vast resources of livestock. About 60% of the world's buffalo population is in India, and it ranks first in the case of cattle and buffalo population. According to provisional estimates of the Central Statistical Organisation (CSO), the gross value of output from the livestock sector at current prices was about Rs.111400 crore which is about 25 percent of the value of the out-put of Rs.449500 crore from the Agriculture Sector. This excludes the contribution of animal draught power. Livestock Sector not only provides essential proteins for nutritious human diet through milk, eggs, meat etc. but also plays an important role in the utilisation of non-edible agricultural by-products. Livestock also provides raw material/by-products such as hides and skins, blood, bone,

fat and casings for industrial and commercial usages.

During the Ninth Plan, the main emphasis has been for improving the production and productivity of the livestock through scientific management of genetic stock resources and up-gradation of the livestock by expansion of artificial insemination network, production of quality feed and fodder, effective control of disease, declaration of disease-free zones, extension services etc.

The Special Action Plan (SAP) for food production in ten years envisages a detailed strategy and specific programmes/activities to substantially increase the supply of various food items. In the livestock sector, some schemes like National Project on Cattle and Buffalo Breeding, Cattle Insurance, Assistance to State Poultry Farm, Duck Farm, Assistance to Sick Dairy Cooperative etc. have been envisaged for implementation.

Review of Annual Plan 1998-99

India's milk output during 1997-98 was 70.5 million tonnes and is expected to reach the level of 73.5 million tonnes during 1998-99. This makes India the largest producer of milk in the world. The per capita availability of milk is also expected to increase to 207 grams per day during 1998-99 from 200 grams in 1996-97. Poultry production in the country has made significant progress over the years. Egg production during 1997-98 was 28,500 million compared to only 800 million two decades ago. It is expected to increase to 30,000 million during 1998-99. Currently India ranks fifth in egg production in the world. Wool production was about 44.6 million kgs. during 1997-98. About 45.5 million kgs. is expected to have been produced during 1998-99.

Cattle and Buffalo Development Programme

The Central Cattle Development Organisation has been producing high pedigree bull cattles of indigenous, exotic and cross bred bull calves. Against the target of production of 330 bull calves during 1998-99, 242 bull calves have been produced up to Nov.1998. Besides, Central Frozen Semen production and Training Institute, Hesarghatta is producing Frozen Semen of indigenous, exotic and cross-bred cattle bulls for supplementing the efforts in cattle and buffalo development. During 1998-99, the Institute has produced 5.38 lakh doses of frozen semen upto Nov. 1998 against the target of 10 lakh. Under the Central Herd Registration Programme, Primary registration of 9718 animals has been done upto November, 1998 against the target to registering 12000 animals in the current year. In addition, two Centrally sponsored Schemes viz., Extension of Frozen Semen Technology & Progeny Testing Programme and National Bull Production Programme have been supplementing the efforts of the State Governments. These two schemes have since been proposed to be revised/reframed to form part of a new scheme viz. National Project on Cattle and Buffalo Breeding.

Poultry Development

The Central Poultry Development Organisation is engaged in the production of high yielding egg-type chicks and fast growing meat type chicks through adoption and developmental breeding programme and training in poultry farms. Against the target for sale of 0.60 lakh egg-type and 0.40 lakh meat-type chicks during 1997-98, 0.54 lakh egg-type and 0.26 lakh meat-type chicks were sold. About 1.00 lakh high-egg production khaki Campbell breeding stock ducklings are likely to have been supplied to the states

during 1998-99. Besides three Regional Feed Analytical Laboratories (RFALS) in 3 different regions at Chandigarh, Bombay and Bhubaneshwar have been assigned to analyse about 3500 feed samples during 1998-99 so as to monitor the quality of poultry feed. During the 9th Five Year Plan, a new Centrally Sponsored Scheme to assist at least two Poultry/Duck Farms in each State of the North East Region has been approved on pilot basis for developing backyard poultry.

Sheep Development

Sheep and Goat are two important livestock species which make substantial contribution to the rural economy. However, production and productivity of these species in the country require improvement. The Central Sheep Breeding Farm, Hissar is engaged in the producing and disseminating acclimatized stud-rams to various State Sheep Farms for cross-breeding and genetic stock upgradation. The Farm has produced and supplied 470 rams upto Dec. 1998 against the target of 750 rams during 1998-99. Central assistance has been provided to the States of Madhya Pradesh, Himachal Pradesh and Gujarat for strengthening State Sheep, Goat and Rabbit Farms and State Wool Boards under the Centrally sponsored Scheme viz "National Ram/Buck Production Programme and Programme for Rabbit Development" during 1998-99.

Piggery Development

There are about 158 State Pig Breeding Farms in the country. An amount of Rs.2.43 crore has been released to various State Governments. Under the scheme "Assistance to the State for Integrated Piggery Development" for Strengthening these farms during 1998-99, 55.64% of this grant has been released to the North East region.

Feed and Fodder Development

The Central Government has initiated two schemes namely, Central Feed and Fodder Development Organisation and Assistance to States for Feed and Fodder Development for promotion of cultivation of crops, availability of improved and high yielding foundation/certified seeds, production of pasture grasses/legumes. Central Feed and Fodder Development Organisation have produced about 368 tonnes of fodder seeds during 1997-98 and 123 tonnes upto Dec. 1998 against the target of 337 tonnes. In addition to this, these organisations have been asked to distribute of 3 lakh fodder mini kits among the farmers with the objective to educate the farmers through field demonstrations.

Animal Health Care

Special emphasis has been given to the improvement in coverage of animal health care services and effective control of livestock diseases. The Central Government is regulating import and export of livestock and livestock products through Animal Quarantine and Certification Services. Besides, the required quantity of animal Vaccines are being produced in 26 Veterinary Biological Production Units for prophylactic vaccination. A National Centre for quality and control of vaccines is likely to be established very soon. The country has achieved major success in the eradication of Rinderpest, a dreadful disease through the National Project on Rinderpest Eradication and getting provisional freedom from this disease on OIE pathway. A major part of the country has been declared provisionally free from rinderpest with effect from May 1994

following the OIE pathway leaving only the southern peninsula as an infected area. In addition, assistance is also being provided to the States/Uts for supplementing their efforts to control livestock diseases under the ongoing Centrally sponsored scheme, "Assistance to States for Control of Livestock Disease" which is having three components viz. Systematic control of Livestock Diseases, Foot and Mouth Disease Control Programme and Animal disease Surveillance.

The Scheme on cattle Insurance with a wider coverage has been proposed to be operated by the General Insurance Corporation (GIC) and its subsidiary companies.

Dairy Development:

Operation Flood, an integrated dairy development programme, and funded by the World Bank completed phase III on April 30, 1996. The main thrust of the programme was to consolidate the gains already achieved, and to strengthen the dairy cooperative structure for sustainable development of the dairy industry in India.

The EFC has approved utilisation of balance fund of Rs.34 crores, after completion of phase III, on the following two major components:-

- i. Women Dairy cooperative Leadership Development Project.
- ii. Strengthening of Dairy Cooperatives to meet the competitive challenges of the next decade.

These components are primarily aimed at strengthening cooperatives at the grass-root level. After the successful implementation of the Operation Flood programme, about 78,945 Anand Pattern Dairy Cooperative Societies were organised in milk shed areas involving about 100 lakh farmer members during 1998-99.

The average milk procurement during April-October 1998 was 121.6 lakh kg/day which is 6 percent higher than the previous year. It is expected that average milk procurement during the current year would be about 5 percent more than during 1997-98. Till October, 1998 about 118.2 lakh litres/day of milk was marketed as against 111.4 lakh litres/day during the corresponding period of the previous year, reflecting a growth of 6 percent. Cooperatives are marketing liquid milk in over 700 urban centres, the total rural milk processing capacity in the programme stood at 204.5 lakh litres a day with powder production capacity at 1054 MT/day. To minimise the adverse impact of regional and seasonal imbalance in procurement and marketing, 1142 road milk tankers and 171 rail milk tankers have been pressed into service for long distance transportation of liquid milk.

The scheme "Assistance to Cooperatives" approved by Govt. is aimed at off-setting the accumulated losses incurred by the Dairy Cooperatives consequent upon the transfer of assets and liabilities by the erstwhile State Dairy Development corporations to Dairy Cooperative Union/Federations. Appropriate rehabilitation plans are to be worked out in each case with a mechanism for thorough appraisal and close monitoring to ensure their continued viability.

An Integrated Dairy Development Programme in non-OF Hilly and Backward Area was launched during the Eighth Plan with a total outlay of Rs.200 crore as a Central Sector

Schemes. This scheme has been continuing in the Ninth Plan. During the year 1998-99 (upto Sep., 1998) over 5000 DCS have been organised under the Project with a total farmer membership of about 4.02 lakh. Three new projects in Nagaland , Orissa and West Bengal have been approved during 1998-99 with an outlay of Rs.11.10 crore.

The DMS was set up in 1959 with the primary objective of supplying wholesome milk to the citizens of Delhi at reasonable prices as well as for providing remunerative prices to the milk producers. Presently 4.0 lakh litres of milk is sold on an average per day by the DMS. Besides, this DMS is also manufacturing and selling ghee and table butter out of surplus fats available. During 1998-99 (upto Nov. 1998) the sale of these products has been 357.76 MT and 43.16 MT respectively.

The actual achievement during 1998-99 and target for Ninth Plan and 1999-2000 in respect of important livestock products.

During 1997-98, Rs.123.27 crores have been incurred under various plan schemes for Animal Husbandry & Dairying Development as against Rs.103.2 crores (RE) in 1998-99.

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A sum of Rs.235.98 crores under the plan schemes has been approved for Animal Husbandry and Dairying Development during the year 1999-2000 of which Rs.160.08 crores would be for the Animal Husbandry Rs.73.9 crores for Dairy Development and Rs.2.00 crores for secretariat economic services.

Fisheries

The Fishery sector plays an important role in the national economy and socio-economic development of the country. This sector also plays a significant role in supplementing family incomes and generating gainful employment in the rural sector, besides providing cheap and nutritional food to millions of people.

The main objectives of the fisheries development programmes of the Government during the Ninth Five Year Plan are: optimising production and productivity, augmenting export of marine products, generating employment, improving the socio-economic conditions of fisher folk/fish farmers, conservation of aquatic resources and genetic diversity, increasing the per capita availability and consumption of fish etc. Besides these objectives an integrated approach for sustainable development of fisheries and aquaculture will be one of the thrust areas during the Ninth Plan period.

Fisheries sector is expected to register a growth rate of 5.7% per annum during the Ninth Plan period. Fish production has been continuously increasing in the country. During the first two years of the Plan, fish production was 53.90 lakh tonnes (1997-98) and 56.00 lakh tonnes (anticipated - 1998-99) respectively. Fish production target for the year 1999-2000 is 58.00 lakh tonnes. Financial outlays/expenditure and physical targets/achievements during the first three years of the Five Years.

Under the centrally sponsored scheme - "Development of Freshwater Acquaculture" programme is being implemented by the States through the Fish Farmers Development Agencies(FFDAs). The network of 422 FFDAs provide technical, financial and

extension support to fish farmers. An area of 1.73 lakh ha (4.56 lakh ha-cumulative) has been brought under intensive fish culture benefitting 2.38 lakh fish farmers (8.30 lakh fish farmers - cumulative) during the Eighth Plan period. The agencies have also trained 1.86 lakh fish farmers (5.77 lakh fish farmers - cumulative) in improved practices during this period. The average productivity from ponds and tanks under this programme has increased from 2000 kg to 2200 kg per hectare per year during the same period. The targets set for coverage of water area, training of fish farmers and average productivity by the end of the Ninth Plan have been 1.5 lakh ha, 1 lakh numbers and 3000 kg per hectare respectively.

Under another programme, 31,000 traditional crafts have been motorised with inboard engines and outboard motors. Motorisation of traditional craft helped in increasing fish production from the traditional sector (A motorised craft is expected to bring in an additional catch of 1 to 1.5 tonnes per annum compared to a traditional craft). It has also increased the net income of individual fishermen. The target set for motorisation of traditional craft is for additional 20,000 numbers by the end of the Ninth Plan. Under another centrally sponsored scheme, 6 major fishing harbours, 20 minor fishing harbours and 129 fish landing centres have been commissioned in the country for providing landing and berthing facilities for mechanised boats and fishing trawlers. The targets for commissioning of additional 3 major, 10 minor fishing harbours and 30 landing centres have been set up for the Ninth Plan. Performance of the above mentioned centrally sponsored programmes has been satisfactory during the first two years of the Ninth Plan.

Two schemes viz. (I) Integrated Development of Inland Capture Fishery Resources such as reservoirs, rivers, lakes, water-logged areas, etc. and (II) Development of coldwater Fisheries by establishing seed, feed and marketing infrastructure facilities for optimisation of fish production in the hilly regions are being envisaged to be implemented during the Ninth Plan period.

In pursuance of the Government's strategy for doubling the food production in ten years, the major thrust of the government will be through a number of fishery schemes/programmes during the Ninth Plan which are as under:-

- i. Programmes for creation/strengthening of shore-based facilities such as fishery harbours, landing centres etc. with cold storage, ice plants, fish processing facilities and marketing infrastructure.
- ii. R&D programmes for development of quality fish/shrimp/fresh water brown seed hatcheries.
- iii. R&D programmes to regulate brackish water aquaculture/farming and also to overcome diseases in cultured shrimps.
- iv. Measures to conserve fishery resources of the coastal waters and programmes to exploit the deep sea fishery resources in the EEZ of the country.
- v. HRD programmes with emphasis on training and skill development in post harvest/processing and marketing activities particularly for fisherwomen.

Agricultural Research and Education:

The Indian Council of Agricultural Research (ICAR) is the apex body in the country in respect of agricultural education, research and frontline demonstration. ICAR undertakes research on problems relating to conservation and management of resources, productivity improvement of crops, livestock and fisheries, etc. In addition to these, the Council promotes and coordinates agricultural education programmes at the National level. The ICAR has 80 Institutes comprising 46 Central Institutes, 4 National Bureaus and 30 National Research Centres. It has also 90 Projects including 10 Project Directorates and 80 All India Coordinated Research Projects/Network Programmes.

In the case of rice, 3 hybrids namely Pant Sankar Dhan-I in Uttar Pradesh, CoRH-2 and ADTRH-1 in Tamil Nadu have been released for generation cultivation. In the case of wheat, dicoccum type high yielding varieties viz. HS 356, NW1012, NW1014, K9546, GW273, IIW1085 and DDK 1009 were released for cultivation in different agro-climatic regions. Technologies have been developed also for zero-tillage and furrow-irrigated-raised-bed sowing of wheat, which are being further refined. In regard to maize, hybrids DMH I and Prakash (single cross) were released for cultivation. An improved variety of Sorghum namely SPV-1359 has been released for Maharashtra. Early Morning hybrids of pearl millet, PUSA 415 for Rajasthan, Gujarat, Haryana, Uttar Pradesh and Madhya Pradesh were released. Late maturing hybrid Nandi-8 for Gujarat and Madhya Pradesh for the same crop has also been released. A high-yielding blast resistant variety of small millet GPV 26 was released for Karnataka. Two new varieties of chickpea i.e. GCP-101 and HDG-72 were identified for pre-release multiplication.

A regular bearing and high-yielding mango clone Dussehri-51 has been released by CISH, Lucknow. As many as 90 new grape gemplasm accessories were collected to increase total number of such accessories to 185. In regard to vegetables, 13 varieties of brinjal, one variety of tomato namely K-517, one variety of garlic GM-282, and KKBG-16 of bitter gourd and HHR-16 of cowpea have been released.

During the year 1999-2000, the priority areas of research will be (i) development of superior varieties of different cereals; (ii) intensified hybrid breeding in rice, maize, sugarcane and pearl millets; (iii) integration of biotechnological approach with crop improvement programmes. In the case of cotton, the thrust area will be exploitation of male sterility, development of better quality and high yielding desi hybrids. In the case of oilseeds, the research efforts will be to improve the productivity of oilseeds.

A 6-row tractor mounted inclined plate planter has been designed and developed for sowing crops like groundnut, maize, pigeon, mustard, gram, etc. A 6-row mat type manually operated paddy transplanter has been developed. Also, a manually pulled pregerminated rice seeder has also been developed which helps in sowing of rice in puddled fields.

For Animal Sciences, National Bureau of Animal Genetic Resources, Karnal have developed information system for validation for carrying out experiments for users benefit. Genetic characterisation of Ongole, Deoni, Gir, Umblacherry cattle, Jaffarabadi buffalo; Osmanabadi and Barbari goat and Assel poultry breeds have been undertaken through survey centres of Network Project on Animal Genetic Resources. Field progeny testing of cross-bred bulls continued at three centres BAIF, KAU and PAU. Under

AICRP on Buffalo, constant improvement has been achieved in milk yield of Murrah Buffalo at CIRB, PAU and NDRI. "Bharat Merino" flock at CSWRI was further improved through selection and interse mating. At CIRG, Makhdoom, "Muzzaffarnagri" sheep was improved through selection and interse mating for increase in mutton production. A prototype unit for continuous manufacture of paneer has been designed and is under fabrication. The design incorporates the optimum process parameters for continuous whey drainage and matting of curd for improved product quality.

Having observed the existence of Brucellosis in large and small ruminants in an agrarian country like India, a national serological survey of bovine serum samples, through use of indigenously developed AVIDIN-Biotin ELISA, showed evidence of widespread IBR infection in buffaloes in all the 20 States/Uts. Therefore, for strengthening the network of disease monitoring, forecasting, control and export strategies, a new and innovative approach to define, delineate and demarcate national micro-level eco-patho zones of livestock diseases based on specific landscapes, livestock demography, agro-geo-climatic and human interventions have been achieved. Concentration of research programmes during 1999-2000 will be on animal genetic resources, livestock improvement and better animal health cover etc.

Gene Banking through sperm cryopreservation has proved a potent tool for increased aquaculture production as well as for servation of germplasm resources. The Gene Bank has sperms of nine species. These include commercial species like catla, Rohu, Mrigal, Common Carp, Rainbow Trout and endangered species like Golden Mahaseer, Deccan Mahaseer and Hilsa. Cross-breeding programmes have successfully been undertaken between distant and discrete populations. Rohu fry/fingerlings have been collected from five riverine sources which have formed the base population for selection and selective breeding. Experiments have been conducted on carp culture programme which have achieved a level of production of 17.3 tonnes per hectare per year. It has been proved by this experience that through multiple cropping, it will be possible to reduce the cost at least by 20 to 30 per cent besides providing revenue from the harvest at regular intervals. Under brackish water fisheries, two successful experiments have been carried out where Asian seabass *Lates calcarifer* and grey mullet were kept under captive conditions and induced breeding. These have shown very encouraging results and the growth of fish was fast. The research programmes proposed for 1999-2000 will cover capture fisheries, culture fisheries, fish and fish processing technology, fish genetic resources development etc.

Under the extensive programme of coverage of the entire country under one KVK or equivalent Centre for extending the transfer of agricultural technology to farmers, one in each district by the end of Ninth Plan, a total number of 20 Zonal Research Stations (ZRSs) have been upgraded during 1998-99 and it is proposed to upgrade another 33 such stations into KVKs during 1999-2000. These activities will also be under the programme of National Agriculture Technology Project (NATP). The existing KVKs in the country is 261. The above additionality is likely to take the number up to 314 by the end of the annual plan 1999-2000.

A total of 11,360 training courses for the benefit of 2,58,000 farmers and farm women has been organised. As many as 2550 long-term vocational and skill-oriented training courses have also been organised covering more than 53,000 rural youth. Frontline demonstrations were carried out on a total of about 2800 hectares of land covering 5600

farmers, who had sown oilseeds crops. A very important aspect of the research carried out by various ICAR Institutions and SAUs is transfer of technology which is being done in the country through the Krishi Vigyan Kendras (KVKs), Zonal Research Stations (ZRSs) and Trainers' Training Centres (TTCs).

The Indian Agricultural Economics and Policy Research Institute undertakes various kinds of studies so that production and productivity levels of various crops in the country could be evaluated. This is finally found to be helpful in suggestions for preparation of policy papers and suggesting strategies for different areas to bring about improvement in yields, transfer of technology and other related work. In the year 1999-2000, as many as 33 ZRSs will be upgraded to function as KVKs whereas the National Centre for Women in Bhubaneswar and Institute in village linkage programmes will be strengthened.

Externally aided projects include National Agriculture Technology Project (NATP), aided by World Bank at a cost of about Rs.1000 crore, which has started functioning and is expected to revitalise the complex technology development and dissemination system of India to meet the challenges of the next century. The programme is operating in a phased manner. India is also collaborating with Israel under an Indo-Israel Project, viz. Use of Plastics in agriculture, which is likely to boost and promote large scale use of plastics in agriculture during 1999-2000, reducing large scale dependence on conventional, costlier infrastructure.

In order to achieve the IX Plan/long-term objectives, the ICAR would focus during 1999-2000, specifically on the following research activities given In the Box-2.

Against the approved outlay of Rs.531.17 crore during 1998-99, the expected utilisation is Rs.445 crore. The approved outlay for 1999-2000 for the ICAR is Rs.573.50 crore. Besides this, a World Bank aided project of US \$ 239.7 million has started being implemented during 1998 which will be continued till 2003.

Agro-Climatic Regional Planning (ACRP)

Review of Annual Plan 1998-99

The Agro-Climatic Regional Planning (ACRP) Project was initiated in 1998. Under the ACRP Project, the following major activities have been carried out during 1998-99.

- a. Operationalisation of ACRP strategies in selected Districts, through the Experimental Projects at 5 locations.
- b. Institutionalisation of ACRP approach at State and District Levels by way of carrying out exercise of integration with the existing plan preparation process in selected States and Districts.
- c. Establishment and equipping of Pilot Centres for Agro-Climatic Planning and Information Bank (APIB).
- d. Establishment of ACRP Documentation and Dissemination Center (ADDC) at Central Support Cell of Agro-Climatic Regional Planning Unit (ARPU), Sardar Patel Institute of Economic and Social Research (SPIESR), Ahmedabad.

e. Carrying out Special Studies of ACRP at Macro and Micro Levels.

The progress of ACRP Project was reviewed at the Tenth Annual Meeting of ACRP Project held at SPIESR, Ahmedabad under the Chairmanship of Member Secretary, Planning Commission. Continuation of the Project in the Ninth Plan in the light to review of the Project and recommendations made by Working Group on ACRP Project and Steering Committee on Agriculture for the Ninth Plan has been recommended.

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In 1999-2000, the crucial exercise under Agro-Climatic Regional Planning Project includes an attempt to complete operationalisation of experimental pilot projects in 5 districts of selected states. The work of amelioration of soils under the Project of ACRP Puri and Shimoga is continuing and the task for activities relating to cropping and horticulture and forestry plantations will be completed during the year. For ACRP Mehsana, Purulia and Tirchirappalli, horticulture and agriculture, as major activities are proposed to be completed during the year 1999-2000.

Institutionalisation of ACRP approach extended for implementation in selected States/Districts levels is being continued during 1999-2000. The other thrust area under the ACRP Project is strengthening the data building base. Pursuing ACRP propaganda and publicity through electronic and other media is being continued at ARPU, SPIESR.

The setting up of Agro-Planning & Information Bank (APIB) included for completion of activities of information through satellite as an arm of the National Remote Sensing Service Centre (NRSSC) and National Natural Resource Management System (NNRMS) of the Indian Space Research Organisation (ISRO) for wider use of the facility by groups of users has started functioning. APIB services in building information for individual farmers, cooperatives banks, financial institutions and Government will be further expended during 1999-2000. Access to information and knowledge base has become an important spectrum of planning. APIB has to complete activities in the context of decentralisation and wider participation of the private sector. APIB would provide access of the data bank to government and non-government agencies as well as to enterprising farming communities in planning inputs and technology.

Animal Production

Adoption of livestock enterprise under the LLP by and large was relatively weak, except at a few centres adopted by the NDRI, Karnal; IVRI, Izatnagar; NDRI, Bangalore; KVK, Sultanpur, etc. However, it has proved successful enterprise in restricted areas, where expertise and resources were made available under the LLP, irrespective of whether the enterprise was of dairy cattle, sheep, goat, poultry, piggery or duckery. Under the LLP, animal husbandry enterprise with cross-bred cows/improved buffaloes/ calf-rearing, poultry (10 to 12 one day old chicks/family, piggery (pair of piglets) alongwith health cover and low-cost feeding and management techniques helped adopted families to raise their income by 60-80%. Goat and sheep rearing (two per family) generated on an average income of Rs.500 per year/family. Piggery enterprise fetched Rs 600 per year/family.

Under the animal husbandry programme (LLCs like BHU, Varanasi; KVK, Sultanpur; Chander Shekhar Azad University of Agriculture and Technology, Kanpur), one or the other technologies related to animal husbandry were introduced. Of these, goat-keeping introduced by the CSAUAT, Kanpur; BHU, Varanasi and KVK, Sultanpur was successful enterprise. Artificial insemination, feed and health cover for dairy cattle and fishery programmes introduced by the KVK, Sultanpur, were also rewarding, primarily because of a good follow-up and continuous supply of basic materials, not only to adopted farmers but also to non-adopted ones. By and large, piggery enterprise was not very successful in this region. Poultry experience was variable; layer enterprise was not very much encouraging, but the broiler enterprise was successful in BHU, Varanasi and KVK Sultanpur. In Patna, scientists of Veterinary College under the Rajendra Agricultural University arranged regular visit of a team of scientists in the adopted village once a week to one of the centres established by the Animal Husbandry Department of the Bihar Government for artificial insemination with Jersey and Holstein-Friesian semen and providing health-cover to animals made a good impact in the area.

Dairying

The dairy enterprise proved important subsidiary occupation in almost all zones. Although it was quite customary at the village level to have one or two milch animals for meeting their own milk requirements, the milk production of the local cattle was normally very low, which called for concerted efforts to carry proven animal production technologies/dairying to households in adopted villages. The programme included various facilities of artificial insemination, health-cover including vaccination against different ailments, balanced feeding, and livestock management.

The programme of feeding concentrates/mineral supplements to cross-bred animals was taken up by the NDRI, Karnal. The results revealed that there was a positive gain in milk production and growth of the cross-bred cows, heifers and calves. A mixture of salt, urea, molasses and minerals was also introduced in the area for the enrichment of wheat and paddy straw. Almost all the cross-bred animals gave milk for about 300 days because of proper feeding management.

NDRI, Bangalore, introduced cattle feed and enrichment of ragi and paddy straw with urea and molasses; vaccination of cattle against foot and mouth disease (FMD) and rinderpest (RP). From zero level of milk production, about 300 litres of milk could be produced daily in the village which was through the Rural Multipurpose Cooperative Society with a daily average business of Rs 800. On an average, it worked out to a net additional profit of Rs 200/animal/month. Similarly, with the supply of feeds and concentrates under LLP in the adopted villages, milk production increased by about 1 litre/animal/day in the cross-bred cows. Through supplementary feed for the cows in the LLP villages adopted by the Kerala Agricultural University, the milk yield increased from 2.5 litres to 3.5 litres/day. The IASRI, New Delhi also organized demonstrations on balanced cattle feed (HAFED) in 160 households in Delhi villages. Milk yield increased by 2 to 3 litres/animal/day with 2 kg of balanced feed given to buffaloes. The Haryana Agricultural University, Hisar, organized clinical-cum-infertility camps in almost all the adopted villages, benefiting both adopted and non-adopted farmers. In addition, feed supplement and medicine for health cover to the adopted families resulted in an increase of milk yield of buffaloes by about 25%. The milk yield increased from 5 litres/day to 6.2 litres/day in buffaloes; and from 3.3 litres/day

to 4.2 litres/day in cows.

Almost all the LLCs provided health-cover to adopted families. the NDRI, Karnal, treated a large number of animals for Dagnella disease with the result mortality rate was brought down to only 4%. Similarly, IARI, New Delhi, provided health-cover against gastro-intestinal parasite, reducing calf mortality in buffalo. FMD and RP were the common diseases for cattle. Almost all the LLCs provided effective vaccination programme in the adopted villages against these diseases thereby saving life of animals.

For economic milk production, farmers were advised about nutritious feeding of their livestock with green forage throughout the year. Technologies related to fodder cultivation were also introduced amongst the lab to land farmers depending upon the soil and agroclimatic conditions. In the northern India under this programme, maize + cowpea, jowar in kharif, followed by berseem + mustard or lucerne + mustard or oat + mustard or chinese cabbage in rabi and maize + cowpea in summer were introduced for fodder in the adopted villages. Multicut mixture included sorghum + sweet sudan + teosinte + bajra + cowpea. This gave an average green fodder yield of 533 q/ha. Similarly, lucerne + mustard gave an average green fodder yield of about 850 q/ha, oat + mustard 475 q/ha, chinese cabbage 414 q/ha and maize + cowpea 900 q/ha.

Artificial insemination(AI) programme for improving local cows was also successful. The NDRI was able to establish 11 rural centres exclusively on frozen semen technology around Karnal and Bangalore. AI of HF and Jersey breed was initiated under the LLP in adopted villages. Similarly, the Agricultural Universities, viz. Birsa Agricultural University, Ranchi; Haryana Agricultural University, Hisar; Mahatma Phule Krishi Vidyapeeth, Rahuri; Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur; and Tamil Nadu Agricultural University, Coimbatore, also initiated artificial insemination programmes in their respective adopted villages with good success.

Calf Rearing

Under calf-rearing, feeding of colostrum, deworming, tick control, dehorning and environmental hygiene were introduced in adopted villages. Myrada (Karnataka) was successful in introducing calf rearing enterprise, particularly for Jersey cross-bred in the adopted villages. The farmers were given female calf 12-14 month old, necessary health cover and feeding schedule. A few of the original female calves started giving milk yield ranging from 6 to 10 litres/day. Innovative calf-rearing scheme under the LLP attracted DRDA also for advancement of loan for the purchase and feeding of calf. Calf-rearing programme under the LLP enabled farmers to purchase cross-bred cows. While DRDA contributed Rs 400, Rs 100 were provided from the LLP fund. These efforts created much interest in development of cross-bred cows even in the remote areas and helped in increasing milk yield to surplus levels for marketing.

During the 3 years of operation under LLP in Phase I, the farmers in the adopted villages by the NDRI, Bangalore, were able to sale crossbred animals worth Rs 2.00 lakh. In spite of sale of 142 crossbred animals, the cross-bred population in the village registered an increase from 142 to 300, an increase of about 150%. It was interesting to note that the crossbred animals with landless labourers recorded highest increase in crossbred population by about 194%.

Fishery

Under fish farming, the LLP farmers were provided training on induced breeding, nursery and rearing-pond management, composite fish culture, integrated fish farming (paddy-cum fish farming), brackish water aquaculture, and polyculture of fish and prawn. CIFE, Bombay, introduced reservoir brackishwater and freshwater fish farming under the LLP in the adopted villages. Reservoir-fish farming with 5 species, viz. catla, rohu, mrigal, silver and grass carps yielded average catch of 4.10 kg/day, valued approximately at Rs 20/fisherman/day. By converting paddy plots into brackishwater ponds with the provision of sluice gates and feeder channels, the adopted farmers could harvest about 100 kg of prawn and 100 kg fish/ha fetching Rs 6,000/annum/ha.

In Arunachal Pradesh, fish fingerlings of rohu, catla and common carps were introduced in the adopted villages. Feed was also provided to the adopted families. With a total investment of input costing Rs 500/family, the farmers got 70 to 80 kg of fish, fetching Rs 1,400, thus resulting in a net gain of Rs 900/family/year. The CRRI, Cuttack, also introduced composite fish culture in the adopted village and provided fingerlings and feed to the adopted families. From an average water area of 0.54 ha, the adopted families could get a net income of Rs 8000 which worked out to be nearly Rs 16,000/ha of water. Similarly, CIFRI, Barrackpore, introduced carps culture, magur culture, and polyculture of brackishwater. The adopted farmers could harvest table size fish ranging from 2,335 to 4,992 kg/ha/year from carp culture and fish ranging 1,832 to 2,900 kg/ha in 6 months from magur culture. From polyculture of brackishwater, the families could harvest fish and prawn ranging from 2,051 to 2,109 kg/ha in 3 months.

The KVK, Nimpith, West Bengal, introduced culture of magur and raising of fry and fingerlings of Indian major carps and common carps. A minimum of 80% and a maximum of 300% increased yield over the local village average was recorded. In a pond of only 0.04 hectare, 2 fish crops were taken/year, Indian Major Carps(IMC) of 6 months duration, followed by magur of 4 months duration. The harvest of IMC 88 kg, fetching Rs 880 with expenditure of Rs.388, and magur culture produced 68 kg fetching Rs 960 with an expenditure of only Rs 480. Hence a net profit of Rs 972 was accrued from an culturable area of only 0.04 hectare in 10 months.

The LLP farmers adopted by RK Mission, Narendrapur, West Bengal, produced 100 kg of fish per year equivalent to Rs 1,000 from a minimum tank area of 1/13th to 1/8th of hectare. Under induced breeding programme, each farm-family generated income of about Rs 1,200 per year.

Paddy-cum-fish culture was also successful in West Bengal, Konkan area of Maharashtra and NEH region. The CICFRI, Barrackpore, could harvest 21,500 kg/ha/year of paddy and 225 kg/ha/year of fish from the same field. The KVK, Dapoli, in Raigarh district could produce 120 kg fish per hectare in 110 days without affecting yield of paddy. In the north-eastern region, the LLP farmers harvested paddy ranging from 2,000 to 3,000 kg/ha and fish from 250 to 550 kg/ha.

Induced breeding of fish in Midnapore district of West Bengal helped generating income of Rs 1,200 per year / family. Fish rearing in pond areas ranging from 1/12th to 1/8th of

hectare gave 100 kg of fish equivalent to Rs 1,000 per year. Families adopting fish-cum-paddy cultivation could produce 100-150 kg of fish per hectare in 110 days without affecting paddy yield.

The CMFRI, Cochin, helped LLP farmers in adopting integrated-farming system covering 136 scheduled castes of a farming society during Phase I. The society increased the capital to Rs 96,000, in addition to total quantity of 3,219 kg of prawns with an average catch of 865 kg/ha/year. Along with this, 2,888 kg of fish was also harvested with an average production rate of 496 kg/ha/year. Thus a total quantity of 1,361 kg of quality prawn and fish/ha/year was harvested as compared to previous yields of 700 to 800 kg/ha/year.

In poor families, who possessed small water area/ponds, fish farming gained momentum in the form of prawn culture under the societies of landless farmers created in Cochin. The farmers through these societies were able to raise prawn worth Rs 53,750/- ha of pond, in addition to some vegetable crops on the banks of the pond.

To mitigate problem of unavailability of quality fish seed, CICFRI, Barrackpore, West Bengal, demonstrated induced breeding techniques to the fish farmers under LLP.

Fish farmers were convinced about the modern technology of seed raising in which a survival of 60-70% was possible against 5-10% under the traditional method. This helped fish farmers in producing quality fish seed not only for their own ponds but also for other farmers, in and around the village.

Sheep Rearing

Sheep rearing proved beneficial to landless labourers and marginal farmers. Tribal farmers in Himachal Pradesh were adopted for sheep rearing and this proved successful enterprise in the area. The CSWRI, Avikanagar, and Carpet Wool and Karakul Production Unit at Bikaner provided exotic rams to adopted villages for natural service and artificial insemination for improvement of local sheep. Health-cover including vaccination and control of internal parasites was taken up by providing doses of copper sulphate and nicotine solution (nilvern) free of cost and dusting of sheep with BHC/malatox for control of ticks in corrals of sheep. With the health-cover, overall mortality was reduced from 19 to 10%. The local sheep stocks were improved for both wool and meat in the adopted also.

The NDRI, Bangalore adopted 200 families for sheep-rearing. The beneficiaries got an income of Rs 200-250/sheep after 8-10 months of rearing. Families let out sheep for grazing in open fields and did not incur any expenditure on feed. Bharat Scouts and Guides in Tamil Nadu provided 4 sheep to every adopted beneficiary under the LLP. At the end of 2 years, the stock multiplied to 10-12 sheep worth Rs 400 and manure equivalent to Rs 500. The annual income of each of the adopted family worked out to be Rs 2,000 per year.

Poultry Production

Under LLP, small units of layers and broilers were introduced as a subsidiary occupation. Feeding up to laying/culling of birds and medicines and technical guidance were provided to adopted families. The poultry enterprise indicated mixed reaction in different zones.

Poultry enterprise offered by KVK, Nimpith, West Bengal, gave on an average a

maximum amount of Rs 738 from layers in 16-18 months and Rs 298 from broilers per family. As compared to layer units, broiler units were preferred because it had better market. Rearing of broiler chicks of 8 weeks, ensured income of Rs 150-300 to each poultry keeper who was supplied with a stock of 40 chicks. The poultry programme became popular in Nimpith (West Bengal) because of which more than 100 non-adopted farmers of the area started poultry enterprise either with their own funds or on bank financing, primarily as subsidiary occupation.

The LLP farmers adopted by KVK, Chethalli (Karnataka), received net profit of Rs 400-500 per family from poultry farming. By adopting scientific broiler production techniques, farmers raised additional income of Rs 400-500 in two and half months. This programme was liked by all the adopted families, but subsequently because of non-availability of chicks it was not possible to continue or expand the enterprise.

Poultry enterprise was successful in north-eastern hills region, including Sikkim. In Arunachal Pradesh with RIR laying birds, as against input cost of Rs 350, each family got a net profit of Rs 775 in about four and half months with 20 birds (18 females and 2 males). Similarly in Sikkim, as against input cost of Rs 2,600 for 200 birds, the families earned a net profit of Rs 1,200 in 6 months. The LLP farmers adopted by the CPCRI, Kasaragod, with 10 birds each had a profit of Rs 160/household. In addition, there were a number of LLCs where poultry enterprise was found successful.

Synthetic birds developed by some of the institutions like UAS, Bangalore, were hardy as well as productive and therefore were kept under backyards. In spite of fascination and utmost care in some cases as much as 25% of the White Leghorn birds died. Thus many LLCs have started distributing Asterlop cross birds which are known for better tolerance to pestilence.

The KVK, Mitraniketan, distributed Asterlop birds to the families under the LLP. On an average, every bird produced 20 eggs a month as against the average of 10 eggs a month from desi bird. The MPKV, Rahuri, introduced Babcock birds in the adopted villages with the help of Co-operative Sugar Factory in Kolhapur district to promote poultry farming in the region. Use of local hens for eggs hatching was popularized resulting in reduced mortality percentage; and renewal of birds became possible.

The NDRI, Bangalore, initiated poultry enterprise in a village where there was no activity in 1980. The village households earned a sum of Rs 2,158(from Sep to Dec) and Rs 4,546 during 1981 (from Jan to May). However, during 1982, the enterprise was given up because of non-replacement of birds. In Medak district, poultry enterprise was introduced to 76 participants (11 birds each). By and large, the enterprise proved satisfactory but none of the beneficiaries came forward to take loan for bigger units of poultry, primarily due to high cost of feed and difficulty in transportation of eggs from far off places.

Piggery Enterprise

Under the LLP, in some LLCs, a pair of piglets of Yorkshire and Landrace cross was distributed to each of the beneficiaries in the adopted villages. By and large, piggery was found successful and remunerative for landless agricultural labourers. On an average, adopted family earned a net profit of Rs 900-1,000 in 10-11 months.

A pair of piglets could create an asset worth Rs 4,000. Pigs reared for a year gained weight of 100 to 115 kg and sold at the rate of Rs 14/kg of meat. The families which allowed pigs to litter got 12-13 piglets/litter. Thus, the adopted families not only built up their assets but also started earning regular income.

Sericulture

With the supply of trays, chandrikas along with new varieties of mulberry (M 5) and fertilizers, adopted farmers could raise 125 to 150 silk-worms/crop, as against 50-100 worms/crop resulting in increase in yield of cocoons from 32 to 52 kg/crop, thus fetching a net income of Rs 3,000/family/year. As a result of growing M 5 and use of fertilizers, leaf yield increased by 100% and this helped farmers increase cocoon yield.

The AIRD, Bangalore, provided M 5 cuttings, fertilizers, trays and chandrikas. For every DFIs reared, the farmers on an average got 45-50 kg of cocoons as against the previous yield of 35-40 kg. Each kg was sold for Rs 35. Efforts were made to activate programme of sericulture for small and marginal farmers under the LLP in Tamil Nadu, Gujarat, Rajasthan, and North Eastern Region, by providing new varieties, protective irrigation, fertilizers, and trays and chandrikas for rearing silk-worms. With the increase in mulberry leaf area and also by increasing infrastructure, the farmers were able to rear more layings; about 6 crops in a year. This provided full time employment for the family with a net profit of Rs 4,500 to Rs 7,500 per year per hectare. This enterprise proved as one of the most effective and profitable one, since the most expensive input, labour, was from the family and it generated more employment.

Duck Rearing

Under the LLP, 4-week-old ducks in units of 25-50 of Khaki-Campbell were supplied to adopted farmers. Some of the duck rearing units supplied by the AIRD, Bangalore, earned Rs 7/day from the unit of 25 with an average of 15 layers. However, some landless labourers could not maintain ducks as expected due to high feeding cost. In LLP households, adopted by NDRI, Bangalore, all the 300 ducklings distributed to 6 farm-families performed well at the end of the programme giving an average of 200 eggs/year/bird. Similarly, in Assam and Tripura with an input cost of Rs.190 only, Rs 1,400 could be earned by sale of 1,640 eggs/year from ducks belonging to 6 families.

Bee-Keeping

The adopted families were supplied 2 bee-hive boxes and 1 honey extractor at a total cost of Rs 300-400. Primarily, the landless labourers and tribals were encouraged to undertake bee-keeping enterprise in almost all zones. By and large, it was observed that families given 2 bee-hives were able to generate income of Rs 900-1,000/year. In addition, the families also started increasing working colonies. This enterprise was successful particularly at KVK, Ranchi; KVK, Indore; YRADA, Karnataka; AIRD, Bangalore; North-Eastern Hills Region and Himachal Pradesh. On an average, each unit gave 3 extractions with an average of 1.5-3.5 kg/unit/extraction. Each family earned on an average Rs 250-275/year/box.

Citizen's Charter

ANIMAL HUSBANDRY DEPARTMENT

ROLE OF ANIMAL HUSBANDRY DEPARTMENT IN THE DEVELOPMENT OF LIVESTOCK WEALTH IN TAMIL NADU

From time immemorial livestock of our Country more particularly in Tamil nadu has been playing a very crucial role and has become part and parcel of the lives of the people. The vast majority of rural folks especially the weaker sections of the society, such as small farmers, marginal farmers and agricultural labourers and the like have been deriving immense economic benefits from livestock rearing. These catagories of people by taking up Dairying, sheep, goat, poultry husbandry besides piggery etc. have had considerable economical improvement and thereby improving their quality of life.

I. LIVESTOCK DEVELOPMENT

The pride of place in Livestock Development is occupied by Cattle development for which numerous development schemes have been launched by the Governments at the Centre and State over the past 5 decades since independence. Starting from mid 50's, from the Key village schemes, through the ICDPs in the mid 60's followed by Cattle development components in almost every scheme formulated such as HADP, Western Ghats development Programme etc. are being implemented over the years. The production capabilities of indigenous cattle through improvement of germ plasm by A.I. techniques of superior exotic breeds have shown fruitful results by registering vast improvement in milk production.

Here it will not be out of place to mention that though our country which possess the largest cattle population in the globe was producing milk in much lower quantities. The implementation of the above mentioned schemes have changed the picture and now we occupy a fairly advanced position in the field of Cattle development and milk production. As per 1989-90 estimation, the production of milk was only 3.4 million tonnes and the per capita availability of milk was 169 grams. Now it has increased to 3.69 million tonnes and 181 grams respectively as per 1994-95 estimation.

The following are the cattle development schemes and programmes that are currently being implemented.

1. CATTLE BREEDING AND FODDER DEVELOPMENT :

With a view to maintain the progress that has already been achieved in the field of cattle development in our state the CBFDs are by their many sided activities such as carrying out AI with frozen semen techniques so that cattle of inferior standard could be improved through superior germ plasm of proven exotic sires.

Any meaningful cattle development programme must automatically include fodder development and these activities are given importance in CBFD's by distributing fodder slips, fodder seeds, fodder trees etc. This will improve the nutritional status of the cattle in the State, thereby increasing the level of development introduced by the above activities.

The twenty Cattle Breeding and Fodder Development units, located throughout the State, are functioning under the control of a Deputy Director of Animal Husbandry. There are 2 Assistant Directors of Animal Husbandry under his Supervision, who are incharge of all the cattle developmental activities, such as regulating the distribution of Liquid Nitrogen, Frozen Semen Straws etc. to all the Veterinary Institutions and Artificial Insemination Centres.

The frozen semen straws of exotic breeds like Jerseys, HF's and Cross breeds of these two species are distributed to all A.I. centres for carrying out A.I. activities without any letup. Consequently there has been considerable increase in the crossbred population, in different districts of Tamilnadu.

As per breeding policy of Tamilnadu and implemented by Animal Husbandry Department and Government agencies, the Jersey breed happens to be the breed of choice for Cattle development. in Plains and HF in the hilly tracts for proper improvement. However, both in plains and hilly areas, Frozen semen straws of other breeds other than the ones mentioned above, in their respective tracts are being used for catering to the preferences of the people.

STAGES IN A.I. ACTIVITIES THROUGH FROZEN SEMEN TECHNIQUE

Production of LN2, in the following places, namely Eachenkottai, Abishekapatti, Hosur, Ooty and Polyclinic, Saidapet, Chennai and Veterinary Hospital, Thirumangalam are being undertaken along with production of Frozen Semen straws of different breeds except Saidapet and Thirumangalam.

Artificial Insemination with Frozen Semen Straws are being carried out in 3572 Veterinary Institutions and Subcentres throughout Tamilnadu. It has also being carried out during Mass Contact Programmes and special camps.

2. SPECIAL SCHEMES :

1) EXTERNALLY AIDED PROJECTS WORK

A. OLD BANK ASSISTED LIVESTOCK DEVELOPMENT PROGRAMME

As one of the components of the Tamilnadu Agricultural Development Project, the Department of Animal Husbandry is implementing the Livestock Development programme assisted by the World Bank from the year 1991-92 at a total cost of Rs.46.62 Crores spread over a period of seven years covering the entire State. With world Bank assistance CBFD's are provided with input facilities, LN2 Production, Production of FS straws, distribution of fodder slips for increased milk production in an environmentally stable manner.

The objectives are :

To develop sustainable livestock production system in Tamilnadu by improving breeding facilities.

Implementation of Fodder Development Programme by provision of infrastructure required for fodder development. - Strengthening of Disease diagnosis and epidemiological work.

120 Nos. of pregnant Jersey heifers were imported from Denmark for the above purpose. Cross bred cows, breeding bulls, Murrah She-buffaloes were procured for the production of pedigree bulls and semen. Frozen Semen stations at District Livestock Farms were strengthened with additional equipments for increasing the production of Frozen semen. Construction of animal houses at Livestock farm were carried out.

Improved varieties of fodder grasses, fodder legumes and fodder tree seeds were imported from Australia for propagation in our State. Infrastructure required for the production of forage at Livestock farms viz., Eachenkottai, Hosur and Orathanad were strengthened. 2.40 lakhs of mini kit for legume production were distributed to farmers. 713 field staff engaged in the extension work were trained in fodder production.

In addition legume fodder and fodder grasses are propagated in 103212 hectares of land and 44615 km. area covering Government lands, Hedge rows, Backyard areas, Waste hallow lands, Road side areas and inbetween plantations for the benefit of livestock.

Regional Diagnostic Laboratories and Veterinary Epidemiological Units were established at Vellore, Coimbatore, Madurai and Tirunelveli. The Animal Disease Intelligence Units were strengthened by providing diagnostic kits, generators and other equipments.

Extension wing of the Department were strengthened with T.V., V.C.R. and other Audio Visual Equipment to carry out impressive and effective extension work. Pamphlets, Booklets and hand bills regarding various Animal Husbandry activities, were printed and distributed to farmers.

In addition to this 383 Mobile Veterinary Units were established to cater the needs of the public. One livestock component cell was established at Directorate and infrastructure facilities were improved. 720 personnel were trained in various Animal Husbandry disciplines.

The services of International Consultants M/s. Overseas Project Corporation of Victoria from Australia was utilised in the field of breeding, Embryo transfer technology, fodder production, fodder seed production, disease diagnosis and Veterinary epidemiology. 193 officers were trained by these Consultants.

B. AGRICULTURAL HUMAN RESOURCE DEVELOPMENT PROJECT

Through AHRDP, Technical personnel are given trainin in the latest technologies, so that their skills may be improved and better utilised for the people. For this purpose, the existing training centres at Eachenkottai, Hosur and Abishekapatti were strengthened. A "Trainee needs assessment cell" was also established at the Directorate.

C. DANIDA ASSISTED LIVESTOCK DEVELOPMENT PROJECT

Under the above scheme, the education of rural people on modern livestock & AH practices is being carried out on proper lines. The main activities under the Danida programme are Livestock Development and Fodder development. In this task, link

worker-couples are selected from the scheme area and given training in above subjects, by technical personnel of the department. These couple, in turn reach out to farmers at village level and conduct classes for educating the general public on latest development in livestock, thereby, immensely benefitting rural people to take up these activities for better profitability through extension aids.

The Danida assisted Livestock Development Project is implemented from 1.8.90 in Annavasal, Kunnandarkoil and Viralimalai Panchayat Unions of Pudukottai district at a cost of Rs.5.46 crores for a period of 6 years as the first phase. As the second phase of the Project, which was commenced on 1.2.97 will cover 46 Panchayat Unions in the following districts viz. Pudukottai, Sivaganga, Ramanathapuram, Tuticorin and Virudhunagar for a period of 7 years at a cost of Rs.27.50 crores covering 2000 sq.km. involving 20 lakhs farmers.

In addition special stress are laid on small ruminants developments such as sheep breeding, Goat breeding, besides poultry development through rural people for which the department is implementing the following special schemes.

2) STATE AND CENTRALLY SPONSORED SCHEME

A. ENRICHMENT OF PADDY STRAW WITH UREA

With a view to improve the nutritive value of the available local paddy straw and improve its protein contents, this scheme is being implemented in selected districts such as Madurai,Theni, Virudhunagar, Tuticorin, Tirunelveli and Kanyakumari. 1500 Farmers have benefited by this scheme; implemented during the year 1997-98 at the cost of Rs.7.5 lakhs.

B. INTEGRATED TRIBAL DEVELOPMENT PROGRAMME

Through this scheme, beneficiaries are supplied with milk dairy animals and sheep units along with grant. In addition, all beneficiaries are given training in dairy management. For this management training, financial assistance is being given, besides providing insurance cover for animals distributed.

Subsidy is given at 50% to all Tribals except Kalrayan Hills (Villupuram) where it is 75% subsidy.

FUNCTIONING AREAS :

Salem - Yercaud, Kolli Hills,Kalrayan Hills, Pachai Hills, Aranuthu Hills

Namakkal - Kolli Hills

Cuddalore - Valli Hills

Dharmapuri - Sitheri

T.V.Malai - Jawad Hills

Vellore - Yelagiri Hills

Trichy - Pachai Hills

Villupuram - Kalrayan Hills

C. HILL AREA DEVELOPMENT PROGRAMME :

2 Mobile Veterinary Units one at Kothagiri and another at Gudalur were established for carrying out Artificial Insemination and Veterinary Services for the upliftment of the Hill Area people.

D. WESTERN GHAT DEVELOPMENT PROGRAMME :

This programme is implemented in Coimbatore, Dindigul, Madurai, Tirunelveli, Kanyakumari and Virudhunagar districts of Tamilnadu to maintain the ecological balance of the Western Ghat Area. Under this scheme, 2 Mobile Veterinary Dispensaries were established, one at Uthamapalayam and another at Vettaikaranpudur for rendering Veterinary Services. The infrastructure facilities of Animal Disease Intelligence Unit in Dindigul and Farmers Training Centre at Abishekapatti were strengthened.

E. SPECIAL CENTRAL ASSISTANCE PROGRAMME:

This scheme is implemented exclusively for the benefit of Hindu Adi Dravidar Community since 1983. It is being implemented in all the districts of Tamilnadu except Chennai and The Nilgiris, with a subsidy of 50% on unit cost. Health cover is provided for the scheme animals by periodical vaccination and deforming.

F. SAMPLE SURVEY SCHEME

The Central and State Governments has been implementing the sample survey scheme since 1977-78 onwards, which primarily aims at making a realistic assessment of the impact of the various livestock development schemes and programmes implemented in our State by estimating the major livestock products like Milk, Meat and Egg, by collecting relevant Statistical data such as milk production, meat production and on egg production. These schemes are functioning under the control of the Directorate of Animal Husbandry.

3. LIVESTOCK FARMS

In every Animal Husbandry Developmental activity, that are undertaken by Animal Husbandry Department, the Livestock Farms in the State play a major role by acting as demonstration farms on selective and scientific breeding of livestock and Poultry, besides they also act as model farms demonstrating to the Livestock owners and disseminating latest technology in livestock breeding, feeding, management practices, disease control, fodder production etc. In addition, they also serve as seed farms by multiplying pedigreed improved livestock and supplying them, to the needy livestock owners in the State. In addition they also supply heifers, Cross bred calves and hybrid sheep and goats, pigs and poultry to the needy farmers based on their availability. They also serve as training centres imparting practical training to Veterinary Assistant Surgeons, Livestock Inspectors etc. on Artificial Insemination techniques and to students of TANUVAS and to interested farmers. Maintaining the indigenous germplasm and improving them by scientific breeding of indigenous animals is yet another objective of livestock farms. In recent times, the production of Liquid Nitrogen and Frozen semen straws, of exotic breeds and cross breeds are also undertaken significantly to sustain the momentum of cattle development in Tamilnadu.

These farms play a major role in fodder production for increasing milk production. Fodder seed production units are functioning in these farms distributing fodder slips, fodder seeds and fodder seedlings to the farmers. District Livestock Farms are located in the following places.

1. District Livestock Farm, Hosur, Dharmapuri District
2. Exotic Cattle breeding farm, Eachenkottai, Tanjore Dist.
3. District Livestock Farm, Orathanad, Tanjore District.
4. District Livestock Farm, Korukkai, Thiruvavur District
5. District Livestock Farm, Pudukottai, Pudukottai District
6. District Livestock Farm, Chettinad, Sivagangai District
7. District Livestock Farm, Abishekapatti, Tirunelveli Dist.
8. District Livestock Farm, Ooty, The Nilgiris District and besides 3 Sheep farms;

(i) Sattur (Virudhunagar District),

(ii) Chinnasalem (Villupuram District)

(iii) Mukundarayapuram (Vellore District).

In addition, Sheep and Poultry units are also functioning in the existing farms in the State. The following main utilitarian activities of Animal Husbandry nature is being carried out for the benefit of the public, at large in the various livestock farms.

(i) Exotic Cattle Breeding Farm, Eachenkottai, Tanjore District

It serves as a Nerve Centre for production of superior Jersey Cattle. It produces Liquid Nitrogen in considerable quantities, which are supplied to field Artificial Insemination Centres for storage of Frozen Semen straws. Production and distribution of pure exotic Jersey straws for supply to Artificial Insemination Centres for the use of the Public is being done here. It serves as a training Centre with trainee hostel facilities.

(ii) District Livestock Farm, Hosur, Dharmapuri District

It serves as a major demonstration Centre for educating the public on modern lines of livestock management. The farm is maintaining native breeds like Sindhi, Kangayam and Hallikar etc. In addition, this farm is maintaining HF, Jersey and Crossbred Cattle for carrying out Cattle development work, besides maintaining sheep breeds such as Mandya, Mandya Corriedale Crosses, Goat breeds like Jamnapari, Kodivalli, Tellicherry; Pig breeds like large white Yorkshire, Landrace, Landrace crosses, and Poultry breeds such as Babcock, HH260 (strain), RIR, Asil and Giriraja. These units serve as model livestock units there by serving to train both technical personnel as well as interested livestock farmers in the State.

(iii) District Livestock Farm, Orathanad, Tanjore District :

In this farm Murrah breed of Buffaloe and White Leghorn breed of Poultry besides Babcock hybrid poultry birds are being maintained.

(iv) Livestock Farm, Korukkai, Thiruvavur District :

This farm is used to preserve and propagate the natural breed of Umblacherry a draught breed of Vedaranyam tract of Thiruvavur District. In addition, Jamnapari breed of goat is also being maintained at this farm.

(v) District Livestock Farm, Pudukottai, Pudukottai district :

It is located at Pudukottai Sindhi, Jersindhi Cross bred are being maintained. In addition, Ramnad White, Dorset Mandya Cross breeds, of Sheep are also being maintained. Tellicherry breed of goats besides large White Yorkshire and Landrace pure breed of Pigs are also maintained. A Poultry unit with Forsgate strain (FGS) of White Leghorn is also functioning in this farm. Here also Pedigreed stock of superior germ plasm as and when available are distributed to interested livestock farmers.

(vi) District Livestock Farm, Chettinad, Sivaganga district:-

The following breeds of Cattle are being maintained at Chettinad.

1. Tharparkar, 2. Jersey Tharparkar Cross, 3. Jersey Sindhi Cross, 4. Sindhi, 5. Friesian Tharparkar Cross. In addition, Ramanathapuram-Kilakaraisal breed of Sheep and Jamnapari breed of goats are being maintained, besides Landrace breed of Pigs and Forsgate (F.G.) strain of Poultry are also being maintained.

(vii) District Livestock Farm, Abishekapatti, Tirunelveli District:

In the District Livestock Farm, Abishekapatti at Tirunelveli Murrah breed of Buffaloe, Gir, Jersey cross, Jersey Sindhi Crosses, HF Sindhi cross. Ramanathapuram-Kilakaraisal breed of Sheep, Landrace breed of Pigs besides Babcock strain of White leghorns are being maintained. Training is being given to farmers under Western Ghat Development Programme.

(viii) District Livestock Farm, Ooty (Nilgiris District):

The following breeds of Cattle are being maintained at District Livestock Farm, Ooty.

1. Holstian Friesian

2. HF, Cross

4. SHEEP DEVELOPMENT

Among the small ruminants which play an important role in raising the living standards of the rural poor, Sheep and Goats play a vital role. The Animal Husbandry Department with a view to preserve the rich germ plasm of indigenous sheep carryout breeding of various local breeds at the Sheep Farms located at Chinnasalem and Sathur besides the Sheep units at various Livestock Farms under the Department.

In various Poverty alleviation programmes Sheep Units are being distributed to poor farmers, with a strength of 20 Ewes + 1 Ram to selected farmers under various development schemes and programmes such as Integrated Tribal Development Programme, Special Central Assistance Programmes. Quality rams of better breeds like Mechery have been supplied to good selective sheep breeders in Erode and Coimbatore Districts during the current year 1997-98.

SHEEP FARMS

1. Sheep Farm, Sathur (Virudhunagar District) In this farm, Vembur indigenous breed of sheep, Kanni breed of goat and White Leghorn breed of Poultry are being maintained.
2. Sheep Farm, Chinna Salem(Villupuram District) In this farm, Mecheri - Indigenous breed of Sheep besides Mecheri - Dorset cross breed of sheep are being maintained. In addition Jamnapari indigenous breed of goats and Babcock strain of White Leghorn Breed of Poultry are being maintained.
3. Sheep Farm, Mukundarayapuram(Vellore District) In this farm, Chennai Red, Mecheri Chennai Red Crosses of Sheep are being maintained. Surplus stock of various breeds of Sheep available in Sheep Farms are supplied to selected Sheep farmers for improving their stock.

INTENSIVE HEALTH COVER :

A massive health cover scheme is being implemented for carrying out sheep deworming activities of the Sheep for the farmers in Tamilnadu, in order to increase the weight gain and thereby augmenting the mutton production. This scheme of Intensive Health Cover was introduced in the year 1982-83 in certain selected districts of the State and later, extended to all the districts except Chennai, Nilgiris and Kanyakumari. The deworming medicines were purchased and distributed depending on the sheep population, number of sheep breeding co-operative societies in the districts and number of sheep supplied under various schemes.

5. GOAT DEVELOPMENT

Goat is often being referred to as the "poor man's" Even a limited availability of meagre fodder facilities and grazing lands, goats thrive well on mere shrubs and scanty grasses. As such farmers find it easy to maintain and gain a lot from Goat Husbandry. The Animal Husbandry Department has taken up intensive rearing of goats in various Livestock Farms such as Dist.Livestock Farm, Chettinad, Hosur, Pudukottai and Korrukai, and also at the Sheep Farm in Chinnasalem and Sathur besides a Sheep breeding unit at Saidapet complex. These units produce improved varieties of famous indigenous breeds such as Jamnapari, Tellicherry, Kodiadu and Kanni Aadu. They provide considerable seed stock to needy poor farmers for better production of meat and milk. Goat, being a versatile animal and capable of being maintained in severe draught condition, it receives instant approval from the public as a choice animal for better productivity. Goat's manure enriches the soil. Its milk is more nutritious because of its easy digestibility. The following breeds are available for the public as and when available in the various Departmental Units.

- 1.Dist.Livestock Farm,Chettinad - Jamnapari
- 2.Dist.Livestock Farm,Pudukkottai - Tellicherry
- 3.Dist.Livestock Farm, Hosur - Kodiadu & Tellicherry
- 4.Sheep Farm, Chinnasalem - Jamnapari
- 5.Sheep Farm, Sathur - Kanniadu
- 6.Goat Breeding Unit, Saidapet - Jamnapari

Experts from Tamil Nadu visited Jaipur in Rajasthan State during 1996, to study the project, which is being implemented with Swiss Development Agency Aid so as to formulate a similar scheme in Tamilnadu for the benefit of women, downtrodden and to maintain the ecological balance.

6. PIGGERY DEVELOPMENT

Maintenance of pig and pig breeding is often considered and looked down upon by the people in our country and it is being undertaken by poorest sections of society for economic gain. Consumption of Pig meat, which was considered to be a taboo is now slowly giving way to awareness among public by virtue of its nutritive value. Accordingly pork meat is being consumed by more and more people than ever before.

The Animal Husbandry Department has taken up Piggery Development on scientific lines by establishing Piggery units at District Livestock Farms at Pudukottai and Hosur besides at Saidapet Polyclinic Campus. As and when stocks are available they are sold to the public, at Government fixed rates and also to members of Pig Breeders Co-operative Societies. Under the integrated Piggery Development Programme, two Piggery units have been opened, One at District Livestock Farm, Chettinad and another at District Livestock Farm, Thirunelveli.

7. DOG BREEDING

There is a growing awareness of the people for keeping dogs both as pets and watch dogs. Consequently more and more people prefer dogs of their own choice. The Animal Husbandry Department has a dog breeding unit at Saidapet with a view to breed indigenous breeds of dogs such as Rajapalayam, Chippiparai and Kombai. This unit, also produces exotic breeds of puppies to cater to the varying needs of the dog lovers. Accordingly, the following breeds of dogs namely Doberman, Labrador Retriever are being bred in this unit. As per the availability of puppies at this unit they will be sold to public, at Government fixed rates.

8. RABBIT DEVELOPMENT :

The rabbit rearing is very economical as they have rapid growth rate, rapid maturity, high productive potential and also can be reared with the use of non-competitive feeds like variety of leguminous trees leaves etc., The Animal Husbandry Department has set up 2 rabbit units one at Saidapet Polyclinic Campus and another at Poultry Extension Centre, S.V.Nagaram, Thiruvannamalai district. New Zealand white, grey giant, Soviet Chinchilla are some of the exotic breeds reared in these units. These units provide technical guidance to unemployed youth and women in rabbit breeding which can provide subsidiary employment opportunities.

9. POULTRY DEVELOPMENT :

Poultry Development is gaining importance as poultry meat and egg has been included in the human diet because of its high nutritive value. In addition, poultry rearing gives employment through out the year. 26 Poultry Extension Centres and 2 hatcheries are functioning in Tamilnadu under the control of Animal Husbandry Department. It acts as a model farm and also advices the interested poultry farmers about the various aspects of poultry breeding and management.

POULTRY DISEASE DIAGNOSTIC LABORATORY :

In certain poultry pockets of Tamilnadu like Salem and Erode, 2 Poultry Disease Diagnostic Laboratories are functioning - one at Andagalurgate in Salem district and the other at Erode, Erode district. It educates the poultry breeders about the modern lines of poultry rearing, diagnosing the various poultry diseases and its preventive measures. It also help in analyzing the poultry feed for toxins and impurities and gives necessary guidelines on the various aspects of feeding and other managements.

II. VETERINARY HEALTH SERVICES

As the saying goes, health is wealth, which is also true in the cases of animals as well. With the view to ensure proper Veterinary aid and animal health services to the livestock and Poultry population of our State, a network of Veterinary Institutions ranging from Veterinary Dispensaries, Veterinary Hospitals, Clinician Centres, Veterinary Poly clinics, Mobile Veterinary Units, Mobile Veterinary Dispensaries etc. besides sub centres are being maintained for extending treatment and Artificial Insemination facilities at various levels. They are also used for taking prompt, preventive measures against various contagious and infectious diseases of different origins. Animal Disease Intelligence Units have been established, to forecast the incidence of Epidemics and thereby assisting the field staff to undertake preventive vaccination of Livestock and Poultry.

Animal Disease Surveillance Unit is functioning in the Directorate combining with National Informatics Centre to monitor the outbreak of diseases in various regions of the State in order to take immediate control measures and give necessary guidance.

A. VETERINARY INSTITUTIONS :

There are at present 3 Polyclinics, 24 Clinician Centres, 121 Veterinary Hospitals, 807 Veterinary Dispensaries, 54 Mobile Veterinary Units, 383 Mobile Veterinary Dispensaries and 14 Animal Disease Intelligence Units serving the Public at large. There are 2126 Sub Centres spread all over the State providing first aid, Artificial Insemination, deworming, castration and vaccination. To have more Artificial Insemination coverage visiting Sub-centres are located, one for each existing sub-centres.

These institutions provide treatment facilities for various types and kinds of ailments of both contagious and non contagious nature affecting various species of Livestock such as cattle, Sheep, Goats Poultry etc. At the Veterinary Dispensary there is only, out patient treatment facilities for cases besides preventive vaccination against infective and contagious diseases and deworming activities in addition to Artificial Insemination activities with Frozen Semen straws for improving the quality of the local indigenous as well as available crosses. These facilities are improved upon at every higher level of Veterinary Institutions such as Veterinary Hospitals, Clinician Centres, Veterinary Polyclinics progressively with more facilities such as Inpatient facilities, X-ray units etc. providing advanced and improved treatment.

B. DISEASE CONTROL AND ERADICATION

i). INSTITUTE OF VETERINARY PREVENTIVE MEDICINE

The Institute of Veterinary Preventive Medicine, Ranipet, is a premier Institute of its kind in Tamil Nadu under the control of Animal Husbandry Department of the State. This institute is producing various kinds and types of vaccines against well known and widely prevalent contagious and infectious diseases such as HS (Haemorrhagic Septicaemia), Black Quarter, Rinderpest, Bovine Lymphangitis, Sheep Pox, Anthrax, Enterotoxaemia, RDVK, Marek's and Fowl Pox that affect and cause large scale loss of lives and loss of production in different species of livestock and poultry. This Institute is also engaged in the production of Pharmaceuticals such as external applications namely Iodine ointment, Sulphur Ointment, Icthamol ointment etc. In addition, this Institute is also playing a key role, in the control and prevention of major livestock and Poultry diseases by Offering diagnostic facilities.

ii). CENTRAL REFERRAL LABORATORY

This laboratory undertakes analysis of Clinical samples such as blood, urine, dung etc, presently received from field level Veterinary Institutions in the State and provide proper diagnostic facilities and guidelines to the field level officers in the control measures. This laboratory along with Institute of Veterinary Preventive Medicine, Ranipet helps in supplementing and augmenting the overall efforts of the Animal Husbandry Department for containing, controlling and eradicating the well known livestock diseases. A good "ELISA" Lab has been set up to diagnose important viral diseases like Rinderpest/PPR and Blue Tongue.

iii). ANIMAL DISEASE INTELLIGENCE UNITS :

This units helps in diagnosing the various diseases and their causative agents during Outbreak. It also helps in prevention and control of infectious diseases. These units are functioning in 14 district viz., Vellore, Madurai, Tirunelveli, Ooty, Cuddalore, Salem, Trichy, Coimbatore, Tanjore, Sivaganga, Kancheepuram, Erode, Dindigul and Tuticorin. It also helps in diagnosing Tuberculosis, Johnes disease and other diseases like Brucellosis, Mastitis etc., The specimens like dung, blood, urine, skin scrappings, nasal washings are collected, examined for diagnosing the various diseases of livestock and poultry. It also helps Institute of Veterinary Preventive Medicine, Ranipet in typing the Foot and Mouth Disease virus.

iv). DIAGNOSTIC LABORATORIES :

4 Regional Diagnostic Laboratories and epidemiological units are functioning at Madurai, Coimbatore, Tirunelveli and Vellore. The Regional Diagnostic Laboratory provide diagnostic facilities to field veterinarians. The epidemiological units are engaged in studying various aspects of disease epidemiology with a view to eradicate the major disease from the State. 4 Mobile laboratories are functioning with their headquarters at Madurai, Vellore, Tirunelveli and Coimbatore with a fixed jurisdiction. The mobile laboratories are provided with all diagnostic facilities. These units visit the disease affected areas and provide on the spot diagnosis and also collect materials for further investigation.

C. SPECIAL SCHEMES FUNCTIONING FOR CONTROLLING AND ERADICATING MAJOR DISEASES OF LIVESTOCK

i). RINDERPEST ERADICATION PROGRAMME:

Rinderpest as is well known, is a deadly livestock disease, especially affecting Cattle, Sheep, Goats etc. causing enormous loss of valuable livestock through large scale mortality. In

order to prevent effectively the heavy losses due to Rinderpest a special programme is functioning to control and eradicate Rinderpest from our State by carrying out massive vaccinations against the dreaded disease by 18 Rinderpest squads, 10 Rinderpest Vigilance Units & 10 Rinderpest check posts.

A special national level programme called as NPRE (National Project on Rinderpest Eradication) with the financial assistance from European Community countries by regrouping the existing 18 squads 10 vigilance units, 10 Rinderpest Checkposts is undertaken to make headway in the Rinderpest Eradication programme by aiming at 100% vaccination of Cattle, Buffalo, Sheep and Goats etc. Immunity levels attained by vaccinated animals are assessed, for their Immune Status. Towards this purpose, Institute of Veterinary Preventive Medicine, Ranipet has been strengthened since November 1993.

ii). FOOT AND MOUTH DISEASE VACCINATION PROGRAMME:

This disease, is another important disease affecting livestock particularly Cattle where the morbidity rate is high and productive capacity of the animals will be very much reduced. As such it is an economic liability, and considerable loss to the livestock farmers. Hence, the Animal Husbandry Department is implementing a Scheme to control and keep under check, this disease. The Foot and Mouth Disease Control Programme is carried out by vaccination of animals of poor farmers with 50% subsidy on the cost of vaccine.

iii). CANINE RABIES CONTROL PROGRAMME

The dreaded Canine Rabies, which is a fatal zoonotic disease of great public health importance, affecting dogs, can be transmitted through bites of infected dogs. As there is no known curative treatment for Rabies it is always considered that "Prevention is better than cure", as is the case with any disease of importance. The Government have accordingly sanctioned a scheme for the compulsory periodic prophylactic door to door vaccination of Pet Dogs and also post exposure vaccination of all pet dogs against Rabies at owners cost.

To start with, this Programme is being implemented at major cities such as Chennai, Coimbatore, Trichy, Madurai and Tirunelveli. In order to educate the public, on the effects of this devastating disease, wide publicity and propaganda is being carried out by distributing handbills, pamphlets besides carrying out Propaganda through mass media such as T.V., All India Radio etc. People are further helped by vaccination of their pet dogs at their door steps for Rs.40/- being the cost of the vaccine.

iv). DISEASE FREE ZONE, NAGERCOIL, KANYAKUMARI DISTRICT :

This Centrally Sponsored Scheme is functioning in Nagercoil and Kanyakumari district. Periodic vaccinations against Rinderpest and Foot and Mouth Disease are being implemented and carried out intensively in this area to promote and build up an export market for India's livestock and its products. Vaccinations are being carried out in this area for the establishment of Buffer Zone of 40 Km. area in and around Tirunelveli. The animals entering from the neighbouring States are also vaccinated. So far, no outbreaks have been recorded in this area.

D. CONTROL OF ZONOTIC DISEASES VETERINARY PUBLIC HEALTH

Veterinary Public health is concerned with the prevention of Zoonotic diseases (TB, Rabies, Anthrax, Brucellosis, Hydatidosis etc.) which are communicable from animals to man. The Department of Animal Husbandry is implementing a special scheme called Canine Rabies Control Programme in 5 major cities to control the most dreaded disease, Rabies. Meat borne diseases like Hydatidosis, Cysticercosis, Salmonellosis, Trichomoniasis are prevented by Animal Husbandry Department by prompt antimortem inspection of live animals and Postmortem inspection of Carcasses in the recognized 183 Slaughter Houses which are under the control of Panchayat Unions.

III. FODDER DEVELOPMENT :

Fodder Development in Tamilnadu has not kept pace with Cattle/Buffalo Development over the years with the result there is a large gap in availability and requirements of green and dry fodder in the State. With the intensification of Cattle/Buffaloe breeding activities in the State, the need for feeding for dairy animals with green fodder has been very keenly felt. The provision of ample green fodder with legumes to dairy animals will help the farmer to keep down feeding cost of dairy cows which would in turn increase profits in dairy farming.

The District Livestock Farms of the department are also actively involved and act as the fodder and seed production units. These units are engaged in multiplication of fodder grass/legume seeds obtained from various external sources and supply fodder seeds, slips and fodder tree seedlings. Under the Animal Husbandry Department, 12 fodder production units are functioning viz., District Livestock Farms, Chettinad, Korukai, Pudukottai, Orathanad, Tirunelveli, Hosur, Ooty, Kuruthukuli, Exotic Cattle Breeding Farm, Eachenkottai, Sheep Farm, Chinnasalem and Sathur, and Fodder farm, Padappai.

IV. EXTENSION ACTIVITIES :

The department is conducting exhibition at various places of the State during the local festivals fairs and other occasions to educate the public on modern Animal Husbandry activities and on public health. Department also participates in All India Trade Fair conducted at Chennai every year. The extension staff of the Department are participating in the weekly T.V. and Radio Programme. The Department has also produced 19 colour films on modern Animal Husbandry activities like breeding and management by engaging popular artists. These films are exhibited in various parts of the State during the Mass Contact Programme, Fairs and Festivals.

The Department is also maintaining propaganda and publicity unit at Saidapet, Chennai for printing publicity and extension materials required for this Department. The Printing Press is equipped with modern equipments like Lazer Printing, Desk Top Publishing under World Bank assisted Livestock Development Programme. The Animal Husbandry Department through its various schemes, projects and institutional setups, have benefitted the people in numerous ways in turn uplifting the animal wealth economy in Tamilnadu.

Integrated farming systems:

The Indian economy is predominately rural and agriculture oriented where the declining trend in the average size of farm holding poses a serious problem. In agriculture, 83 percent of the holdings are lesser than 2 ha, majority of them are dry lands and even irrigated lands depend on monsoon. The situation is further weakened due to failure of monsoons. At present, the farmers concentrate mainly on

crop production, which is subjected to a high degree of uncertainty in income and employment to the farmers. In this context, it is imperative to evolve suitable strategy for augmenting the income of a farm. Integration of various agricultural enterprises viz., cropping, animal husbandry, fishery, sericulture, horticulture, mushroom, vermiculture, bio-gas, forestry etc. have greater potentialities in the agricultural economy. These enterprises not only supplement the income of the farmer but also help in increasing the family labour employment.

The integrated farming systems approach introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources. The farm wastes are better recycled for productive purposes in the integrated system. A judicious mix of agricultural enterprises like dairy, poultry, piggery, fishery, sericulture etc. suited to the given agroclimatic condition and socio-economic status of the farmers would bring prosperity in the farming.

Research on integrated farming systems was done both at on-station and on – farm studies on integrated farming system involving poultry-cum-fish culture and mushroom production under lowland situation; dairy and biogas under irrigated situation; goat rearing and agro forestry under situation have been conducted at TNAU., Coimbatore.

IFS Model for upland with supplemental irrigation

Integrated farming system in uplands with supplemental irrigation is more beneficial over conventional cropping system even under water constraint condition both in vertisol and alfisol. To prove this concept, an experiment was contemplated under upland with supplemental irrigation at Tamil Nadu Agricultural University, Coimbatore, between 1988 and 1993, with crop as base activity integrating with dairy, biogas, silviculture and mushroom cultivation as other components. The details and results obtained in the said model is furnished below.

Under gradenland situation, dairy and biogas were integrated in 1.00 ha area. the dairy unit; comprised of 3 graded Jersey cross breed milch animals with two calves. For effective recycling of farm and animal waste, a biogas unit of 2 cubic metre capacity was installed. Making use of the biogas generated and sorghum grain available, spawn production program was linked for effective recycling and higher net income. The results of the study revealed that the entire system produced a net income of Rs.20,702/ha/yr.

IFS model for rainfed situation

Rainfed area, constitutes, more than 2/3 of total net cultivated area and the income derived constitute less than 40% of the total income anticipated in agriculture. This is because of the erratic rainfall and poor performance of the crop under rainfed condition. To overcome the uncertainty in income in rainfed area (vertisol and alfisol) an IFS model having crop as base activity silviculture, sylvipasture and goat rearing components were integrated and an experiment was carried out from 1988 to 1993 in rainfed lands of Central Farm, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore. The details of the model and results obtained are indicated below.

The goat unit comprised of Tellicherry goats, 20 ewes and 1 buck. The result of integrated farming system was compared with the control. The net income from the farming system was Rs.5,671/ha/yr and that of control Rs.1,919/ha/yr. Of the income from the integrated farming systems, 59 per cent was from goat rearing. The additional net income realized from integrated farming system was Rs.3,752/ha/yr as compared to cropping alone. The additional employment gained through integrated farming system over cropping was 314 mandays/ha/yr.

CULLING

Culling is defined as the removal of uneconomical, unproductive and surplus animals from the herd.

1. Provides opportunity to make progress in the genetic potential for productivity and profitability.
2. Culling can also represent a substantial loss to the producer. The cost associated with rising of replacement stock.
3. It works out to 20 % of the over all operating expenses.

DAIRY HERD CULLING:

Rate at which the cows are culled can be expressed as

1. Percentage of herd culled per year.
2. Percentage of herd culled per lactation.

Over 20 % of the cows may be culled per year in a well organized farm to make improvement in the genetic potential. In other words about 80 % of the females are retained to maintain herd size constant. Culling rate decides intensity of selection for improvement. Culling can be described under two categories:

A. VOLUNTARY CULLING

B. INVOLUNTARY CULLING

Voluntary includes sales and low production animals removed.

Involuntary culling is based on reproduction, Mastitis, diseases or injury; too long inter calving period, short lactation period, fracture of feet and legs, temperament, etc.

In any farm on an average 55-60 % of all culled animals may come under involuntary culling.

Involuntary Culling is great financial detriment and should to the minimum, by better management practice.

FACTORS AFFECTING REASON FOR CULLING.

1. Age; Risk of being culled after 5-6 is always high.
2. Low production: Culling for low production is highest as after 2nd lactation.

INTEGRATED FISH-CROP-LIVESTOCK PRODUCTION SYSTEMS PROBLEMS AND PROSPECTS IN PAKISTAN

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ABSTRACT

In Pakistan, the idea of integrated fish-crop-livestock production system is in embryonic form. So far, very little scientific work/study has been attempted in this aspect. Also very little investment has been made in this sector. This is mainly due to diversified ecological zones in the country, religious trend of the people, lack of education of the farmers as well as consumers and relatively less practice in modern technologies and recent advances in the production systems. Eating habits of the people have discouraged the investors which play an important role in the development of livestock/fish industry. However, by adopting this type of production system, with little extra investment, small farmers can increase significantly their income. Moreover, rural population particularly women can also be involved in livestock, poultry and fish production. Different aspects pertaining to integrated fish-crop-livestock production systems have been discussed in this review article.

INTRODUCTION

The present economic pressure for maximizing food production and minimizing production cost with a general concern for energy conservation has led to an approach of integrating fish farming with animal

husbandry and agriculture. Although integrated fish farming system has long been practised in China and other Asian countries, yet the concept has been introduced in Pakistan only recently. The integration of fish culture with livestock or cash crops, holds a considerable potential for augmenting production of animal protein, generation of employment opportunities in the rural areas and improvement of socio-economic condition of the farmer.

Integrated farming activity has opened new horizons of increasing production per unit area at low inputs through an increased interest in utilization of animal manures as a substitute of high cost of major inputs (fish feed and inorganic fertilizer, involved in aquaculture). It is a multi-commodity farming system with the waste recycling as the key feature and fish culture as the major activity.

FISHERY

Under fish farming, the LLP farmers were provided training on induced breeding, nursery and rearing-pond management, composite fish culture, integrated fish farming (paddy-cum fish farming), brackish water aquaculture, and polyculture of fish and prawn. CIFE, Bombay, introduced reservoir brackish water and freshwater fish farming under the LLP in the adopted villages. Reservoir-fish farming with 5 species, viz. catla, rohu, mrigal, silver and grass carps yielded average catch of 4.10 kg/day, valued approximately at Rs 20/fisherman/day. By converting paddy plots into brackish water ponds with the provision of sluice gates and feeder channels, the adopted farmers could harvest about 100 kg of prawn and 100 kg fish/ha fetching Rs 6,000/annum/ha.

In Arunachal Pradesh, fish fingerlings of rohu, catla and common carps were introduced in the adopted villages. Feed was also provided to the adopted families. With a total investment of input costing Rs 500/family, the farmers got 70 to 80 kg of fish, fetching Rs 1,400, thus resulting in a net gain of Rs 900/family/year. The CRRI, Cuttack, also introduced composite fish culture in the adopted village and provided fingerlings and feed to the adopted families. From an average water area of 0.54 ha, the adopted families could get a net income of Rs 8000 which worked out to be nearly Rs 16,000/ha of water. Similarly, CIFRI, Barrackpore, introduced carps culture, magur culture, and polyculture of brackish water. The adopted farmers could harvest table size fish ranging from 2,335 to 4,992 kg/ha/year from carp culture and fish ranging 1,832 to 2,900 kg/ha in 6 months from magur culture. From polyculture of brackish water, the families could harvest fish and prawn ranging from 2,051 to 2,109 kg/ha in 3 months.

The KVK, Nimpith, West Bengal, introduced culture of magur and rising of fry and fingerlings of Indian major carps and common carps. A minimum of 80% and a maximum of 300% increased yield over the local village average were recorded. In a pond of only 0.04 hectare, 2 fish crops were taken/year, Indian Major Carps(IMC) of 6 months duration, followed by magur of 4 months duration. The harvest of IMC 88 kg, fetching Rs 880 with expenditure of Rs.388, and magur culture produced 68 kg fetching Rs 960 with an expenditure of only Rs 480. Hence a net profit of Rs 972 was accrued from a cultivable area of only 0.04 hectare in 10 months.

The LLP farmers adopted by RK Mission, Narendrapur, West Bengal, produced 100 kg of fish per year equivalent to Rs 1,000 from a minimum tank area of 1/13th to 1/8th of hectare. Under induced breeding programmed each farm-family generated income of about Rs 1,200 per year.

Paddy-cum-fish culture was also successful in West Bengal, Konkan area of Maharashtra and NEH region. The CICFRI, Barrackpore, could harvest 21,500 kg/ha/year of paddy and 225 kg/ha/year of fish from the same field. The KVK, Dapoli, in Raigarh district could produce 120 kg fish per hectare in 110 days without affecting yield of paddy. In the north-eastern region, the LLP farmers harvested paddy ranging from 2,000 to 3,000 kg/ha and fish from 250 to 550 kg/ha.

Induced breeding of fish in Midnapore district of West Bengal helped generating income of Rs 1,200 per year / family. Fish rearing in pond areas ranging from 1/12th to 1/8th of hectare gave 100 kg of fish equivalent to Rs 1,000 per year. Families adopting fish-cum-paddy cultivation could produce 100-150 kg of fish per hectare in 110 days without affecting paddy yield.

The CMFRI, Cochin, helped LLP farmers in adopting integrated-farming system covering 136 scheduled castes of a farming society during Phase I. The society increased the capital to Rs 96,000, in addition to total quantity of 3,219 kg of prawns with an average catch of 865 kg/ha/year. Along with this, 2,888 kg of fish was also harvested with an average production rate of 496 kg/ha/year. Thus a total quantity of 1,361 kg of quality prawn and fish/ha/year was harvested as compared to previous yields of 700 to 800 kg/ha/year.

In poor families, who possessed small water area/ponds, fish farming gained momentum in the form of prawn culture under the societies of landless farmers created in Cochin. The farmers through these societies were able to raise prawn worth Rs 53,750/- ha of pond, in addition to some vegetable crops on the banks of the pond.

To mitigate problem of unavailability of quality fish seed, CICFRI, Barrackpore, West Bengal, demonstrated induced breeding techniques to the fish farmers under LLP.

Fish farmers were convinced about the modern technology of seed rising in which a survival of 60-70% was possible against 5-10% under the traditional method. This, helped fish farmers in producing quality fish seed not only for their own ponds but also for other farmers, in and around the village.

LIVESTOCK-CUM-FISH CULTURE

The use of animal waste to fertilize fish ponds leads to greater fish yield, as the manure provides active nutrients (NPK) for the metabolic cycle in the ponds and promotes the growth of plankton which is natural food for fish. Cattle, poultry and ducks can be raised on the embankments or in the vicinity of the ponds.

Cattle-Fish Farming

A large population of cows and buffaloes exists in the country which plays a vital role in the national economy. Fish farming can become more production-oriented if integrated with cattle farming. Cattle are allowed to graze on pond banks and grassy areas in the vicinity and manure is either collected or washed directly from the cattle sheds into the ponds. It has been proved that in the composite fish culture (rohu, mori, thaila and 3 Chinese carps) when the ponds are manured with cowdung @ 15,000 kg/ha/year, an excellent yield of 5,000 kg fish/ha/year can be obtained. Fertilization of nurseries and rearing ponds with cowdung is a widespread practice in Pakistan. However, there is a strong need to standardize the number of animals required to provide manure per unit area of fish ponds. It has been estimated that fresh cowdung manure voided by two cows is sufficient to fertilize one ha of pond area.

Poultry-Fish Farming

Poultry farming is now an established commercial enterprise in Pakistan. It can be effectively combined with fish farming keeping in view the fact that poultry droppings serve as an excellent fertilizer for fish ponds. The joint farming operation requires little space, low capital investment, quick returns and distributed turnover. Poultry droppings are the richest in highly soluble inorganic salts and have the highest N and P values as compared to other manures.

It has been experimentally indicated that droppings of 500 birds is enough to fertilize one hectare pond area. The yield of about 3.9 t/ha/yr has been obtained in composite culture system stocked @ 8,000 fish/ha. High survival rate and faster growth were recorded when a mixture of cowdung and poultry droppings was used.

Livestock-Poultry-Fish-Horticulture

Integrated system has been experimented at Pakistan Agricultural Research Council, Islamabad, Pakistan (Muller, 1987). Under this model, the main purpose of the integrated recycling is to utilize the wastes and by-products from one component of the cycle to the other as a feed, fuel or fertilizer. Poultry litter has long been considered as an excellent source of protein and minerals for feeding the ruminants. Poultry litter can substitute cottonseed cake used at 20 percent level in a complete beef ration and has also proved to be an important economical feed ingredient for lactating animals. In

general, broiler litter may substitute some 40 percent of the forage and feed cost by 40 percent of more. In addition to the economic consideration, the most important problem in the country is the poor availability of forage during the scarcity period when forage has to be either substituted by crop residues, which are of much lower nutritional value than broiler litter, or by concentrated feeds which are expensive. It has been calculated that 158 broilers, or 107 replacement birds, or 45 layers, or 33 growing turkeys, reared on litter, are required to recycle the waste per large ruminant at 30 percent litter feeding in the ration. The litter so collected can supply 60–100 percent of protein requirement and 40 percent of the bulk required by an average dairy animal.

The manure collected from the buffaloes is flushed to the biogas plant, and after it is fermented into the digester, methane gas is produced which can be used as fuel for household use. The slurry coming out from the biogas plant is collected, diluted with water, and is fed to the fish ponds. The phytoplankton and zooplankton growth is used by the fish as feed (Fig. 1). The fish can attain on the average about 500g liveweight when reared on effluents within a period of 4 months, whereas the fish attained over one kg liveweight when ponds were supplemented with rice bran or wheat bran.

Duck-Fish Farming

The system is based on the same concept of an efficient use of water area to increase its biological productivity through the use of duck droppings which either fall directly in water or are collected from duck sheds and used for fertilizing the ponds. Ducks usually consume tadpoles, mosquitoes and dragon fly larvae which are not consumed by fish. Another advantage is that ducks feed on snails which are vectors of certain fish parasites. Ducks not only fertilize ponds but also release nutrients from the pond soil by dabbling activity, thus resulting in enhanced pond productivity. In Pakistan, however, there is a need to educate the consumers to take duck meat and eggs so that the system can become economically viable.

ECONOMICS OF FISH-CROP-LIVESTOCK FARMING

Unfortunately, no experimental case studies have so far been undertaken in Pakistan from economic standpoint. However, several surveys conducted in Asian/European countries have clearly demonstrated that this system of increasing animal protein production can be profitable and contributes significantly to rural economy.

AGRICULTURE-CUM-FISH CULTURE

Culture of fish in rice fields and cultivation of vegetation, fruits and crops along the dikes is prevalent in China and South-East Asia countries.

Rice-Fish-Prawn Culture

It is being practised in many countries of Asia. Fish cultured in trench or canal dug in paddy fields in low-lying areas yielded 700 kg/ha fish alongwith 5.5 ton/ha of paddy. There also exists great potential for culture of air-breathing fish in the paddy fields as they can easily withstand low water and oxygen levels. The possibility of fish culture in paddy fields in Pakistan can be worked out to utilize low lying water areas for dual purpose.

Fish Farming-cum-Horticulture

Pond banks provide a suitable place which can be economically used for raising fruit plants like banana, papaya and vegetables. Farmers in Pakistan have realised the usefulness of horticulture as a source of regular income. They are using pond dikes for cultivation of fodder, napier grass, Sudan grass, maize and alfa-alfa which are used as food for animals as well as grass carp, thus ultimately cutting down the production cost.

Fish Farming-cum-Sericulture

Mulberry plants are grown on and around pond dikes which are irrigated with pond water. The system is commonly practised in China and newly introduced in other countries. Silk is extracted from the silkworms which are reared on mulberry leaves while the remaining pupae (having very high protein

content) are fed back to the fish and excellent growth of fish feed on pupae has been recorded. This technique is now becoming popular and can also be tried in Pakistan in pilot scale projects.

POULTRY-FISH FARMING IN PRIVATE SECTOR

Under private sector, one integrated poultry cumfish-farm has been established by M. Haq Nawaz near village Chinawan, Tehsil Wazirabad, district Gujranwala, Pakistan (Javed and Akhtar, 1989). Twenty fish ponds, each measuring one hector have been established. Water depth is maintained at 4-5.5 feet. All ponds are surrounded with eucalyptus trees. In each pond, 2500 fingerlings (2-3 cm) of Indian major carps (Kahu, 45 %, Mori 10 %, Thella 15 %) and Chinese carps (Silver carps 20 %, Grass carps 10 %) were placed. Ponds are watered with tube wells especially arranged for this purpose. Mixed fresh droppings from poultry and cowdung was placed on two sides of each pond at the rate of two trollies. It is expected that after 18 months, fish will attain on an average 2 kg. The project has been recently started and results are awaited. Waste water from the ponds is used for irrigation purpose and vegetables are grown.

PROSPECTS FOR DEVELOPMENT

In order to develop integrated production systems in Pakistan, following areas need to be stressed.

Research

Integration of aquaculture with livestock and agriculture is an efficient way of increasing production per unit area with low inputs involved in the system. Although enough amount of information is available throughout the world to standardize the number of animals to be used per hectare of fish pond area, yet more efforts should be directed towards the adaptive research to make efficient use of the existing technologies. In case of livestock-fish farming system, the frequency of manuring, optimum manure loading rates, desilting of ponds and other management measures need to be worked out to ensure healthy rearing of fish with minimum economic losses.

Training and Extension Services

To minimize the technological constraints, there is an urgent need to train a large number of technicians, extension workers and farm engineers to support and sustain the integrated fish farming programme. Infrastructure and suitable facilities for undertaking such training programmes should also be developed at the educational and training institutions. Besides, demonstration farms and training centers with an objective of 'learning by doing' can also be right steps in this regard.

Credit Facilities

Adequate banking facilities and loan-giving agencies should be made available for aquaculture development. The strategy should be developed in such a way that development investment be shared more by the small-scale marginal farmers who constitute the majority. Similarly, low interest rate and long repayable period will serve as incentives for the farmer to establish his farm and make more income.

CONCLUSIONS

The integration of fish culture with livestock and agriculture needs to be seriously viewed because this activity can go a long way in the uplift of rural life through manifold increase in return on investment. Although the information concerning production data does not exist, it appears that with proper management and technical skills, integrated farming could become a profitable and viable industry in a country like ours where the economy is largely based on agriculture.

Manure management Methods:

Composting- vermicomposting
Biogas plants.

Class 4 :Definition of breed-classification of indigenous, exotic cattle and buffaloes -Breed characteristics of Sindhi, Kangayam and Umblacherry, Jersey, Holstein Friesian, Murrah and Surti.

Breed: Definition : Denotes an established group of animals / birds having the similar general body shape, colour, structure and characters which produced offspring with same characters

I . Cattle - 1. Indigenous 2. Exotic

Indigenous Breeds are classified under three groups based on utility / purpose.

- a. Milch - Example- Sindhi, Sahiwal, Gir and Deoni
- b. Dual - Example- Hariyana, Ongole, Tharparkar, Kankrej
- c. Draught – Example- Kangayam, Umblacherry, Amritmahal, Hallikar

2. Exotic – Milch – Jersey, Holstein Friesian

Red Sindhi

Also Known By: *Malir (Baluchistan), Red Karachi, Sindhi*

The Red Sindhi originated in the Pakistani state of Sind but due to its hardiness, heat resistance and high milk yields they have spread into many parts of India and at least 33 countries in Asia, Africa, Oceania and the Americas.

Under good management conditions the Red Sindhi averages over 1700 kg of milk after suckling their calves but under optimum conditions there have been milk yields of over 3400 kg per lactation.

The average height of a Red Sindhi cow is 116 cm with a body weight of 340 kg. Bulls average 134 cm in height and a body weight of 420 kg. They are normally a deep, rich red color but this can vary from a yellowish brown to dark brown. Males are darker than females and when mature may be almost black on the extremities, such as the head, feet and tail.

Red Sindhi in Australia

Red Sindhi cattle arrived in Australia in 1954 from Pakistan, as a gift to the Australian Government. While traditionally considered a milking breed they have been successfully used in crossing systems with British breeds to produce tropical beef types. In Australia, they have been an adaptable, hardy breed, good foragers and have a high degree of resistance to heat and ticks.

JERSEY

The Jersey breed originated on the Island of Jersey, a small British island in the English Channel off the coast of France. The Jersey is one of the oldest dairy breeds, having been reported by authorities as being purebred for nearly six centuries.

The breed was known in England as early as 1771 and was regarded very favorably because of its milk and butterfat production. At that early date, the cattle of Jersey island were commonly referred to as Alderney cattle although the cattle of this island were later referred to only as Jerseys. Jersey cattle were brought to the United States in the 1850's.

Adaptable to a wide range of climatic and geographical conditions, outstanding Jersey herds are found from Denmark to Australia and New Zealand, from Canada to South America, and from South Africa to Japan. They are excellent grazers and perform well in intensive grazing programs. They are more tolerant of heat than the larger breeds. With an average weight of 900 pounds, the Jersey produces

more pounds of milk per pound of body weight than any other breed. Most Jerseys produce far in excess of 13 times their bodyweight in milk each lactation.

The modern Jersey breed is unexcelled in dairy type. Breeders in the United States commonly referred to two distinct types of Jerseys in the past, these being the Island and the American; this distinction is not commonly made at present. It should be recalled that this is a different usage of the word "type" than is usually implied and refers to the general size and quality of the animal rather than to its use for dairy purposes. The Island-type Jerseys excelled in refinement and those qualities that were deemed necessary to win in the show ring. Refinement and beauty of such cattle in mature form led to the marked superiority of cattle imported from the island of Jersey or their direct descendants in winning most of the major awards of the American show ring. The so-called American-type Jerseys were noted much more for production than for beauty. Cattle referred to by this description are usually larger, a bit coarser, and have been bred for years for those qualities that suit them for milk and butterfat production. Some have referred to them as the "Farmer's" Jersey. Usually after two or three generations in the United States in the hands of the ordinary feeder, the refinement of the Island cattle gives way to the larger and less refined American kind.

In recent years there has been less concern about these type variations; no doubt the program of type classification has tended to reduce the extremes. Additional emphasis on milk production and less stress on butterfat production had, no doubt, resulted in general acceptance of Jersey cows with more size and scale. Recent importations of Jerseys have consisted of larger cattle than many previously brought to the United States. Their offspring have not only been acceptable in type but have also been used advantageously in improving production.

Cows show very marked refinement about their heads and shoulders, carry long, straight top lines, and usually carry out long and level at the rump. For their size, they are usually deep in the body and full and deep in the barrel. There is no more appealing dairy animal than the well-balanced Jersey cow, and although usually somewhat more nervous in disposition than the other dairy cows, she is usually docile and rather easy to manage. Jersey cows usually have an extreme weight range of between 800 and 1200 pounds, but medium-sized cows are usually preferred.

Jersey bulls, while small as compared to the other dairy breeds, are extremely masculine. They are quite muscular about their crests and shoulders and are considerably less refined throughout than are the females. The same general qualities of straight lines and dairy conformation as are found in the cows are desired in bulls. They usually range in weight from 1200 to 1800 pounds, but as in the females, medium weights are usually preferred. Jersey bulls are known for having the least docile temperament of the common breeds of cattle. It is folly to trust any dairy bull and particularly Jerseys past eighteen months of age.

Modern Jerseys may be of a wide range in color. There is little preference today between the solid and broken colors although most breeders slightly prefer the cattle with an unbroken color pattern. Most prefer the dark tongue and switch, but this is more a matter of an identification point than a point of discrimination. The color in Jerseys may vary from a very light gray or mouse color to a very dark fawn or a shade that is almost black. Both the bulls and females are commonly darker about the hips and about the head and shoulders than on the body. Most breeders slightly prefer the medium shades of color to the extremes, but nearly all of them realize that type and producing ability are far more important than the shade of color or whether the color is solid or broken.

Holstein

Origin of the Breed

The Holstein cow originated in Europe. The major historical development of this breed occurred in what is now the [Netherlands](#) and more specifically in the two northern provinces of North Holland and Friesland which lay on either side of the Zuider Zee. The original stock were the black animals and white animals of the Batavians and Friesians, migrant European tribes who settled in the Rhine Delta region about 2,000 years ago.

For many years, Holsteins were bred and strictly culled to obtain animals which would make best use of grass, the area's most abundant resource. The intermingling of these animals evolved into an efficient, high-producing black-and-white dairy cow.

Imports to America

After the New World was settled, and markets began to develop for milk in America, dairy breeders turned to Holland for their seed stock.

Winthrop Chenery, a Massachusetts breeder, purchased a Holland cow from a Dutch sailing master who landed cargo at Boston in 1852. The cow had furnished the ship's crew with fresh milk during the voyage. She proved to be such a satisfactory producer, that Chenery made later importations of Holsteins in 1857, 1859 and 1861. Many other breeders soon joined the race to establish Holsteins in America.

After about 8,800 Holsteins had been imported, cattle disease broke out in Europe and importation ceased.

Americans Build Their Own Breed

In the late 1800's there was enough interest among Holstein breeders to form associations for the recording of pedigrees and maintenance of herdbooks. These associations merged in 1885 to found the Holstein-Friesian Association of America, the Holstein Association.

Characteristics of Holsteins

Holsteins are most quickly recognized by their distinctive color markings and outstanding milk production.

Physical Characteristics

Holsteins are large, stylish animals with color patterns of black and white or red and white.

A healthy Holstein calf weighs 90 pounds or more at birth. A mature Holstein cow weighs about 1500 pounds and stand 58 inches tall at the shoulder.

Holstein heifers can be bred at 15 months of age, when they weigh about 800 pounds. It is desirable to have Holstein females calve for the first time between 24 and 27 months of age. Holstein gestation is approximately nine months.

While some cows may live considerably longer, the normal productive life of a Holstein is six years.

Milk Production

Average production for all Holsteins enrolled in official U.S. production-testing programs in 1987 was 17,408 pounds of milk, 632 pounds of butterfat and 550 pounds of protein per year.

Kangayam

The Kangayam cattle conform largely to the Southern Indian Mysore type, though there is evidence of the blood of the gray-white Ongole cattle in their composition. Possibly this mixture has given the breed its larger size in comparison with other cattle of the Mysore type. This breed, in its native area, is also known by other names of Kanganad and Kongu though the name Kangayam is well-known. These cattle are bred in the southern and southeastern area of the Coimbatore district of Madras State in India. It is observed that there are two varieties of Kangayam cattle, one small and the other large. The smaller variety is found to be more numerous in the Kangayam, Dharampuram, Udmalpet, Pollachi, Paddadam and Erode subdivisions, while the larger variety is found in the areas of Karur, Aravakurchi and Dindigul subdivisions. The breed is found in its pure form in the herds of some large breeders, notably the Pattagar of Palayakottai, who is supposed to have one of the best herds of the breed in the country.

Characteristics

Both varieties of this breed are strong and active, with compact bodies and short, stout legs with strong hooves. Horns in the smaller variety spread apart nearly straight, with a slight curve backwards. In the larger variety, the horns are much longer, curve outwards and backwards and almost complete a circle at the point where they approach the tips. The head is of moderate size with only slightly prominent forehead. The head is more proportionate to the body with a straighter profile than in most of the Mysore type cattle. The ears are small, erect and pointed. The eyes are dark and prominent with black rings around them.

The neck is short and thick. The back is short, broad and level. The body is compact, with well sprung ribs. The quarters are slightly drooping. The dewlap is thin and extends only up to the sternum. The sheath is well tucked up to the body. The hump in bulls, though well-developed, is firm. The hair is fine and short and the skin is dark in pigment and fine in texture. The tail is of moderate length with a black switch reaching well below the hocks.

Kangayam color is usually gray or white. The males generally are gray with black or very dark gray coloring on the head, neck, hump and quarters. In the cows, the prevailing color is white and gray with deep markings on the knees, and just above the fetlocks on all four legs. The calves are light or dark brown with gray or white on the inside of the thighs, ears and forelegs, and occasionally with gray or white rings on the pasterns and fetlocks. At two years the heifer turns gray or dark gray and retains this color but with advancing age after maturity the color fades and becomes white. Male calves become dark gray or iron gray with black shading over the head, neck, hump, dewlap, fore and hind quarters. With maturity the black shading becomes intensified. Castrated males, however, show fading of the color.

Kangayam cattle are of moderate size, active and powerful, and are highly prized draft animals. The cows are generally poor milkers but there are encounters of fair producing abilities.

II. Buffalo – Murrah, Surti

Murrah ;

The breed tract is Rohtak, Hisar and Jind of Haryana. The breed characteristics are massive body, neck and head comparatively long, horns short and tightly curled, Udder well developed, hip broad and fore – and hind quarters drooping. The tail is long reaching the fetlock s. The colour is usually jet black, with white markings on tail, and face and extremities sometimes found. The bullocks are good draught animals though slow and powerful. The average milk production per lactation is 1,500 to 2,500 kgs. and the heritability of this trait is 0.2-0.3. The age at first calving is 45 – 50 months in villages but in good herds it is 36 – 40 months in intercalving period is 450 – 500 days.

Surti : The breeds tracts of this breed is Kaira and Baroda districts of Gujarat. The body is well shaped and medium sized. The barrel is wedge shaped. The head is long with prominent eyes. The horns are sickle shaped. moderately long and flat. The back is straight and tail is fairly long. The colour is black or brown the peculiarity of breed is two white collars one round the jaw and the other at the brisket. The milk yield ranges from 900 – 1300 Kgs. The age at first calving is 40 to 50 months with an intercalving period of 400 – 500 days. The heritability of the trait is 0.2 to 0.3. the peculiarity of breed is very high fat percentage in milk (8 to 12%). The bullocks are good for light work.

Class 5 :Breeding- importance of cross breeding. Signs of estrous cycle-Artificial insemination-merits and demerits.

CROSS BREEDING:

This is mating of animals from the two different established breeds

Eg.: Jersey (b) x Kangayam (c) : Jersey (c) x Holstein Friesian (b). The cross bred animals will exhibit the mixture of qualities of both the parents breeds. The progeny will improve in production performance and will exhibit marked disease resistance characteristics of the native breed and is well adapted to with stand local climatic condition. 62.5% of exotic blood & 37.5% local blood – ideal .

Jersey x local breed.- F₁. 50% ND(c) x J (75%) + 25% ND – F₁ 50 J 50 ND x 100 J (B) So cross breeding is also taken up to evolve new breed.

Age at maturity	Economic traits
1.Age at 1 st calving	: Age in days of the cow or buffalo on the date of 1 st calving.
2. Lactation Length	: Days in milk from the date of calving to the final drying off or or cessation of milk (305 days)
3. Lactation Yield	: Milk yield in Kgs from the date of calving to the date of drying (corrected to 305 days)
4. Dry period	: Days from the date of drying to the date of calving
5. Inter calving period:	Days from the date or one calving to the date of next calving (1 st ,2 nd)
6.Peak yield	: The highest daily yield in Kgs during lactation period
7. Average Fat%	: Average Fat %
8.Service period	:The interval between calving and subsequent service resulting in conception
9.Breeding efficiency	: Measured as the No. Services/Conception

Breeding : Production of off springs / young ones

Scientific breeding is needed to get better performance in livestock – milk – meat – wool – Egg

Inbreeding : mating of closely related animals in the same breed such as brother – sister mating

ii. **parents off spring mating-** when the mates have common ancestors -with in 4 generations this results in inbreeding

Advantage : A pure line of a particular breed can be maintained

Dis advantage : Loss of vigour, size, production fertility problems

Out breeding : Mating of unrelated animals in the same breed but with no common ancestor for a minimum of 4-6 generations.

Grading : Grading is a form of out crossing, where in bulls of a distinct breed are bred on non descript cows from generation to generation, so that in course of time a populations essentially resembling the breed from which the Bulls are used.

Non descript cow x Jersey Bull

F₁ 50% ND + 50% Jersey x Jersey Bull

F₂ 25% ND + 750% Jersey x Jersey Bull

F₃ 12.5% ND + 87.5% Jersey x Jersey Bull

After 5-6 generations the off springs will have 96.9 & 98.3% of the hereditary characters of 'Pure Breed'

So grading is a process by which a few 'Pure Breed' sires can rather quickly transform local variety of animals into a 'Group' resembling the pure breed.

Economic Traits

Particulars	Local	Exotic	Cross breed
Birth weight	20Kg	Jersey – 25-30kg. Friesian – 30-35kg.	
Age at maturity	33 Months	15 months	18-24 months
Age at 1 st calving	42 months	24 months	30 months
Lactation yield	12000 Kg.	3000-6000Kg.	2100-2400
Lactation period	180-210 Days	305 days	240 – 270 days
Dry period	90-120 days	60 days	75 days
Inter calving period	18 months	12-13 months	13-14 months

Oestrus cycle

Proestrus:(2 days) Period of building up growth of graffian Follicle which helps for the nourishment of ovum fluid contains hormone called 'oestrogen'. It causes changes in uterus, blood supply.

Oestrus: (1 day) During which the female is ready to receive male.

Metoestrus :(4 days) Implantation of the embryo takes place C.L. takes place. Prevents the growth of graffian follicle thereby arrests oestrus cycle.

Diestrum : (14 days)Further development of uterus takes place. If the animal has not conceived involution of uterus take place.

Symptoms of Heat:

1. Off feed 2. Drop in milk yield 3. restless and excited 4. Bellowing 5. Oedema / swelling of genitalia 6. frequent urination 7. Transparent mucous discharge 8. cow/buffalo which are in heat will mount on other animals and allows mounting of other animals.

OPTIMUM TIME FOR CROSSING

Egg/ova from ovary – released about 12-18 hours after the onset of symptoms of heat. Ovum will survive upto 16 hours after the release. Sperm live for 12-14 hours.

Morning signs of heat are exhibited – AI done in the evening : 12 hours delay.

Proestrus : This marks the animal – coming in heat.

GF – Ovary – growing – increased secretion of follicular fluid – Estradiol - increase No.of Cilia – increased Vascularity of uterus – increase in thickness of Epithelial wall of vagina .

The vaginal wall adjustment is well filled to prevent possible damage to the wall when coitus occurs.

Oestrus : This is the period of desire.

'Graffian Follicle' – Ripe or very turgid

This period is brought to an end by the rupture of the follicle (or) ovulation. Vulva becomes swollen.

Vulva and Vagina – congested

Met Oestrus : This is the period when the organ returns to normal non congested condition.

During this period the cavity of the GF from which ovum has been expelled becomes recognized and forms a new structure known as C.L.

1. It prevents the maturation of further graffian follicle
2. It is essential for the implantation of the fertilized egg.
3. It is intimately concerned with the development of mammary gland.

Diestrum :Longest part of estrus cycle

Implantation – uterine milk –for the nourishment of the embryo prior to implantation. Absence of pregnancy. – returns to normal and thus the cycle continues.

ARTIFICIAL INSEMINATION.

Artificial insemination is the deposition of male reproductive cells (sperm) in the female tract by mechanical means rather than “Natural Service”

ADVANTAGES :

1.Increases usefulness of superior sires to extra ordinary degree.

2.Services of Superior Sires are greatly extended.

If the sires are used for Natural Service the animal can serve only 50-60 animals/year but under Artificial Insemination the amount of semen secreted by the animal can be used to satisfy the requirements of 1000 animals per year

DILUTION OF SEMEN

Average of Sperm/mL : 1000 million

Total volume of semen/2 ejaculate : 6 mL

: (i.e.) 6000 million sperms.

No. of motile Sperms : 90 %

∴ Total number of motile sperms : 5400 million.

Expected wastage during processing : 10 %

(i.e.) filling and sealing

Net no.of sperms available : $5400 - 540 = 4860$

Minimum No. of sperms required / dose : 30 Million.

∴ @ this rate no. of doses that could be prepared : $4860 / 30 = 160$ doses

So, total no. of doses that can be prepared / week : $160 \times 52 \text{ weeks} = 8320$ doses.

Frozen semen required / dose : 1 mL.

3.No need to maintain Breeding Bull.The frozen semen can be stored in the Liquid Nitrogen- -196°C .

4.Semen can be quickly and easily transported by air to different continents.

5.Spreading of diseases is absolutely- NIL.

6.Overcomes the difficulty of size and weight between Dam and Sire.

7.Increase the rate of Conception because in the artificial insemination the semen is being deposited in the mid cervix .

8.Outstanding animals located apart can be mated.

9.Helps in better record keeping.

10.Old and heavy sizes bulls ,injured / disabled sires can be used.

MERITS:

1.Semen can be stored in the frozen state , so progeny can be obtained even after the transfer, WHY even after death of bull-15-20 years.(atomic, radioactive, X-ray unit)

2.Semen is expanded and no. of animal can be crossed.

3.Frozen semen can be transported to destination once in a month from the semen bank.

DISADVANTAGES.

1.Some bulls semen may not freeze well.

2.If inferior bull semen is frozen and used –Extensive damage is caused.

3.Maintenance of frozen semen bank is not economical for a small area of operation.

4.Requires well trained technical personnel's and special equipments and hygienic measures are to adapted in preparation.

5.Improper cleaning of instruments and unsanitary condition may lead to lower fertility and may be nucleus for the spreading of diseases.

Class 6:Housing management-farm site selection-space requirement for calves, heifer, milch animal and work bullocks-Type design of house.

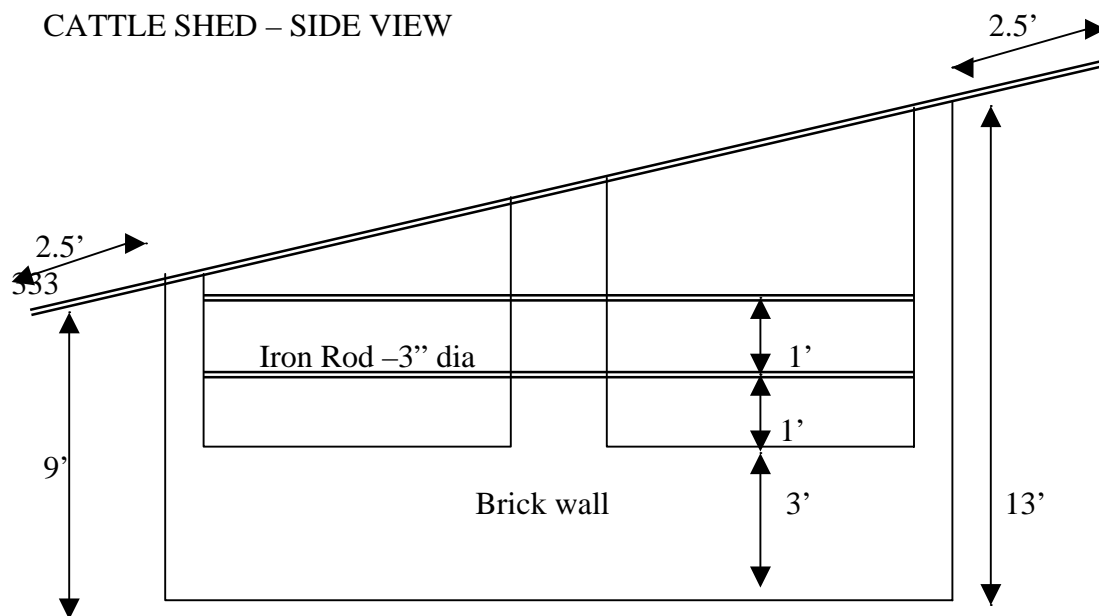
Housing of cattle

Housing is a essential for maintaining health, comfort and protection for getting maximum production from the livestock.

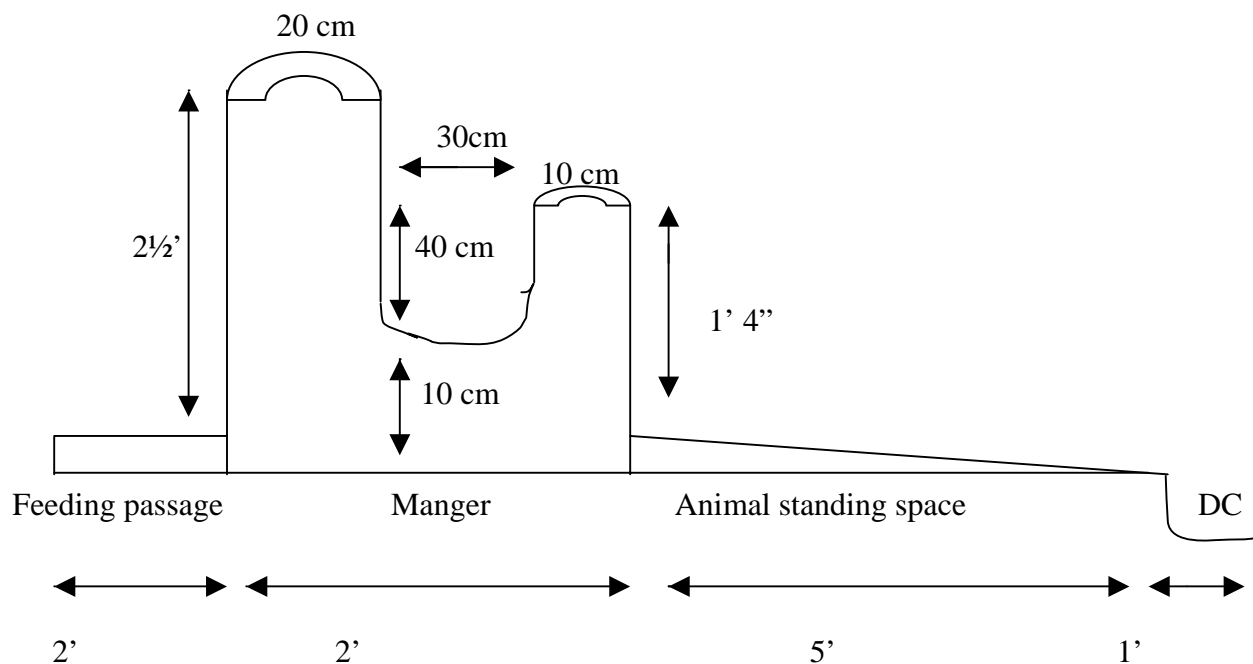
Selection of site :

1. Topography and Drainage
2. Soil Type
3. Water Supply
4. Accessibility
5. Labour
6. Marketing
7. Electricity
8. Ventilation
9. Theromo neutral zone
10. Miscellaneous

CATTLE SHED – SIDE VIEW



CROSS SECTION



Floor space requirement per animal

	Covered area (m ²)	Open area (m ²)
Cow	3.5	7
Buffalo	4	8
Young stock Upto 3M	1	1.5
Young stock upto 3-6M	1	2.5
Young stock >6	2	4
Pregnant Cow	4	8
Bull	12	120

Roofing material

- Thatched – 1. Palmyra 2. Coconut
- Tails – 1. Country tails 2. Mangalore tails 3 Flat tiles.
- Asbestos
- Iron sheets
- Light roofing
- RCC

Class 7: Systems of housing-Single row system-Double row system- head to head and tail to tail-merits and demerits.

Types of Housing – 1. Single row – Less than 15 animals
2. Double row – More than 15 animals
a. Tail to tail system b. Head to head system

Advantages of tail to tail system

1. All animals get fresh air.
2. Spreading diseases through respiratory system is minimum
3. Supervision of animals are easy (60% of the time is being devoted on the hind quarters)
4. Cleaning is easy

Disadvantages of tail to tail system

1. Spreading of diseases through digestive and reproductive system is high
2. Drainage channel is not exposed to sunlight.
3. Feeding of animals is laborious

Head to head system

1. Advantages and disadvantages – vice versa of tail to tail system

Class 8: Care and management of new born calf and heifers.

Care of the New-Born calf

Remove the mucus from the nose and mouth and clean it. If the calf does not start breathing, artificial respiration should be used by pressing and relaxing alternatively, the chest walls with hands. Another method is to hold the calf by the rear legs and lift from the floor with the head down. This may be repeated several times and helps in restoring respiration.

As soon as the calf starts breathing, observe as to whether the navel cord is still attached. The navel cord should be disinfected. The navel cord of the calf is tied about 2.5 cm away from the body and cut about one centimetre below the ligature. Apply tincture of iodine to the cut end and repeat it 2-3 days. This will prevent infection. Then, if the cow does not lick the calf dry, or if the weather is cold, the herdsman should wipe the calf to clean and dry.

The next important step to follow is to feed the Colostrum **within 15 minutes** of calving, the calf should be fed with colostrum at the rate- $1/10^{\text{th}}$ of body weight and buffalo calves at the rate - $1/15^{\text{th}}$ of body weight. Colostrum containing low fat, high protein, vitamins and minerals forms a balanced feed for new-born calves. This helps to protect the calf against various diseases as it contains antibodies. Colostrum also helps to eliminate the material accumulated in the digestive tract before it was born.

If muconium (first faecal matter) is not voided out, mild enema by dissolving soap in a liter of warm water should be given.

Weaning: If weaning at birth is followed care should be taken to see that adequate colostrum is fed for the first 3-4 days. If weaning is practised 4 days after calving, then further ration has to be fed as per the schedule described.

Calf rearing system varies with the facilities available to farmers. They may be reared indoors or outdoors or partly indoors and partly outdoors. The important factors to be considered are:

1. Availability of quality fodder.
2. The humid tropical environment is ideal for the proliferation of internal parasites and it is very difficult to keep the calves free from massive infection if they are grazing.
3. Outside grazing may not provide sufficient nutrients for optimum growth.
4. Climatic stress affects growth and utilization of feed nutrients.

In humid tropics, it may be desirable to keep the calves indoor in day time and outdoor at night. This will reduce parasitic infection also. Thus, it is advantageous to keep new born calf in individual pen for the first 3-4 weeks of age. Calves that are running in batches often suckle or lick each other after feeding and it is a good practice to keep them in their ties for some time after milk feeding. Hair swallowed by the calves after suckling each other often form a hard ball in the abomasum and this is a constant cause of digestive disturbances. Cleaning the mouth of the calves after each milk feeding is a sanitary practice. The calf pens should provide comfort and easy cleaning.

Identification : This is essential for good management, especially in breeding farms. The best method of permanent identification is by tattooing the inside of the ear with indelible ink. Metal ear tags or button with letters and numbers may be inserted in the ear as a means of identification. Neck strap or neck-chain with a number plate attached, make an easy method of identification.

Body weight: of the calf is recorded on a balance along with length, breadth and height for the computation of milk allowance. Well fed cross bred calves on an average should gain 400 grams a day or 2.5 to 3 kilograms per week.

Removal of supernumerary teats is also important and this has to be carried out before development begins. This is usually done in the first month of age with the help of a short pair of sterile scissors. If the extra teat is at the base of the normal teat, veterinary help may be resorted to remove it.

Dehorning or disbudding: Disbudding is carried out either by the use of hot iron, caustic sticks and electrical dehorning cone. Both the buds are destroyed at the early age (within 3 to 10 days).

Feeding Management: Utensils in which whole milk or milk replacer is fed to calves, must be clean and should be cleaned after each feeding. Severe digestive upsets can result from such contamination of the feeding parts. Either the nipple pail or the open type bucket are satisfactory for feeding milk or milk replacer. It may take less effort to teach a calf to nurse from a nipple pail than to drink from an open pail. Also, a rapid consumption of milk from an open pail may at times cause digestive upsets.

To teach a calf to drink from an open pail, place your fingers in its mouth and after it starts to nurse lower its head into a pail of warm milk or milk replacer. It may be necessary to repeat the process several times. A stubborn calf may need to be backed into a corner and restricted by standing aside its neck. Maintaining the temperature of the milk as removed from the cow is not necessary. However, it should be aimed to feed the milk at this temperature itself. However, cold milk at 35^o to 40^o F may cause calves to shiver and chill. At any rate, calves should not be overfed.

CARE AND MANAGEMENT OF HEIFERS.

1. Heifers are reared indoors, outdoors- 9-12 months.
2. Outdoors-protection from the adverse climatic condition ,rain,hot sun, snow, heavy winds biting flies , parasitic infestation.
3. Exotic breeds-Heifers performance is slow in tropical areas in the out doors.
4. Small breeds –Age at first breeding -15 months. Large breeds-18 months.
5. Adequate live weight would be 200-225 kg for smaller breeds and 275 kgs for the larger breeds.
6. Cross bred heifers show signs of heat as early as 10 months of age but none of them are mated until attain the body weight of 225/275 body weight or a minimum of 14 months age.
7. Age at first calving 25-28 months.
8. Feeding of Heifers.
 - A. Concentrate feed :
 - a. 3 months- 1 year : 1 kg.
 - b. Above one year : 2 kg.
 - c. Pregnant Heifers : 3-3.5 kg.
 - B. Green Fodder
 - a. Leguminous fodder : 10 kg.
 - b. Non Leguminous fodder : 25 kg.
 - C. Dry fodder : 3 kg.
9. Vaccination Schedule.

Brucell Strain 19 –to prevent abortion due to Brucellosis-Vaccinated at the age of 4-6 months of Calf.

Other Contagious Disease Vaccination are done accordingly prior to the prevalence of disease and prior to rainy season

Foot and Mouth disease : Once in 4 months/9 months/12 months.

Rinderpest : 1-3 years.

Haemorrhagic Septicaemia: 1 year.

Anthrax : 1 year.

Black Quarters : 1 year.

Housing : Already discussed in the housing Class.

a. Outdoor system / Grazing method b. Indoor method

a. Reared chiefly of grazing

1. Care to be taken not to overstock on limited grazing land.
2. Rotational grazing.
3. Arrangement of shade and drinking water – pasture land
4. Concentrate feed is to be provided – Centrally located feed trough.
5. Protect from rain.

b. Indoors

1. Management in covered area.
2. Sufficient concentrate feed and fodder provided.
3. Steaming up of heifers.

Feeding grains to pregnant heifers prior calving at 1.5 Kg. per day. It helps in their growth, bear the stress of foetus. It produces more milk after calving and increases lactation length.

Training of heifers.

Heifers in early stage should be lead with halter to make them docile.

Pregnant Heifers are to be housed along with milking cows atleast a month prior to calving.

The udder should be washed warm water and mopped with cloth to accustom her to feel the hands in this place. Just few days prior to calving pulling teats slightly may be practiced so that heifer would not excited.

Control of Parasites – Dewormed periodically – 4 – 6 months intervals

Grooming is to be practiced to avoid ecto- parasites.

Class 9: Care and management of pregnant, lactating animals and work bullocks.

Care, management of Pregnant animals

1. Identify pregnant-after A.I.-90 days
2. Provide gentle treatment
3. First quarter of gestation period are critical
4. In early stages of pregnancy disturbances can cause abortion.
5. Provide concentrate feed 3.5 kg per day.
6. Provide 25 – 35 Kg. Green fodder per day and 5 Kg. Paddy straw.
7. Minimum 45 – 60 days of dry period is essential.
8. Avoid long distance travel.
9. Avoid slippery condition in the shed.
10. Avoid chasing by dogs, bulls or children.
11. Avoid infighting between pregnant animals.
12. Separate pregnant animals from recently aborted animals or carriers of diseases like brucellosis.
13. Provide adequate clean drinking water
14. Protect against extremes of climate.

Care and Management: Lactating animals.

1. Protection against inclement weather.
2. Housing – Discussed earlier – space requirement.
3. Hygiene and sanitation of cattle shed and animals grooming, washing, disinfection etc.
4. Feeding a) concentrate – DM, DCP TDN b) Roughages – GF – L, NL – DF
Thumb Rule : 450 – 500 g Concentrate / Kg. milk production
DCP 15% : TDN 75% : M.33% GNC : 25% Wheat Bran : 40% Mineral Mixture : 1% Salt : 1%
Green Fodder – 1/3 L : 2/3 NL
5. Peak yield – 6 week – ‘ca’ definition 1-1-1.3/1.18 g ca : 1.1/1.0 g ‘p’
Supplemented : Lime coat manger : ca i/v injection
6. Breeding – 60 days after calving does not come to heat – check with veterinary Doctor.
7. Artificial Insemination – Pregnancy verification – 90 days
conception delayed – 2 A.I : check – 13-14 month calf.
8. Pregnant – 45 – 60 days period.
9. Drying – withdraw concentrate : feed dry fodder : milking alternate M/E – 4 days.
10. Periodical vaccination
RP, Bq, Hs, Anthrax Once in a year.
Foot and mouth – once – 4 months.
11. Isolation of pregnant animal
Gilmore (1952) reproductive efficiency
$$RE = 12 \times \text{No. of calves born} / (\text{age of cow (month)} - \text{Age at 1}^{\text{st}} \text{ breeding}) + 3 \times 100$$

$$= 12 \times 4 / (60-15) + 3 \times 100 = 12 \times 4 / 45 + 3 \times 100 = 100\%$$

Care and management of Work Bullocks

1. 60% - 70% of time – allotted to care and management of limbs and neck.
2. Total energy required for Agrl. Sector is 44 million hp energy for both stationary and tillage. 11.8 million hp – Human source : 28.0 million hp Livestock : 4.2 mhp – electricity
80 million work animals : 70 million work bullocks : 8 million . Buffalo
3. Avoid over working the bullocks. The work should be evenly distributed in such a way that light and heavy work are distributed evenly.
4. Protect the bullocks from rain and inclement weather exposure
5. Lean type roof on the side of farmers house.

6. Shoe the bullock properly before using them for work on hard ground.
7. The hoof should be prepared first and shoe should made to fit the natural shape of hoof.
8. Shoeing – road work – once in a month
Field work – once in two months.
9. Hooves should be hard, black and waxy
the two halves should be even. The cleft of hoof should be narrow.
10. Grooming is essential as it increases cutaneous respiration, spreads subcutaneous uniformly and parasitic infection is avoided.
11. Feeding depends of type work
 1. Normal – 2-4 hours
 2. Heavy - 8 hours (Ploughing, pulling loaded cart etc.)

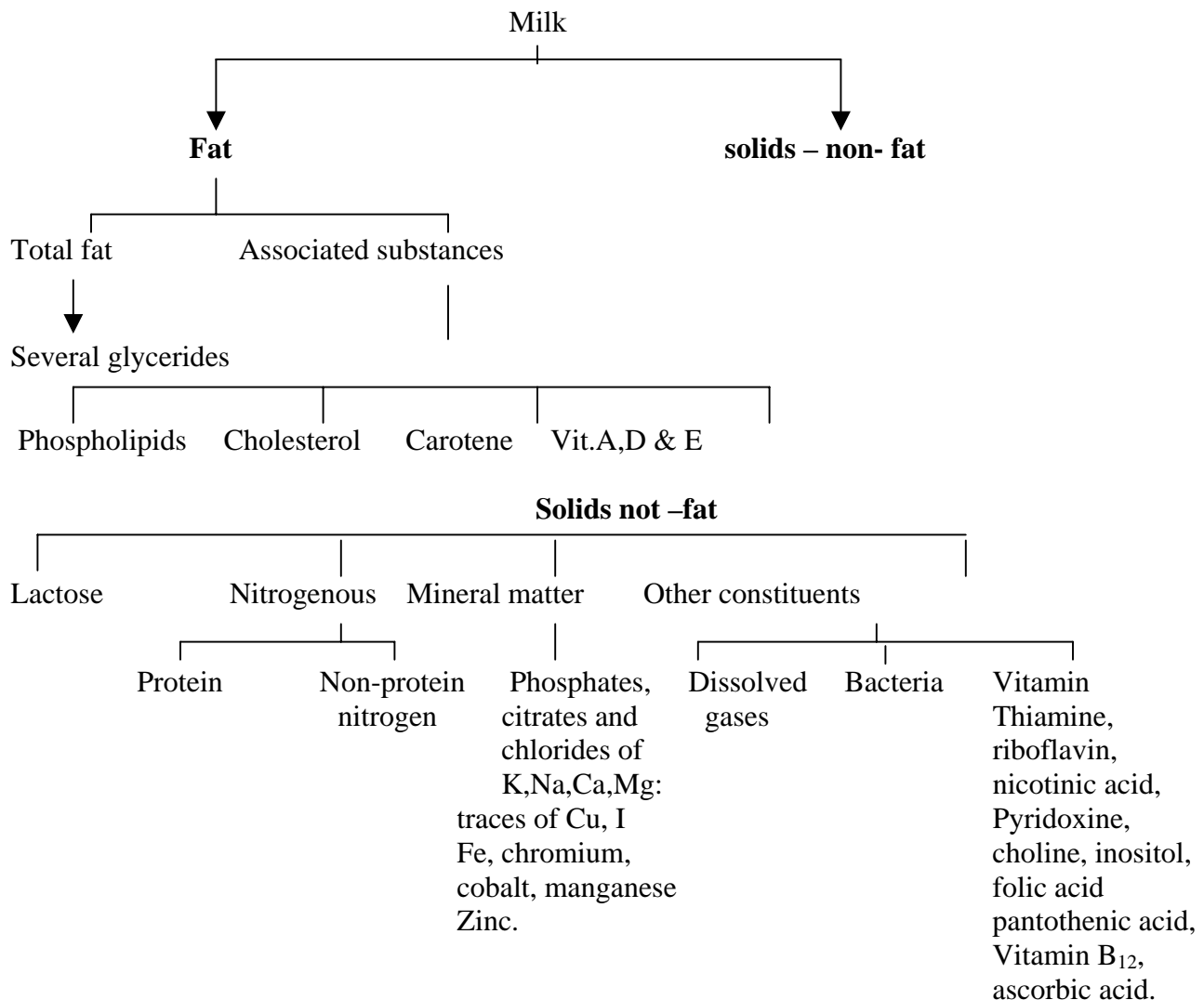
Maintenance – 1.5Kg. concentrate

Body weight	Normal work	Heavy work
300 Kg.	2 Kg.	2.5Kg.
400 Kg.	2.5 Kg.	3 Kg.
500	3	3.5

In addition 25 Kg of green and 3 to 5 Kg of dry fodder should be give.

Class 10: Milk-Definition – clean milk production-methods of milking – hand and machine milking. Preservatives and common adulterants of milk.

Milk is the lacteal secretion of the mammary glands of animals. It is obtained generally from the cow or the buffalo during the period following at least 72 hours after calving or until the milk is colostrum free. Milk is a white opaque fluid in which fat is present as an emulsion, protein and some mineral matters in colloidal suspension, and lactose together with some minerals and soluble proteins in true solution.



Average composition of milk of different mammals (in per cent)

Species	Water	Fat	Protein solids	Total	SNF	Lactose	Ash
Human	87.43	3.75	1.63	12.57	8.82	6.98	0.21
Cow	86.61	4.14	3.58	13.19	9.25	4.96	0.71
Buffalo	82.76	7.38	3.60	17.24	9.86	5.48	0.78
Goat	87.00	4.25	3.52	13.00	7.75	4.27	0.86
Sheep	80.71	7.90	5.23	19.29	11.39	4.81	0.90
Camel	87.61	5.38	2.98	12.39	7.01	3.26	0.70
Mare	89.04	1.59	2.69	10.96	9.37	6.14	0.51
Ass	89.03	2.53	2.01	10.97	8.44	6.07	0.41

Average composition of milk of some important milch breeds of cows (per cent)

Breed	Total solids	Fat	Protein	SNF	Lactose	Ash
Red Sindhi	13.66	4.90	3.42	8.76	4.81	0.70
Jersey	14.91	5.37	3.73	9.54	4.93	0.70
Friesian	12.26	3.40	3.13	8.86	4.86	0.67
Crossbred	13.13	4.50	3.37	8.63	4.92	0.67

Clean Milk production :

Both pre-and post-secretory management of milk at the farm level should be focussed upon for controlling the quality of milk. The post-secretory changes in milk are of paramount importance. Some of the vital factors responsible for good milk production that deserve immediate attention are type of farming, type of milk, impact on environment, farm waste disposal facilities, milking practices, procurement systems and inconsistent price policy and farmers' education/training programmes.

Milk once secreted becomes the target for transformation by a variety of host organisms at the farm itself. Hence, proper care must be taken regarding preservation of milk, protection of milk constituents, protection against high temperatures and natural calamity. Strict protocols are to be observed and implemented both in hand and machine milking. The microbiological quality deserves special attention for stringent export requirements for milk products in global market. The custodian of milk should never compromise on quality.

Rural milk collection

In India, milk production is a subsidiary activity to agriculture in contrast with organized dairy in western countries. Farmers and landless labourers mostly maintain 1-5 milch animals. As a result, small quantities of milk are produced in a scattered manner. Milk procurement models from western countries, such as bulk cooling, bulk transportation etc. are not applicable due to this reason, under

Indian conditions. Collection of small amounts of milk scattered over long distances, therefore, poses a formidable challenge in maintaining the quality attributes and keeping costs down.

A systematic approach to rural milk collection suitable for tropical climatic and techno-economic conditions prevailing under in India has been developed based on the indigenous experience gained over past few decades. In the first phase, extensive surveys are undertaken in the milk shed areas, where milk plant is to be established. The second phase involves “route planning” taking into account availability of quantities of milk, access to roads for plying vehicles and distance from the site of dairy plant. Then zones are identified, representing equal costs of collection and transportation. In the third phase, planning is done for locating the primary collection centres as well as chilling centres, where, **milk can be cooled to 4°C** before transporting to the milk plant. Milk may be collected from individual procedures either by the contractor or by forming village level cooperative societies.

At the village level, milk brought by the individual farmers is first tested for quality. As soon as the milk supply reaches collection centres, it is weighed and a representative sample is drawn for quality grading. The common tests carried out at the point of milk collection are taste and smell, sediment, fat and SNF contents and acidity test. These quick tests generally form the basis for acceptance or rejection of milk supplied. In India it is common to pay the producer on the basis of the quantity of fat, while the minimum standard for SNF is set for accepting milk. All the milk so collected is generally filled in cans to enable transportation to the chilling centre or directly to the milk plant. Care should be exercised to bring the milk for chilling/processing within 3 hours of milking otherwise serious deterioration of milk takes place, which affects the quality of products.

Transportation :

In the Indian context, most of the milk is transported from rural collection centres to the dairy plant depending upon the volumes of milk handled.

- Cans for handling up to 2,000 litre of milk per day.
- Tankers for handling between 2,000 and 5,000 litre per day.
- Rail tankers for handling 10,000 litre or more for long distance transportation as in the National milk grid.

Grading of milk at collection centres

Following criterion, based on organoleptic tests may be used for grading of milk at the rural milk collection centre.

Flavour	: 45
Sediment	: 10
Cleanliness of container and closure	: 5
Temperature	: 5°C

Milk reception at chilling centre

In a distant milk plant, rurally collected milk is first brought to a common chilling centre. In view of the high ambient temperatures prevailing in the tropical climatic conditions in India, it is imperative to chill milk to 4°C and transport it at the same temperature to the milk processing plant. The chilling centre may be operated by dairy plant directly or by the contractor, in accordance with the prevailing situations. The collection of milk from the chilling centre usually takes place once a day. At the chilling centre, milk is promptly chilled to 4°C and stored in large tanks of 2,000-10,000 litre capacity. Chilling centre operation is economical only when about 30,000 litre of milk is handled per day. It is then transported, through tankers, to dairy processing unit.

Following equipment are used for chilling of milk:

Surface cooler : (Direct expansion type, ice bank and brine)-for handling up to 5,000 litre of milk.

Plate cooler : This is suitable for handling more than 30,000 litre of milk.

Grading of milk at chilling centre.

Smell	: 45
30 MBR test	: 35
Sediment	: 10
Container/Closure	: 5
Temperature	: 5°C

Titration, clot on boiling test, alcohol test, and alcohol alizarine test may be done on suspected samples of milk for confirmation.

Milk reception at dairy plant

The milk at the dairy plant is received either in cans or road/rail tankers. There are separate reception docks where milk is received through tankers and cans. Milk reception dock is designed for unloading the cans directly on the platform. Milk cooled in cans is brought to the dairy in trucks/lorry from where the cans are unloaded onto a conveyor

The milk from each can is automatically or manually emptied into a weighing bowl, that indicates the quantity, which is recorded by the operator. The empty cans are further conveyed to can washer where they are automatically washed with detergent and hot water and steam sterilized to be made ready for next collection trip. The milk from chilling centre is usually transported in tankers to the dairy. Milk received by tanker can be measured by weight or by volume. Generally the milk from the tanker is measured by volume. A flexible line is connected between the tanker milk delivery pump and **flow meter** installed at the reception dock. The milk is pumped through the flow meter into large vertical storage tank (25,000-1,50,000 litre capacity) called '**Silo**'. The flow meter continuously indicates the volume of milk received. Alternatively, the tanker can be weighed before and after unloading to know the amount of milk received at the dairy. This is also possible by using special tanks fitted with load cells that supply electric signal, which is proportional to the weight of the tank. The weight of the contents in the tank can be recorded after all the milk is delivered. The milk is then pumped into the silo.

Preservation of raw milk.

In order to produce milk products conforming to international quality standards, it is important that the milk is collected, transported and cooled immediately under strict hygienic conditions. Ideally, all the milk reaching to the dairies should be bulk cooled.

Under tropical conditions, it would be beneficial to have access to methods, other than refrigeration, for retarding the bacterial growth in raw milk during collection and transportation to the dairy plants. However, whatever method is adopted it should not have harmful or toxicological effects. Further, the main objective of the method should be to maintain food safety and not otherwise. One of the methods, which has some merit and is worth considering, is LP system (Lactoperoxidase/thiocynate/hydrogen peroxide system). The LP system is an indigenous anti bacterial system in milk and human saliva. The enzymes lactoperoxidase is present in cow and buffalo milk in relatively high concentrations. The anti bacterial effect of the LP system is mediated by short-lived

oxidation products of thiocyanate. To activate the LP system in milk, adequate concentrations of thiocyanate and hydrogen peroxide are added. The optimum way of applying LP activation has to be decided on a case to case basis, but it is quite feasible that the required concentration of hydrogen peroxide, the thiocyanate are converted in the form of tablet which is sufficient for one can of milk. It is very important that preservation of raw milk by LP system is controlled at the society level and the individual farmers do not have direct access to such chemicals.

Adulteration : Adulterants in milk

Definition : Addition or removal of legally prohibited substances from the milk with the view to increase quantity and reduce the quality to make extra profit.

Common adulterants :

1. Addition of water
2. Removal of fat.
3. Addition of starch
4. Addition of milk powder
5. Addition of carbonate and bicarbonate.

The practice of adulteration of milk is a reality. It is paradoxical that human instinct for greed so far as to touch the precious food meant to protect the health of vulnerable groups of infants, children and the elderly. Some of the known adulterants are water, salt, sugar, wheat, starch, washing soda, formalin, urea, hydrogen peroxide etc. Some are used for increasing volume and SNF content of milk while others as preservatives to extend shelf life.

Detection of adulterants

Detection of water : water is a most common adulterant and its presence can be detected by testing the freezing point of milk. The official method of AOAC assumes a freezing point for normal milk of -0.550°C

$$\text{Percentage added water} = \frac{0.55 - x_t}{0.55} \times 100 \text{ where } x \text{ is freezing point depression.}$$

A tolerance of 3% is allowed which is equivalent to specifying a minimum freezing point depression for authentic milk of 0.5335°C . The presence of water can also be checked by the use of lactometer.

Detection of neutralizer in milk

Difference in coagulation behaviors of milk in the presence of alcohol. Add 5 ml of distilled alcohol (95%) to 5 ml of milk sample, mix the contents thoroughly by shaking and observe the coagulation behaviour of the sample. Appearance of fine and uniform sized flakes indicates the presence of added neutralizers in milk whereas appearance of bigger and unevenly sized flakes indicates their absence.

Rosalic acid test:

Add 4 drops of freshly prepared alcoholic solution of 1% Rosalic acid to the above mixture and mix gently. Appearance of pink colour at the junction of mixture and Rosalic acid indicates the presence of either sodium hydroxide potassium hydroxide or calcium hydroxide added to milk, and that of rose red colour indicates the presence of sodium carbonate or sodium bicarbonate. The appearance of brownish colour indicates the absence of any of these neutralizers.

This test can detect the addition of sodium hydroxide, potassium hydroxide and calcium hydroxide in milk up to 15-20 mg/100ml and sodium carbonate, sodium bicarbonate and potassium carbonate up to 25-30 mg/100ml. The higher amounts of the neutralizer can be detected from the appearance of pink rose red colour even after thorough mixing. The presence of neutralizers can also be detected by testing ash content.

Detection of starch:

Place in a test tube about 3ml of well-mixed sample. Boil it by holding the tube over a flame. Allow cooling to room temperature. Add a drop of 1% iodine solution. Presence of starch is indicated by the appearance of a blue colour that disappears when the sample is boiled and reappears on cooling,

Detection of gelatin:

Gelatin produces a yellow precipitate with picric acid solution. While cloudiness shows smaller amount and yellow precipitate a large amount of gelatin in milk.

Detection of cane sugar:

To about 15ml of milk in a test – tube add 1 milliliter of concentrated hydrochloric acid and 0.1g of resorcinol and mix. Place the tube in boiling water-bath for 5 minutes. In the presence of cane sugar red colour is produced.

Detection of saccharin:

Curdle an aliquot of the diluted sample (about 25ml) with dilute acetic acid. Shake well and filter. Acidify the clear filtrate with 2ml of concentrated hydrochloric acid and extract with 25ml portion of ether. Draw off adequate layers and wash the combined ether extract with 3 successive portions of 5ml of water. Evaporate the ether extract on water bath and add a drop or two of water, mix well with glass rod and taste little. Characteristic sweet taste indicates the presence of the saccharin.

Detection of glucose or monosaccharides (Barfoed's test) :

The reagent is prepared by dissolving 6.5 of crystallized copper acetate in 100 ml of 1% acetic acid solution. For the test heat 5ml of Barfoed's reagent in boiling water for 3 ½ minutes. Production of red precipitate of cuprous oxide indicates the presence of monosaccharides.

Detection of sodium chloride :

Take 2 ml of milk and add 0.1ml of 5% potassium chlorinate and 2ml of 0.1 N silver nitrate. Appearance of red precipitate indicates the presence of sodium chloride.

Detection of urea in milk :

Take 2ml of milk and add 2ml of p-dimethyl amino benzaldehyde reagent (1.6% in ethyl alcohol containing 10% HCl). Development of distinct yellow colour denotes the presence of urea. The pure milk samples show a faint pink colour which should be ignored due to the presence of natural urea (up to 50mg/100ml.) This test should be carried out with the control sample. A sample paper strip method has also been developed using the above principle.

Detection of formalin:

Take 5 ml of milk sample in test – tube and add 5ml of concentrated sulfuric acid containing traces of ferric chloride. Formation of purple ring at the junction indicates presence of formaldehyde in milk.

Detection of hydrogen peroxide :

The presence of hydrogen peroxide can be detected by an intense blue colour developed on addition of 2 drops of paraphenylene diamine hydrochloride to 10ml of milk.

Detection of buffalo milk in cow milk:

The presence of buffalo milk in cow milk can be detected by Hansa test, which is based on immunological assay. A drop of suspected milk after dilution with water (1:4) is treated with a drop of antiserum obtained by injecting buffalo milk proteins into rabbits. The characteristic precipitation reaction indicates the presence of buffalo milk.

Detection of added colour:

The chief colouring materials which are considered here are some natural colouring material like annatto, turmeric or coal-tar dyes. Some of these dyes are permitted only in some products. While the use of annatto is prohibited in milk, its use is permitted in butter. To detect annatto the milk fat is shaken with 2% sodium hydroxide and the mixture is poured on filter paper. The filter paper absorbs the colour, which remains even after washing with water. When the stain is treated with a drop of 40% SnCl_2 and dried, a purple colour indicates the presence of annatto. Turmeric is detected when the colour aqueous or alkali, extracted is treated with HCL. The resulting orange colour is treated with H_3BO_3 crystals, a red colour indicates the presence of turmeric.

Coal-tar dyes adhere to animal fibres more firmly than natural colour. The curd of pure milk is white when extracted with ether but one containing coal-tar dyes remains orange or yellow; this when treated with concentrated hydrochloric acid becomes pink.

Detection of pulverized soap :

Soaps are generally defined as sodium and potassium salt of fatty acid. Therefore, to detect the presence of pulverized soap, iodine value refractive index, fatty acid composition, salt ratio and ash content are excellent methods. The presence can be judged by qualitative method. For example, in 10ml milk, 10ml hot water is added followed by 1-2 drops of phenol-phathlene indicator solution. Development of pink colour indicates the presence of soap in milk.

Detection of vegetable fat:

The adulteration of vegetable fat in milk can easily be detected by the following methods. In case of synthetic milk, the fat is extracted either by Rose-Gottlieb method or fat extracted in butyrometer can also be used.

- Fatty acid composition : Milk fat is characterized by lower chain fatty acids. for example butric capric, capralic, etc. whereas most of the vegetable fats do not contain these fatty acids. Therefore, the adulteration of the vegetable fat can easily be detected by analyzing the fatty acid profile by gas chromatography.
- Detection by measuring different physico-chemical properties: The adulteration of vegetable fat can also be detected by measuring various physico-chemical properties. For example, refractive index, RM and Polenske values iodine value. etc.
- Hydrogenated vegetable oils like vanaspati is a common adulterant in milk fat. Its presence in milk fat can be detected by the fact that sesame oil is added in vanaspati as per the law. The presence of sesame oil can be tested by Baudoin test.

Detection of adulteration by using kits: with the advancement in analytical chemistry, several test kits for testing chemical adulterants antibiotic residues, aflatoxins, pesticides, etc have been developed. In India, The National dairy Research Institute, Karnal, and Central Food Technological Research Institute, Mysore, have developed rapid detection kits for chemical adulterants and environmental contaminants respectively. Similarly for detection of mastitis, simple strip test has been developed and is being used under field conditions. Further, M/s Gist-brocades. The Netherlands, have developed Delvotest Kit for testing presence of antibiotics and sulpha residues in milk.

Preservatives:

For testing of samples it is essential milk must be kept sweet (without decomposition) while the sample is being assembled. This is accomplished by use of a preservative. It is a good plan to place the preservative in the empty bottle before milk is added. A wide-mouthed glass bottle with a rubber stopper has been found to be the most reliable and practical container for keeping composite samples of milk or cream. The common preservatives used are; (i) Mercuric chloride or corrosive sublimate. This is very poisonous. It may be added in the form of tablets, which are coloured (usually bright red) to prevent the milk being mistaken for food. (ii) Formalin. This is a 40 per cent solution of formaldehyde. Being in liquid form, it is very convenient to handle. However, it interferes with the fat test. (iii) Potassium dichromate. This is not as effective as the above two, but it is easy to handle in dairy plants because it is available in tablet form.

Clean milk production :

Definition : Milk is defined as whole, fresh, clean lacteal secretion – complete milking of healthy milch animals excluding that obtained 15 days before or 5 days after calving and containing prescribed % of fat and SNF.

Milking Methods.

Hand milking and Machine milking

The method of adopted for harvesting of milk from the udder of the animals is being carried out by two methods. Hand / machine milking.

Clean milk:**Advantages :**

1. Protects the health of calves
2. Protects the health of consumers especially infants, growing children and aged people.
3. The cleaner the milk longer in its keeping quality and flavour.
4. Consumer will demand milk when confidence is developed on its wholesomeness.
5. Sour and off flavoured milk – not readily marketable

Disadvantages.

1. Keeping quality of milk is poor.
2. Nucleus for spreading of diseases-sore throat, brucellosis.
3. Health of the calves are affected – chances for increased calf mortality.
4. Disposal of poor milk is difficult.

PRINCIPLES OF MILKING

Milking is defined as the critical and laborious process which involves hormonal reflex. The art of milking performed within 5-8 minutes. Normally milking is done twice a day. The cattle and buffaloes are exclusively maintained for milk production. Though the primary objective is to produce milk, the amount of milk produced by the indigenous breeds are very low compared to the amount of milk secreted by the exotic animal which are very high and which is more and above the requirement of calf. If the calf is allowed to suckle the complete quantity of milk it leads to digestive disturbances, enteritis, etc., usually milk is fed to calves depending upon the body weight of the calf the rate of 1/10 of the body weight during first week and 1/15 the body weight during the second week.

Though milking is a laborious process, under present circumstances new innovation has been made to extract the milk from the udder. They are said to be mechanical milkers or milking machines. The pulsation and intermittent vacuum and pressure are basic concepts of the milking machines. The advantages of the milking machines are that a large quantity of milk can be harvested in a shorter duration with the help of unskilled personnel. The major portion of the work of a dairy man is from milking to disposal of the milk. Nearly 65% of the time is to be devoted for the management in connection with milking and marketing of milk.

PRINCIPLES OF REMOVING MILK:**3 PRINCIPLES**

1. Natural Technique (calf suckling)
2. Manual Technique (hand milking)
3. Mechanical Technique (machine milking)

Natural Technique:

This method calf is able to draw the milk from the udder. To extract the milk the calf presses the teat with the tongue and pallet on the other side. The tongue encircles the teat and vacuum is created in the mouth by separating the jaws and retracting the tongue nearly 100-200 alternating cycles may be observed per minute. A calf's suckling is the best method of evacuating the milk with least damage to the delicate tissue of mammary gland. The art of milking is a cycle

1. Active Phase

2. Restive Phase

ACTIVE PHASE:

- a) Creation of vacuum in the teat canal
- b) Pressure is applied over the teat canal
- c) The base of the teat is apparently occluded with the help of the tip of the tongue with the idea to prevent the back flow of the milk into the gland cistern when the pressure is applied which is followed by restive phase

RESTIVE PHASE:

At this stage 20mm Hg pressure is created at the teat end. In the phase both active and restive phase are alternated and it has been scientifically proved that the amount of pressure applied over the teat canal by calf is 535mm Hg pressure whereas in the case of hand milking the pressure is 310mm of Hg.

In the mechanical milking pressure on the teat is with the range of 350 mm-400mm Hg. In the case of buffalos 400mm of Hg of pressure is applied but in the case of cattle it can be restricted to 360-380mm of Hg. It has been proved that cycling rate during nursing is twice as fast as hand or machine milking. Thus the difference along with increased cycling rate facilitates and explains the removal of milk from the udder at a faster rate by a calf when compared to hand or machine milking.

Hand milking: It is commonly practiced in the harvesting of milk. In order of milking of various teats also differ.

1. Teats crosswise left four and right hind or right four and left hind.
2. Fore quarters teat together
3. Hind quarters teat together
4. Teats appearing more distended should be milked first. The milk should only be squeezed and not drawn

STRIP CUP:

It is a device with four circular plates for each quarter which has the quantity of milk normally first few strip of milk are drawn in the respective circles to assess the physiological status of the udder. If there is any change in color, consistency appearance, etc., the milk should be drawn at the end so as to prevent spreading the disease from one quarter to other.

Prevention of Kicking of the cow:

1. Application of milk man's rope.
2. Anti cow kicker.

METHODS OF MANUAL MILKING.

1. Fisting 2. Knuckling, 3. Stripping

1. FISTING. In this method the whole teat is held first with the thumb and the index finger encircling the base of the teat. The base of the teat is closed by the ring formed by the finger, so that the milk that is trapped in the teat canal cannot slip back into the gland cistern. Simultaneously the teat is squeezed between the hollow of the palm and with the middle, ring and index finger. The process is repeated in succession. It is the best method of hand milking though most of the milkmen follow knuckling method.

2. KNUCKLING METHOD

Many milkers tend to bend their thumb against the teat canal and drag the milk out. This practice should be avoided as it is injurious to the teat.

3.STRIPPING

This method is followed where the length of the teat is small; it is normally practiced towards the end of milking in order to evacuate the milk completely. The last drawn milk is called stripping which is rich in fat content. The process of stripping should be done in quick succession otherwise the animal will become stripper where the letting down of milk is delayed.

TYPES OF HAND MILKING

1. DRY AND 2. WET

In most of the place wet milking is practiced. The milkman moistens the hand with certain type of emollients like castor oil, or few strips of milk or even their own saliva. This should be avoided for the sake of cleanliness. If wet milking is practiced, the teats will look harsh and there is every possibility of development of cracks. Both the hands can be used for milking in continuous milking. The maximum flow of milk from the udder is usually referred to as letting down and it is a highly inherited character, cows possessing a teat with a small orifice is very difficult for milking and there is leaking teat when the teats are pressed. Both the narrow orifice and leaky teat animals are to be culled.

FREQUENCY OF MILKING:

It depends upon quantity of milk yield. Under normal circumstances the quantity of milk is less than 10 litres/day – 2 times milking is followed when more than 10 litres three times milking is followed. It has been observed and proved that three times milking improves milking 10-15%. The factors that are to be considered during milking.

1. Avoid excitement of the animal during and prior to milking. If the animal is excited then there is release of adrenaline and it will cause vasoconstriction.
2. Prepare and collect all the milking equipments prior to milking.
3. Milking operation should be continuous one.
4. As far as possible exact time of milking is to be followed.
5. Prepare the cow for milking.
6. Complete the milking within 5-7 minutes.
7. Use both hands for milking.
8. Use correct method and type of milking.
9. Weaned animals should not be milked with the calves nearby.
10. Provide concentrate mixture at the time of milking.
11. Remove the first few stripping for any possible abnormalities of milk.
12. Group the animals 2 hours prior to milking.
12. More than one milkman should milk a cow during the lactation so that any change in milkman will not affect / cause any problem in milking especially in the letting down process of lactating animals.

MACHINE MILKING:

A calf and the machine do the harvesting of milk in a similar fashion. The function of the tongue, dental pallet and jaw movement of the calf is done by the inflation tube, pulsator and vacuum pump. Milk removal is largely dependent upon the differential pressure across the teat canal. The total differential pressure created by the milking machine is approximately 352 mmHg, in the case of cattle and 400 mm Hg. in the case of buffaloes. The pressure facilitates the expulsion of milk from the canal.

MERITS.

1. Easy method of extracting milk.
2. Does not require any skill.
3. Keeping quality of milk is high.
4. Chances of spreading of disease of the milk man to udder through milk are negligible.
5. Time consumed is less. One or two animals can be milked simultaneously and the maximum of eight animals can be milked at a time.

DEMERITS:

1. Cost is high
2. electricity is essential.

One milking machine for – 10 animals yielding 10 litres / day will be economical to maintain.

Class 11: Processing of milk-Cooling-Pasteurization-Definition-Various methods-Low Temperature Long Time, High Temperature Short Time and Ultra High Temperature-advantages and disadvantages.

Thermal processing :

The main purpose of heat treatment of milk is to render it safe for human consumption and to enhance its shelf life. Thermal processing is an integral part of all operations/processes of milk and milk products manufacturing units. The common pathogenic organisms likely to occur in milk are killed by relatively mild heat treatment. The most resistant organism is the *Bacillus tuberculosis* and hence has been made as index organism to achieve complete safety of milk. Any heat treatment, which may destroy this organism, can be relied upon to destroy all other pathogens in milk. The thermal death of such pathogenic organisms like Tubercle bacilli, Typhus and Coliform bacteria of such pathogenic organisms like Tubercle bacilli, Typhus and Coliform bacteria and ***Coxiella burnettii* (Q fever organism)** has made the basis for time-temperature combinations is also a matter of optimization where both microbiological effects and quality aspects must be taken into account. Various categories of heat.

Different categories of heat treatment.

Treatments	Process	Temperature (°C)	Time(seconds)
Pasteurization	LTLT	63	1800
-	HTST(milk)	72	15-20
-	HTST(cream)	>80	15
Thermization	-	57-68	15
Sterilization	-	115-121	180-780
Ultra-pasteurization	-	115-130	2-4
UHT	-	135-150	1-6

Pasteurization :

It is the process of heating every particle of milk or milk products, in properly designed and operated equipment to specified temperature and holding at that temperature for specified period of time followed by immediate cooling and storing at low temperatures. Pasteurization can be achieved either by holding method (batch process) or continuous process. Under batch process the milk is heated to 63°C for 30 minutes in a double-jacketed vat. Heating and cooling is done by spraying or circulating hot water /steam or chilled water between the inner and outer jacket of the

vessel. The milk is kept gently agitated mechanically to ensure uniform heating/cooling. The process is called **low temperature long time (LTLT) method**. This method is suitable for small quantities ranging from 200-1000 litre requiring low initial cost of equipment.

High temperature short time (HTST) treatment for pasteurization of milk refers to heating every particle of milk in a continuous flow to a minimum of 72°C for at least 15 seconds followed by immediate cooling to 4°C. The entire process is automated and is ideal for large scale handling of 5,000 lph or higher. The complete process of preheating, heating, holding, pre-cooling and chilling is completed in a plate type heat exchanger mounted on a compact frame with inter connected sections to make the process continuous. The heat exchanger plates are so designed as to prevent mixing of thin channels of product and heating/cooling medium by separating the plates with rubber gaskets. The complete equipment consisting of four sections is called pasteurizer. Each section consists of varying numbers of plates depending on equipment capacity. The raw cold milk (4-5°C) from balance tank enters the pre-heating/pre-cooling (regeneration) section, where hot pasteurized milk (72°C) flows counter current to the raw cold milk, within adjacent plates, thereby, transferring heat for pre-heating of raw milk and pre-cooling of pasteurized milk resulting in energy saving. The pre-heated milk then enters the heating section where it is heated to a temperature of 72°C, using hot water or steam, passes to holding section where the temperature of milk is maintained for specified period of time (15 seconds) until it leaves the section. A flow diversion valve is placed at the outlet of holding section that senses the temperature and accordingly diverts the milk either forward or returns to balance tank if not properly heated. The pasteurized milk thus passes to regeneration section followed by cooling section where it is chilled using chilled water or glycol solution as a coolant.

Thermization

This process consists of heating milk below pasteurization temperature to temporarily inhibit bacterial growth. The process is useful where it is not possible to immediately pasteurization all the milk and some of the milk needs to be stored for hours/days before further processing. The milk is heated to 63-65°C for 15 seconds and rapidly chilled to 4°C or below to prevent aerobic spore forming bacteria from multiplying after thermization. Thermization has favourable effect on spore forming bacteria to revert to vegetative state which are destroyed upon subsequent pasteurization.

Ultra –pasteurization.

Its objective is to enhance or extend the shelf life of the product (milk) by 15 – 30 days. The fundamental principle is to reduce main causes of reinfection of the product during processing and packaging. This is achieved by heating milk to 115-130°C for 2-4 seconds and cooling it to below 4°C. This requires extremely high level of hygienic practices to be followed during production and maintenance of temperature lower than 4°C during distribution of such products. Ultra pasteurized products are packed in pre-sterilized containers aseptically and held refrigerated to achieve extended shelf life.

Ultra-high temperature treatment (UHT)

It is a technique for preserving liquid food products by exposing them for brief intense heating. In short the process is termed as UHT treatment. The heating temperature normally ranges from 135-150°C for 1-6 seconds. The process is continuous which takes place in a closed system that prevent the product from being contaminated by air-borne microorganisms. The product passes through heating and cooling stages in quick succession followed by aseptic filling as an integral part of the process. There exist two methods of UHT treatment indirect heating and cooling in heat exchangers and direct heating by steam injection or infusion of milk with steam and cooling by expansion under vacuum. UHT-treated products are packed aseptically in specially designed multilayer containers, and can be stored at room temperature for extended period of time (2-6 months) without bacterial growth.

Sterilization :

In this process milk or condensed milk packed in clean containers is usually subjected to high temperature (115-120°C) for 20-30 minutes. The containers may be tin cans (200-400 g capacity) for evaporated/sweetened condensed milk or glass bottle for milk. The process of heating and partial cooling is achieved in a rotary autoclave for batch production or hydrostatic tower for continuous production. In container sterilization is the original form of sterilization and is still used.

Microwave heating :

It is a novel method of heating, which greatly reduces the effect of heat penetration lag associated with traditional process of convection or conduction. Microwaves form part of the electromagnetic spectrum (frequency range 915 and 2450 MHz). The heating effect is achieved by transfer of energy to a dipole (in water) within the product. The constant movement of dipole due to oscillation of molecules generate heat. The high temperature produced in are of high water

concentration transfer heat to other areas of food not absorbing microwave energy so well. Microwave absorption is inversely proportional to the penetration depth as a function of water content, salt content and temperature. During microwave heating temperatures at the surface, are often lower due to evaporative cooling than at the centre of the product. Conduction effects are only the means of leveling out the temperature imbalance due to microwave heating, Microwave absorption characteristics change with change in physical phase of the product. In frozen state molecules are less free to move and therefore less able to interact with electrical field. As the product melts the areas of water and dissolved salts appear which absorb microwaves rapidly.

Keeping quality of milk – treatment of milk – pasteurization different types – preservation and storage

Keeping quality of milk is influenced mainly by clean milk production and type of milking – mechanical-high, manual-low.

Bacteriological standard milk raw milk. (standard plat count / ml.)

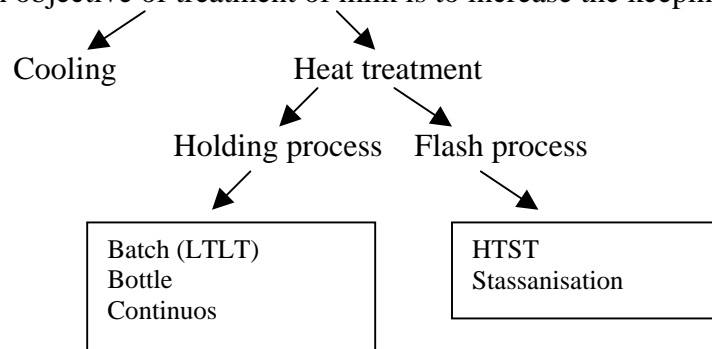
1. spc - not exceeding 2 lacs. very good
2. 2 – 10 lacs. – good
3. Bet 10-50 lacs fair
4. > 50 lacs poor

Pasteurized milk – spc should not exceed 30,000

COB (Clot on boiling test) to determine the heat stability.

Treatment of Milk

The main objective of treatment of milk is to increase the keeping quality.



Importance : Milk contains some micro organism when drawn from the udder, that number increases during subsequent handling. The common milk microorganisms grow best between. 20 and 40⁰C bacteriological growth is invariably accompanied by deterioration in market quality due to development of off flavour acidity etc. One method of preserving milk is by prompt cooling to a low temperature.

The term pasteurization has been coined after the name of Louis Pasteur of France (1860-4) who demonstrated that heating wine at 122 to 140°F (50 - 60°C) killed the spoilage organism and helped in its preservation. Although Louis Pasteur pioneered studies of heat treatment for preservation, **pasteurization of milk was attributed to Dr.Soxhlet of Germany in 1888.**

EFFECT OF TEMPERATURE ON BACTERIAL MULTIPLICATION

Effect of storage temperature on bacterial growth in milk

Milk held for 18 hrs at Temperature °C	Bacterial growth Factor *
0	1.00
5	1.05
10	1.80
15	10.00
20	200.00
25	1,20,000.00

* Multiply initial count with this factor to get final count

Pasteurization of Milk

Louis Pasteur found heating the wine to 140°F (60°C) greatly improved keeping quality by destroying most of the bacteria.

Pasteurization is the processing of exposing the milk to a controlled temperature for a specific time with the object of destroying all the pathogenic bacteria and cooling the milk immediately to a temperature low enough to retard the growth of the surviving bacteria 161°F for 15 seconds and rapidly cooling to 50°F sufficient to kill the most common disease producing bacteria .

Advantages :

1. Pasteurization renders milk safe for consumption
2. It destroys all the common disease producing organism eg. TB, Typhoid, Diptheria, etc. which may be present in milk.
3. Pasteurization destroys approximately 99% of all bacteria and most of the yeast and moulds.
4. Keeping quality is improved facilitating easy transport of milk over long distances.
5. Pasteurized milk or cream – desired type of ripening can be obtained more effectively.
6. Pasteurization eliminates undesirable taints from milk.
7. Products prepared from Pasteurization milk are of more uniform quality.
8. Natural flavour of milk is not affected by Pasteurization.
9. Pasteurization destroys lipase enzyme / which is responsible for rancidity of milk .

Objections to Pasteurization

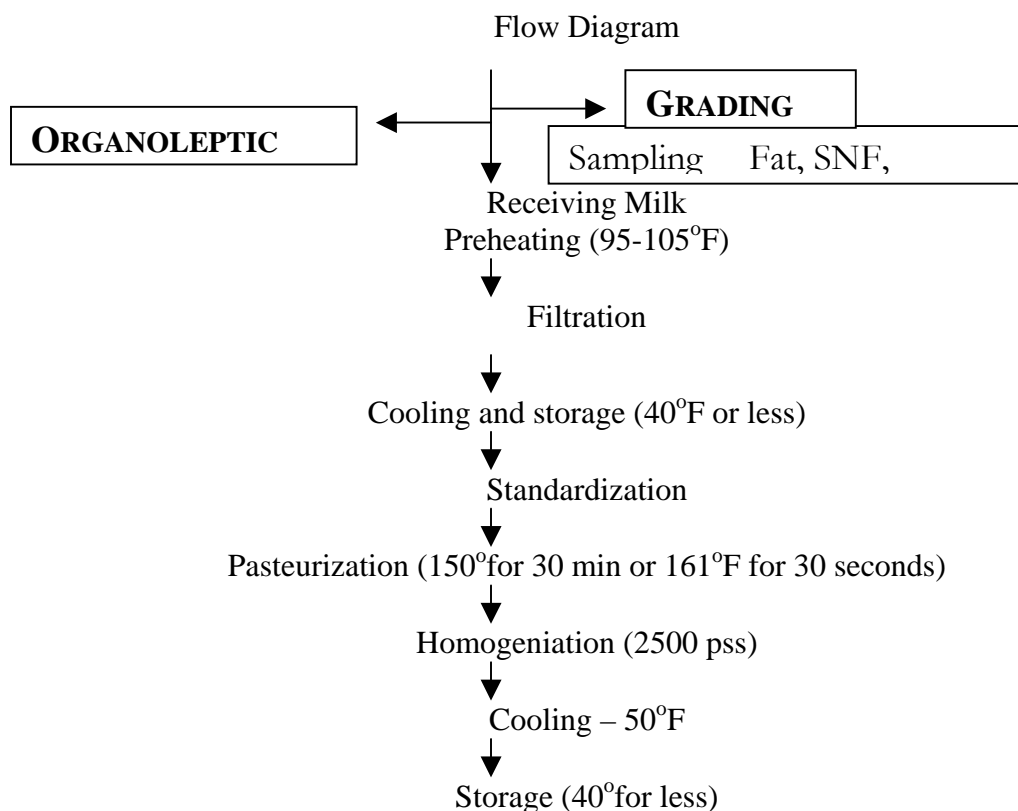
- a) Organisms developing in Pasteurized milk form harmful products. streptococcus theremophilus, S.liquifaciess and M.candidus varian and M.Luteus.
- b) Infants do not develop so well on Pasteurized as on raw milk
- c) Products of bacterial growth are not destroyed.
- d) Pasteurization may be used to mask dirty milk.
- e) Pasteurization bring about chemical changes in milk. Cause ppt. of ca and Phosporus
- f) Pasteurization - partial destruction of vit.E and K, vit.C is destroyed varying degree dependent on the system.

Holding process: Low temperature long time (LTLT method milk is heated to 150°F and is held at that temperature for 30 minutes then it is cooled to a temperature not more than 50°C.

Flash Pasteurization

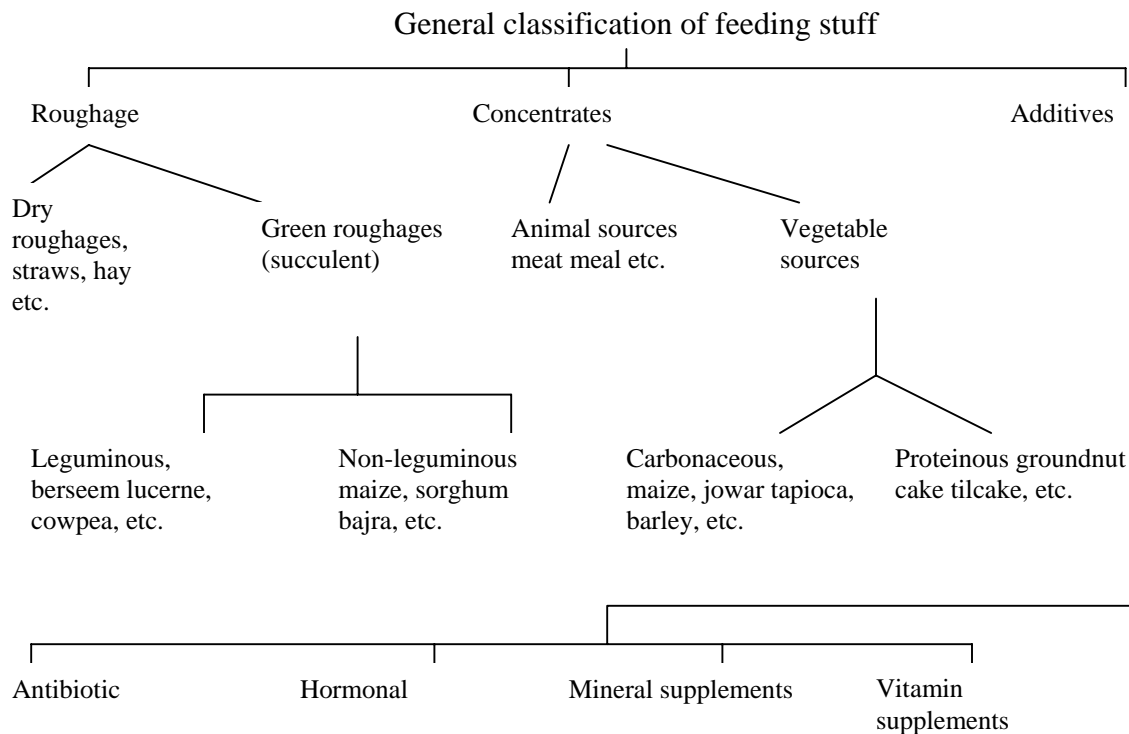
1. Milk is heated to 161°F held for 15 sec.
2. Plate heat exchanger is the most widely used.
3. It includes a section of regenerative heating and cooling followed by final heating and cooling.
4. From the balance tank milk is sucked under slight vacuum through regenerative section – 120-130°F by the hot Pasteurization milk flowing in pipeline.
5. The partially heated milk then is pumped through final heating section under 10 lbs pressure, where it is heated to the required temperature by hot water at temperature 2 to 3°F higher than final temperature.
6. Final heating section- the pasteurized milk passes through a holding tube of such capacity that the holding time is not less than 15 sec. and then regenerative section where it is partially cooled and final cooling.

Stassanisation : The milk is heated to about 165°F for 7 seconds under slight pressure in a thin layer between two heated surfaces (in order that all carbonic acid may be returned) the process is carried out in a tubular heat exchanger consisting of 3 concentric tubes by passing milk between two water heated pipes through narrow space of 0.6 to 0.8 mm. It is claimed that there is practically no milk stone formation, less destruction of vitamins, no evaporation of milk and more economy in steam utilization than in conventional pasteurization. This device was invented by Dr. Henre Stassano. Adv. Easy cleaning.



HTST : This was 1st developed by A.P.V. Co., in the U.K. 1922.

Class 12: Nutrition-Definition-Ration-Balanced ration-Desirable characteristics of a ration.



Nutrition involves various chemical reaction and physiological process which transforms Food into body tissue (milk, meat, egg, wool)and activities (Work power).Nutrition involves ingestion, digestion, and absorption of the various Nutrients and their transport to all the body cell and the removal of unusable elements and waste products of Metabolism.

Nutrients are defined as the substances which can sustain or aids in the support of the life. Lavoiser-French Scientist is referred as father of Nutrition. There are two aspects in Animal Nutrition

1. Science of Nutrition – It is the work of Animal Nutritionist
2. Art of feeding of animals.- Good stockman ship.

RATION :

is the feed allowed for a given animal during a day of 24 Hours.

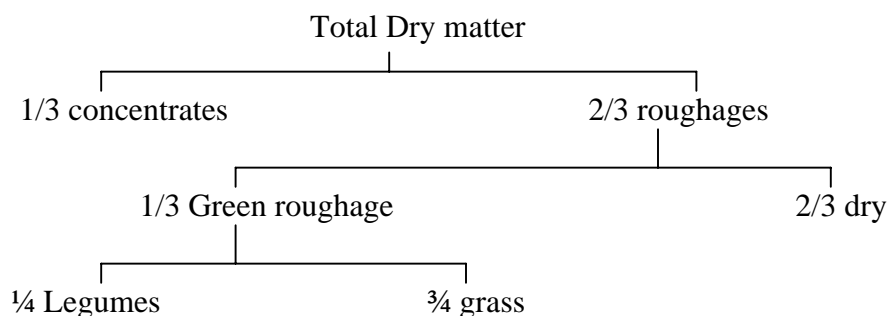
Balanced Ration.

Balanced ration which provides essential nutrients to the animals in such proportion and amount that are required for the proper nourishment of the particular animal.

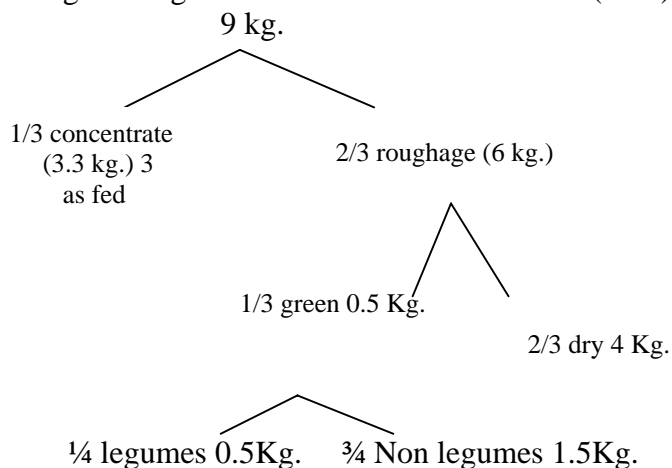
S.No.	Concentrate	Roughages
1.	10 % Moisture and 90% Dry matter	Dry fodder--10 % Moisture and 90% Dry matter Green Fodder---80-90 % Moisture and 10% Dry Matter
2.	Highly Digestible	Comparatively less digestible
3.	Crude fibre less than 18%	More than 18%
4.	Nutritive Value/unit mass is high	Low
5.	Compact in Nature	Bulky
6.	Keeping quality -High	Variable : Dry Fodder – High, Green fodder- Less/low

Desirable Characters of a ration.

1. Liberal feeding ; Satisfy all the physiological status +waste in preparation+Feeding.NOT over feeding-Doubly Wasteful.
2. Individual Feeding : Avoid Competition ; adequate –individual feeding is always better.
3. Properly Balance : Concentrate; Roughage. a. green fodder i. Leguminous and Non Leguminous fodder. b. Dry fodder.
4. Palatable & Variety : Better and balanced mixture of protein, vitamins and other nutrients.
5. Good and Sound : Low quality-unwholesome ingredients, may contain toxic components-poor quality –reduce feed value.
6. Mineral Mixture : Every Kg milk- 0.7%.-Deficit –depletion cause metabolic disease. milk contains eg. Ca 3 g and 2.7 g in milk and 3 grams in egg shell.
7. Laxative : otherwise food will be incompletely digested constipation-digestive disorder-utilistion –nutrients affected-reduction in production.
8. Bulky : Capacious and satiety .
9. Green Fodder : Source of vitamin-‘A’-reproduction-Bulky- laxative-cost wise cheap-unidentified factors-easily digestible.
- 10.Avoid change in the diet: Bacterial digestion-Prevalence of specified species-sudden change – digestive disorder.
- 11.Maintain regularity : Glandular Secretion-essential for digestion.
- 12.Properly Prepared : Hard grain-Coarsely ground-Cottonseed soaked-coarse fodder – chaffed-sprinkled salt-molasses-increases consumption.
- 13.Labour and cost ; ultimate –aim-profit ; 70 % cost of production is attributed to feeding of animals.



Eg. 400 Kg. B.weight 2 – 2.5 % Bwt. – x-9 (8-10)



Class 13: Requirement and importance of green fodder, carrying capacity and forage cycle.

IMPORTANCE OF GREEN FODDER

Animals as well as man, could not exist were it not plants, and among them are GRASSES, the most useful of all plants.

Green fodder is the primary only source of vit A for lactation

vit 'A' is present in the form of precursor.

Req. of vit A -50 I.U/live wt M : 87 I.U(M+P)

→ Maintenance & function of the mucous membrane

→ is directly related to vision.

→ is essential reproduction a. conception, b. early embryonic mortality, c. maintenance of pregnancy, d. shedding of placenta.

→ is essential for the respiratory tract

→ is essential in the Gastro intestinal tract/ digestive tract-deficiency causes diarrhoea, mal absorption of nutrients etc.,

→ is essential for the urinary tract –deficiency causes stones in the kidney, ureter, bladder.

→ During lactation 2000 I.U. of Vitamin 'A' is eliminated in every litre of milk-It is to be replenished

→ laxative in action

→ cheap source of Vitamin 'A'

→ source of minerals, Crude protein, Total digestible nutrients and dry matter

→ unidentified factors.

Carotene Content of some fodder

- a. Agathi 18.3 mg / 100 dry matter
- b. Lucerne 15.6 mg / 100 dry matter
- c. Guinea grass-14.2 mg / 100 dry matter
- d. Desmodium 7.09 mg / 100 dry matter

Feed should be available to cows at least 20 hours / day.

Feed at least 60 % of ration during night in the hot weather (Summer)

Cows → reduce feed intake by about 3.3% for every 2.2 rise in temperature over 24⁰ C

High producing cows will eat up to 12 meals / day each averaging 23 minutes.

First calf Heifers will spend 10 to 15 % more time eating time when compared to old cows

Water should be available At libitum.

IMPORTANCE OF GREEN FODDER PRODUCTION

INTRODUCTION

Green forages have cooling effect on the animal body, more palatable contain easily digestible nutrients, provide fresh effectively utilizable nutrients in natural form and slightly laxative. The use of concentrates no doubt will give the greatest animal production per unit feed intake, but this may not be economical in countries like India where grains and concentrates are costly and/or in short supply. On the other hand animals yielding as high as 8 litres of milk can easily be maintained solely on green fodder without any concentrate. But unfortunately only 6.9 million ha or 4.4% of the country's area is under fodder cultivation and hardly any scope for further expansion because of pressure on agriculture land for food and cash crops.

India has about 15% of world livestock population with only 2% of world's geographical area. The projected green and dry fodder requirements for the year 2000 A.D. are 1136 million and 949 million tons respectively. The current feed and fodder resources in India can meet only less than 50% of the requirement of its livestock population of 450 million. The grazing intensity is very high viz.,

2.6 cattle unit per ha as against 0.8 cattle unit per ha in developed countries. We are highly deficient in various livestock products, though we have about one-fourth of the total cattle population of the world. The analysis of this situation reveals that one of the main reasons for the low productivity of our livestock is malnutrition, under-nutrition or both, besides the low genetic potential of the animals.

Fibre for rumen health.

- ❖ Forage dry matter consumption should be near 2% of the body weight.
- ❖ At least 19-21% acid detergent fibre should be in the total ration.
- ❖ At least 28-30% neutral detergent fibre should be in the total ration.
- ❖ Provide at least 2 Kg of fibre a day.
- ❖ Rumen PH should be above 6.0. A lower PH could limit fiber digestion and protein synthesis.
- ❖ Fibre particles should be long enough to stimulate 15 minutes of cud chewing time per half a kg. of dry matter.
- ❖ Fibre length should be chopped at ½ inch to stimulate rumen buffering from cud chewing.
- ❖ Sodium carbonate or its buffer equivalent should be added at 0.75% of total ration dry matter, especially with high-corn-silage or high moisture corn rations.
- ❖ Feed should be available to cows at least 20 hours/day
- ❖ During hot weather feed at least 60% of ration at night.
- ❖ Cows reduce dry matter intake by about 3.3 for every 2.2° rise in temp. over 75°F(24°C).
- ❖ High producing cows eat up to 12 meals/day each averaging 23 minutes.
- ❖ Heifer calves will spend 10-15 minutes more time when compared to old cows.

SYSTEMS OF FODDER PRODUCTION

The system of fodder production vary from region to region, place to place and farmer to farmer, depending upon the availability of inputs, namely seeds, fertilizers, irrigation, insecticides, pesticides, etc. and the topography. An ideal fodder system is that which gives the maximum yield of digestible nutrients per hectare, or maximum livestock products from a unit area. It should also ensure the availability of succulent, palatable and nutritive fodder throughout the year.

Fodder production for intensive Livestock farming

The requisites for intensive livestock-farming are that (i) fodder is required in uniform quantity throughout the year, (ii) the fodder crops in the rotation should be high-yielding, (iii) the area for production of fodder should be fully irrigated, and (iv) other inputs, such as fertilizers and pesticides, should be available in optimum quantity. The different systems of fodder production fall into two categories, viz. the overlapping cropping and the relay-cropping. In the overlapping system, a fodder crop is introduced in the field before the standing crop completes its life cycle. In relay-cropping, the fodder crops are grown in successions, i.e. one after another, the gap between the two crops being very small.

Overlapping system

The overlapping cropping system is evolved by taking advantage of the different growth rate of different species. It ensures a uniform supply of green fodder throughout the year. One such system continues for three years. The best rotation in this system is berseem + sesame - Hybrid Napier + cowpea - Hybrid Napier. This system of intensive fodder production is economically viable only for 3 years. After three years Hybrid Napier is uprooted and fresh planting is taken up. When the stumps of Hybrid Napier become old and the tillering capacity diminishes considerably. This system ensures green fodder throughout the year. It takes care of the dormancy period of Hybrid Napier during winter. The inter-row spaces of Hybrid Napier are efficiently utilized for raising berseem or other legumes in winter and cowpea in summer. The growth of legumes enriches the soil.

NUTRITIVE VALUE OF FODDER CROPS

These are highly digestible (55 – 65%) mostly when harvested at a proper time. The crude protein may range from as little as 3% in very mature forages to over 30% in young heavily fertilized grass (on DM basis). The soluble carbohydrate of grasses ranges in the dry matter from 4-30%. The cellulose and hemicellulose are generally within the range of 20-30% and 10-30% of the dry matter respectively. Grass proteins are particularly rich in arginine, glutamic acid and lysine. Green forages are excellent source of carotene 250mg/kg), the precursor of vitamin A.

Generally leguminous fodder contain 8-12% DCP and 45-60% TDN. The phosphorus content of leguminous fodder are poor. It is advisable to supplement a ration containing a large amount of leguminous fodder with a limited quantity of wheat or rice bran, which is rich in phosphorus. The non-leguminous fodder are having 2.5% DCP and 45-60% TDN on dry matter basis. Green fodder is the primary source of vitamin A. Vit.A is present in the form of precursor. Green fodder contains 100 mg carotenes /Kg when compared with about 20 mg /Kg in silage. Carotene requirement of milch animals is 60 mg for production, 30 mg for pregnancy, for growth requirement is 11 mg carotene per 100 Kg live weight.

Vit A is directly related to vision, maintenance and function of mucous membrane, essential for reproduction (for conception, maintenance of pregnancy, shedding of placenta), deficiency leads to diarrhoea, mal absorption of nutrients, incidence of stone in the kidney, ureter & bladder. During lactation 2000 I.U. of Vit.A is eliminated in milk.

VALUE OF TREE FODDER

Trees, which can be grown either in combination with agricultural crops or on separate land usually not fit for agriculture, offer opportunity of producing green nutritious fodder for the livestock. It is seldom realised that in some parts of our country, probably more animals feed on shrubs and trees than on grass or grass legume pasture. Trees can produce as much, if not more, green fodder per unit area as agricultural fodder crops. The more important desirable agronomic features of a tree species are

- .. Be reasonably easily and reliably established
- .. Exhibit a good competitive ability against weeds
- .. Remain regally productive under repeated ability or grazing and browsing.
- .. Be well adopted to the particular climatic and edaphic features of the environment
- .. Require, no or little fertilizer
- .. Be resistant to local pests and diseases
- .. Have adequate forage production or be reliably vegetatively propagated and
- .. Have good nutritive value and reasonable palatability and acceptability to animals.

Multipurpose trees (MPTS)

The term ‘multipurpose tree’ refers to all woody perennials that are purposefully grown so as to provide more than one significant contribution to the production and/or ‘service’ functions of the land-use system they implement.

Nitrogen fixing trees (NFTS)

No flowering plant grows without nitrogen and few crops grow economically without adding inputs of this plant nutrient. Many farmers and tree growers cannot afford to buy nitrogen fertilizers, so yield suffers. A NFT lives in a symbiotic or mutually beneficial relationship with root micro-organisms: the latter transform atmospheric nitrogen into a form usable by the trees which in return provide carbohydrate to the micro-organisms. Such a built-in living nitrogen fertilizer factory often allows an NFT to grow more rapidly with fewer inputs in nitrogen-poor soils than most non-nitrogen-fixing trees. Thus the nitrogen can be used not only for the NFTS growth, but as a green manure for other crops and trees. Protein rich leaves and pods make many NFTS excellent forage that animals readily eat.

Nutritive value of fodder trees

Shrubs and leguminous trees are good source of digestible crude protein (DCP) for supplementary feeding to farm animals. Tree leaves are useful as protein supplements to straws and low protein fodder. Tree leaves are good sources of calcium but low in phosphorus. The nutritive value of shrubs and tree species vary widely due to varying inherent nutritive value between species and within species because of climatic and edaphic conditions, cutting and grazing strategies and the soil in which the plant is growing.

NUTRITIVE VALUE OF TREE LEAVES (%DMB)

S.No	Tree species	CP	EE	CF	NFE	TA	DCP	TDN
Nitrogen fixing trees								
1	Gliricidia sepium	17.21	4.25	15.50	51.65	11.40	14.90	62.20
2.	Inga dulci	15.21	4.37	13.81	55.71	10.91	-	-
3.	Albizia lebbek	16.85	3.16	15.21	51.98	10.82	14.70	57.30
4.	Sesbania grandiflora	29.88	3.02	8.61	46.08	12.52	-	-
5.	Leucaena leucocephala	16.74	4.90	12.94	53.32	12.10	16.70	65.00
6.	Erythrina indica	17.52	4.29	13.76	50.51	13.92	-	-
7.	Acacia nilotica	14.00	4.30	12.50	64.70	4.50	10.20	66.50
Non-nitrogen fixing trees								
1.	Artocarpus heterophyllus	14.01	5.63	18.74	50.53	11.07	8.04	68.19
2.	Ficus bengalensis	11.40	5.17	15.46	53.59	11.93	6.22	46.63
3.	Ficus religiosa	9.84	3.97	23.20	49.17	13.82	6.24	40.00
4.	Millingtonia hortensis	8.444	4.81	22.49	50.08	14.18	8.29	54.85
5.	Lannea Coromandelica	12.06	5.23	20.61	53.72	7.48	5.93	55.15

FODDER CULTIVATION PER ACRE (40 GOATS)

A varieties of green fodder are relished by goats. For better feed conversion and weight gain the goats are to be fed with mixture of leguminous and non leguminous fodder. The fodder obtained from one acre of land is sufficient to maintain 40 heads of goat with its followers. A model out lay of various types of fodder crops to be raised is given below.

[illegible]

AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA

A Subabul ----- Live fence

♣ C03 (Cumbu napier) ----- 60 cents

] Agathi ----- 1 meter gap (on the bunds of the water channel)

γ Maize ----- 20 cents

or

Δ Soya /Cowpea ----- 20 cents

or

β Sorghum ----- 20 cents

≤ Hedge Lucerne ----- 20 cents

Strategies for improvement

Several combat strategies have been suggested in different forums to take on the feed and fodder deficiency and a few are listed below:

Control of number and better utilization of improved breeds.

Increasing the efficiency of available feed.

Increasing green fodder production.

Judicious use of concentrates.

3Identification and utilization unconventional feed and fodder.

Allocating more land for their production could not narrow the existing fodder deficiency. Alternatively the Animal Nutritionists globally are searching for Unconventional New Feed Resources (NFRs) like Agro-industrial by products, cellulose wastes livestock wastes, Top feed resources etc.

Unconventional Feed resources

The NFRs in general are poor in available nitrogen, fermentable energy and minerals. The fibre is complex due to signification. Several anti nutritional factors in them further reduce the nutritive value and affect production and re-production adversely in livestock. The levels of inclusion of various unconventional feeds are given in the tables.

Optimum level of inclusion of unconventional feeds

Newer feeds	Species	Level %
Fallen tree leaves	Cattle & goat	50
Ground nut haulms	Cattle & goat	40
Cotton seed hulls	Cattle	40
Sun flower straw	Bullocks	50
Sun hemp leaves	Poultry	8
Poultry excreta	Poultry	5-15
	Sheep	20-30
	Cattle	30
Rice husk	Sheep	5
Sugarcane bagasse (Untreated)	Bullocks	10

Sugarcane bagasse (Treated)	Sheep	20-30
Spent tea leaf	Calves	17-20
Castor bean meal	Bullocks	10-30
Mango seed kernel	Calves	20
	Bullocks	40
	Cows	10
Rubber seed meal	Pigs & Poultry	20
	Calves & Cow	20-30
Sorghum straw	Ruminants	20-46
Wood pulp waste		12.5-50.0
Fallen teak leaves		17.5-70
Fallen mango leaves		30-60
Saw dust		30
Cotton straw		45
Castor bean meal	Sheep	10
	Buffalo	30
Safflower cake	Cattle	10
Sunflower head meal	Sheep	48
Niger cake	Cattle	8
Tamarind seed hulls	Calves	10-25

Toxic principles

Type of feed	Toxic principle
Banana waste, stems and leaves	Tannins
Cassava leaves, peeling and pomace	HCN (17.5 mg/100g in leaves)
Castor seed meal	Ricinoleic acid (0.2%)
Cocoa seed husks	Theobromine (trace)
Coffee seed hulls, pulp	Caffeine and tannins (2.8% DM)
Cottonseed cake	Gossypol (0.05-0.20%)
Cowpea seed meal	Trypsin inhibitor
Guar meal	Trypsin inhibitor and gum
Kapok	Cycloponopeniod acid
Mango seed kernel	Tannins (5-10%)
Neem seed cake	Tannins
Palm oil mill effluent	High ash 912-26% DM)
Rubber seed meal	HCN (9mg/100g)
Sal seed meal	Tannins (6.2-13.7%)
Spent tea leaves	Tannins (12% DM)
Water hyacinth	Oxalic acid (2.4% DM)

Fodder	Toxin	Toxin effect
Acacia leaves	HCN, tannins, fluoro-acetic acid, oxalates	Laboured respiration, depression, coma and death
Albizia foliage and many other tree leaves	Tannins	Depression in dry-matter and protein digestibility, impaired kidney and liver functions
Blighia sapida seeds	Hypoglycin	Hypoglycaemia
Delphinium spp.	Alkaloids	Stiffened joints, bloat and death
Indigofera herbage	Indopicine, 3-nitropropanic acid	Hepatotoxic agent
Lantana foliage	Lantadene	Hepatotoxic agent, photo-phobia and blindness
Leucaena foliage	Mimosine	Goiterogenic and alopecia
Robinia foliage	Robin phytotoxin	
Sambucus nigra	Sambunigrin (glucoside)	Depressed respiration, coma and death.

Sugarcane tops as livestock feed – on study on sugarcane tops feeding to sheep and calves to conducted under NATP project at IAN Kattupakkam Sugarcane tops with either grass, groundnut haulms or sorghum straw were fed to animal in the form of complete ration. The feed efficiency of these economic feed rations was 15 – 17. Kg. and 5.9 – 6.1 Kg. for sheep and calves respectively. feed cost to produce 1 Kg. live weight was Rs.44 – 51 for sheep. The feeding of sugarcane tops increased to growth rate of ram lambs by 29.4% and calves by 29.2%.

Ardu leaves

Two species of the genus *Ailanthus*, Viz. *Ailanthus grandis* and *A. grandulosa* are commonly found in India. These species grow into enormous trees with clear cylindrical holes. A fully grown tree gives 6 to 7 quintals of edible leaves twice a year. The leaves are quite palatable to both small and large ruminants. The voluntary intake is from 1.5 to 2.0 per cent of the live weight. It contains 13 per cent digestible crude protein (DCP) and 63 per cent total digestible nutrients (TDN). Adult ruminants can be maintained exclusively on ardu leaves.

Bamboo leaves (*Dendrocalamus strictus*)

Bamboo grows in many parts of the tropical region. Its leaves are primarily used for paper manufacture. Nearly 90 to 150 tonnes of leaves are available from a hectare of bamboo forest. The tender bamboo leaves are relished by the livestock. The ruminants can consume about 3.4 to 3.7 per cent of dry matter of the body weight. Fresh leaves contain 40 to 65 per cent dry matter, 15 to 22 per cent crude protein, 3 to 4 per cent ether extract and 20 to 34 crude fibre. The leaves contain about 9.4

per cent DCP and 94 per cent TDN. Negi et. al, (1979) indicated that in spite of the higher crude protein content during the early stage of growth in bamboo, the digestibility of the crude protein was 10 per cent higher at the later stage.

Banyan (*Ficus bengalensis*)

Bargad or banyan is a large evergreen tree. It produces numerous serial roots from the branches, which, upon reaching the ground, thicken rapidly and form support to the branch. There are many species of *Ficus* such as pepal (*Ficus religiosa*), pilkan (*Ficus infectoria*).

Beduli (*Ficus glomerata*)

Almost all the *Ficus* tree leaves are lopped for feeding the livestock especially the goats. *F.scandens* leaves form a very good nutritive fodder. They are fed as protein supplement to the lactating animals in the hills during winter. The *Ficus* species are mostly found in plains up to 1,000 m above sea-level. The figs (fruit) of *F.palmata* and *F.roxburghii* are consumed by human beings.

Biul (*Grewia optiva* syn. *G.oppositifolia*)

Biul also known as bhimal is a small, medium-sized tree mostly found at an altitude of 500 to 2,500m above sea -level. It is also found in the plains. A tree gives about 15 to 20 kg of green leaves per year. The bark of the tree is used for rope manufacture.

The leaves are highly palatable and nutritious (Sharma et al., 1966; Negi et al., 1979). They are lopped for animal feeding during winter months. The leaves contain 17 to 23 per cent crude protein, 2.5 to 5.0 per cent ether extract, 17 to 24 per cent crude fibre, 11 to 13 per cent ash, and 35 to 45 per cent N-free extract. The tannin content is negligible while the digestibility of crude protein is very high (75 per cent). The voluntary intake of the leaves is very high (3.5 per cent of the body weight). It contains 15 per cent DCP and 62 per cent TDN. It forms an excellent leaf-meal (Pachauri et al., 1974).

Beri (*Ziziphus jujuba*)

Beri or Chinese dae is a very common shrub in the arid regions of the tropics (Indian subcontinent, Southeast Asia, North Africa, etc.). It is commonly found in the desert regions of India. The leaves are highly palatable and are used as a conventional fodder for sheep and goats. In Rajasthan and Gujarat, that the beri leaves are dried and stored for use as a protein supplement with the normal

grazing. It contains about 18 to 20 per cent crude protein, but has poor digestibility owing to the presence of high amount of tannins. *Z. nummularia* is also a good fodder.

Erythrina spp.

It is a leguminous shrub. It is also used as a live fence in southern India and Sri Lanka. It produces high proteinous leaves (22-25 per cent protein). There are two species common in the subcontinent. One is *E. indica*, a thorny drought-resistant plant commonly found growing in dry zone. The leaves are lopped for goats and cattle. *E. lithosperma* a non-thorny plant common in hill country, is found growing in areas up to 500 to 1,500 m height above sea-level.

Gliricidia (*Gliricidia maculata*)

Gliricidia is a deep-rooted legume. It is mostly grown as a live fence and is used as a support plant for black pepper and as a shade tree for tea plantations in some of the tropical regions (India, Sri Lanka, the Philippines, etc.).

It grows well on very poor and acidic soils without any fertilizers up to 1,000m elevation. It can be propagated both by seeds and stems.

The leaves contain 25-30 per cent protein and can be harvested at every 3-4 months interval. It is highly palatable fodder. Paddy straw (1.5kg), *gliricidia* leaves (6kg) and rice bran (1kg) supported a growth rate of 500g in a crossbred heifer at Haregama Farm, Sri Lanka (Ranjhan, unpublished). It is a good fodder for sheep, goats and buffaloes, and can be used as a protein supplement.

Ipil-ipil, subabul (*Leucaena leucocephala*)

It is a perennial shrub. The young foliage is highly palatable and rich in protein. The seeds can be used as feed concentrate. The leaves contains 21-25 per cent protein. The fodder is suitable for ruminants, but is toxic to pigs and horses because of mimosine, a toxic amino acid. When grown for fodder, the first cut can be taken within 6-9 months of sowing and subsequent cuts at intervals of about 4 months.

Subabul can make up the protein requirement for maintenance of cattle and buffaloes weighing 400 kg, if given at 25-30 per cent of the paddy straws. Feeding larger quantities to lactating cows gives taint in the milk. It is believed to cause sterility in cows and sows. Feeding up to 25 per cent in daily ration has not shown any adverse effect (Chadokar, personal communication).

Subabul has been extensively propagated in the Philippines, Sri Lanka, Thailand and other tropical countries in Asia for animal feed. In the Philippines, subabul leaf-meal pellets are manufactured and exported to Japan for use in poultry feed.

Jack (*Artocarpus heterophyllus*)

Jack is a common deciduous tree of 30 m height and 2m girth, in the South and the Southeast Asia. The fruit is used both as vegetable and as a fruit when ripe.

The leaves are palatable to sheep and goats. There is another species of *Artocarpus* (*A. intergrifolia*) which is also common in the southeast Asia. The leaves contain 13 to 14 per cent crude protein.

Mulberry leaves (*Morus indica*)

This tree is grow in up to 1,200 m in the sub-Himalayan tract in India. Mulberry is also grown in the silk-producing areas of India where silk-worms feed on these leaves. The leaves are highly palatable to sheep, the feed intake being 3.4 per cent of the body weight. The stalks contain about 11.4 per cent crude protein. The leaves are highly palatable and contain 7.8 per cent DCP and 48.4 percent TDN.

Melia azedarach

It is a deciduous tree found in the Indian subcontinent. It is a good fodder tree. Its leaves contain 13 to 14 per cent of crude protein.

Neem leaves (*Azadirachta indica*)

The neem or margosa tree grows in the Indian subcontinent, in the major part of Africa and in the arid and sub-humid tropic. The tree remains green throughout the year and is drought resistant.

The leaves are not relished by the large ruminants. Sheep and goats consume them in small amounts. The leaves contain 6.2 per cent DCP and 52.5 per cent TDN.

Pipal (*F.religiosa*)

The leaves are relished by sheep and goats. The dry-matter consumption is about 2.4 per cent of their body weight. However, cattle and buffaloes do not relish them and the palatability is only about 0.9 per cent of their body weight. Leaves form a maintenance ration for goats when fed alone. The leaves contain 5.5 per cent DCP and 39.2 per cent TDN.

Siras (*Albizia lebbek*)

Siras is a medium sized deciduous tree. The leaves contain about 11 per cent DCP and 50 per cent TDN. Cattle and buffaloes do not relish the leaves very much, however, sheep and goats like them.

Sainjana (*Oleifera moringa*)

It is a medium-sized deciduous tree common in the tropics. The flowers and fruits are used as vegetable. The leaves are relished by the ruminants. They contain 11 per cent DCP and 62 per cent TDN.

Tamarindus indica

Tamarind tree is very common in most of the tropical countries. It is a tall deciduous tree, grows to a height of about 20m. The leaves are rich in protein (14 per cent) and are relished by small ruminants.

Tapioca leaves (cassava, *Manihot esculenta* syn. *utilissima*)

Tapioca is a tuber crop extensively grown in many countries of the tropics. *M.esculenta* is the most commonly cultivated species in India. The annual world production is about 117.2 million tonnes; out of this only 3.5 million tonnes is grown in India. About 41 million tonnes are produced in Asia (35 per cent). At harvest time, the tuber is collected and the leaves are thrown away.

Tapioca leaves are rich in protein. They contain 8.3 per cent DCP and 45.5 per cent TDN on dry-matter basis. When fed to growing calves, 2.3 kg of partially dried tapioca leaves can replace 0.7 kg of groundnut-cake. Lactating animals when fed on tapioca leaf-meal show good results. About 50 per cent of groundnut-cake can be replaced by tapioca leaf-meal contain about 7.6 mg of HCN per 100 g of dried leaf-meal (ICAR, 1970). At an intake level of 0.5 to 0.8 per cent of body weight, it does not produce any adverse effect.

Thespia populnea

It is a big deciduous tree that grows in the sub-humid region of the tropics and is common to the Indian subcontinent. The leaves can be included up to 30 per cent in the ruminant's ration along with paddy straw for maintenance without deleterious effect (Chadokar, personal communication). It contains 19 to 20 per cent protein. Ferric salts have been used to reduce the uptake of mimosine and DHP from *Leucaena*. They also have a positive effect on the use of high-tannin sorghum by poultry. Polyethylene glycol is effective in counteracting the effect of condensed tannins by complexing with them to the exclusion of protein (Barry and Balaney 1987; Pritchard et al. 1988). The current price of polyethylene glycol makes it uneconomical as a supplement but there is always the possibility of

natural analogues (soluble, nondegradable polyhydroxy compounds) occurring in other feed plants, with a positive interaction if the plants were fed together. Activated charcoal can be used as a general agent for binding toxins in the gut.

Although providing supplements may seem impractical in some village farming systems, the low sodium content of tree leaves and, indeed, most forage plants in the humid tropics indicates that optimum growth will not be obtained without salt supplementation (Little et al. 1988).

Leaf meal

Plant leaves are commonly processed into leaf meals for non-ruminants particularly for poultry. A good quality leaf meal must be free of stems, kiln dried, and dehydrated. It must not be sun dried, because this treatment inactivates a high percentage of the carotenoids. Leaf meals are included in poultry feeds primarily as pigmenting agents because of their low energy value (<6.25 MJ/kg) and low protein digestibility. The maximum level in broiler diets is about 3%, as high levels may decrease growth rates. Conversely, good quality leaf meal is almost always used in feed formulations for layers, the usual upper limit being 5% by weight of feed.

In general leaf meals are good pigmenting agents. This is due to the presence of several different xanthophylls of the general family of carotenoids. Xanthophylls are the hydroxy derivatives of carotene hydrocarbons. Feeding trials with growing pigs have shown that feeding LLM at 5, 10 and 15% caused no ill effects (Patricio 1956; Iwanaga et al. 1957; Rivas et al. 1978). In fact, LLM at 5 and 10% levels is useful in growing and fattening swine. Rivas et al. (1978) found that pigs fed 20% leucaena without FeSO₄ showed the lowest growth rate, average feed intake and feed conversion efficiency; pigs also lost hair and had defective hoofs and pasterns. Growing finishing pigs, however, could be raised using a diet containing 20% LLM, provided 0.4% FeSO₄ was added.

Cutting management

Method of harvesting the tree fodder

Management of tree components at suitable age and interval is one of the vital importance in an agro forestry system. This is primarily required to provide necessary light reception to ground flora.

Many trees and shrubs have the capacity to regenerate new growth after being cut. Several different harvest methods like coppicing, pollarding, lopping, pruning and thinning are advocated as cutting technologies for trees.

Coppices:

It is one of the most widely used harvesting method in which individual trees are cut at base usually between 15-75 cm above ground level. New shoots develop from the stumps. For pole and

fodder production 2-3 sprouts should be allowed to grow. Several rotations of coppicing are usually possible for most tree species. The length of coppice period depends on the specific tree products that are needed. For exclusive fodder production, the tree can be coppiced very frequently. The coppice shoot growth of 1.5 years old subabul had been found to be equal to that of original 3 years growth of that tree. Eventually after several harvest sprouting vigor diminishes. Subabul and Gliricidia sepium are examples of good coppiciers.

Pollarding:

In this system all the branches including top of the tree are removed at a height of 1-3 meters above ground level. New shoots sprout from the main stem to form new crown. The main stem continues to increase in diameter but not in height. This system is used for management of live fences, hedge rows in alley farming etc. An advantage of this system is that the new shoots are high enough off the ground and thus are out of reach of grazing livestock. Subabul, Gliricidia sepium, Erythrina indica, Moringa oleifera, Mulberry, Neem etc. respond well for pollarding.

Lopping:

In this system most of the branches are removed. Though this system is widely used in our country, excessive and indiscriminate lopping of fodder trees results in depletion of valuable tree fodder resources and consequent soil erosion. Intensity and frequency of lopping depend upon the species, age, growth rate of the tree, soil type etc.

Pruning:

It is the harvesting system usually involves in the removal of smaller branches and stems. These pruned biomasses constitute a major source of fodder, fuel and mulch for tree crops. Pruning is often required for maintenance of fruit and forage trees, alley farming and live fences. Among fodder trees, Gliricidia sepium, Subabul, Acacia etc. respond for pruning.

Thinning:

It is a traditional forestry practice followed to maintain desirable trees by eliminating the poor and desired ones to improve the stand by reducing competition for light and nutrients.

Other management factors that affect tree productivity include age at first cutting, cutting height, cutting frequency and season of cutting. It has been generally stated that where trees are older at first cutting, higher rates of regrowth will be observed. This would be expected because older trees would have thicker stems, more carbohydrate. 1m is often used for fast growing short rotation trees. Grown up trees could be pollarded at a height of 2-4m in order to facilitate manual working and to avoid frequent browsing by livestock. The cutting interval will be dictated by the purpose for using the trees. In humid climates, where the major emphasis is on leaf production for feeding to animals,

shorter cutting intervals (6-10 weeks) will be preferred. This will produce feed of a higher nutritive value. Longer intervals (10 - 14 weeks) would be appropriate if fuel wood is also important. With fast growing trees, the regrowth height will be 1.5m for leaf production and 2.5m for leaf and wood production. In less humid environments, longer cutting intervals may be required. The critical period for food supply to the animals is the dry season. Hence carrying over the leaves of wet season into dry season and successive cuttings during dry season are recommended. The surplus production of foliage during wet season should be conserved as hay and silage for feeding in dry season. Most of the long and medium rotation trees tolerate annual lopping (30-50%). The *L.leucocephala*, *Gliricidia* and *Sesbania* species tolerate recurring lopping.

Feeding the tree tops during lean periods

All the tropical and subtropical grasses, owing to their faster rate of growth during the monsoon provide grazing for the livestock, mainly in the monsoon and post-monsoon periods. With the advent of winter and owing to the lack of sufficient moisture in the soil in a ready available form, they enter dormancy. Thus during the lean periods of spring and summer, tree-tops come to the rescue of the livestock-owners. The young leafy, succulent material, highly nutritive and rich in crude protein and minerals, serves as a concentrate, even if fed in small quantities along with other dried grasses and crop residues. The lopping of the trees obtained in spring and summer also contain some substances, which bring the animals quickly into the reproduction phase. Some of the important trees giving lopping and producing gum are koo-babul (*Leucaena leucocephala*) and *Sesbania aegyptiaca* and *Saculeata*. The gum content in the seeds of the two species of *Sesbania* is of superior quality and has a property to reduce the cholesterol content in the blood. These trees, therefore, need immediate attention and may be planted on the boundaries of the fields, in the cattle-yards, etc. to serve as shade-cum-fodder-cum-gum-producing plants. The spacing between the trees should be 6-8 metres or even more in cattle-yards and 5-6 metres on the bunds of the fields.

Besides the use of trees on the farm for various purposes the trees are planted in the pastures as companion species with grasses.

Method of feeding

Physical treatments like sprinkling of molasses, water, salt solution or wilting in shade for 8 hours for *Gliricidia* or neem leaves, shade welting resulted in the significant improvement in palatability for sheep rather than feeding fresh leaves. Roughage should be fed at the rate of 65% of dry matter requirement in ruminant animals. However, feeding of cereal and legume green fodder alone meet the nutrient requirements for producing up to 10 kg of milk. For small ruminants cereal fodder, legume fodder and tree leaves at 2:1:1 ratio supply the nutrient requirements.

Leaf meals

Leaf meals are commonly included in broiler ration up to 3% and layer ration up to 5% primarily as pigmenting agents for pigmentation of meat and egg. This is due to the presence of xanthophyll. A good quality leaf meal must be free of stems, klin dried and dehydrated. It must not be sun dried because this treatment inactivates high percentages of carotenoids.

NUTRITIVE VALUE OF TREE LEAVES (%DMB)

S.No	Tree species	CP	EE	CF	NFE	TA	DCP	TDN
Nitrogen fixing trees								
1	Gliricidia sepium	17.21	4.25	15.50	51.65	11.40	14.90	62.20
2.	Inga dulci	15.21	4.37	13.81	55.71	10.91	-	-
3.	Albizia lebbek	16.85	3.16	15.21	51.98	10.82	14.70	57.30
4.	Sesbania grandiflora	29.88	3.02	8.61	46.08	12.52	-	-
5.	Leucaena leucocephala	16.74	4.90	12.94	53.32	12.10	16.70	65.00
6.	Erythrina indica	17.52	4.29	13.76	50.51	13.92	-	-
7.	Acacia nilotica	14.00	4.30	12.50	64.70	4.50	10.20	66.50
Non-nitrogen fixing trees								
1.	Artocarpus heterophyllus	14.01	5.63	18.74	50.53	11.07	8.04	68.19
2.	Ficus bengalensis	11.40	5.17	15.46	53.59	11.93	6.22	46.63
3.	Ficus religiosa	9.84	3.97	23.20	49.17	13.82	6.24	40.00
4.	Millingtonia hortensis	8.444	4.81	22.49	50.08	14.18	8.29	54.85
5.	Lannea Coromandelica	12.06	5.23	20.61	53.72	7.48	5.93	55.15

CARRYING CAPACITY OF PASTURE.

Sheep in India are mostly maintained on the Pasture. The type grasses in the pasture are highly variable according to the location. Paddocks which were commonly sown with White Kollukkattai (*Cenchrus ciliaris*), Black Kollukkattai (*Cenchrus setigerus*), Blue buffel (*Cenchrus glaucus*), Kikiyu (*Pennisetum clandestinum*), Tuber Grass (*Phalaris tuberosa*), Rye grass (*Lolium multiflorum*, *L.perennae*) and clover variety (Subterranean Clover) of grasses.

Eighteen ewes were allowed to graze on the basis of 0.2 ha / sheep in sown pasture and 0.4 ha / sheep in natural pasture. The ewes under the sown pasture paddocks showed better gains than on

natural pasture paddocks. It has been proved that under natural pasture paddock there was a reduction of 7 % in the plant cover paddocks. Allowing for improvement of the poor grassland , the grazing capacity for the maintenance is recommended at 2.47 wethers per hectare on year long basis. On an average the wether produced 1099 g of wool per head per year, which compares favourably with the average production of Marwari breed. Growth studies conducted in lambs showed greatest gain in body weight under continuous controlled grazing on a year long basis.

FODDER CYCLE.

Is directly related to number of heads of livestock that can be maintained with the green fodder bio mass that is obtained from the specified quantum of land. The area of land for forage production will vary according to the type and variety of green fodder.

The requirement of green fodder will vary according to the live body weight of the animal. On an average 8-10 % of live weight of the animal is to be provided in the form of green fodder. An adult Cattle weighing 400 kg body weight will consume 32-40 kg green fodder. Out of the total requirement of green fodder one third of green fodder is to be provided as Leguminous fodder and remaining two third is to be provided as non leguminous fodder.

For an example a mini dairy with 10 cows and 5 calves will require green fodder as follows :

10 Cattle x 35 kg/day x 365 days = 127.75 tonnes.

05 Calves x 20 kg /day x 300 days = 30.00 tonnes.

Totally approximately 150 tonnes /year.

Leguminous fodder : 50 tonnes

Non leguminous fodder : 100 tonnes.

To produce the above quantity of green fodder the land area is to be worked out based upon the type and variety fodder crops that are cultivated.

Eg : Let us taken an example that Co3 variety yields 150 tonnes /acre/year Lucerne yields 80 tonnes / acre means two third acre is to be allotted for production of Co3 grass and 60 cents are to be allotted Lucerne to get sufficient fodder to meet the requirement of 10 cattle with its 5 followers .

To maintain 40 goats with its followers a minimum one acre of land with irrigation facilities is essential to produce sufficient quantity of various variety green fodder. (40 adults x 5 kg x 365 days = 73 tonnes ;

100 kid x 2kg x180 days = 36 tonnes; 73 + 36 =109 approximately 100 tonnes)

UNDERSTANDING PASTURE-STOCKING RATE AND CARRYING

One of the first questions the new owner or potential buyer of a unit of pasture or rangeland asks is "How many cattle, sheep, horses, etc. can I graze on this land?" In other words, what is the carrying capacity.

There is no simple answer to this question. Carrying capacity may vary depending on management goals, grazing systems, season of use, weather, and many other factors. There are several terms related to carrying capacity that need to be defined.

CARRYING CAPACITY is defined as the maximum stocking rate possible which is consistent with maintaining or improving vegetation or related resources. It may vary from year to year on the same area due to fluctuating forage production..

STOCKING RATE is defined as the number of specific kinds and classes of animals grazing or utilizing a unit of land for a specified time period. It may be expressed as animal unit months or animal unit days per acre, hectare, or section, or the reciprocal (area of land/animal unit month or day).

GRAZING CAPACITY, although sometimes used synonymously with carrying capacity, is defined as the total number of animals which may be sustained on a given area based on total forage resources available, including harvested roughages and concentrates.

GRAZING CAPACITY is the relationship between number of animals and area of land at any instant of time. It may be expressed as animal-units per acre, animal-units per section or AU/ha. For definitions of other terms used in this discussion, see the Glossary of Terms Used in Range Management.

The Recommended Method to Determine Carrying Capacity



By far the easiest and most accurate method of determining the carrying capacity of a unit of land is to obtain past stocking rates and grazing management history from the previous owner/grazer and then assess the ecological status (range condition) and **range trend** of the land.

If range trend has been stable or upward the past few years, then the stocking rates have been within carrying capacity limits and past management practices have been effective. If trend is downward, then an adjustment in management or stocking rate is needed.

Caution! Downward trend does not necessarily mean numbers of animals should be reduced. In fact, stocking rate is the last thing to consider. A more likely cause of downward trend, especially on Idaho rangelands, is poor livestock distribution. This can be easily assessed by doing some simple utilization mapping. If there are areas of a pasture that are under used and others over used, then what can be done to encourage the livestock to make more use of the under utilized areas?

Other factors to consider before reducing stocking rate are:

- Is a change in grazing season warranted?
- Is the grazing system being used working or are changes needed? Would a shorter period of grazing or a season of rest improve the range?
- Is the appropriate kind of animal being used (i.e. is the rangeland better suited for sheep than cattle, etc.)?
- Is there an alternative source of forage available? Or is brush or weed control warranted?
- Has there been a recent extended drought?
- Have other uses increased (i.e. numbers of wildlife) or caused the downward trend?

If it is determined that one or more of these factors is not the cause of downward trend, then an adjustment in stocking rate may be warranted. Make the adjustments you feel may be necessary, monitor trend, and readjust upward or downward as conditions warrant.

Another easy and fairly accurate method of determining carrying capacity is to look at comparable pasture or rangeland in the area and find out what their carrying capacity estimates are. The local [Cooperative Extension Service](#) or [Natural Resources Conservation Service](#) offices may also be able to assist you in determining carrying capacity. If the unit of land you are interested in is public land, the administering agency should already have an estimate of carrying capacity.

What if there is no historical stocking rate available?

If there is no historical stocking rate information available or the local Extension Service or Natural Resources Conservation Service offices can not provide such information, they may be able to assist you in measuring annual forage production on the land in question and calculate an estimate of carrying capacity.

This may very well be the case if you have irrigated pasture that is seeded to a forage species or mix of species that is not commonly grown in your area.

Caution! This method works well in theory, but is based on a series of estimates. The final result is only as good as the estimates. Contact your local [Cooperative Extension Service](#) or [Natural Resources Conservation Service](#) office for assistance.

Carrying Capacity

In ecological terms, the carrying capacity of an ecosystem is the size of the population or community that can be supported indefinitely upon the available

resources and services of that ecosystem. Living within the limits of an ecosystem depends on three factors:

- the amount of resources available in the ecosystem;
- the size of the population or community; and
- the amount of resources each individual within the community is consuming.

The concept of carrying capacity is closely related to the idea of "capital". The term "capital" is most commonly used to refer to money and material goods. However, in the context of sustainability, communities have several different types of capital that need to be considered - natural, human, social, and built capital. Together, these types of capital are referred to as community capital. All four types of capital are necessary for communities to function. All four types of capital need to be managed by a community. All four types of capital need to be cared for, nurtured and improved over time. A community that is living off the interest of its community capital is living within the carrying capacity. A community that is degrading or destroying the ecosystem on which it depends is using up its community capital and is living unsustainably. Carrying capacity is much harder to measure for human, social and built capital than for natural capital but the basic concept is the same - are the different types of capital being used up faster than they are being replenished?

For example:

- A community that allows its children to be poorly educated, undernourished, and poorly housed is eroding its human capital.
- A community that allows the quality of its social interactions to decline through lack of trust, respect, and tolerance is eroding its social capital.
- A community that allows its buildings, roads, parks, power facilities, water facilities, and waste processing capability to decay is eroding its built capital. Additionally, a community that is creating built capital without considering the future maintenance of that capital is setting itself up for eventual decay.

So, in the context of sustainability, carrying capacity is the size of the population that can be supported indefinitely upon the available resources and services of supporting natural, social, human, and built capital.

Class 14:Diseases-classification-viral, bacterial and metabolic-General control and preventive measures.

Health

The Condition in which all the organs and tissues in the system functions normally and harmoniously.

Any change from normal state either to single or great extent is called disease stage.

Health is fundamental for a sound enterprise.

Most of the disease can be avoided by proper attention, sanitation, hygiene, nutrition and management practices.

Once outbreak of disease complicated – strain – financial loss – dual – production expenditure on medicines.

So the farmer – vigilant – day to day activities- to avoid or prevent spreading of disease and to have a check on financial loss.

Control of Disease

Provide well ventilated and proper housing

Provide balanced nutritious diet

Strict hygiene and sanitation of animal houses.

Adhere regular and routine ‘vaccination’ schedule

Avoid entry of outsiders within the farm-premises.

Follow up of latest scientific know how and management practices.

Disease

Bacterial	Viral	Mycotic	Metabolic
BQ	FMD	Dermatitis	Hypo cal pica
Hs	Rp		mg tetany

Prevention is better than cure

Periodical vaccination

Quarantine

Hygienic measures – Mastitis public importance economic loss.

Deworming : Broad spectrum antihelmenthic-Panacur, Nilverm, helmonil , Cu so₄

Ecto + Endo – Ivermectin

Ecto – Butox

Tictac

Pestoban

Ectomin

Classification

Infectious or contagious	Non infectious or non contagious
1. Bacterial a) Anthrax b) Black quarters c) Halmorrhagic septicalmia d) T.B e) Brucellosis	Metabolic Milk fever or Hypocalcaemia Acetonemia or Hypo glycaemia, Ketosis
Viral a) Rinderpest b) Foot and Mouth	Dietary Tympanites or Bloat impaction Non specific enteritis
Parasitic Ecto parasite : Tick, lice and mite Endo parasite : Tape, Round	
Fungal Aflatoxicosis	

CLASS 15: VIRAL DISEASES- FOOT AND MOUTH - BACTERIAL DISEASES- ANTHRAX, HAEMORRHAGIC SEPTICEMIA AND BLACK QUARTER - METABOLIC- TYMPANITES, KETOSIS AND MILK FEVER. MASTITIS AND ITS CONTROL.

Foot and Mouth Disease

FMD – Highly communicable disease – cloven footed animals

Causative organism : family : Picornaviridae

Genus : Aphthovirus

Smallest of the Animal virus : 7 types virus : O,A,C Asia I, SAT 1,2,3

Transmission : Direct contact : Thro water : manure : Pasture and cattle attendant

Symptom : Incubation period 2 – 5 days : Temperature 40°C

Drooling of saliva : Loss of appetite

Vesicles in Tongue : gum : inter digital space, udder & teat . Rough coat with long hair, panting. The animal loses appetite and body weight milk production reduced. Lameness on account of painful foot lesions.

Treatment : Nil. External application of anti septics contributes to the healing of ulcers and wards off attacks by flies

Antibiotics may be administered to counter bacterial infections.

Prevention : Thorough disinfection of shed, utensils, clothes of attendants.

Control : Vaccination – polyvalent – once – 4months or varies with type of vaccine

Hoechst 3ml .oil adjuvant : IVPM – 20 ml calves – 40ml adults.

Rinderpest : Most destructive of the virus disease

Causative organism : Virus, Family, paramyxoviridae

Genus : Morbillivirus

X-Breed and Pure bred – Highly susceptible

Transmission : Virus found notably saliva, discharge from eyes, nostrils, urine and faeces.

Incubation period of the disease 3-7 days 4 – 6th day – Temperature 40-41°C

Symptom: Loss of Appetite : Lachrymation : dryness of muzzle, arching of back.

Shooting diarrhoea : Ulcers in the mouth 7 – 9 day – ulcers in the lips and Gums

Death – 10th day after on set of symptom

Prevention and Control : Segregation of affected animal periodical and routine. Disinfection of shed.

Control : Vaccination 1.TCRV 2. GTV – Immunity – 3 years 1 ml s/c – Neck

Treatment : Antibiotics and Astringent : Fluid therapy

FROM 1.3.1998 TAMIL NADU PROVISIONALLY DECLARED FREE FROM RINDER PEST – INTENSIVE VACCINATION PROGRAM CONDUCTED ZERO SURVEILLANCE BEING UNDERTAKEN.

THE SAME VIRUS AFFECTING SMALL RUMINANTS (SHEEP AND GOAT) DISEASE IS CALLED- PPR – PESTE DES PETITS RUMINANTS.

ANTHRAX : Peracute disease affecting cattle, sheep, horses and pigs. **man is susceptible but is not a primary host-wool sorters disease.**

The disease is always fatal in animals

Causative organism : Bacillus Anthracis – Bacterial Disease - sporulation occurs outside the body. spores highly resistant and not killed by heat, light & disinfectant

Symptoms : Peracute – death occurs within minutes and animal collapses with convulsions

Acute : high rise of temperature : shivering Abdominal pain ; before death blood Oozes out of rectum and nostrils.

All the orifices usually exude dark tarry blood which does not clot. Death is suspected for anthrax carcass should not be opened.

Spleen is enlarged 10-15 times its normal size.

Diagnosis : Sudden death : acute bloat : exudation of blood – orifices

Blood smear – presence of large blue rods which pink capsule.

Control : Annual vaccination

A live spore vaccine prepared from a virulent uncapsulated strain of B.Anthraxis dose 1ml.

Prevention : Hygiene and sanitation – the carcass of the animals suspected of dying due to anthrax should never be opened. The carcass is burnt or buried in a deep pit and lime is applied.

ANTHRAX

Synonyms : Splenic Fever

Etiology : Bacillus anthracis is a gram, positive, non motile spore.

Forming bacterium of relatively large size (4 to 8 μ x 1 to 1.5 μ) the bacilli grow in chain formation, but may occur singly or in pairs. They form spores after discharge from an infected animal or an opened carcass. The spores are resistant to heat, chemical disinfectants and prolonged drying. Anthrax bacilli have remained viable in soil stored for 60 years in a rubber stoppered bottle.

Transmission : Infection gains entrance to the body by ingestion inhalation or through the skin. It is generally considered that mode of infection is by ingestion of contaminated food or water. Inhalation infection is thought of be of minor importance in animals although the possibility of infection through contaminated dust must always be considered. "Wool sorter's disease" in man is due to the inhalation of anthrax spores by workers in the wool and hair industries. Spread of the organisms with an area may be accomplished by streams, insects, dogs and other carnivores, and wild birds and by faecal contaminate from infected animals.

Clinical findings. : The disease occurs on i. Peracute ii. Acute iii. Chronic and iv. Cutaneous form.

Peracute form: Characterized by its sudden onset and rapidly fatal

- i) staggering, difficult breathing, trembling.
- ii) Collapse after a few convulsive movements.

Acute form

- i. Rise in body temperature (107⁰F)
- ii. Period of excitement followed by depression.
- iii. Respiratory or cardiac distress
- iv. Staggering, convulsion and death
- v. Bloody discharge from the natural body openings.

Chronic form

Local lesions confined to tongue and throat is absent mostly in pigs but occurs occasionally in cattle, horses

Cutaneous form (or) Localised form

- i. characterized by swelling in various parts of the body
- ii. Anthrax organism lodged in wound (or) abrasions of the skin.

Human beings.

1. Man may develop localized lesions (Malignant) from contact with infected blood (or) tissue.
2. Acquire fatal pneumonia (wool sorters disease) from inhalation when handling animal by products.
3. Occasionally man develops "Acute meningitis". From systemic involvement, (or) intestinal anthrax from consumption of meat.

Necropsy finding:

- i. A carcass suspected for 'Anthrax' should not be opened
- ii. Blood smear should be subjected to microscopical examination.
- iii. Striking absence of rigor mortis and the carcass undergoing rapid gaseous decomposition.
- iv. All natural orifices usually exude dark, blood which does not clot
- v. Gross enlargement of spleen

Diagnosis

Microscopic examination of blood smears

- a. The organisms is stained by "Polychrome methylene blue".
- b. Giemsa stain to demonstrate encapsulated bacilli.

ii. observation of death of guinea pig or mice (experimental animal within 48 hours following inoculation of blood (or) tissue suspension.

Differential diagnosis:

- i. Lightning stroke may be confused with anthrax
- ii. Acute leptospirosis,
- iii. Anaplasmosis (Gall sickness)
- iv. Acute poisoning from bracken fern, sweet clover leaf.

Treatment

- i. Antibiotics and anti anthrax serum are commonly in treatment
- ii. Penicillin - 5 million units twice daily
- iii. Streptomycin - 8 to 10 g daily in 2 doses - cattle
- iv. Oxytetracycline (5 mg/kg) parentally in the treatment of clinical cases after vaccination in cattle.
- v. Anti anthrax serum intravenously in doses of 100 to 250 daily is effective in conjunction with an antibiotic. It is too expensive for routine use.

Prevention: Vaccination - Periodically in endemic area. The vaccine consists of living attenuated strains of the organisms with low virulence but capable of forming spores have been most successful.

Control:

- i. Hygiene is the biggest single factor in prevention of spread of the disease.
- ii. Careful disposal of infected material is most important

- a. infected carcasses should not be opened.
- b. Burned (or) buried together with bedding and soil contaminated by discharges.
- c. Burial should be atleast 6 feet deep with an ample supply of quick lime added.
- iii. All suspected cases and in contact animals must be segregated .
- iv. Disinfection of premises, hides, bone meals, wool hair requires special care.
- v. Disinfection with 5% lysol require to be in contact with spores for at least 2 days.
- vi. Strong solutions of formalin or sodium hydroxide (5 to 10%) are probably most effective.

Black quarter :

Acute infectious disease but not contagious - inflammation of muscle, severe toxemia.

Causative organism : Bacteria – *Clostridium chauvoei* – gram positive

Anaerobic spore.

Young stock mostly affected – 6months – 2years disease outbreak which the onset of rainy season.

Symptom : Animals may die without showing symptom obvious sign – crepitant swelling in hind and fore quarters which crackles when rubbed due to gas in the muscle.

Lameness – Fever – twitching of muscle - affected region is hot and painful but becomes cold and painless.

skin over affected area – dry, hard and dark

Diagnosis : affected part is black or dark red - characteristic rancid smell.

Control: Hygiene and prophylaxis control.

Prevention : vaccination – before onset of rainy season – 5ml –polyvalent s/c (*clostridium* sp.).

Antibiotics like penicillin and tetracycline may be given.

Haemorrhagic septicaemia (HS)

Causative Org : Bacteria – *Pasteurella multocida*

- Symptoms :
- i. Acute form : Septicemia
 - ii. Sub acute form : edematous swelling
 - iii. Chronic form : with pulmonary infection

Acute High temperature 106°F rapid and Difficult breathing discharge from nostrils and watery faeces dehydration, prostration and death.

Sub acute swelling in the throat, neck, dewlap and Brisket extending upto fore lines

Tongue : Swollen and protruded out

Laboured breathing with stertorous sound

Chronic form : Painful with thick and blood discharge from nostrils.

Treatment : injection of sulphadimidine

Prevention : Vaccination once 1 year – before – rainy season

Control : Isolation – Routine hygiene and sanitation

Mastitis – Inflammation of the udder – physical and chemical changes in milk – major economical loss to dairy industry – due to reduced milk production.

cause : Bacterial origin mainly – *Stragalactiae*, *Staphylococcus*, *Corynebacterium*, *E-coli*.

Transmission: Infection occurs via the teat canal – contaminated environment – skin of udder, milking equipment, milker etc.

Symptoms : Hot, Swollen, painful udder with purulent yellow secretion.

Rise in body temperature enlargement of udder and cessation of milk secretion.

Milk secretion becomes blood stained and may contain pus.

quarters may be completely affected.

In some severe cases animals may die or toxæmia.

Diagnosis : early detection is important by physical examination of the udder.

Many kits are available for diagnosing the disease.

Treatment : Effective drugs are available for treatment

Control: Hygienic measures are important.

- a. Animals diagnosed positive should be milked at last.
- b. Milkers should wash their hands before milking and should use well washed white overalls.
- c. A separate clean cloth for each cow is used for washing the udder with a disinfectant.
- d. The first stream of milk from each quarter should not be allowed to drop on floor but collected in a separate container. Milkers should not wet their hands with first stream of milk.
- e. Normal milk-room hygiene including washing of milk containers and equipment should be practised.

Milk fever : (parturient paresis, metabolic disease in cows soon after calving)

cause :Serum calcium levels fall in cows after calving as a result of failure to mobilize calcium reserves and of the development of negative calcium balance in late pregnancy.

symptoms: Disease flares up within 72 hours of calving initially the cows show excitement, incoordination of movement muscular tremors in limbs and head, lying in recumbent position with her head directed towards flank. In final stages subnormal temperature, dilatation of the pupil, impalpable pulse, coma and death.

Diagnosis of the disease is based on the occurrence of milk fever in recently calved animals.

Treatment & Control : Dramatic recovery by intravenous administration of 300-400 ml calcium borogluconate with Vitamin D₃ injected intramuscularly. Continued mixing of ½ liter of supernatant lime water for cow may reduce the incidence.

Ketosis : Acetonaemia – disturbance of carbohydrate metabolism in high producing dairy cattle – hypoglycaemia and appearance of ketone bodies.

Causes : Disease is caused by deranged metabolism of carbohydrate and volatile fatty acids resulting in reduced level of sugar in blood (hypoglycemia), increased level of ketones in blood (ketonemia) and in urine (ketonuria)

Symptoms : Cardinal signs in digestive and nervous type of ketosis usually appear in good milkers from 7 days to six weeks after calving. Loss of appetite, rapid loss of weight and marked reduction in the milk yield observed in digestive type of ketosis. In nervous type symptoms include depression, a staring expression, walking in circles, treading with the feet, incoordination of movements, convulsions, sudden falling on the ground with wide expression of bulged eyes. Respiration becomes shallow emanating fruity odour on the breath.

Diagnosis : Examination of ketone bodies in the urine helps in diagnosing the disease besides the symptoms noticed.

Control and Treatment: Intravenous administration of 500-1000 ml of 40 per cent glucose, Repeat for 5 days. Cases not responding to glucose therapy, intramuscular injection of 100-200 mg of hydrocortisone or 50 to 200 mg of prednisolone acetate. Concentrate feeding with good fodder during dry period in high yielding cows, ½ to one kg maize or cholam made as gruel mixed with ¼ kg of jaggery or molasses daily to be given to cows nearing parturition.

Bloat : (TYMPANY); is a disease of ruminants in which rumen and reticulum is over distended with the gases of fermentation.

Cause : Excess intake of fresh legumes and feeding of high grain ration lead to frothy bloat. Obstruction to normal expulsion of gases from rumen by choking the oesophageal passage by corncob, turnip and sugar beet cause free gas bloat.

Symptoms : Acute form of tympany results in sudden death before rendering any aid to the affected animal. In acute cases, the distension of the rumen occurs quickly, the flank and the whole abdomen is enlarged. On percussion the left flank produces a drum like sound, Initially the animal frequently gets up and lies down, kicks at belly and even rolls. Breath becomes difficult and is evidenced by oral breathing, protrusion of tongue and salivation. When the distension of abdomen becomes extreme, the animal exhibits uncoordinated movement, inability to stand, falls all of a sudden. Collapse and death occur quickly. In chronic tympany, the distension of abdomen and intra-abdominal pressure are not serious. The gas is 'free' but retained because of obstruction of the passage thereby preventing normal eructation of gases.

Diagnosis - of tympany is easy by the characteristic symptoms of distension of abdomen and distress by the affected animal.

Control and Treatment : in per acute cases puncture the rumen with a sharp knife or with a trocar and canula to expel the gases. Administer orally oil of turpentine 60 ml well mixed with one litre of groundnut oil or gingelly oil or cocounut oil. After six to eight hours administer powdered ginger 30 grams, Asafoetida 30 gram, well mixed to jaggery. Fresh legumes should be wilted and then fed to stallfed animals. Feed dry roughages before turning the cattle to luxuriant pasture to avoid bloating.

CLASS 16: ZOO NOTIC DISEASES – PREVENTION AND CONTROL (ANTHRAX, TUBERCULOSIS, BRUCELLOSIS, AND RABIES)

ZOONOSSES : Are diseases of animals including Homo sapiens. Its infective agents have become adapted to a particular animal species during course of evolution and can exist in these animals by uninterrupted infection chains. In narrow (epidemiological) sense, transfer of causative agent of an animal disease to human beings is zoonoses.

They are diseases and infections the agents of which are naturally transmitted among other vertebrate animals and man. Also included are a number of infections, which are shared but not naturally transmitted.

Classification

- a. Direct Z. – example rabies
- b. Cyclo Z. – eg. -teaniasis
- c. Sapro Z. – eg. – histoplasmosis
- d. Meta Z. – eg. – Japanese encephalitis
- e. Anthrupo Z. – Eg. Brucellosis

Disease	Cause	Non human principal hosts	Modes of infection	Symptoms	Class of zoonoses
Brucellosis	Brucella abortus Br. melitensis Br. Suis Br. canis	Cattle, goat, sheep, swine, caribou, dog.	Occupational exposure through air, contact, Ingestion of infected milk /food	IP 1-3 weeks, or month; septicaemic; continued, intermittent or irregular fever, chills, profuse sweating, weakness, fatigue, patients get up as normal in the morning to fall in bed with high temperature in the afternoon, insomnia, headache, arthralgia, splenomegaly, disease lasts for weeks, months or even years.	Direct anthroozoonosis
Anthrax	Bacillus anthracis	Cattle, sheep, goat, horse, wild herbivores	Occupational exposure through contact, air-borne, vehicle (meat)	1 P. 2-5 days Cutaneous form : Vesicle develop into black depressed eschar, generally uncared, not treated in time resulting into septicaemia and death. Pulmonary (wool sorters disease) resemble common infection of upper respiratory tract : 1, P	Direct anthroozoonosis

				3-5 days, acute, fever, shock and death. gastrointestinal form IP 4 days, gastroenteritis blood in stools, death.	
Tuberculosis	Mycobacterium bovis	Cattle	Occupational exposure through contact; ingestion of raw milk, inhalation	Extra pulmonary form most common. Cervical adenitis, genitourinary, bone, joint infections; meningitis, pulmonary form in occupational groups, transmit back to cattle.	Direct anthroponosis
Leptospirosis Weil's disease	Leptospira interrogans	Rodent, domestic and wild mammals, contaminated soil water at neutral to alkaline pH	Occupational and recreational exposure through contaminated water, ingestion	IP 1-2 weeks, as short as 2 days, septicaemic phase (1-10 days), leptospiuria (1 week to several months) Icteric form (Weil's disease), hepatonephritic form fever, headache conjunctivitis, vomiting, diarrhoea and constipation.	Direct anthroponosis

17TH CLASS:- MID SEMESTER EXAMINATION.

BEST WISHES

**CLASS 18: SHEEP AND GOAT FARMING-CLASSIFICATION OF BREEDS OF INDIAN AND EXOTIC ORIGIN-
NOMENCLATURE ALONE.**

Sheep belongs to the family Bovidae ,Genus Ovis and Species- aries. The sheep an important economic livestock species contributes greatly to the agrarian Indian economy. They play and important role in the livelihood of a large percentage of small and marginal farmers and land less labourers. Sheep manure is an important source of organic fertilizer especially in the southern state where they are folded on fallow land for increasing fertility of the soil. Sheep are mostly maintained on natural vegetation grazing lands (common) waste lands and uncultivated lands, stables of cultivated crops and tree loppings. Sheep are mostly reared for meat and wool.

Population - world 1110.78 millions (1993)

India – 49.20 million (1992) – 6th in over all sheep population in the world.

Breeds: There are 44 describe breeds of sheep

Northern temperate region – Eg. – Gaddi, Kasmir Merino, Gurez

North west Arid region – Eg. Chokla, Nali, Hissardale, Bharath merino

Southern – Nellore, Mandya, Mecheri, Kilakaraisal, Vembur, Coimbatore, Nilgiri, Ramnad White, Trichy Black, Madras red.

Eastern – Balangir, Shahdadi.

Exotic breeds – Merino, Rambouillet, Dorset, Corriedale.

Nutrition : Sheep prefer ground vegetarian grasses, legumes, and wide varieties of forages.
water requirement adult sheep 2 – 4 liters

Energy : Adult – Non pregnant sheep – 93 K cal. ME / kg. W^{0.75}

Lactating - 102 K cal. ME / kg. W^{0.75}

Protein – DCP requirement – 1 g for every 1kg live weight (adult non pregnant)

Increases by 50% during pregnancy and 100% during lactation.

Housing and shelter management : Normally sheep do not require elaborate housing facilities but minimum provision will definitely increase productivity. Shed could be along the wall of the house. Further protection could be provided with gunny bags and protection made of thatching material and bamboo.

space requirement – 1 m² space per head. shed measuring 18m x 6 m can accommodate 120 sheep.

Dipping and deworming are important management practices to be adopted.

GOAT : Family – Bovidea Genus Capra

Goats provide an dependable source of income to more than 40% of the rural population who live below the poverty line in India.

Population – 114.32 x 10⁶ (1992 estimated)

Goats are mostly raised by land less labourers and marginal farmers. Goats produce lean and juicy meats (chevon) which is preferred by all religious sects.

The goat milk contains lower fat percent with smaller fat globules, higher protein and lactose and rich in minerals.

Breeds : 23 well defined breeds goats in India
for meat and skin – Black Bengal, Kanni adu
Meats, skin and milk – Barvari, Malabari (Tellicherry), Sirohi, Surti
Meat hair and skin – Gaddi, Kutchi, Marwari
Milk meat and skin – Beetal, Jamunabari,

Exotic breeds and crossbreeding experience :

Specialized exotic dairy breeds of the temperate zone, viz, Alpine, Saanen, and Hohair breeds. , Angora had been used in controlled experiments in India to assess the improvement of milk yield and Mohair production. The level production of crosses of high yielding indigenous dam breeds, Eg. Beetal were superior to those of the crosses of relatively low yielding Malabari in spite of similar body size. The advantage of improvement in milk yield of exotic crosses at all the experimental stations, has been further discounted by abysmally low fertility and high mortality of kids.

Nutrition : Goats generally accept a wide variety of feeds but what is acceptable to one may not be equally acceptable to the others. They prefer to select from the wide variety of feeds and vegetarians (Preferably leaves) and like fresh fodder, grains, seeds and pellets rather than the wet feeds, silages, chopped greens, soiled forages and hays. Goats have higher tolerance to the wide variety of otherwise undesirable phyto-chemical compounds which enable them to consume a wide range of plant species.

In comparison with cows, then milch goats require a higher amount of TDN. Goats have the capability of consuming dry matter to the tune of 5 to 8% of its body weight. As a species, it can utilize lignin and cellulose better than the other ruminants and sustain water deprivation for longer periods. The nitrogen recycling through rumen is also considered better.

The deficiency of major nutrients, energy, protein and dry matter, in the country amounts to 50-60. 50-75 and 80% respectively. Availability of the grass, browse and agro-industrial by-products for goats is approximately to the tune of 40, 9.6 and 48 million tonnes/annum in the country.

Goats are normally reared on browse and pasture forage that other ruminants do not consume. major part of feed of goats comes from natural vegetation on common grazing land range land and other non cultivable areas.

Top feed resources

A large variety of tree leaves (top feed) save as promising feed resources for goats. It is estimated that annual production of green leaves for fodder from trees in the country is to the tune of 24 million tones. Against the requirement of 1.9 m tones of DCP and 17 x 10 Million M cal DE the tree leaves provide 0.7 mt DCP and 4 x 10 m M cal DE to goats. Most of the tree leaves contains 20 – 40% dry matter 4 – 15 % DCP and 50 – 60% TDN depending on the season of harvest but their palatability is poor which limits the energy supply to goats.

Housing

Shed – long axis East west
Floor space- adult goat 1.2.5 – 1.5 m²
Pregnant doe and bucks – 2 m².
Kids – 3 – 6 months 0.7 to 0.9 m²
6month – 1 year 1m²
Individual kidding pens are essential to house does in late pregnancy.

Importance of small ruminants in Indian Agricultural

GOAT

1. Adapted to different agro-climatic condition.
2. Un fastidious in food habit
3. No religious prejudice against chevon.
4. Low cost of maintenance, short term return and low risk.-better suited for small and marginal farmers.
5. Can thrive in conditions where cows and buffaloes can not sustain.
6. 35% of meat production and 3% of milk production of India.
7. During grazing 50% of time is spent only on tree leaves.
8. Being smaller in size - with larger surface area, well adapted to high temperature - arid areas.
9. Semi-arid areas with sparse vegetation, bushes, shrubs - steeply sloped mountainous regions cannot be suited for cattle but goat and sheep.
10. Physical characters of different breeds in various regions are well adapted. to the local need - large size with longer legs to suit longer distance walk in high temperature areas and small size with shorter legs are found in humid areas.
11. Special feeding habits with mobile upper lips and highly prehensile tongue can take foliage which are not available to other livestock species.
12. Higher crude fibre digestibility.
13. High growth rate in population (2%) despite being slaughtered at higher numbers due to its prolificacy, short generation, regular breeding through out \ the year, short inter kidding interval.
14. High growth rate in body weight.
15. Adaptable in to any system of management.
16. No competition human beings.
17. Moderate milk yield, (1.5 to 2.5 Litres) from poor quality pasture
18. Manure from 1 goat is sufficient to manure half an acre.
19. High disease resistance.

Sheep

1. High adaptability to extremes of climate
2. Gregarious animal
3. Uniparous
4. Important in arid and semi- arid area for marginal sub-marginal holdings.
5. 6% of world population.
6. Insurance during the crop failure and during monsoon failure.
7. Apt to hilly, drought and desert regions
8. Important subsidiary and complimentary unit in mixed / integrated farming.
9. Can thrive on are agro-climatic regions except rainfall areas.
10. Can thrive in low set sparse vegetation where other livestock can not thrive because of close grazing.
11. No expensive investment for buildings equipment - suitable for marginal small farmers.
12. valuable manure.
13. Populations fluctuate due to diseases

Northern temperate Region - Fine wool
And Nilgiris of Tamil Nadu
North West arid Region - Carpet wool
Southern Region - Meat
Wool potential : 3.5 - 5 kg - exotic breeds
1 - 2 kg - Indian breeds

Poor management TM 20% of meat realisation

Effective utilization of and cultivable waste lands, unwanted shrubs and weeds.

Sheep breeds :

Southern region -

1. *Mandya*

Native tract : Karnataka

Colour - White

Physical traits - White, compact body, typical reverse "U" shaped from year end.

Body Weight - Male 35 kg : Female 25 kg

Good quality Mutton

2. *Nellore*

Native tract : Andhra

Colour : white

Physical traits : Tallest in Indian breeds.

Body weight - Male 36kg ; Female 30 kg.

Tamil Nadu

1. Nilgiris : developed from Tasmanian merino, Cheviot, dorset and south down breeds

Colour : white

Physical traits : polled, roman nose,

Body weight : 30 - 40 kgs.

Wool yield : 600 to 900 gm per annum

Only breed in south India producing apparel wool .

2. Coimbatore / Kurumbai / Sulur

Native tract : Coimbatore District

Colour : White with black or brown markings on face and neck

Body weight : Male 25 kg : Female 20 kg.

Coarse fleece : 400 - 500 g.

3. Madras red

Native tract : Chengalpet and Madras District

Colour : brown

Body weight : Male - 35 ; female - 25 kgs.

4. Mecheri

Native tract : Salem and Coimbatore District

Colour : Light brown

Body weight : Male 35 kg : Female 20 kg.

Polled

5. Keezhakaraisal

Native tract : Ramnad, Dindukal, Pudukottai, Madurai Districts

Colour : Dark tan with black markings on head, belly and legs.

6. Ramnad white

Native tract : Ramnad, Pudukottai, Thanjavur Districts

Colour : White with black markings on head, belly and leg.

Body weight : Male - 31 kg : Female - 20 kgs.

7. Vembur

Native tract : Virudhunagar, Tuticorin Districts.

Colour : White with red or fawn markings

Body weight : Male - 35 kgs : Female - 28 kgs.

8. Trichy black

Native Tract : Trichy, Arcot, Salem Districts.

Colour : Black with White face.

Body weight : Male - 25 kgs : Female - 18 kgs.

Exotic Breeds

1. Merino : Best fine wool breed

Native tract : Spain

Body weight : Male - 90 kgs : Female - 70 kgs.

Dense, strong staple, close crimps

2. Rambouillet

Native tract : Descendant from Merino developed in France.

Body weight : Male - 90 kgs : Female - 70 kgs.

3. Polworth :

Native tract : Australia (for areas not suitable for merino)

Lincoln x Merino

4. South down :

Native tract : England

smallest of meat breed

Typical meat breed (compactness short legs)

5. Cheviot : Superior and effective meat producer

Body weight : Male - 80 kgs : Female - 55 kgs.

6. Corridale : Dual purpose (meat and wool)

Native tract : New Zealand

Lincoln x Merino

7. Karakul : Pelt breed

Goat Breeds :

Jamunapari

Home tract : Etawah district and tract between Jamuna and Jambal river in UP.

Physical traits : Larg, tall, long folded pendulous ear, prominent roman nose, long and thick bunch of hairs on hind quarters

Length : 3½' - 4½'

Height : 2½' - 3½'

Body weight : Does 45 to 60 kg

Buck 60 to 85 kg

Milk Yield : 2.25 to 2.75 kg per day.

Beetal

Home tract : Punjab

Colour : Red, tan

Physical traits

As this breed evolved from Jamunapari physical traits are almost similar to it.

Barbari

Home tract : UP, Hariyana

Colour : white with red spots

Body weight : Does 25 to 35 kgs.

Buck 35 to 45 kgs.

Suitable for stall feeding.

Prolific breeder and high milk yielder

Black Bengal

Home tract : West Bengal

Colour : Black

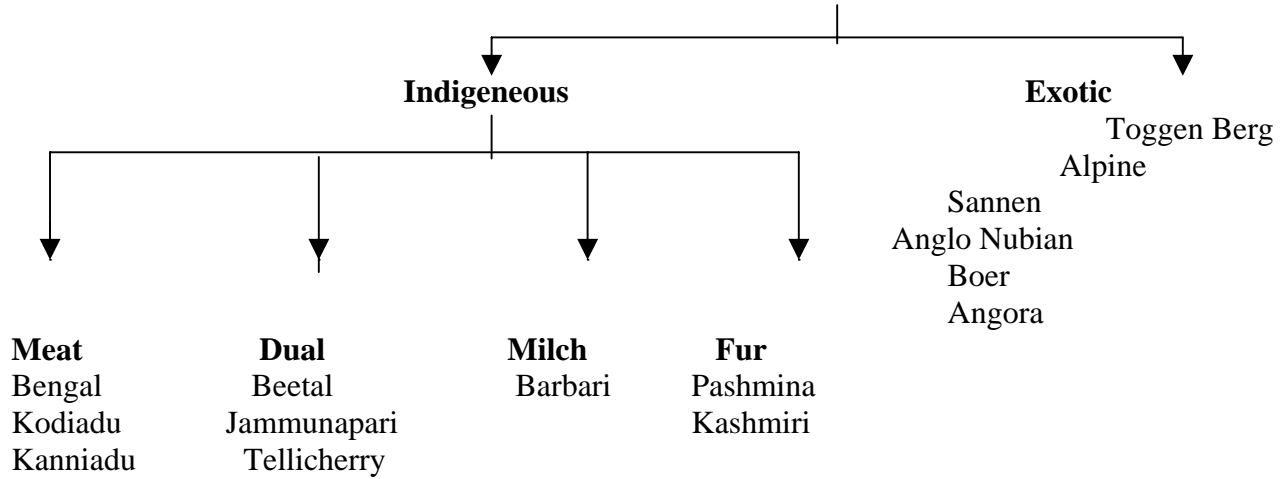
Physical traits : shorter breed.

Body Weight : Does 10 to 15 kg

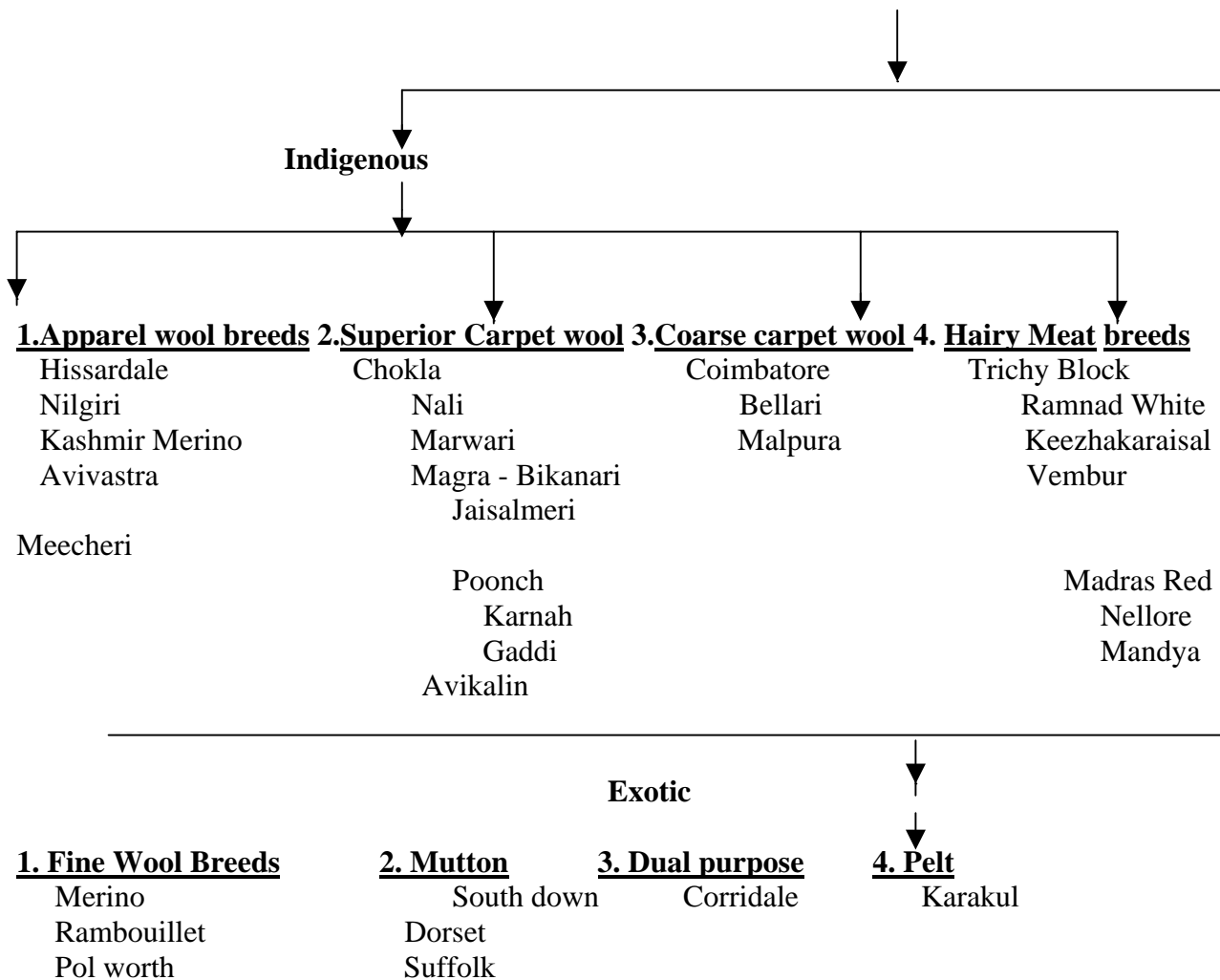
Buck 15 to 20 kg

Nomenclature		
Traits	Sheep	Goat
Species	Ovine	Caprine
Group	flock	Band/herd
Adult male	Ram	Buck
Adult female	Ewe	Doe
Young male	Ram lamb	Buckling
Young female	Ewe/Gimmer lamb	Goatling
New born	Lamb	Kid
Castrated Male	Wedder	Wether
Castrated Female	spayed	Spayed
Act of parturition	Lambing	Kidding
Act of mating	Tupping	Servicing

Breeds of Goat



Breeds of sheep



Breeds

Temperate Himalayan : good quality wool.

1. Gurez
2. Bharwal
3. Gaddi
4. Ramper Bushiar

Western region : - superior carpet wool.

Magra

Chokla

Nali

Bikanari

Coarse wool - Marwari

Class 19. Systems of rearing-Housing management- Type design- Floor diagram-Space requirement for adult and young stock.

System of Production :

Nomadic:

Permanent 1. Subsistence
commercial

1. Teathering 2. Extensive 3. Semi intensive 4 Intensive

Teathering :

- ❖ Sedentary system
- ❖ Suitable to areas of intensive agriculture
- ❖ Controlled system of management
- ❖ Minimum labour input
- ❖ Utilization of feed stuffs in site

Extensive system:

Allowed for grazing on agriculture land after harvesting and on natural bushes, shrubs and natural pasture land.

Disadvantages : Low carrying capacity

- ❖ Deficit of nutrients excepts during monsoon.
- ❖ Only poor quality (High fibre) plants are available.
- ❖ Less weight gain : 20-40gm/day
- ❖ No possibility of separating on age basis.
- ❖ No scientific management is possible
- ❖ Improvement by.

1. Indiscriminate breeding – avoided
2. Castration of scrub bucks and rams.
3. Timely vaccination and deworming.
4. Bran supplementation.

Semi intensive system : On return from grazing – being supplemented with concentrates – Western countries – provision – of pen with paddocks. – Growth rate – 40-50 gm/day. High margin of profit.

Intensive system : Confined / provision of pen and run / grazing on cultivated fodder and concentrate supplementation in stalls.

Advantages :

- ❖ Don't destroy plants – preventing soil session.
- ❖ Carrying capacity is high.
- ❖ FCR is high
- ❖ Good quality manure is obtained.
- ❖ Labour efficiency is high.
- ❖ Scientific management is possible.

Disadvantages :

- ❖ Parasitic problem - external.
- ❖ Free roaming- restriction land to reduced feed in take and weight gain.
- ❖ So should be confined from young age onwards.
- ❖ High quality litter management NH₃ production – respiratory problem.

❖ Heat identification – problematic.

Housing

1. Not expensive
2. Adequate space
3. Proper ventilation
4. Good drainage
5. Plenty of light
6. Protection from predators and adverse climate
7. Dry floor.

Space allowance

Adult : Male : 20- 25 sq.ft.
 Female: 15-20 sq.ft.
 Young : 10 sq.ft.

Intensive system :

Deep litter system
Slatted floor
Concrete floor

Breedable male shed : 2.5 m x 2.0 m
Individual one to avoid fighting

Parturition shed : Individual basis preferably with paddocks.
Segregation / Isolation shed / sick animal shed : 10' x 5'
One corner of farm
Leeward side

General flock shed 50- 60 does

Kid shed : 20-30 nos.
Hay racks : Box made up to wooden reaper fixed at the interval of 5 cm. Elevated benches.

CLASS 20. CARE AND MANAGEMENT OF RAM, EWE AND LAMB-NUTRITION- FEEDS AND FODDER FOR SMALL RUMINANTS.

&

CLASS 21. CARE AND MANAGEMENT OF BUCK, DOE AND KID- NUTRITION- FLUSHING.

Nutrition – small ruminants

Uniqueness

Goat : Browsing – selective feeding of

1. Tender twigs and leaves – not available for other species.
2. Wider feed acceptability.
3. High crude fibre digestibility
4. Consuming more dry matter / unit body weight
5. High convertibility : 45-71% , cow : 38%
6. Capable of thriving on bushes, shrubs, herbs, tree foliage and tree leaves.
7. Highly prehensile tongue and mobile upper lip.
8. Small in size – split feeding is essential
9. Faster passage and fermentation rate
10. To certain extent withstand toxic alkaloids

Sheep : Grazing – better thrive -on stubble after harvest

1. Highly resistant- water deprivation .
2. Bifid upper lip.
3. Consideration for fleece.

Model Concentrate Mixture

	Young	Grower	Adult
Maize	60	30	36
GNC	20	30	21
Fishmeal	10	-	-
Molasses	-	7	-
Bran	7	30	40
Mineral Mixture	2	2	2
Salt	1	1	1

Feeding schedule

upto 3 months	: Milk	Conc	roughage.
3-6 months	:	50 – 100g	adlib
6-1year	:	100 – 150 g	adlib
Adult	:	200 – 250 gm	adlib
Lactating	:	250 – 300 gm	adlib
Pregnant	:	300 – 350 gm	adlib
Breedable male	:	250 – 300 gm	adlib

General considerations

1. Protein feeding during pre-ruminant stage
2. Tree fodder
 - a) Emergency fodder
 - b) Rich in calcium
 - c) Low in fibre when compare to grasses.
 - d) Rich in tannin
3. Pasture : Poor in quality

Mixture of legumes and non legumes best.

Rich in nutrients

High voluntary intake

Enrichment of soil

Carrying capacity :

1/unprotected pasture

2-5/protected pasture

40/ cultivated pasture

Rotational grazing

Young ones :

1. Colostrum feeding

2. Milk feeding

3. Milk replacer

4. Creep mixture

Protein rich concentrate from 2nd week of life upto 3 months of age, with restricted suckling for better growth and early maturity and marketing.

4 – 5 times a day

60-80 gm gain / day – smaller breed

100 – 140 gm gain / day – larger breed.

Composition :

Maize : 60%

GNC : 20%

Fishmeal : 10% DCP : 18%

Wheat Bran : 7% TDN : 70-80%

Mineral Mixture : 2%

Salt : 1%

Antibiotics

Vitamin mixture : 25 gm

Extra feeding for early weaned, orphaned, and mates of multiple litters.

Fattening young ones:

Concentrate : Roughage ratio varies with market need

Lean carcass : 30-40% roughage

fatty carcass : 20 – 25 % roughage

Replacement stocks :

For early maturity, good quality roughage and concentrate

250 – 400 gm with 10-12% DcP and 65-70% TDN.

Breedable females :

Flushing :

Natural flushing

Over feeding

fatty deposition

Poor breeding

Extra feeding just before breeding season – body weight

early onset of breeding activities

synchronized.

Increased ovulation rate

effective in poorly fed animals

Increased conception

Multiple birth

Better weaning .

Management of breedable males.

1. Selection
2. Breeding allowed at the age of 18 months.
25-30 females / male initially – 40-60 / Matured male
Females / beyond 2 years of age.
3. Criss crossing of age groups for better breeding
4. Extra males during synchronization
5. Controlled access to females
 - a) Flock mating
 - b) Pen mating
 - c) Hand mating
6. Exercise in paddocks / range land other wise – slow breeding.
7. Teaser maintenance
8. Marking of male's brisket and breast.
9. Changing of individual once in 2 year to avoid inbreeding.
10. Culling – Poor breeder, Extra feeding, infertile, deformed, aged.

Extra breeding just before and during breeding season.

1. Avoiding adipose tissue deposition.
2. Periodical grooming
3. Periodical evaluation of semen.
4. Protection against parasitic infestation and infectious diseases.
5. Disbudding.

Management of female stock

1. Selection
 2. Breeding : Regular.
- Oestrus Signs : 18 – 21 days : 30 –40 hrs.
Tail wagging
Mucous discharge
Frequent urination
Swollen vulva
Bleating.

Mating : at second day of oestrous

1. Breeding performed – to receive young ones in favourable season
2. Mating by 14 –15 months of age & once in 8 months .

Flushing –

Repeat Breeder.

1. Synchronization of oestrus– Telescoping .
2. Artificial Insemination
3. Embryo transfer technology.

Pregnant females : 148 ± 3 days.

Isolation – diagnosed by $2\frac{1}{2}$ - 3 months of age.

Quality feeding

Exercise

Pregnant Animals : During last 1/3rd period 70-80% of growth of foetus so better care is needed.

Good quality legumes and concentrate to support foetal growth.

To make up loss in previous lactation

To maintain reserve for ensuing lactation.

To meet their own growth.

Poor feeding – Low birth weight – poor survivability

Pregnancy toxaemia

Lactating ones. – low voluntary intake – not sufficient

So reserve during pregnancy created – to meet out peak lactation.

Male – Extra feeding just 40 days prior to breeding season to maintain better libido and fertility.
fattiness should be avoided.

Parturient animals.

1. Based on breeding records.
2. Udder engorgement
3. Relaxed perinium
4. Isolation - fussy in nature
5. Care during prolonged time - Dystocia - Due to disproportionate mating
6. Avoid too much handling to avoid abandoning
7. Watch for shedding of placenta and avoid placenta eating.
8. Provide laxative diet – roughage during peripartum to avoid udder stress.
9. Lactating females: Special Nutrition : Avoiding buck odour
Hoof trimming, Weaning, proper udder care.

Culling : Poor breeder, poor mothers, irregular breeders, aged beyond 7 years of age.

Management of young ones.

1. Starts in pregnancy itself
 - a) By extra feeding b) deworming and vaccination
2. Birth in clean environment
3. Cleaning of mucous from all over the body -induce licking by dams.
4. Care of Navel cord – to avoid naval ill and joint ill.
5. Resucitation for breathing
6. Colostrum feeding with in 15 – 30 minutes.
7. Weighing and identification
8. Fostering : milk feeding for individuals of large litter, orphaned young ones -early weaned.

weak Young ones

I 1/6th Birth weight

II 1/8th Birth weight

III 1/10th Birth weight

Concentrate and roughage from 2nd week onwards.

1. Well ventilated shed.
2. Isolation during early stage along with dam for better growth and to avoid licking each other
3. During winter – heat supplementation
4. Creep ration : high quality concentrate containing animal protein sources.
5. High Quality concentrate containing animal protein sources.
6. Periodical weighing and culling.
7. Periodical deworming, vaccination and deticking.
8. Separation of sexes by 3 months of age.
9. Castration of marketable male kids.
10. Disbudding – sometimes.
11. Marketing by 6-9 months of age.
12. Exercise
13. Docking of lambs – to avoid blow fly infestation.

Creep ration

Grains	: 60%
GNC	: 15 %
Fishmeal	: 7%
Bras	: 15%
Mineral Mixture	: 2%
Salt	: 1 %
Antibiotics vitamins.	

Class 22: Common ailments of sheep and goat-Sheep pox-Foot and Mouth-Blue tongue-Enterotoxaemia – Ecto and Endo parasites.

Blue Tongue : Viral Disease

Infectious non contagious disease

transmitted by Culicoides midges

Virus – Orbivirus - Reoviridae

Sheep are mainly affected – congestion, oedema and haemorrhage, fever lameness

Symptom : Inflicting Mucous membrane of the Buccal Mucosa and

Gastro intestinal tract

Epithelial desquamation of sensitive laminae of hoof udder etc.

No vesicle formation

Pyrexia

Congestion oedema and Haemorrhage of Buccal cavity

Control : A live attenuated polyvalent vaccine

prior to rainy season

Annual vaccination

Pregnant animals vaccinated prior to Lambing

Routine hygiene and sanitation.

Vector control is very important in disease prevention.

Sheep pox : Viral Disease – pox virus

Symptom : Contagious Disease : Inflicting severe losses

High fever – Dullness – Isolation from herd discharge from Natural orifices – Eyes and Nostrils with swelling of eye lids – ‘Pox’ eruptions on the skin of ears, head, inside of thighs, scrotum, lower side of the base of the tail. infection affection – Pneumonia in lambs is more common and death.

Treatment: No specific treatment – Nursing is important. Tissue culture vaccines may be administered.

Skin lesions – dressed with sulphanilamide and neem oil

Broad spectrum antibiotic therapy to prevent secondary bacterial infections.

Control: Sheep pox vaccine,

Enterotoxaemia:

Bacterial Disease - Clostridium perfringens type D and Cl. welchii type ‘D’

Symptoms: Young stock – death occurs instantaneously, convulsions in lambs prior to death.

Adult: Initially calm and Quiet, frothy mouth, champing of jaws, rolling of eyes, convulsions.

Treatment: Sulphadimidine 33 1/3% 1/r +antibiotic therapy- tetra cycline, streptomycin + Penicillin.

Lambs: 3-8 weeks – Pulpy kidney disease

Control : Proper disposal of dead animals

Vaccination : Lambs – 2 weeks of age

sheep – yearly – endemic areas – pregnant ewes – before Lambing.

FMD – refer cattle disease notes.

Ecto parasite and Endo parasites

1. Blue bottle fly : Black Blow fly

Eggs – dirty area of open wound

2. Lice and ticks – wool damaged

a) Fascioliasis – loss of condition

b) Round worms – Anemia

c) Tape worms – bottled jaw – distended Abdomen

weak, anemia, Stunted growth
3. Mites – sheep scab –restlessness
wool loss -treated by using melathion 0.5%
Sumithion 0.1% Sevia 0.8%
Dip – lime sulphur 0.4% W/V

Profuse yellow dark watery faeces -
diarrhoea – deworming.

class 23: Swine Husbandry –Common breeds of exotic origin-nomenclature alone-housing of pigs.

&

Class 24: Care and management of Sow, Boar and Piglets-Nutrition- Creep feeding. Control and prevention of swine diseases –Hog cholera, Foot and mouth, Ecto and Endoparasites.

SWINE- PIG

Industry status

- 1.Primitive
- 2.Poor quality meat and low aesthetic value of meat produced.

Advantages

1. High Prolificacy : 6-12 no./litter
2. FCR –1:2.5 - 3
3. Short generation interval
4. More quantity of meat/unit weight
5. More energy / unit weight
6. High meat : Bone ratio
7. Easily adapted to integrated or mixed farming system.
8. Successfully maintained on discarded feed, garden waste and kitchen waste.
9. High dressing percentage
10. High growth rate : 10Kg./month
11. Early maturity : 9-10 month of age
12. Early puberty : 5-8months
- length of oestrus cycle : 21 days
- Oestrus period : 2-4 days
- Service : 2nd /3rd day of oestrus
- Rebreeding after parturition : 3-4 weeks after weaning.

Comparison between desi Vs. Exotic (India)

	Desi	Exotic
Litter size at birth	7.5	10
Birth weight (Kg.)	0.91	1.4
Weaning weight (kg.)	4.1	13.5
Weaning percentage	54	78.5
Dressing percentage	66	68
Maturity (Months)	14	8 - 10
Growth rate (gm)	70-100	over 300 gm.
Back fat thickness – (cm)	3-7	4-5

Nomenclature

Species : *Sus scrofa vittatus*

Sus scrofa indicus

Group : Stock / Drove

New Born : Piglets (Last born piglet- Runt)
Young male : Boarling
Yong female : Gilt
Adult Male : Boar
Adult female : Sow
Castrated male: stag / Hog
Parturition : Farrowing
Mating : Coupling
Sound : Grunting

Breeds: Large white Yorkshire : Chester white
Middle white Yorkshire : Tamworth
Berkshire : Landrace
Poland china
Spotted Poland china
Duroc
Hampshire

Large white Yorkshire : UK

White, occasionally black spots

Erect ears and dished fore head

Long and deep body

Snout length is medium

Mature body weight : Male : 300-400 Kg.

Female : 230 – 320 Kg.

Middle white Yorkshire : UK

Developed from crossing Small and Large White Yorkshire

Extensively used to upgrade desi pigs as it is smaller in size

Early maturity, rapid growth and can be raised on pasture

But not prolific as that of Large white Yorkshire

mature body weight Male : 250-350Kgs.

Female-180-270Kgs.

Land race : Denmark – Bacon Breed

White with blackspot,

Long snout

Excellent suited for upgrading desi pigs as it needs less feed resources for their maintenance and efficient converter of feed.

Suitable for breeding smaller desi pigs

Mature body weight : Male : 270 – 360 Female : 200-300

Swine Nutrition

Monogastric and omnivorous – low fibre, high quality protein (Animal sources)

Requirement : Energy, protein, mineral, vitamins and additives

Energy : Starch – grains

Fat - oils – upto 10% (normally 4-6%)

fibre – Should not exceed 5-6% if exceeds – low growth rate digestibility

Sources : Cereals, Millets, Byproducts – Bran, molasses – rich in Vit B complex .

Protein : High quality – essential Amino acids – 10

Animal source : rich in lysine % methionine ca, protein, Vit.B.

Vegetables source : rich in Tryptophan and limited in lysine and methionine (Grains – maize)

For effective growth rate : both animal protein sources and vegetable protein sources should be balanced.

By feeding leguminous fodder, we can save the protein requirement from concentrate

Minerals : Micro : Cu, Fe, Co, I, Mn, Se, Zn

Macro: Ca, P, Na, K, Mg.

Ca: P -2:1

‘P’ from plant sources, availability is low as they are in “phytate” from like wise any organic form so DCP, DFRP.

Nacl : 0.5% depending on fishmeal inclusion

Fe: 80 mg/ kg feed

Cu: 8 mg/Kg.feed

Co: essential for B₁₂ Synthesis

I₂: deficiency results in gritre, hari less piglets

Zn: Parakeratosis

Vitamins

Fat soluble vitamins (A,E & K) – corns, Legumes

D₃ – sunlight exposure

B-Complex – greens

B₁₂ -Animal protein sources.

Additives

1.Antibiotics

Water reqt: 2-3 times of feed (4-5 litres/ litre of milk)

2. Probiotics

3.Copper Sulphate

Ration formulation

Requirement

Age	Prewaning	Grower (20 – 90Kg.)	Adults
CP%	22%	18-13	14-15%
ME (k.cal/kg.)	3500	3500-3800	3300

Ca : 0.5 – 0.8%

P : 0.4 – 0.6%

Salt : 0.5%

Model composition

	Creep mixture	Grower	Adult
Maize	53	53	50
Cakes	22	16	7
Wheat Bran	7.5	17	35
Fishmeal	15	12.5	6.5
Mineral mixture	2	1	1
Salt	0.5	0.5	0.5

Allowance

Creep mixture : 0.2 – 0.6

Grower : 0.6 – 2.0

Adult : 2 - 3

Systems of feeding

1. Slope(wet mash) Vs dry mash
2. Restricted – lean meat Production
3. Pelleting
4. Frequency – 2-3 times
5. Fibre diet – Pelleting improves digestibility
6. FCR decreases as age advances – 1.2 – 2.8-3 kg feed / kg. gain during 60 days to 9months.

Breeding animals

Should not become fatty. Grower ration for breedable population. Pregnant animals; Should gain 35 Kg – sows 55 kgs. – Gilts

Ration should ensure

1. Good growth rate in piglets
2. Regular Breeding
3. High quantity carcass
4. Good quality carcass
5. Resistance to diseases

High growth rate – deficiency

Soft fat Vs firm fat.

oil rich cakes, maize , Millet, animal protein sources

difficulty in handling

drip loss

During early age : maize and oil rich cakes

during marketing age – cereals and animal protein sources.

Garbage feeding : 1 kg concentrate can be replaced for every 10 kg of garbage (kitchen waste & market waste)

Pig sty :

1. Away from living (Human) dwellings and dairy plants
2. Good flooring – cement to avoid damage due to prodding / snouting
3. Easily cleanable
4. Provision of pen and run
5. Horizontal ventilation
6. Effective drainage
7. Provision for feeder and waterer in pen and run respectively
8. Two rows of house for effective labour management

Provisions

1. Separate Pens for Boar and Sows.
2. Farrowing Pen
3. Lactating Pen/nursing Pen.

4. Weaned piglets – Grower and finisher

Farrowing Pen

1. Guard Rails
2. Creep area
3. Brooder arrangement

Guard rails :

1. To avoid crushing of piglets.
2. To avoid eating of creep ration by sows.

Brooder

1. Piglets 'born naked'
2. 30-32°C – Heat supplementation for atleast first week of age.

Farrowing crates : To restrict movements of sows during the time of birth
Space 8' x 2'.

House for piglets

1. Grouped according to body weight
2. Housed in community Pen
3. Not more than 20 numbers.
4. Number reduced as age advances.

Wallows : 10' x 6' x 15"

1. To induce evaporative heat loss
2. Sparse hair
3. Limited sweat glands
4. High subcutaneous fat cover

Poor possibility of heat dissipation especially for breeding and fattening animals.

Slotted floor : metal / wooden slots

1. Avoids contact between animal and excreta
2. Complete confinement

Movable accommodation

-] Simple fencing in pastures.
-] Periodically changed
-] Grouped into 20-30 sows / hectare of pasture

Space Allowance (sq.ft.)

Class of animal

Growers	Pen	Run
20 Kg.	8	8
40 Kg.	12	12
60 Kg.	16	16
90 Kg.	20	20
Pregnant sows and boar	25	25
sow	40-60	35

Weaning : 56 days – 2 farrowings / year

based on weight

To avoid stress, gradual separation of piglets

Deworming

Piglet Anaemia

1.Under intensive system – no snouting of sand and accessibility to greens

2.Milk deficient in Fe & Cu

3.Large litters premature births

low liver storage of iron.

Symptoms : weak/run – dyspepsia – edematous – death –distressed breathing - thumps.

Prevention :

1. Swabbing of udder – concentrated solution of FeSO_4 (0.5 kg / 10litres of water)

2.1% FeSO_4 in creep mixture

3.Provision of run with mud and sand

4. Access to pasture

5. Injection Iron Dextron @ 100-150mg. at neck to avoid lameness at 3 weeks of age.

Breedable Population

Boar :

Selection : Masculine

1. Dam's characters (large (10-12) weaned litter

2.High growth rate 90Kg. – 9months of age

3.High FCR

4.Adequate length, width

5.BFT : 3.2 cm Boar

4.0 cm Gilt

6.Free from physical defects.

7.High birth weight and weaning weight

8.Well descended testicles.

Housing : Individually 15 – 20 sq.ft.

Feeding: 2-2.5Kg (Cp-14%)

Puberty : 5-6 months of age

Maturity : 8-9 months of age

Sex ratio : 10-15 females – young boar

20-40 females – mature

4-5 mating / week - matured one

2-3 mating / week – young one

Mating : Hand mating

Pen mating with change of boar everyday

During first mating, better to allow matured sows rather than Gilts and excited sows to

avoid development of aversion and poor breeding efficiency of

young boar.

* Mating : cool hours evening and morning

* Twice mating at 12 hours interval for better conception.

* Careful handling to avoid viciousness in mature boar and timidity in young one.

* Fertility checkup : Just prior to breeding season, allowing mating with marketable Gilts

more returns – Poor fertility

* Good exercise to have high virility

* Trimming of feet to avoid lameness

* Cutting of tusk to avoid damage during mating – once in year.

Gilt

Selection :

1. Pedigree records
2. Littermate performance
3. Her own performance
4. Progeny testing

Characters – Large litter – High growth rate – sows – 150 Kg. litter weight at weaning

Gilts – 120 kg. litter weight at weaning

Loin Eye area

BFT – 1 ½ - 2” away from vertebral column

No. of teats – 12-14

Free from physical deformities

Free from genital disease

good temperament

Age to breed : To get first litter by 12-14 months of age

Mating by 100 kg body weight

Mating by 3rd heat as ovulation rate increases

Oestrus identification : Oestrus discharge, swollen vulvas – pricked ear – frequent urination –

Grunting – pressing of Hindquarters against walls - restlessness.

Tests : Approaching hind quarters – no mobility.

Riding test : pressing over loin / croup region or even sitting over back will make no movement – standing heat – oestrus- By teasing – Teasers

Time to breed: II and III day or two mating at 12 hours interval.

After weaning : Heat by 2nd week – But it is better to breed after weaning – 2nd heat after weaning.

Feeding: 12-14% Cp.

Just prior to breeding enhanced feeding will increase ovulation rate and fertility rate.

Effective temperature control – Housing : group – 15-20 sq.ft.

Culling : Repeaters

1. After 5th – 6th Farrowing
2. Low fecundity
3. Poor mothering ability
4. Poor litter weight at birth and weaning (>1Kg at birth)

Pregnant Animal : Period : 114 days

Separate Pens : Groups initially and latter on just prior to Farrowing individuals

Balanced ration : 14 – 15% Cp

3-5 Kg concentrate

during last part of pregnancy to – recoup loss - Foetus growth – maintenance of themselves – Growth of young gilts – Gilts should gain 35-40 Kg during pregnancy. sows should gain 50-60 Kg during pregnancy – periodical exercise – House : 30-40 s.ft. – 40 – 60 s.ft. – good quality water.

Management during Farrowing

1. This period is critical as there is more mortality (20-30%)

2. Transferred to Farrowing pen atleast one week prior to expected Farrowing
3. Date is noted by date of service.
4. Before transferring, animal as well as should be cleaned and thoroughly disinfected.
5. Chopped straw to the tune of 4" is added. But unchopped straw is not advisable as piglets get entangled.
6. Daily exercise.
7. Time of Farrowing is noted by nervousness, tendency to form nest and colostrum secretion.
8. During Farrowing sows should not be disturbed as they become nervous. But attendants should be ready to save the piglets from crushing.
9. Farrowing happened within 2-4 hours and placenta shed within 2 hours.
10. Feeding prior to Farrowing should be restricted and laxative diet.
11. Space allowance : 40 – 60sq.ft.

Market Pigs

Lean meat production – market requirement

Port : 70-75 Kg. – low fat and high protein

Bacon : 75-90 Kg. – Moderate fat.

Heavy hog : 120-125 Kg. – High degree of fat.

Production of port is very economical

Law of diminishing return starts to operates in later stages.

FCR is low (1:1.2 – 1:4)

Proportionately low weight – in latter stages due to fat and high proportionate weight during early part due to accumulation of minerals, proteins and water.

Costly process of conversion of nutrients into fat operates in latter stages.

Pork:

Fat : 24.8%

Protein : 17.1 %

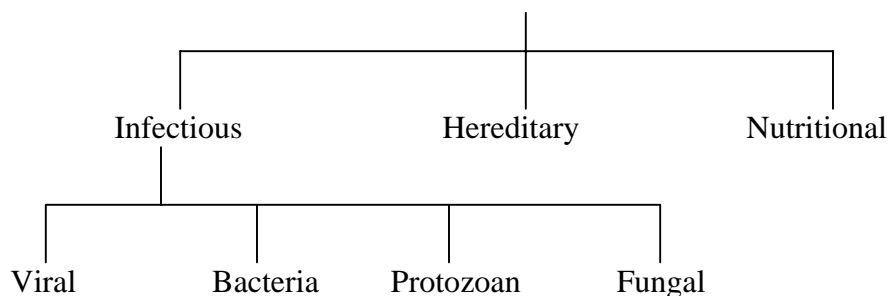
Dressing percentage : 70 – 75%

Lactating animals

Housed in Farrowing pen or separate pen. space 40 – 60 sq.ft.

4-6 kg. concentrate with 14-15% CP gradually increased over a period to avoid digestive problem. under fed animals – low milk yield – poor growth rate – high plane of nutrition because highly concentrated form of milk. Protein 6%, fat - 6% and Lactose 6%, Thumb rule : 1.5Kg / sow, 0.5Kg /piglet. Allowing for good quality pasture. Prior to weaning, gradually reduce the feed allowance to reduce milk secretion otherwise stagnation of milk – mastitis.

Swine Disease



Viral

Swine fever

1. Young animals more susceptible
2. Dark red or purple colour patches on neck and abdomen.
3. Sticky discharge from eyes
3. High mortality. – Prevention – vaccination –

Swine Pox,

FMD,

Swine influenza

Bacterial –

Swine Erysipelas – *Erysipelothrix rhusiopathiae* – High fever – Reddish ‘diamond’ shaped discoloration on body. Prevention and vaccination –

Anthrax –

Brucellosis –

Tuberculosis.

Internal parasites : *Ascaris lumbricoides*

Ecto parasites : Sarcoptic mange

Nutritional : Avitaminosis – vitamin A –

Rickets –

Piglet anaemia

Control :

1. Clean environment
2. Well ventilated enclosure
3. Frequent removal of faeces
4. Regular vaccination and deworming .
5. Avoiding overcrowding.
6. Isolation of diseased.

Hog Cholera.

Swine Fever

Affects all age group-Viral Disease.

Transmission : Urine and Dung.

Symptom : Pyrexia 105-108° F ,off feed, Drooping of Head, Arching of back, Cough, mucous discharge, from the eyes, nostrils, Pneumonia Symptoms .Diarrhea Reddening of Skin, Belly and thigh-Vomiting Death.

Control : Hygienic and Sanitation-Vaccination at 3 months.

Ecto and Endo Parasites are eradicated periodically.

Endo parasite affected animals show anaemia, pot belly, diarrhea, stunted growth, edema in the jowl etc.,

Ectoparasite ;

Scratching, discoloration of skin Albendazole, Fenbendazole or Narrow Spectrum Copper sulphate.

Combination of drug (Ivermectin)of choice for both ecto and endo parasites.

- 1.Efficient Feed conversion
- 2.Prolificacy in Reproduction.
- 3.Mortgage lifters.
- 4.Generation interval –Less.
- 5.Pork- Cheaper.
- 6.Religious Taboo/ unhygienic
7. Quantity meat available from / unit is more
- 8.Live weight is greater.
- 9.More energy than any other meats/unit weight.
- 10>Returns over investment is quick.
- 11.Simple stomached animals-Requires grains
- 12.Markerting and feed supply are important.
- 13.60-70 kgs within 180-210 days.

ECONOMIC TRAITS.

- 1.Litter Size.
2. Weight at Birth.
3. Weaning Weight.
4. Litter size at Weaning.
5. Growth rate:
 - a. Birth to Weaning --- Weaning wt.- –birth wt./ 56
 - b.Weaning to 154 days---Weight at 154 days-Weaning weigh/ 98 days
 - c. Weight at 154 days to 210 days ---Wt.at 210 days- Wt. at 154 days / 154 days.
- 6.Feed efficiency – Feed consumed per of kg of Live weight.
- 7.Mortality percentage.

Points to be considered in Breeding :

Maturity Age ; Male : 7 months, Female ; 6 months.

Optimum weight in Crossing Male : 80-110 kg ; Female 80-100 kgs.

Oestrus Cycle once in 21 days.

Signs of Oestrus :

- a.Restlessness,b. Champing of jaws,c. Grinding of teeth,d.Mounting on other animals,e.Time for mating 24 hours after the onset of oestrus,f.Second crossing 8- 12 hours after first crossing ,
- Gestation period : 114 days (3months,3weeks and 3 days)
8. Suckling period : 56 days.

Management of Boar :

- 1.Off springs- Better producing parents.
- 2.Bigger litter size.
- 3.Heavier birth weight.
- 4.Weight at weaning ---12 kg female ;Male—15 kgs.
- 5.Boars selected at 5 months Age : atleast 60 kg body weight.
- 6.No.of teats –Minimum 14 in number.
- 7.Male : Female = 1 : 5
- 8.Exercise should be given daily.
- 9.Boars are to maintained separately.

10.Periodically tested for Brucellosis.

Management of Sows :

1. Balanced Ration –It should contain 14-16 % Protein.

Maize : 50 parts.

Groundnut Cake : 13 parts

Rice Polish : 10parts.

Fish Meal : 05 parts.

Mineral Mixture : 1.5 parts.

Salt : 0.5 parts.

Vitamin premix : 2 gram / 10 kg feed; B-Complex- : 5 ml/ animal,.

2. Space requirement : 15-20 sq.ft.

3. Regular Exercise.

4. Do not mix with boars.

5. Sows and gilts are to be maintained separately.

6. Avoid over crowding.

7. During the third quarter sow should gain weight by 30-35 kg and gilt should gain weight by 40-45 kg.

8. Avoid Slippery ground.

Care and Management of New Born Piglet.

Clean and wipe with a towel and the mucous on the body, nostrils, etc.,

2. Naval cord- 1” –severed ligated-Tincture Iodine.

Clip the needle Teeth (wolf teeth)

3. Practice Colostrum feeding.

4.Iron injection-Avoid Piglet Anaemia or Thumps.

5.Allow piglet to suckle-5-6 times a day.

6.Creep Mixture- upto 8 weeks of age.

a. Crude Protein 22-24 %

Composition :

Maize :50 parts.

Groundnut Cake : 25 parts

Wheat Bran : 13 parts.

Fish Meal : 10 parts.

Mineral Mixture : 2 parts.

Antibiotics—1 gram/ kg feed; Vitamin premix : 2 gram / kg feed

B-complex liquid : 3 ml / animal in Water.

b. Easily digestible.

c. Feed : 0-8 weeks.100-600 grams / day up to 10 body weight

d. **Orphan piglet**- Special ration with milk replacer containing 26-30 % Crude Protein.

Ground Maize : 45 parts

Groundnut cake :30 parts.

Fish meal : 10 parts.

Lucerne Meal : 05 parts.

Molasses : 10parts.

Antibiotics—1 gram/ kg feed; Vitamin premix : 2 gram / kg feed

The feed is wetted with skim milk, antibiotics and vitamins.

Care and Management of Growing and Finishing pigs.

Period of 56 days to market age of (6-7 months) the animal should attain a body weight of 70-90 kg.or the weight gain should be a minimum of 10 kg / month.

Males- Castrated.Open method.

Unwanted gilts-Fattening.

Growers Group according to age size,body weight,etc.,

Space requirement 5-8 sq.feet.Feeder space 20-25 cm.and Water Space 15-20 cm.

Feed Efficiency

2.5 kg-50 kg body weight	: 1 : 2 ,	} Average : 1: 3
50 kg- 100kg body weight	: 1: 2.8,	
Above 100 kg body weight	: 1 : 4	

To get a body weight gain 60 kg : The animal will consume 180 kg feed.

GROWER MASH : 8- 12 weeks; 18-20 % Crude Protein

Maize	: 55 Parts
groundnut Cake	: 17 Parts
Wheat Bran	: 20 Parts
Fish meal	: 1.5 Parts
Mineral Mixture	: 1.5 Parts
Salt	: 0.5 Parts

Class 25: Classification of poultry viz. layer, broiler and dual purpose- Nomenclature of commercial layer and broiler strains.

India occupy 5th place in worlds Egg production -32700 million. The per capita consumption of an India is approximately 33 eggs as against the recommendation of 180 egg.

Indian poultry population – 435 million – 4% World poultry.

Tamil Nadu ranks second in the country producing 4400 million eggs per year. Namakkal is a second largest poultry pocket in India with the population of 75 lakhs chicks and growers and about 196 lakhs layer birds. The poultry production through out the world is carried out by a highly specialized efficient Poultry Industry that has been a leader in trends of scale. Poultry Industry has shifted itself rapidly and completely from a small scale non intensive production units to a highly specialized intensive industry. The progress is attributed to the conceptual change that had taken place in the middle of the century.

Which is attributable to the demands of the situation

Shortage of red meat,

Lesser cost and land involvement

Shorter generation interval

Higher multiplication rate.

The following are the reasons for the phenomenal development of the Industry.

1. Evolution of High yielding strains
2. Economic management systems.
3. Improved Nutritional systems.
4. Advanced Desired control technology.
5. Automation in operation.
6. Integration
7. Increased consumer awareness.
8. Improved marketing system.
9. Insurance and Bank Assistance.

Poultry Industry:

Grand parent Hatchery

Parent Hatchery Sub-Franchisers

Grower farms

Feed manufacturers

Equipment manufacturers

Marketing enterprise.

disease control units and poultry service organisation.

Breed of poultry

Class : Many groups of birds belonging to a particulars tract or locality Eg. English, Asiatic, American.

Breed refers to a group of domestic fowls with a common ancestry and having similarity in shape, conformation, growth, temperament, shell colour of egg and breed true to type. Variety is a subdivision of breed and within a breed there may be several varieties. The term variety is used to distinguish fowls having the characteristics of the breed to which they belong but differing in plumage colour, comb type etc. from other groups of the same breed. A breed/variety may also have several strains or lines identified by a given name and produced by a breeder through at least 5 generations of closed flock breeding for a particular purpose. Several strains within a breed/variety phenotypically may look alike but often differ in their production performance depending upon their breeding history.

Breed of Poultry

Asiatic	American	English	Mediterranean
Aseel	Plymouth Rock	Sussex	Leghorn
Karaknath	Wyandotte	Orpington	Minorca
Ghagus	Rhode Island Red	Australorp	Ancona
Chittagong	New Hampshire	Cornish	Spanish
Mini			Andalusian
Brown Desi			
Denki			
Naked neck			
Brahma			
Cochin			
Langshan			

Poultry may also be classify based on were utility

1. Layer – Leghorn, Minorca
2. Broiler – Orpington, Cornish
3. Dual – Plymouth, Rhode island red

Based on the utility and perfomance many hybrid strains of poultry have been developed and commercially produced.

Layer – Babcock 300, Hyline-WS 36, Bovans.

Broiler – Ross, vencobb, hybro.

Egg Science and Technology :

Egg is the physiological product of the female reproductive system and a hen's egg, apart from the ovum does contain other nutrients for the growth and development of the embryo.

Egg average weight : 50-60 gm.

Egg contains yolk – 30%

White or albumen – 58%

Inner & outer shell membranes & shell – 12%

Nutrient composition : on egg weight

12% Protein

11% Fat

12% minerals and 65 % water

Colories : 148 cal/100 gm.

grading of eggs :

By wt. : Extra large 60 gms/egg

Large	53-59 g.
Medium	45-52 g.
Small	38-44 g.

Agmark grading :

- A- grade : Clean, unbroken shell, aircell, 4mm depth, clear, firm white well centered yolk free from defects.
- B-grade : Clean, moderately tainted shell, aircell 8 mm depth, slightly off centered and shape visible
- No grade : Eggs classified as loss or no grade is edible - contaminated by smoke, chemical and other foreign materials, which may effect the character and appearance.

26. Care and management of day old chicks-Brooder management.

Preparation of Brooder

Brooder means to give a heat source by artificial means for the period of growth of chicks from 0 day (Day old) to 4 weeks. The heat source generally has a large reflector (Hover) under which the chicks will get the heat uniformly.

Aim

The day old chicks do not possess the insulating feather coverage to protect them from cold. It may result in the losing of body heat to the environment resulting in chilling which will create the ground for many diseases.

Preparation of Brooder and daily routine work carried out in the farm

Objective

Chicks do not possess a well-developed thermo- regulatory mechanism. The day old chicks don't possess the insulating feather coverage to protect them from chillness. The body temperature of chick is 107°F which is always more than the ambient temperature. It may result in the losing of body heat to the environment. So a source of heat is given by natural brooding or by Artificial brooding up to 4 weeks of age.

Materials required

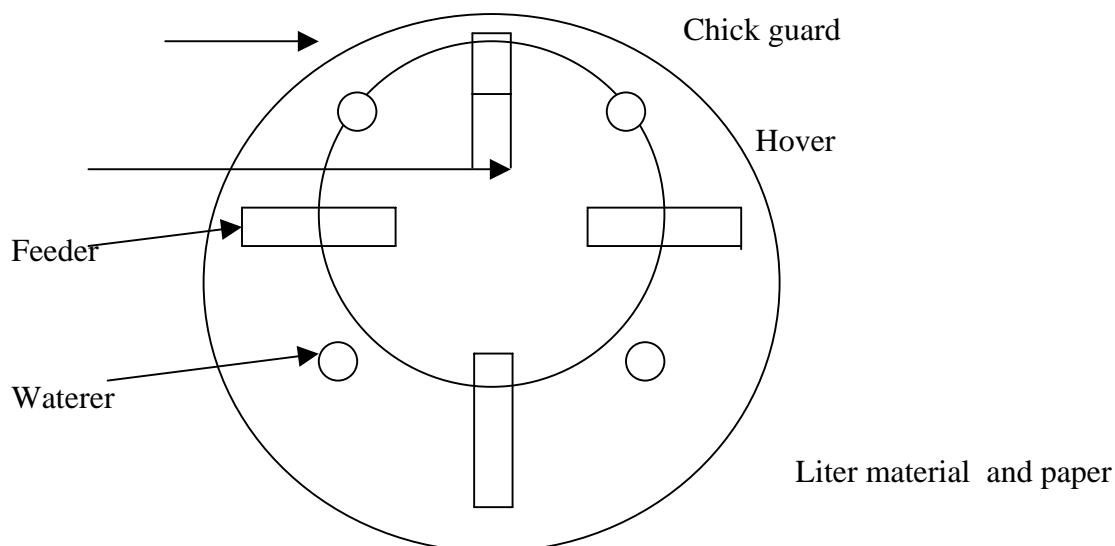
Hover or wooden cross bar. Automatic brooder, fuel heaters like lantern.

1. Bulbs
2. Chick guard
3. Thermometer (0 to 110°F)
4. Waterer
5. Linear feeder,
6. Lime powder
7. Lysol
8. Sprayer
9. Coirpith, GN husk or paddy husk
10. Waste news paper
11. Flame gun
12. Automatic vaccinators .
13. Debeaker
14. Bucket

15. Broomstick
16. Rake
17. Electrolyte
18. B Complex and Vitamin A
19. Antibiotics
20. Lasota F₁ Vaccine
21. IBD Live vaccine

Preparation of Brooder House

1. The litter material of the previous batch should be heaped up first so that building up of germs could be destroyed.
2. After 2 to 3 days the heaped up material can be removed from the brooder room.
3. The portion of the litter sticking over the ground must be scraped and removed.
4. The removal of spider web, cob webs and dirt are also essential.
5. The floor and sidewalls should be washed with plain water.
6. Disinfection of the room is carried out by spraying phenyl, lysol, etc at 5% concentration.
7. Use Flame gun to destroy the insects.
8. The entire floor and side walls should be white washed with fresh limestone.
9. Feeders, waterers, , chick guards should be washed and disinfected in phenyl or lysol. Dry it in the sun for a day.
10. Hang the gunny bags around the brooder house to maintain the room temperature to maintain temperature not below 80⁰F in the first week 75⁰F in the 2nd week 70⁰F III week, 65⁰F -IV week.



Decide on the no. of brooders depending on the number of chicks ordered

1. Connect the chick guards in circular fashion with diameter of 5 feet to accommodate 150-200 chicks.
2. Spread the litter material like coirpith, or paddy husk or ground nut husk on the prepared floor to a depth 2 inches.
3. The litter material is to be covered with newspaper.
4. The feeders and waterers are to be arranged in a radiating fashion from the light source.
5. 4 hours before the scheduled arrival of chicks place the waterers with water in order to bring water to room temperature.
6. The brooding unit should be kept ready at least a day before the arrival of chicks.
7. The brooding bulb must be switched on atleast 24 hours earlier to make the area warm at the time of housing the chick.
8. Depending on weather condition put curtains on all four sides of room to maintain room temperature.

Brooder Management

1. Spread finally grained maize over the news paper before the arrival of chicks.
2. Give cool water after boiling. Add electrolytes, B Complex and antibiotics.
3. Distribute chicks equally after counting under the brooders.
4. Before putting chicks under the brooder scale their beaks with water.
5. For first 3 days provide crushed maize twice a day. Also provide ground maize in the feeder.
6. Change newspaper sheets immediately if they get wet.
7. Remove newspapers on 5th day.
8. Remove wet litter under waterers immediately and add fresh liter.
9. On fifth day give Lasota F₁ Vaccine.
10. According to the age of the birds brooder temperature should be adjusted.
11. Medication and vaccination
 - a) 1st day give 5% glucose in water.
 - b) 2nd to 4th day - antibiotic + Vit.A + B Complex.
 - c) 5th day - RDVF vaccination

d) 10th day - IBD vaccination.

12. Daily morning and evening wash the waterer and give freshly boiled and cooled water.

13. Give 24 hrs. light up to 3 weeks to induce night feeding.

14. Debeaking is done at 2nd week to prevent cannibalism and feed wastage.

15. Chick mash should contain 22% protein and 2800 kcal/kg ME

Observation

Watch the chicks under light, if chicks are spread uniformly under the light and brooder area, then the temperature maintained is correct. If the chicks are huddled under the light, heat provided is not enough. If the chicks are away from the light source, the heat intensity is high. Give enough space for watering and feeding for growing chicks according to the age of the birds.

Brooder management : Zero –8 weeks

Chick hood is the most critical age in birds life as it readily picks up problems due to chilling, mal - nutrition, over crowding and diseases.

Productivity of a layer or a broiler depends largely on the way how they start their life.

New born chicks require warmth to keep them in comfort. Hence they are provided with artificial heat by a device called brooder.

Brooder can be hover type, flat, type, wooden reapers fitted with bulbs or heating bulbs or infra red bulbs

Brooding Temperature : 95°C I week

90°C II week

85°C III week

80°C IV week

Floor space : ¼ sq.ft/bird 0-3 weeks

½ sq.ft./bird 4-8 weeks

Feeder space

0-3 weeks 1"

4-8 weeks 2"

Water space

0.3 week ½"

3-8 weeks 1"

Arranging for brooding

Spread litter on a prepared floor, over which place old news paper arrange the heating device in the middle. Cover the desire area with chick guards. Keep waterers and feeders, radiating from the heat source.

Conserve heat by blocking the side-mesh with gunny sacks.

Medications

I day glucose- 5% in water

II to 7th day – antibiotic + Vit.A + B Complex

III week & VI week coccidiostats in water.

Always use boiled and cooled water for 1st three weeks.

Then sanitize the water for the rearing period

Vaccination : Mareks, Ranikhet and Fowl pox.

After 3 weeks continuous or 23 hours light period has to be given to the chicks to induce night feeding and avoid trampling. Debeaking is done at II week to prevent cannibalism and feed wastage – Feed used in chick mash. Contains 22% crude protein and 2800 kcal/kg ME.

Grower management

8 - 20 weeks. –floor space : 1-1 ½ Sq.ft. feeder space – 3” water space : 1½-2” feed – Grower mash

Restricted feeding

To keep the birds in normal desirable wt. range -10% to 20% of the feed required by the bird is restricted from 10-18 week of age.

Lighting : Grower should not be provided with extra light except day light to counteract undesirable effect on sexual maturity.

Deworming :

Debeaking, delicing if necessary – are to be carried out before the onset of lay.

27. Systems of housing- Deep litter and cage systems – merits and demerits.

System of poultry rearing :

In the annals of Poultry Development, one can see a gradual development in respect of the allotment of space, feeding, nutrition and in management etc. on the basis of scientific and technological developments poultry management moved from free range system to semi intensive system and then to intensive system.

Free range system:

Birds are allowed free range, such that it can wander at will, over the allotted paddock or field and are not controlled by fences.

Deforested land was used. 200 birds/acre allotted. In an ordinary land 100 birds/Acre was allotted. They received their bulk quantity of feed from the land in the form of herbage, seeds, insects etc. besides in small quantity by hand feeding. A small housing is provided for night shelter.

Advantages :

1. Maintenance on clean ground decrease the risk of disease.
2. Reduction in cost of management.
3. Birds get good amount of feed from the land
4. Cost of housing is less.
5. Soil fertility is maintained
6. Farming operation is not interfered with

Disadvantages

1. Losses are serious where predatory animals are abundant
2. Wild birds may consume much feed and they transmit disease.
3. Eggs may be lost when laid in hedge rows.
4. Impossible for adoption unless ample land is available.

Semi Intensive systems :

Birds are provided with a pen and run. Pen is an enclosed house and run is an enclosed grass area with fence.

As few as six to as many as 200 can be kept in are acre of land in this system.

3 to 4 sq.ft / bird in the pen.

Floor level should be at least 10” from the ground level

Advantages:

1. Complete control over operation
2. Useful for record purposes
3. Operational throughout the year
4. Economic use of land (free range)
5. Better protection during winter

Disadvantages

- 1.High cost in fencing
- 2.Danger of over stocking

Intensive system

- 1.Deep litter system
- 2.Cage system

The concept of deep litter system

Birds are raised within four walls, over litter material which is of organic in nature capable of absorbing moisture and releasing moisture to the atmosphere and also to serve as a bedding material for the birds.

Coirpith

Paddy husk

Ground Nut

Saw dust

Wood shavings

straw chopping

paper straw chopping

sugarcane baggase

When moisture is absorbed there will be controlled microbial activity and odour will also be minimum.

Vit. B12 and B2 are available

depth four inches at beginning. 6-8" – later

Qualities of good liter material

- 1.It should readily absorb moisture
- 2.should not cause injury to birds.
- 3.Moisture level should be less than 15%
- 4.Should get decomposed and form good manure.
- 5.Should spread evenly
- 6.Should be non-toxic.
- 7.Should not cause dust pollution.

Advantages:

1. Land requirement is minimum
2. Easy and economic management
3. Scientific feeding and management
4. High degree of supervision.
5. Minimum Labour.
6. Automation is possible.
7. Manural value is increased.

Disadvantages

If the management is bad, liberation and accumulation of ammonia, wet litter problem dirty eggs, disease problems may result.

Cage system : Battery cages.

Very popular, called as Californian cage system. Birds are kept under total confinement with minimum space feed and water provided from outside. Eggs laid will get rolled out by the inclined floor bottom.

Types of cages

1.Single

2.mutiples

colony cages 20-30

Advantages :

1.Vertical expansion

2.Easy feeding and management.

3.Protection from Vermin and wild birds.

4.Litter borne disease are avoided

5.Spreading of disease minimum

6.Minimum area is required / bird.

Single 1 /sq.ft.

Multiple – 0.75 sq.ft.

colony – 0.5 sq.ft.

7.Cleaner eggs.

8.Research data collection easier

9.Identification of birds, handling and culling of non layers easier.

10.Insects and pests controlled

11.Vices are kept at minimum

12.Birds are of softer flesh than the floor reared birds.

Dis-advantages.

1. High cost of installation

2. Breeding is not possible unless Artificial Insemination is practiced.

3. Cage layer fatigue or paralysis is a problem if not attended to.

Housing management

Poultry should be provided with a good housing which will facilitate 1. shelter 2. Protection from wild animals 3. Bad weather condition. Ideal housing helps the birds to perform well. To establish a viable poultry enterprise capital, land, labour and technical know how are essential.

The housing design should be flexible and it depends on

1.Age and stage of the birds.

2.Functional requirement.

3.The climate and environment.

4.For efficient supervision

5.Minimum structures to have efficiency.

6.Economy in construction.

Selection of site and construction of houses.

1. Hard soil type

- 2.elevated area should be selected for house construction
 - 3.Cheaper in cost.
 - 4.should have continuous water supply - good and wholesome.
 - 5.Should be away from the urban area and also should be at an easy reach.
 - 6.should have good road/rail facilities for transport.
 - 7.should be easily accessible for supervisor
 - 8.should have good ventilation
 - 9.There should be freely available space for expansion.
 - 10.Marketing- preferential
 - 11.Management of brooder cum grower, layers, breeders should be specified in distinct areas to avoid crisscross movement of birds and inter current infection - such segments should be 100 feet away from each other.
 - 12.Building should be constructed in east-west direction that is long axis should lie in east-west direction
 - 13.Width of the building should be restricted to 30 feet and the length can be extended to the requirement. Height 10-12 feet.
 - 14.North and South sides of the building should be fitted with wiremesh to permit airflow.
 - 15.Roofs can be –thatch, Tiles, asbestos, light roofing or zinc sheet.
 - 16.there should be minimum structures so that there could be good air movement
 - 17.Manure pit and the incineration room should be constructed at the far end in leeward direction.
 - 18.Farm house should be located at the entrance to minimize the movement of visitors into the deeper areas.
 - 19.Agriculture operations can be combined with poultry farming.
- Desing of poultry houses.

Shed – lean to roof

Gable

Half Monitor

Full Monitor

Flat roof houses.

kinds of poultry houses.

1. Brooder house.
2. Brooder cum grower house
3. Layer House
4. Breeder House
5. Broiler House
6. Cage House

		Layer	Broiler
Temperature	Comfort Zone	10-24°C	21-25°C
	Optimum	13-20°C	24°C
Humidity	Acceptable	50-75%	50-75%
	Preferable	60%	60%

CLASS 28 : RAISED PLATFORM HOUSING – FLOOR SPACE REQUIREMENT – LITTER MANAGEMENT.

Latest developments in Housing and management of commercial Layer Farms.

New concepts in poultry house design and farm management are finding their way for improved flock performance through better environmental conditions and automation in feeding, drinking and related systems. All this ensures more comfort to birds leading to better production and higher profitability. Among the recent innovations which have been successfully adopted in the country including construction of elevated platform cage and environmentally controlled houses with automatic drinking and feeding systems for rearing layer birds. This integrated and latest approach to housing design, nutrition, management and disease control would eventually influence flock performance and profitability.

ALTERNATIVE HOUSING SYSTEMS

TRADITIONAL FREE RANGE :

In the past , free range was a general description indicating only that poultry was allowed to range over the fields. Today, free range is specific term and flocks were described as much meet the criteria listed below.

1. Birds should have continuous access to open runs and the ground to which they have access must be mainly covered with vegetation.
2. The entire area should be well fenced to keep out the predators.
3. Stocking density should be not greater than 1000 birds / ha. of available ground (1 hen / 10 m²)
4. A very high degree of management is required.

Semi-intensive –Modified free Range :

For these systems , as for free range with exception that the maximum outdoor stocking density should not be greater than 4000 hens / ha. of land available (1 hen / 2.5 m²)

DEEP LITTER

An egg producer who wants to market eggs with label “deep litter” must fulfil the following conditions. The maximum stocking density may not be less than 7 hens / m² of available floor space (1400 cm² / bird) with at least one third of this area are being covered with litter material. A sufficient large part of the floor area should be available for the collection of droppings.

MODIFIED CAGES :

These cages offer the hen a more complex environment while retaining the advantages of small colony size, hygiene and economics of battery system. Birds area specifications are identical to battery cages. At least 450 cm² of cage area per bird and 10 cm / bird of trough space with an adequate water supply is essential.

Management problems associated with rearing birds in alternative systems have received critical attention and their ‘Welfare friendly’ status is frequently diminished as the project is translated from the experimental to the commercial situation. Alternative systems offer a degree of freedom to the birds, which the battery system fails to satisfy ; they also encourage a greater degree of conflict within the flock and the latter is not commensurate with ‘GOOD’ shell formation.

ELEVATED PLATFORM TYPE CAGE HOUSES FOR LAYERS.

The main purpose of poultry house is to provide comfortable and healthy environment to the birds. Ventilation is a major factor in producing good environment in poultry houses. It also a deciding

influence on the flock performance, disease control and energy used. Ventilation system designed to create the proper flow of air in the shed to keep the birds healthy and protective. A good ventilation system in a house will:

Provide adequate fresh air and oxygen for the birds, thus maintaining a uniform and healthy environment throughout the house.

Provide the desired temperature and humidity – necessary for optimum performance and efficiency of the birds.

control moisture and poisonous gases arising from the microbial fermentation in dropping / litter (ammonia etc.,)

Maintain better conditions minimize incoming dust

Dilute disease- causing organisms.

Allow a large increase in the number of birds per house.

An essential requirement of any ventilation is to have a constant control of air movement in a poultry house. Air volume in summer months must be adequate and in correct direction to ensure uniform distribution throughout the poultry house.

Specification of elevated platform type cage house in layer farms:

01 Pillar height to lay platform

4.5- 6.0 feet depending on the capacity of the birds and soil type of that area.

02 Length of the house

Length can be at any length depending upon the capacity of the birds.

03 Breadth of the house

Breadth of the house is restricted to 30-330feet.

04 Height of the wire mesh

From the platform to overhang 8 to 10 feet.

05 Height of the house.

14 feet from platform to centre.

06 Arrangement of cages

2- M type cages triple deck in centre of the house + 2-L type cages in two sides.

3- M type cages triple deck, 4 birds / cages compartments.

07. Distance between cage arrangements (Pathway)

2.50 to 2.75 feet.

08. Feeder and drinker

Channel type feeder and waterers

09. Channel type and nipple drinkers

Automatic feeding system + nipple watering system.

09. Side mesh.

Chain link 2 inch x 2 inch

ADVANTAGES IN ELEVATED TYPE CAGE HOUSES IN LAYER FARMS.

- i. Hens reared in elevated type cage houses attained 50 % egg production earlier than other systems.
- ii. Bird reared in elevated type cage houses resulted in higher hen-housed and hen-day production.
- iii. Eggs collected from elevated cages houses had better shape index, Haugh unit and yolk colour scores.

ENVIRONMENTALLY CONTROLLED LAYER HOUSES.

An environmentally controlled layer house is one which inside conditions is maintained as close as possible to the bird's optimum requirements. The house is closed and insulated and trusts on artificial ventilation and air movement. The structural make up is similar to that of elevated platform layer houses. Large number of layers may be accommodated in these houses.

In the environmentally controlled layer houses air is mechanically moved inside, the width of the house greater and is 40' making it more economical to construct. To provide working comfort the side height of the house at the eaves should be 8'. To minimize heat gain in summer and heat loss in winter the ceiling must be fully insulated and it should be wash proof. Care must be taken to see that there is no air leak in the roof. Double walled plastic curtains along the side walls with which arrangements to open or close are to be provided. The curtain should have an overlap of 3"- 4" over the side wall to prevent leakage of air. The floor should be of concrete or watertight stone slabs.

ADVANTAGES OF ENVIRONMENTALLY CONTROLLED LAYER HOUSES.

- a. Number layers can be accommodated.
- b. Less labour and more efficient working atmosphere.
- c. Less feed wastage and more feed efficiency.
- d. Less fuel cost in turn less cost of production.
- e. Less cost of medication and more livability.
- f. Higher egg production and more profitability.
- g. Cleaner egg production.

FUTURE PROSPECTS IN MODERN POULTRY HOUSING AND MANAGEMENT.

The above innovations have improved the poultry house environment and permit increased density thereby housing a large number of birds in the same house. With introduction of various devices to control environment in poultry houses, it would not be long before microprocessors would be used to monitor temperature, humidity, noxious gases, and consumption of water, feed and the light. Also devices to collect eggs, computed record keeping would expedite these processes.

29. Care and management of layers.

Layer Management: From the point of lay to one year it is called laying period.

When first egg laid – Pullet – pullet egg.

Floor space	: 2 sq.ft.
Feeder space	: 4 sq.ft.
Water space	: 2 sq.ft.
Nest space	: 1 box for 5 birds
Litter Depth	: 6 box for 5 birds.

Feeding : Layer mash is fed during this period - 18% protein. Daily ration is decided and issued two to three times in a day. This helps in lesser feed wastage and better balancing.

Choice feeding of calcium : Calcium is supplied to the birds in feed. Supply of calcium in the feed assures a more uniform intake of calcium by all the birds.

For hens in very high egg production and in high environmental temperature supplementation of extra calcium is necessary. This is given in the form of shell grit. 5-10 Kgs./100birds/Month.

Lighting : Layer birds has to be kept with a period of at least 16 hours a day. Twelve hours of day light is supplemented with additional 4 hours night lighting. It is introduced as step up programme.

20 th week	6-6 ½ PM	5.30 – 6.00 AM
21 st week	6-7 PM	5 - 6 PM
22 nd week	6-7.30 PM	5 – 6 AM
23 rd week	6 – 8.00 PM	5 – 6 AM
24 th week	6 – 8.30 PM	5 – 6 AM
25 th week	6 –9.00 PM	5 – 6 AM

Light stimulates anterior pituitary gland through brain and the liberation of F.S.H. helps the follicles to mature.

A forty watts bulb at a height of 7 feet with 100 feet distance from another, will provide the required intensity of light for 100 sq.ft. area.

General guidelines :

1. Provide balanced feed.
2. Use clean wholesome water
3. Never reduce the light during laying period
4. Supplement vitamins to relieve stress
5. Deworm once in 45 days.
6. Litter to be raked up once a week
7. Add Lime at 5-10 Kg/100 sq.ft. to keep them dry.
8. Cull-the unproductive birds/then and there.

Vaccination - refer disease

Culling

Cage layer fatigue

Calcium feeding.

30. Care and management of broilers.

Broiler management :

Broiler is defined as the tender meat chicken of either sex which grow from 35 to 40 gms of initial weight to 2kg or more in 6 weeks of age by consuming around 4 kg of feed.

	0-4	4-8
floor space	½ sq.ft.	1 sq.ft.
feeder space	3 sq.ft.	6 sq.ft.
water space	2 sq.ft.	4 sq.ft.

Brooding and management similar to layer brooding

Feeding : Two types

1. Broiler starter - 0-3weeks - CP 23 – E 2900
2. Broiler finisher - 4-6 weeks - Cp 20 – E 3000

Vaccine : 1. Mareks Vaccine day old

2. R.D.V.F. 5- 7th day

The use of liver stimulants and vitamins help in better feed utilization and better body weight gain.

Mortality and livability

Market weight

Feed conversion efficiency.

31. Poultry Nutrition-Feed formulation-composition of chick mash grower, layer, broiler starter and finisher mashes .

Feeding Management

Poultry being simple stomached species, cannot synthesise most of the nutrients required for them and so the nutrients become dietary essentials chicken has to be fed adequate quantities of balanced diet for its growth, livability and to exhibit its genetic potential to the full extent. Poultry differ from other species of livestock in body temperature and digestion

Biological activity and maturity.

Poultry feed is composed of

60-65% Energy giving materials

30-35% of Protein source

2-8% Minerals source.

And above all water. Which is considered as the Principal nutrient should be pure, whole some, free from physical impurities, toxic substances and Bacterial contamination.

Water : feed ratio 2.2 : 1

It is variable with age, climate, feed and physiological activity. Excess energy is stored as body fat.

Yellow maize

cumbu

chulam

Rice polish.

This energy materials constitute 50% of the ration.

Protein : Protein is required by the bird for

1. Growth 2. Maintenance of body tissues 3. Production.

Both vegetable and animal proteins are used in the feed.

Vegetable Protein :

Ground nut oil cake

Soyabean oil cake

Gingelly oil cake

Sunflower oil cake

Mustard oil cake

This is added at 15-25% in the ration. It is always advisable to add two or more for better balancing.

Animal Protein: Fish meal, meat meal, Blood meal

silk worm pupa meal

out of this fish meal is ideal

this forms -5-10% of the ration.

Grain bye products like bran in included from 10-30% for fibre, bowl movement and minerals. if molasses available it can also be added for energy at 5-7% levels, which is a cheap source of energy, reduces dustiness, improves palatability.

Mineral mixture for poultry :

Included at 2.3% It is advisable to use salt free mineral mixture because fish meal available in our country is salted. Calcium supplements such as shell grit, calcite, limestone, etc. are used at 4-5% levels.

Standard requirement of nutrients:

	Chick	Grower	layer mash	Broiler starter	Broiler Finisher
Crude Protein % min.	22	16	18	23	20
Crude fibre % max.	7	8	10	6	6
Calcium % min.	1	0.8	2.75	1	1
Total phosphorus % min	0.7	0.6	0.75	0.7	0.7
Metabolizable Energy K/ca/kg.	2800	2600	2700-2750	2800	2900
Lysine (%min.)	1.0	0.7	0.5	1.0	1.0
Methionine (% min)	0.35	0.25	0.25	0.35	0.35

Approximate feed intake by commercial chicken in tropics

	Egg type (grm.)	Broiler (G.)
1 st week	10	15
2 nd week	15	25
3 rd week	20	35
4 th week	25	50
5 th week	30	65
6 th week	35	85
7 th week	45	105
8 th week	50	120

9-12 weeks – 40

13-16 weeks – 50 Restricted feeding

17-20 weeks – 60

During laying

0% Egg Production	80 gm.	70 %	115
25% Egg Production	95 gm.	80 %	120
50% Egg Production	105gm.	Over 80%	12
60% Egg Production	110 gm.		

Guide lines for feed management

1. Purchase quality ingredients / feed. with least moisture and devoid of adulteration.
2. If own feed is mixed formula may be modified depending upon the cost and availability of ingredients
3. If agricultural farm is attached farm grown grain can be used
4. Purchase one month or two months requirements.
5. Screen the feed store room against rodents, sparrows other vermins.
6. Observe the feed intake by the birds during summer, winter.
7. If moisture level exceeds 15% (except molasses) during hot season it may cause growth of fungus and precipitate problems like aflatoxicosis.

The feeder should not to filled to full to minimize the feed wastage..

Class 32 : Feed Conversion Ratio / dozen eggs or kilogram of meat. Marketing channels in poultry-Integration.

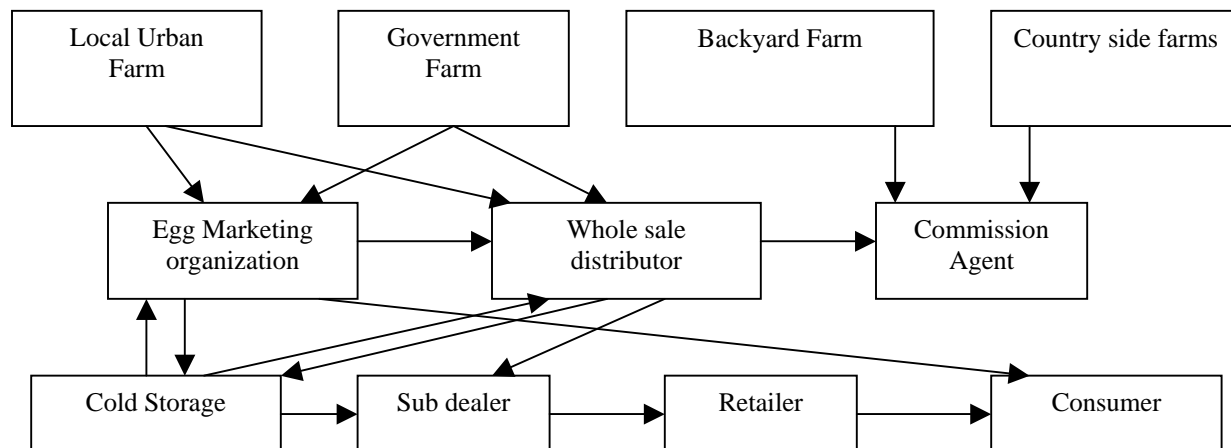
Egg marketing : The wholesale trade of eggs in big cities, where potential demand exists, is in the hands of a few traders who have monopolized this trade for their own advantages. Egg prices vary from one market to another and from one season to another. In summer, the egg prices crash down to a level which is sometimes less than the cost of production, even though the retail price does not vary proportionately. Therefore proper attention has to be given to the problem of most efficient disposal of market eggs.

Distribution channel.

The eggs are distributed through different channels, viz. producers to consumers, producers via retailers to consumers, producers via assemblers to consumers, wholesalers, retailers to consumers, and producers to consumers via co-op societies/egg marketing organizations. Eggs should be distributed through relatively shorter channels to speed up supply and avoid delay and repeated handling.

Marketing agencies.

Marketing of eggs is primarily handled by traders and commission agents. The NAFED regulates price stabilization activities. The NECC nowadays plays very important role in stabilizing egg prices.



MARKETING OF BROILERS

Marketing plays a vital role in overall development of any economic unit, since marketing consists of the performance of business activities that direct the flow of goods and services from the producer to the consumer or user for the transfer of title of the ownership of goods .In broiler marketing ,the producers/farmers and buyer are brought together.

Market is a place wherein the exchange of goods or the change of title of goods takes place.

Broiler marketing Covers the job of

1. assembling of birds from the area of production
2. converting them into cut that are in demand by the final consumers and

3. placing these products in the hands of such at the desired place, at the right time and in quality.

Thus the marketing of broilers includes all the intermediaries from the producer to the final consumer in the channel of marketing.

The large farms which had their own retail outlets, made more profit due to better sale price per kilogram live weight. In Tamilnadu 41.98% of farmers resorted to direct marketing, 45.68% through middleman and 12.34 % resorted to both direct and through middlemen.

MARKETING INTERMEDIARIES

Marketing Intermediaries are institutions that facilitates flow of goods and services between poultry industry and its final market. They include wholesaler, agents (brokers), transporting companies, warehouses and retailers.

CURRENT MARKETING SYSTEM.

At present in Tamilnadu, broilers are marketed through i. Wholesalers ii. Retailers with cold storage (deep freezer facilities),iii Retailers without cold storage facilities, iv. Chain storage v. Hotels and restaurants

Retailer with cold storage

These retailers sell broiler and layer chicken regularly either as fresh or frozen depending on the facilities and demand from the consumers. These retailers also stock other animal products in addition to chicken products Many retailers have slaughtering facilities at their premises. Some retailers

purchase dressed chicken from wholesalers and sell them after packing with a margin. The higher income and middle income groups of consumers prefer to purchase these frozen /chilled chicken as they are kept in hygienic condition

RETAILER WITHOUT COLD STORAGE FACILITIES.

These retailers mostly purchase live broiler from wholesalers / producers and stock the live birds in their premises .As and when the consumers demand ,the live birds are dressed and sold as fresh and remaining birds are kept for subsequent days sale -since most of the consumers of middle and lower middle class people like only fresh chicken rather than frozen or chilled . Now a days these retailers even started selling portion of chicken.

CHAIN STORES

There are many organizations having branches situated at different localities of the same city and different towns ranging from 3to 6 branches with cold storage facilities. All the branches of each organization are under central ownership and control .It is a compromise between large scale and small scale organizations. The management , purchase , processing and controls are centralized while sales are decentralized and carried out on a small scale. The chain stores obtain their supplies directly from producers instead from wholesalers. They buy in lots and perform the work of wholesalers in respect of transport , warehousing, risk bearing and financing .Chain stores are strictly retailers enterprise to eliminate the wholesalers.

MARKETING CHANNEL

Marketing Channels simply mean the paths or routes through which produce from the producer reach the ultimate destination (consumers). There are five different marketing channels being identified in broiler marketing in Tamilnadu.

1.Producers----- Wholesaler-----Retailer-----Consumer.

2. Producers----- Wholesaler -----Consumer.

3. Producers-----Chain store -----Consumer.

4. Producers -----Consumer.

5.Producer-----Integrator/Commission Agent-----Wholesaler-----Retailer----Consumer.

The first channel is more commonly observed in all the cities. The wholesaler purchase the live birds from farm itself on live weight basis and transport in their own transport vehicle and sell to retailers either live or dressed and the retailer in turn sell the product to consumers. In general live birds are

preferred over dressed chicken in the city, accordingly large number of live birds are sold to retailers. The wholesaler take the risk of transport , storage losses due to shrinkage and mortality.

In the second channel retailer procure the birds from the farm and sell to the consumer either dressed or live.

In the third channel , the chain store procure birds from the farm and sell them after processing to consumers.

In the fourth channel, the birds are either sold as live or dressed and in this the producer is able to get 100 percent of consumers rupee since there are no intermediary.

The fifth channel, operates mostly outside the state and in the districts where the integration of poultry farming is gaining momentum.

CONSTRAINTS OF MARKETING.

1. Increase cost of feed.
2. Variable quality of poultry feed.
3. Presence of many poultry diseases(Panic sales with low price).
4. Seasonal fluctuation in poultry meat prices.
5. Unorganized market infrastructure.
6. Non-adherence to quality and safety standards(Bio Security Measures).
7. Lack of Vertical integration.
8. Little efforts for manufacturing value added products.
9. Due to unplanned growth in poultry industry, mushroom growth of small hatcheries without adequate hatchery hygienic practices.
10. Unexpected arrival from other states.
11. Chicken meat is more perishable than egg and thus requires an immediate sale.
12. Lack of consumer preference.
13. Transportation of dressed chicken carcasses in refrigerated trucks to marketing centers is costly affair.
14. Defective processing, storage and distribution of dressed carcasses

INTEGRATION IN BROILER INDUSTRY.

An integrated marketing in broiler industry covers al the aspects of production i.e. from breeding to marketing of the final product. Two kinds of integration exist in marketing:

1. Vertical integration: When more than one stages of producing and marketing a poultry product are controlled by the same individual or company ,e.g. A hatchery supplying chicken and marketing the farmer's final product.
2. Horizontal integration: Two or more companies at one level join together to follow a new marketing opportunity.

A completely integrated production and marketing system can also be organized under the management of a grower ; wholesale processing co-operative, hence called cooperative integration.

Poultry industry provides dramatic examples of the integration of farm production and marketing activities. Poultry production itself is a highly integrated operation combining specialized breeding, hatchery, grained farming and feed mixing, packing operations and marketing firms.

There are 3 types of production- marketing integration in poultry industry.

1. Owner Integration: The integration of product and marketing is controlled by an individual or a single firm.,i.e., the facilities for the meat production is under the ownership and the meat are marketed by him to retailer or consumer.

2. Contract marketing: Buyers sets minimum standards for the meat to be produced by the producer. Here the meat producer bears price uncertainties in addition to production cost. But the quality of meat and the time of delivery are specified and assured.

3.Contract production: Here the producer is asked to grow the birds for the specific distributor- under closely supervised conditions and for a guaranteed return, i.e., the integrator supplies inputs like chick, feed, field supervision, etc., and the grower using his sheds, water and labour grows the birds and returns after getting specified amount plus incentive for superior feed conversion efficiency.

MARKETING INTEGRATION IN BROILER

Broiler farming in India is following the path towards integration. The integrator is involved in all the above steps, which may or may not include supply of chicks to independent commercial farmers. In some parts of the country, a trend towards integration on part of dealers has started. The broiler dealer who were already operating at the middle of the above pathway by purchasing grown birds from commercial farms is now going into forward and backward integration.

i. Forward integration : It includes some sophistication in his dressing plant and extending his reach to retail and institutional outlets.

ii. Backward Intrgration : It involves the following steps:

- a. Setting up his own /contract commercial farm.
- b. Becoming chick agent for the hatchery to supply chicks to farms.
- c. Setting up of a feed plant to supply feed to farmers.
- d. Setting up of hatchery, purchasing of eggs and producing day old chicks for his farmers.
- e. setting up a breeding farm to supply the hatchery

Normally, in broiler industry, the chicken reaches the consumer through : 1. Breeder 2.Hatchery 3. Commercial growers. 4. Processor 5. Wholesaler and finally 6. Retailer at each step, overheads and profits are added making retail price very high for the consumer thus losing competitiveness in business .But in the integrated operation, it does not take the profit at each stage into account, but only from the sale of the end product. Hence, there is an urgent need for integration in the broiler industry. Advantages:

1. In broiler industry a farmer spends Rs 25 /= for production of one kg.of meat. While marketing entrusts only to the wholesalers. So the farmer is able to sell his broilers 2 to 5 rupees per kg than the actual market price. But in integrated marketing , the fluctuation in market price and considerable amount of profit to middlemen will not arise.
- 2.In integrated marketing, a farmer does not involve directly in marketing. So he need not maintain different age groups of birds in his farm. He can rather switch to “All –in-All-out” system of rearing. Hence, he attains profit as a whole in a single spell itself.
3. As chicks, feed and vaccines and other inputs are provided by the integrator the farmer needs to put only a lesser investment.
4. Variation in consumers’ demand and market prices depending upon season will not affect the farmer.
5. Timely attention with respect to the diseases prevention is provided by the integrator himself which reduces loss.
6. There is change of shift in broiler units from urban area to rural areas, as the integrated marketing makes the farmers not to trust the wholesaler for the marketing their birds. Moreover, the cost of land and labour are comparatively very cheap in rural areas.

Benefits to Integrators.

1. The chicks produced in hatcheries are better channeled through farmers to market. Further, the hatchery receives the cost of chick from the farmer at a specified period and marketing is well organized.
- 2 Since, the feed is prepared as a lot, production cost of feed is also reduced to the integrator.
3. Integrator can decide over the market place of broiler meat as most of the rearing units are in the hands of integrators.

33. Classification of Poultry diseases- Viral-Bacterial-Protozoan- causative organisms, symptoms and prevention – Viral diseases – Ranikhet disease – Infectious bursal disease.

Disease and their control.

Disease is defined as the deviation from the normal state of health which may be characterized by impaired body functions, decrease in production, mortality and morbidity

General Control measures:

1. Buy chicks from reputed disease free companies.
2. Adhere strictly to vaccination programme.
3. Keep the houses dry cool and well ventilated.
4. Rodent and fly proof.
5. Sanitation of litter, feeder and waterer.
6. Follow medication schedules.
7. Proper disposal through burial or incineration of the waste and dead.
8. Earmark areas for specific age group.
9. Screening visitors.
10. Foot baths with sanitizers.
11. All in all out system.
12. Personnel sanitation.

Vaccination

It is correctly pointed out that " Prevention is better than Cure ". Many viral diseases cannot be treated but can be controlled only by preventive vaccination.

1) Routes of administration

Administration through 1) Drinking Water : It is time and labour saving method. Vaccine is reconstituted in cold drinking water along with skim milk powder at the rate of 4 gram per litre of water and used immediately. For example RDV Lasota Vaccine.

2) Intra ocular -Intra nasal instillation.

The vaccine is reconstituted in normal Saline solution. One drop of diluted vaccine is applied to the nostrils or eye. Ex : RDVF . The virus particle gets absorbed in the mucous membrane and immunization is obtained.

3) Spray Vaccine

Spray or mist spraying is done in chick boxes in the hatcheries. Small drops of equal size is sprayed and the boxes are allowed for 10 to 15 minutes for drying. Drying should not be done near light or by hot air.

4) Wing Web puncture method

Fowl pox vaccine is reconstituted in 50% glycerol saline and taken in forked needle and vaccination is done by puncturing through wing web. Care should be taken that muscle, nerve and blood vessels are damaged by the vaccination.

5) Feather Follicle Method

Pigeon pox vaccine is reconstituted with 50% glycerol saline. After plucking of the feather follicles in the internal thigh region, with the help of a glass rod, the vaccine is smeared and rubbed. After 5 days the birds have to be examined for "Takes". Takes are cellular reaction taking place in the nervous system.

6) Subcutaneous injection

Ranikhet K vaccine is reconstituted with normal saline and 0.5ml is given between two layers of skin in the wing web region without damaging nerves, blood vessels and muscle. The vaccine should be protected in ice box during vaccination and should be used within one hour.

S.No.	Age	Name of the vaccine	Route of administration
1.	1 st day	Marek's Disease vaccine	Subcutaneous injection at Hatchery
2.	7 th day	Ranikhet Disease F Strain/Lasota. RD killed.	Eye drop or Nasal drop.0.2 ml S/C.on the same day
3.	14 to 16 days (II week)	Infectious Bursal disease(live) IBD(killed)	Eye drop 0.2 ml. S / C on the same day
4.	21 to 24 th day (III week)	Infectious Bronchitis	Eye drop
5.	30 to 35 days	Ranikhet disease-Lasota strain	Eye drop
6.	42 to 45 days	Infectious Bursal disease (live)	Eye drop
7.	56 to 70 days (8-10 th week)	Ranikhet disease "K" (Mesogenic)	Subcutaneous
8.	84 to 91 days (12 - 13 th week)	Fowl Pox vaccine	Wing web puncture or Intramuscular
9.	91 to 98 days (13 to 14 th week)	Infectious Bronchitis Vaccine	Through Drinking Water
10.	126 to 133 days	Ranikhet disease K" (Mesogenic)	Subcutaneous Injection
11.	After peak production , every 8 Weeks	Ranikhet Disease Vaccine "Lasota"	Through Drinking Water

1. Live vaccine and killed vaccine should be administered on the same day by different persons.
2. The IBD vaccine should be administered only in the out break area.
3. In the pullet(nearing egg laying stage)or during out break of Ranikhet disease the RDVK vaccine should be preferred to Lasota strain.
4. Before RDVK vaccination the birds should be dewormed.

Debeaking

It is recommended to debeak the layer birds to control feather pecking and cannibalism, bullying. It is carried out by means of electrocautery. It is important to remove only one third of the upper beak taking care to avoiding tongue. It is usually practiced at the age of 10-14 days and repeated at the age of 14-16 weeks. Debeaking should never be done with penknife.

Overcrowding, inadequate space for standing/ feeding/ watering and resting, starvation, external wounds, less fiber diet and deficiency of vitamins and minerals may pre dispose the birds to cannibalism.

Procedure

The bird has to be restrained by holding wings and legs by left hand and the tongue is pushed backwards by opening mouth and introducing index finger so that the tongue is not cut The upper beak is cut to $\frac{1}{3}^{\text{rd}}$ of it's length and the lower beak is slightly trimmed.. After debeaking vitamins and antibiotics are to be administered for 3-5days to avoid stress and secondary infections.

Deworming

Is the process of removing worms from digestive tract of the birds. The tapeworm passes segments and is consumed by intermediate host (earthworm, cockroach) where intermediate stage get developed and passed out, which inturn is consumed by host. The eggs or ova of round worms are passed in the droppings which is picked by other birds directly or indirectly with the help of chance carriers (personnel, insects, flies, ants, etc). Sometimes wild birds such as crows may serve as source of infestation.

Birds show the following symptoms when they are infested with worms

- 1 Dullness- weakness, emaciation
- 2 Paralysis-due to toxins produced from worms
- 3 Enteritis-diarrhea with blood
- 4 Anemia-due to sucking of blood by worms.
- 5 Drop in egg production.

If infestation is on a larger scale there may be mechanical block of intestinal lumen and some times rupture occurs. This may also result due to intestinal stasis of food particles.

Deworming is practiced at intervals of 45 days in layer birds and also before RDVK vaccination. Deworming is done against tape worms only on absolute necessity.

Delicing

Is the process of removing of external parasites like ticks, mites and fleas which suck the blood from the bird .The following symptoms are observed during external parasitic infestation: itching, restlessness, external wounds, loss of body weight, weakness, anemia and drop in production.

Procedure

The dipping of the birds in sunny days has to be done with the following chemicals to remove the external parasites.

1. sumathion or malathion -5ml in 100ml of water. The bird has to be immersed in the chemical solution avoiding eye and mouth. The dipped one has to be dried in a separate enclosure. The feeders, waterers and building should be sprayed with this chemical solution to remove the external parasites. After dipping, to relieve stress to the bird vitamin A, B complex has to be given to improve the health of the birds.

Ranikhet Disease – New Castle Disease

Virus- Para myxo viridae

Very important disease affecting poultry

rainy season in India has been found to be more favourable for the occurrence and spread of the disease. In native fowls this disease occurs in summer.

Peracute- without symptoms and sudden death

In a typical outbreak depression is observed, characterised by prostration, closed wyes, drooping wings and loss of appetite.

There is usually greenish or yellowish diarrhoea.

sometimes in neural form there may be twitching of neck, incoordination or even paralysis. Egg production drops and sometimes-soft shelled or shell less eggs may be laid. Respiratory distress may be observed.

Prevention and control: chicks should be vaccinated with F strain or lasota strain on the first day or within 5 days after hatch and with a booster dose at 8-10 weeks. RDVK strain is usually administered at 8 weeks of age. In layer flocks, booster dose of Ranikhet vaccine is given every 2 months.

Infectious bursal disease: Gumboro disease

-Highly contagious

IBD virus

Bursa is affected- Immuno suppression- humoral antibodies production affected

Usually chicks of 2-6 weeks old affected

Symptoms- whitish diarrhoea, vent pasting, unsteady gait, tremors,

Prevention – Vaccination at 2nd & 3rd weeks of age

34. Bacterial diseases-E.coli-Coryza-Salmonellosis-Protozoan-Coccidiosis-casulative organism – symptoms and preventive measures. Nutritional deficiency diseases and its control.

Bacterial Diseases

Coli Bacillosis

Escherchia coli infection

Aggravated by other stress factors

Symptoms- Diarrhoea, swelling of joints, comb, and wattle.

mortality – very high

Prevention- Proper sanitation and management, avoiding stress

addition of antibacterials and antibiotics in feed and water

Infectious coryza

Haemophilus gallinarum

Symptoms- all ages – affected, Acute respiratory infection, high morbidity and low mortality, oedema of face, wattle and comb, discharge from nostrils

Recovered birds – carriers

Prevention and control- Better hygiene, Addition of Anti bacterials and antibiotics – Sulpha in feed, Tylosin, tetracycline

Salmonellosis

Paratyphoid, Pullorum

visceral organs – affected

S.pullorum- pullorum disease

, S. gallinarum-typhoid/bacillary white diarrhoea

, S.typhimurium- paratyphoid

Symptoms- Chalk like diarrhoea, huddling, weight loss, pasted vent.

Treatment: Sulpha drugs, Hygienic management, hatchery hygiene is important.

PROTOZOAN

Coccidiosis:

Eimeria tenella, E.necatrix

Severe upto 10 weeks of age, due to poor litter management,

bloody droppings, high mortality, production performance is hampered

Prevention and control: Anti coccidials, litter management and hygiene.

Amprolium, sulpha drugs. Coccidiostats may be mixed with feed.

Nutritional Deficiencies and control:

Vitamin:

Vit A: Xerophthalmia- Gout, - retarded growth, discharge from eyes and nose. – Cod liver, fish liver oil, vit A supplementation

Vit D3: Ricketsia, - leg weakness, swollen hock joints, rubbery beak, thin shelled eggs.- Cod liver, fish liver oil, vit D3 supplementation

Vit E: Encephalomalacia- crazy chick disease – paralysis of leg – retraction of head, convulsions, death- vegetable oils, synthetic Vit E.

Vit B1: Thiamine – poly neuritis – paralysis of wing and neck.- yeast products, synthetic vit B1

Vit B2- Riboflavin – curled toe paralysis- tendency to walk on hocks – dermatitis on corners of mouth, vent and foot pads – fish products, Vit B2, rice bran.

Vit B12- Cyanacobalamine- retarded growth, increased mortality, drop in production and hatchability- fish meal, meat meal, synthetic B12.

Choline – Fatty liver syndrome- poor feed utilization, ruffled feathers, increase in liver fat, -fish, meat, ground nut meal.

Mineral deficiency:

Manganese: slipped tendon – deformity of hock joints – fish, meat meal

Goose stepping – Zinc,magnesium deficiency – bone formation affected.

Calcium, Phosphorous: def of vit D, deficiency during laying- imbalance in Calcium and Phosphorous- poor egg shell formation, curved beak, bone deformities.- supplementation with ca and p.

External And internal parasites; Lice , ticks and mites- deticking, delicing
round worm, tape worm infestation – deworming regularly.

