

Lecture 6

Cattle Production Systems

Livestock production systems may be classified according to a number of criteria, the main ones being integration with crop production, the animal-land relationship, intensity of production, and type of product. Other criteria include size and value of livestock holdings, distance and duration of animal movement, types and breeds of animals kept, market integration of the livestock enterprise, economic specialization, household dependence on livestock and farming systems approach. A farming system is defined as a group of farms with a similar structure, such that individual farms are likely to share similar production functions. A farm is usually the unit making decisions on the allocation of resources.

Pastoral and agropastoral systems

Pastoral systems are associated with zones that are too dry for cropping to provide a basis for subsistence and are defined as land-based systems occurring in areas with a length of growing period (LGP) of less than 180 days, where the grazing of ruminants is the predominant form of land use. Based on the degree of economic dependency on livestock, a pastoral production system has been defined as one in which 50 percent or more of household gross revenue (the total value of marketed production plus the estimated value of subsistence production) comes from livestock or livestock-related activities, or where more than 20 percent of household food energy is directly derived from livestock or livestock-related activities. Three types of pastoral system can be identified. In the rainfall range of less than 400 mm per year:

- nomadic pastoralism, which is a pure pastoral system, characterized by little or no agriculture and by high mobility of people and animals in search of grazing and water;
- transhumant pastoralism, which is based on more or less regular seasonal migrations from a permanent homestead. It is characterized by almost exclusive reliance on animals and animal-related activities for household revenue. There is no cultivation and there is little use of crop residues by animals. The basic production units are independent nuclear families or groups joined together in camps, whose composition varies seasonally and whose members cooperate to varying degrees in economic activities. The animals are grazed on communal pastures using family or hired labour.

In areas with annual rainfall between 400 and 600 mm:

- agropastoralism, in which livestock production is associated with dryland or rainfed cropping and animals range over short distances. This system is characterized by a high degree of reliance

on pastoral activities for household revenue, but rainfed cultivation by, or on behalf of, the household also contributes an important share (up to 50 percent).

The main functions of livestock production in pastoral households are to provide subsistence products (milk, blood and meat), to meet social obligations (bride price, stock alliances and stock patronages) and to insure against disaster (drought, epidemics, raids).

Livestock management in pastoral systems is characterized by three principles; adaptation to the environment in the attempt to ensure subsistence, risk averting strategies and adaptation to the institutional environment (characterized by communal grazing systems).

Mixed systems

Semi-arid, subhumid and humid zones:

The term mixed systems has a dual meaning: the farming system is based on livestock but practiced in proximity to other farming systems based on cropping (e.g. pastoral systems in arable areas) and livestock subsystems of integrated crop-livestock farming. The first type is more common and is characterized by seasonal penetration into the more humid areas, with southward movements during the dry season and northward movements during the rainy season. Integrated crop-livestock farming is categorized based on agro-climatic conditions in particular rainfall and cropping pattern, pressure of human population expressed by cultivation intensity, tsetse challenge and overall importance of livestock expressed by livestock densities and species.

A major characteristic of mixed farming systems is the varying degree of interaction between crops and livestock. Mixed systems have also been defined as those which derive between 10 and 50 percent of gross revenue from livestock, or 50 percent or more from cropping. The basic principle of these systems is that rainfed agriculture is the main source of income, although livestock provide an important additional source.

Livestock management is usually sedentary and if movement is part of the management system, it is generally restricted to short distances. Cattle are normally grazed on communal pastures, herded by family or hired labour and kraaled at night in order to prevent theft or crop losses. Manure is often collected and calves are separated from their dams to make milking possible. In some areas, cattle are left free to wander during the dry season after the crops have been harvested.

Highland zones:

The mixed systems of the highlands have special features that justify their separate consideration:

- good soils and suitable climatic conditions, allowing higher crop productivity and consequently higher population densities;
- high cropping intensities and more or less permanent cropping patterns as a result of generally high population pressure;
- crops are grown are unsuitable for the lowlands, such as wheat, barley, coffee and tea;
- crops and livestock are normally produced within the same management unit, hence approaching the concept of mixed farming;
- absence of trypanosomiasis; and
- ecological conditions suitable for the intensification of both crop and livestock production through the introduction of varieties and breeds from temperate zones.

Highland mixed systems are particularly important in East Africa, which has 70 percent of sub-Saharan Africa's highland area. Livestock and livestock products account for some 80 percent of mean farm cash income.

The animals are herded and grazed during most of the day. After the crop harvest, cattle are needed for threshing and grazing time for oxen reduces accordingly. Labour inputs to livestock production consist of efforts related to milking, barn clearing, manure collection, feeding, herding and watering, the dominant input being for herding. Animals are grazed private grazing land, communal grazing land and on the stubble of crops grown on family farmland.

Production Parameters of Cattle in Traditional Systems

Production parameters include the following:

- mortality risk, defined as the probability of an animal dying during a specified time period (one year for cattle);
- age at first parturition, expressed in months;
- parturition rate, defined as the number of parturitions per female per year;
- prolificacy, defined as the number of live offspring per parturition;
- milk offtake per lactation, defined as the milk used for human consumption (i.e. excluding that consumed by the calf);
- offtake rate, defined as the proportion of animals sold or consumed in a year; and
- mean live weight of breeder females and males (uncastrated adult males used for breeding).

These parameters determine the population dynamics and gross productivity. The gross productivity of livestock production systems is generally closely linked to the basic production parameters of fertility and mortality, the difference between which allows management decisions on the trade-off between sale, consumption and investment in herd growth.

Traditional systems are characterized by high mortality risks, low fertility rates, low milk offtake and low cattle offtake. Calf mortality risks are practically the same between pastoral (21.4 percent) and mixed (22.6 percent) systems. Since stock mortality is one of the most important parameters determining population dynamics and hence the gross productivity of livestock production systems, high mortality risks, especially among calves, is a major constraint in traditional cattle production systems in sub-Saharan Africa.

Cattle in traditional systems generally have a delayed mean age at first calving of 47.9 months, with a wide range from 33.4 months to 62.5 months. The mean ages at first calving are virtually the same in pastoral and mixed systems.

Calving rates in traditional cattle systems are low, at 58.7 percent (median of 58 percent). The mean calving rates for pastoral and mixed systems are similar, at 60.8 percent and 58.2 percent respectively.

Milk offtake per lactation in traditional systems is generally low, at an average of 252 kg (median of 251 kg). It ranges from 60 kg to 508 kg per lactation. The mean milk offtake per lactation reported in pastoral and mixed systems is virtually identical and very low.

The mean of reported offtake rates for cattle in traditional systems is 9.9 percent (median of 9 percent) and ranges from 1.2 to 20.0 percent. Mean offtake rates for cattle in pastoral systems are higher than in mixed systems.

The mean weight of mature cows in traditional systems is 244 kg (median of 250 kg), ranging from 152 kg to 357 kg. The mean weights of mature cows in pastoral and mixed systems are similar. Weights of mature cows are different across the sub-regions and across the systems. Mature cow weights in the mixed systems in the semi-arid and subhumid zones are higher than those in mixed systems in the humid zone and in the highlands. The mean weight of mature bulls in pastoral systems (322kg) is similar to mixed systems (326kg).

Ranching Systems

Ranching systems consist of labour-extensive enterprises specializing in one or more livestock species and producing mainly live animals for slaughter (for meat, skins and hides), but also for wool and milk.

Management is characterized by grazing within the fixed boundaries that delimit tenure. Ranches are generally commercial enterprises, with generation of a cash income as the primary function of the livestock raised on them. It supporting fewer people per land area, since tenure is generally individual (although not necessarily private) and providing options for intensifying water and feed supplies.

Ranching may take any of the following forms:

- Cattle ranching for meat (the most common type),
- Dairy ranching,
- Stud breeding.

Ranching systems can either hold both breeding and growing stock or specialize in rearing/fattening animals, according to environmental and economic conditions. Ranching systems are commonest in the arid and semi-arid zones of East and southern Africa and occur only sporadically in the drier parts of West and Central Africa. Ranches are also found in the humid zone of Central and West Africa but are not a predominant form of land use there. A few ranches are also found in the highlands.

Ranches generally exhibit improved herd, pasture and water management. Records are kept, herding patterns are closely adapted to the needs of different animal groups, and more external inputs are used (labour, purchased feed, inputs for animal health, etc.).

Smallholder Dairy Systems

Smallholder dairy systems may be characterized as mixed systems whose principal output is milk for sale. They are found mainly in the highlands. Smallholder dairy systems predominate in the high-potential highlands of Kenya and occur to a lesser extent in other East African highland areas. Livestock production is integrated with the growing of subsistence crops, such as maize, beans and potatoes, and of cash crops, including coffee, tea and pyrethrum. Besides engaging in crop farming and keeping other livestock, smallholder dairy farmers in Kenya also typically keep two or three dairy cows with their offspring which are mostly grade animals, but some are zebu or zebu x taurine crosses.

The herds are composed of 80 percent female cattle and 20 percent male (mainly young males). Breeding bulls are not important in this system and represent less than 1 percent of the total herd.

The farms practice zero grazing, free grazing or a combination of these. In general, land ownership is private rather than communal and livestock management varies from family to family, with some families keeping grade cattle under improved management regimes involving stall feeding, use of concentrates and disease control.

Production Parameters of Cattle in Non-traditional Systems

Beef systems

The mean calf mortality risks in beef systems located in the arid/semi-arid zones (10.2 percent) and in the subhumid/humid zones (10.1 percent) are similar. The mean replacement mortality risks are 10.0 percent and 7.8 percent, while the mean cow mortality risks are 5.7 percent and 6.2 percent in beef systems located in the arid/semi-arid and the subhumid/humid zones respectively. The mean age at first calving for beef systems in the subhumid/humid zones is 41 months, while no values are available for the arid/semi-arid zones. The calving rates in beef systems in the arid/semi-arid and subhumid/humid zones are similar, at 76.6 percent and 76.2 percent respectively. The mean weight of cows (414 kg) and bulls (495 kg) in the arid/semi-arid zones is higher than the mean weight of cows (309 kg) and bulls (440 kg) in the subhumid/humid zones.

Dairy systems

The mean calf mortality risks reported in the smallholder dairy systems are 12.4 percent and 15.9 percent for female and male calves respectively, while the mean replacement mortality risks are 9.1 percent and 22.4 percent for females and males respectively. The mean reported cow mortality risk in smallholder dairy is 5.2 percent, while the mean age at first calving is 48 months, the mean calving rate is 71.9 percent and the mean milk offtake per lactation is 2,050 kg. The mean weight of cows and bulls in smallholder dairy systems is 320 kg and 450 kg.

Mean calf mortality risk in large-scale dairy systems is 8.1 percent and 6.4 percent for female and male calves, respectively. The mean reported replacement female mortality risk in these systems is 1 percent, while the mean cow mortality risk is 4 percent. The mean age at first calving is 33.4 months and the average calving rate is 87.2 percent. The mean milk offtake per lactation in large-scale dairy systems is 3 911 kg, with a median of 3 195 kg and a range of 2 112 kg to 6 715 kg. The mean weight of mature cows and bulls is 414 kg and 450 kg respectively.

Methods of Determining Age of Cattle

The beef cow has relatively short life span. After their peak productive age, breeding market value usually declines as the animal gets older. Year branding or ear tag numbering are good methods of permanently identifying the age of cattle. These practices usually add value when selling bred cows. Buyers can bid with confidence on the age of cow they are purchasing. However, many cattle ranchers are unable to accurately identify the ages of their cattle.

The approximate age of cattle may be determined by examining the teeth. The tooth method of aging cattle involves noting the appearance and the degree of wear on the temporary and permanent teeth. The temporary or the milk teeth,, are easily distinguished from the permanent teeth by their smaller size and white colour. At maturity, cattle have 32 teeth, 8 of which are incisors in the lower jaw. The two central incisors are known as pinchers; the third pair are called second intermediates or laterals; and the outer pair are known as the corners. There are no upper incisor teeth; only the thick, hard dental pad. Becoming proficient at aging cattle by the tooth method requires practical experience and a lot of practice.

A second method of aging cattle involves reading the brucellosis tattoo in the right ear of female cattle. The tattoo (if legible) will reveal the year that the cow was a weaned calf and brucellosis vaccinated. The first digit of the tattoo represents the quarter of the year that the animal was vaccinated. For example, a two would mean the animal was brucellosis vaccinated in April, May or June. The middle portion of the tattoo is a shield. The last number is the year the animal was vaccinated. For example, a 7 would mean the animal was vaccinated in 1997, as a calf. The calf could have been born in 1996 or during 1997. Brucellosis tags do not reveal the year of vaccination. The following are the guide to determining the age of cattle by the teeth:

Birth to 1 month: Two or more of the temporary incisor teeth present. Within first month, entire 8 temporary incisors appear.

2 years:As a long-yearling, the central pair of temporary incisor teeth or pinchers is replaced by the permanent pinchers, At 2 years, the central permanent incisors attain full development..

2 ½ years: Permanent first intermediates, one on each side of the pinchers, are cut. Usually, these are developed at 3 years.

3½ years: The second intermediates or lateral are cut. They are on level with the first intermediates and begin to wear at 4 years.

4½ years: The corner teeth are replaced. At 5 years, the animal usually has the full complement of incisors with the corners fully developed.

5 to 6 years: The permanent teeth pinchers are leveled, both pairs of intermediates are partially leveled, and the corner incisors show wear h show noticeable wear.

7 to 10 years: At 7 or 8 years, the pinchers show noticeable wear, at 8 or 9 years, the middle pairs show noticeable wear, and at 10 years, the corner teeth.

12 years: After the animal passed the 6th year, the arch gradually loses its rounded contour and becomes nearly straight by the 12th year. In the meantime, the teeth gradually become triangular in shape, distinctly separated, and show progressive wearing to stubs. These conditions become more marked with increasing age.