EQUIPMENT FOR CATTLE PRODUCTION

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Keywords: cattle, grazing, buildings, fence, feeding, milk, milking machine, welfare, mastitis, lameness , infertility, robotic, computer

Contents

Summary

The equipment required to apply industrial techniques of cattle production are described and discussed. The equipment needed is determined by climatic factors, the proximity of markets for meat and dairy products and the labour and capital available. Cattle production is divided into four types, range beef requiring virtually no equipment, intensive beef requiring housing and some feeding, extensive dairying requiring milking system and intensive dairying requiring a comprehensive set of equipment. The methods of feeding fodder and concentrates are described. The choice of total mixed

ration or transponder controlled feed stations has a major effect on the design of milking parlours. The method of bedding and means of disposing of effluent determines the choice of method of cattle housing which could be tie stalls, cubicles or open yards. The thermal environment is not a major restriction on cattle housing systems. The main production diseases of cattle influenced by building design are lameness and mastitis. Milking equipment can range from the rudimentary to the totally automatic. The operating principles of the milking machine are described and parlour layouts for efficient milking of cows are discussed. A number of devices and systems to aid the management of cattle are described, these include transponders to identify cattle, rotary calendars, computer programmes and procedural systems to manage mastitis. New developments of automatic systems to monitor oestrus and health are discussed. The review concludes that the selection of equipment from the wide range available allows the farmer to design a system of cattle production to match the needs of his market.

1. Introduction

There are an estimated 1.6 billion domesticated cattle in the world. In terms of total biomass they probably outweigh humans. Cattle have been farmed since stone age times across Africa and most of Eurasia. Breeds of cattle suited to various climatic zones and modes of production have developed through human intervention and natural selection. Cattle are used in different cultures for the production of milk and dairy products, meat, hides, pharmaceutical raw materials and their dung is used as fertiliser and fuel. Cattle are also a major source of draft power. Cattle also have a cultural role and carry potent symbolism that varies around the world. There are many areas of the world where cattle are managed with equipment that has barely changed since the stone age – ropes to capture and restrain individual animals, barriers to corral the herd, a bucket to collect the milk and a shovel to handle the dung. This article will concentrate on equipment that is principally used in industrialised agriculture to increase the productivity of the farmer and stockbreeder and to raise the efficiency of land use. It is probable that the tools of industrial agriculture will continue to displace traditional methods of production and thus allow milk and beef to be affordable by even the poorest in society rather than being, as they were, rare, luxury foods for the rich.

In temperate zones, simple systems of cattle production evolved that is still practised widely. Hardy breeds of cattle that would over-winter outside and rear their young for slaughter were always available. Production of milk in excess of that required by the calf must at some point have been recognised as having great value to humans. Cattle were kept at pasture during the summer months and housed during the winter when grazing was not available. Forage (usually of hay) was conserved in the summer and fed to the cows during the winter. Only the breeding animals would be kept over winter, usually chained by the neck for restraint. The surplus milk production of the summer would be consumed in winter in the form of cheese or beef. Other available sources of feed were the by-products of milling and food processing (for example sugar beet pulp). In this way, humans developed a system of harvesting and storing the abundant sources of organic cellulose found in plants across the planet that are otherwise indigestible by the human metabolism.

The production of milk all the year round became the principal objective of some cattle

owners. This change was presumably driven by a change in social organisation with production for a market becoming a major objective. The balance of value of the output from a cow switched from the calf as meat animal to the milk and its products. Specialist dairy producers are a relatively modern phenomenon. Until very recently all production systems were large scale versions of antique husbandry systems using manual labour. However, in the twentieth century a number of factors (refrigeration, tractors, milking machines, world food trade, concrete, steel etc.) have enabled novel systems of beef and dairy production to become the common form of production in the temperate climatic zones.

The type of production system used by any individual farmer is determined by a complex mix of climatic, market, historical, cultural and technological factors. This article will describe the technological factors involved in cattle production systems and describe how such systems are responding to changing markets. The basic system of cattle production, upon which intensive dairying is based was first developed in Europe and then exported to areas with either no aboriginal cattle culture (the Americas and Australasia) or overlaid onto Asian and African conditions. This article has a slightly Eurocentric bias but the development of high technology dairying is a global phenomenon. Systems and machines developed for local needs are quickly adopted and transferred to other areas.

2. Types of Cattle Production

2.1 Range Beef

This system is usually found in areas of the globe that are distant from markets, where land cannot be tilled and where the climate allows the production of sufficient herbage to support cattle. It is common in upland areas of Europe and North America, in tropical and temperate South America, Australasia and throughout Africa. Cattle are allowed to graze extensive pastures with very little intervention from the farmer. Steers (male animals up to 1 year old) and unproductive cows are culled at least annually for beef. Control of grazing is sometimes undertaken by fencing land into fields so that animals can be directed to new pasture to allow re growth of herbage. Equipment for this type of production system is minimal. The value of individual animals is generally low and so attention is paid to the herd rather than the individual.

2.2 Intensive Beef

Where land is more valuable or where labour is scarce, beef is produced by housing cattle all or part of the year. Cattle in these systems need equipment to corral them, protect them from the weather, feed them, provide a bed and to remove the fouled bedding. In areas of low rainfall the cattle can be corralled into large open pens known as feedlots and the feed brought to them. The faeces dry rapidly and provide a bed for the animals that is removed periodically.

2.3 Extensive Dairying

In areas where grazing is available all the year round such as New Zealand, milk is

often produced from cows that live outside throughout the year. The amount of equipment is limited to that for milking the animals and controlling the grazing.

2.4 Intensive Dairying

This is common in Europe, N. America and East Asia. Cows are housed all or part of the year and systems and equipment for feeding, bedding and milking them are essential. The equipment can range from the minimal, with all work done by hand, to the most technically sophisticated with work done entirely by automatic systems. In the most automated systems the role of the human becomes entirely supervisory and dedicated as much to maintaining the equipment as the animals. The individual animal output frequently exceeds 8000 litres per year and thus each animal is very valuable and is managed accordingly. All the tools (housing, feeding, milking and management) of intensive dairying are capable of being used in the other less intensive systems but the issue is one of cost effectiveness and appropriateness.

3. Method of feeding

3.1 Fodder

Cows need a large proportion of their diet in the form of fresh cut or stored (usually ensiled) herbage from grass, maize, lucerne (alfalfa), straw and other forage crops. As fodder is generally regarded as the cheapest feed available on the farm the principal objective of the feeding system is to allow as much access as possible whilst preventing wastage. Ensiled material can be fed where it is stored by allowing cows to eat at a movable barrier that is pushed forward as the silage is consumed. This self-feed silage system has the advantage of needing minimal equipment but places constraints on the design of the silo. The reach of the cow limits the height of stored material to about 2 m and each cow requires about 1 m width of feed barrier at which to eat. The wide low silos that this system enforces are difficult to seal and act as a catchment area for rainwater thus adding to the burden of effluent. More commonly barriers of steel, timber or concrete are erected and the forage is brought to the feed barrier by tractor drawn or self-propelled feeder wagon at regular intervals. In wet climates, the fodder is protected from leaching by being kept under a roof. The principle design considerations for feed barriers are the size and type of cattle and whether the trough is to be filled from the cow side or the feed side. For buildings with central feed passages the latter is wasteful of space within the building but makes for an easy working routine. The former requires a machine with a discharge high enough to put forage over the top of the barrier but requires the feed wagon to be co-ordinated with cow movements.

Where fodder is available in big bales cattle can be fed in ring feeders. These are portable feed barriers made in a ring of approximately 3 m diameter around which a dozen cattle can feed. The big bales are brought to the feeder with a tractor mounted loader. This system has the advantage of great flexibility and can be moved from location to location. It is particularly useful where the grazing is supplemented by the offer of a feed of straw or other forage.

Because of the bulkiness of fodder various mechanical aids have been developed to

handle, transport and distribute it. To facilitate the use of tractors and self propelled feeder wagons silage clamps or silos usually have concrete floors. The individual machines for handling and distributing forage are too numerous and diverse to be listed out here. They can be seen at machinery fairs and purchased from agricultural machinery dealers.

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Bibliography

Bramley, A.J., Dodd, F.H., Mein, G.A. and Bramley, J.A. Editors *Machine Milking and Lactation*, 1992,. Insight Books, Newbury, UK and Huntington, Vermont. ISBN 0 9519188 0 X. [This is by far the most comprehensive book on the design and technical performance of milking machines.]

F.R. Lowe *Milking Machines*, 1981, Pergamon Press, Oxford, UK, ISBN 0-08-024582-7. [A handy practical guide to maximise the performance of the milking machine.]

Wathes, C.M. and Charles, D.R., *Livestock Housing*, 1994, Editors CAB International, Oxford, UK, ISBN 0 85198 774 5. [Is a standard textbook for anyone needing the detailed technical information to optimise livestock house design]

David Bebb, *Mechanised Livestock Feeding*, 1990, BSP Professional Books, Oxford, UK., ISBN 0-632-02035-0. [A comprehensive guide to equipment for feeding farm animals.]

Ipema, A.H., Lippus, A.C., Metz, J.H.M. and Rossing, W. *Prospects for automatic milking*, 1992, Proceedings of the International Symposium Wageningen, Metherlands, 23-25 November 1992. (EAAP Publication No. 65, 1992) Editors, Pudoc Scientific Publishers, Wageningen, 1992. [This is a conference proceedings and has some omissions but nevertheless is the most comprehensive summary of the state of the art of robotic milking in 1992. Much has changed since then and another conference planned for August 2000 will update muh of the information.]

The International Dairy Federation, Place Vergote, Bruxelles, Belgium, publishes a number of technical bulletins on dairy cattle management and convenes meetings of the International Committee for Animal Recording that oversees milk meter tests.

ISO standards 3918, 5707 and 6690 relating to milking machines are available from national standards organisations.

Biographical Sketch

Toby Mottram worked as a tractor driver and dairy herdsman for 15 years after leaving school. He retrained as an engineer through the Open University. In 1987 he completed an MSc at Silsoe College specialising in Agricultural Machinery Design and moved into a career in dairy research. In 1989 he joined the Silsoe Research Institute to develop aspects of robotic milking. Since 1995 he has specialised in measuring animal health and fertility non-invasively. In 1997 he built and tested a system for detecting ketosis automatically by sampling cows breath. He is currently working on a biosensor based system to predict ovulation automatically. He was a member of the British Standards Committee contributing to the revision of ISO 5707 and is a member of an IDF group writing a review of robotic milking.