

## Farm machinery

**Farm machinery has been developed over thousands of years. The ancient Egyptians used animal drawn ploughs and the Romans ox-pushed reapers, which stripped the heads off grain rather like some combine harvesters today.**

The corn drill which plants the seeds in rows was developed by Jethro Tull and the threshing machine by Andrew Meikle, both in the eighteenth century. These inventors would recognise their ideas in today's machines. The great expansion of ideas began in the nineteenth century. Exposure to international competition in the 1840s and expanding markets in newly industrialised areas, were important incentives. Many agricultural organisations, particularly the show societies, were active in fostering the development of machines and equipment, offering medals and prizes for new ideas. By the end of the nineteenth century, agricultural mechanisation had made many of the technical advances that are in use today. Some fixed machinery was driven by steam or water power. Steam traction engines were used for threshing and some heavy cultivation work. The main source of power was, however, the heavy horse. The use of horse power had severe limitations in terms of versatility and the amount of power available. Horses were very labour intensive and large areas of land were needed to feed them. Some tractors with internal combustion engines came into use early in the 20th century but the major expansion came just before and during the Second World War. Soon after the war, tractors were replacing horses on farms, one-for-one. The horse equals about one 'horsepower' and tractors, at that time, were about 20 horsepower. There was, therefore, a very rapid increase in the power available on farms. These days, the average tractor exceeds 100 horse power (75 kW), reflecting a huge increase in the power available per worker. The other vitally important and more recent development has been the arrival of electronics technology for control, computing and sensing in farm machinery.

### Tractors

Early tractors were direct replacements for the horse. They simply had the capacity to tow implements. For a considerable time they used the actual horse implements, rather than purpose designed tractor implements. The new machines could travel over fields and ploughed land but were unable to travel on public roads at speeds suitable for transport work and without damaging road surfaces. One of the first advances was the introduction of rubber tyres in place of steel wheels. This allowed quick and legal movement on public roads and made the tractor, with a trailer, a farm transport

machine. Very soon, more than half of the total tractor hours in Britain were used on transport work. The new tyres had a large area of contact with the soil, reducing the damage done to the soil by a heavy tractor. Early tractors were fitted with pulleys which allowed them to drive threshers and other machinery through drive belts. These took over from the steam and stationary engines of the past. Later, these were replaced by a drive shaft mechanism that transferred power direct from the tractor engine, called the 'power take-off'. Later still, the way in which tractors and their implements could be used was transformed with the invention of the 'hydraulic lift', enabling implements to be raised, lowered and transported. The implement, once attached, then became an integral part of the tractor; its weight and the forces developed as it worked improving tractor performance. The farm tractor today continues to be refined and improved. Many of the functions are electronically controlled and the operator works in a quiet, safe and comfortable cab.

## Field operations

Crop production usually requires cultivation to prepare the land for the seed or seedlings. The purpose of cultivation is mainly to loosen compacted soil, to dispose of plant remains and to control weeds. The plough creates a furrow by lifting and turning the soil. Alternatively a series of concave discs, called the disc harrow, or steel tines to lift and break the soil, are used for the first stages of cultivation. The soil is broken down further by secondary cultivation with various combinations of lighter discs, tines, rollers and power-driven rotary machines. This provides a seedbed of the required fineness and firmness for the chosen crop.

- **Sowing** There are a great variety of sowing machines. This is because seeds differ greatly in size from the small brassica (cabbage family) and cereal seeds to the larger seed potatoes. All seed drills are designed to plant the seed to a consistent depth in straight lines. Some also add fertiliser before covering the seed with soil. Crops such as potatoes and sugar beet are planted individually by machine and are very carefully spaced. As the crop is sown in straight lines it is easy for the farmer to weed between the rows using a hoe, pulled behind a tractor.
- **Fertilising and crop protection** Once planted the crops need to be protected from weeds and diseases and to be encouraged to grow: fertilisers to provide essential nutrients; herbicides to control weeds; and pesticides and fungicides to control disease. All these need to be applied in exactly the right quantity and at the right time. Fertilisers and crop protection chemicals may be applied as solids or liquids. In practice, most fertiliser is handled as solid granules and crop protection materials as a spray. Fertilisers are applied using an implement that 'spins' the

material on to the soil. Sprayers deliver measured quantities of liquid across a wide area, up to 36 metres across. The exact size of the spray droplet is important: too large and it will roll off the plant, too small and it may drift away. The selection and time and method of application of sprays is subject to very strict regulation to protect workers, the natural environment and the final user of the produce.

- **Harvesting** The combine harvester cuts and threshes the crop, cleans and holds the grain and leaves the straw on the ground behind the machine. The process is highly efficient with over 99% of the crop normally being recovered. The combine harvester can also be adapted to harvest oilseeds, linseed, maize and other minor crops. Root crops such as sugar beet, potatoes and carrots are harvested by machines which dig the crop from the row and then separate it from the soil, stones and clods. The speed at which they are harvested can be high; up to one tonne a minute, but often some of the crop can be lost or damaged. The straw that is left behind the combine harvester may either be chopped and incorporated into the soil, or compacted into round or rectangular bales for storage or transport. The round baler is also commonly used to bale grass for preservation as silage.

## Storage

Grain, potatoes and vegetable crops are often stored on farms. Grain may be moist when harvested and require drying and cooling to prevent damage from moulds, mites and insects. Potatoes and vegetables are cooled and held under controlled conditions of temperature and humidity to maintain the quality of the produce in storage.

## Livestock

Silage is the main farm-produced livestock feed, other than fresh grass. Whilst almost any green crop can be made into silage, most of it is grass that has been cut and allowed to wilt for a few hours in the field. It is then collected in bales which are polythene wrapped to exclude air, or picked up, chopped and stored in large polythene covered trenches called silos. With the exclusion of air, lactic acid is produced to 'pickle' and preserve the grass as silage. Most cows are milked twice a day in a specially designed parlour. The most common is known as a 'herring-bone' parlour, so-called because of the position in which the cows stand. The cows are milked by a worker who stands in the 'pit' at a lower level than the cows. The milk is squeezed from the udders by a gentle vacuum system and is then transferred through pipes to a large refrigerated tank. The

cows are often recognised electronically from a tag attached to their ears or around their neck. Computer systems then measure each cow's rations, her milk yield and even health problems. These details are then recorded automatically from the animal's individual code number. There are many other machines for use with livestock. Complete diets for cattle are mixed and fed by mobile feeder wagons. Intensive livestock such as pigs and poultry live in houses in which the environment is carefully controlled and the food is delivered automatically. This allows the stockman more time to observe and care for the welfare of the animals. Chickens may be caught by a machine with large, soft gently moving rubber fingers which causes them very much less disturbance than human catchers.

### **Automation and robotics on the farm**

A rapidly developing aspect of automation on the farm is the plotting of cereal yields by the combine harvester. This is based on satellite positioning techniques and produces 'yield-maps' showing variations in yield across the field and which may be used to control fertiliser and spray applications automatically and according to crop need. There are many other examples of automation and robotics in use on farms. There are a number of robotic milking plants installed in this country where the cow comes to the milking machine unattended. Vehicles are also in use which will work unattended in the field and recognise and spray individual plants, or follow rows of plants for hoeing more accurately than could be achieved by a human driver. Automatic machines which recognise shape and smell are used in quality control, harvesting, packaging and animal welfare systems. In addition, there are many semi-automatic devices which assist human control, rather than fully replace the operators of large and complex machines. The main value of robotics in agriculture is not to replace human labour but to make arduous jobs safer and more acceptable, to raise standards of animal welfare and to enhance the quality of the final product.

### **The economic importance of farm machinery**

The cost of machinery and the labour to operate it is a very large part of the total cost of farm production. As farmers strive to become more efficient they invest in larger and more complex equipment to enable fewer workers with fewer machines to operate increasingly large farm enterprises.

### **Further reading:**

**Farm Machinery** by Brian Bell. 1996. £18.50. Available from Old Pond Publishing, 104 Valley Road, Ipswich IP1 4PA, 01473 210176  
ISBN 0 85236 319 2

**Fifty Years of Farm Machinery** by Brian Bell. 1995. £18.50.  
Available from Old Pond Publishing. Address as above. ISBN 0  
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