



## Draught Animal Power.....



*Land preparation using traditional animal-drawn plough in Peru*

.....An Overview

**Agricultural Engineering Branch**

**Agricultural Support Systems Division**

**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS**

### **Animal power world-wide**

Domestic work animals exist in all regions of the world. Animals assist in eliminating poverty, reducing drudgery and creation of wealth. Animal traction is particularly important for food security in smallholder farming systems. Animals can assist directly with crop production (ploughing, planting, and weeding). Food production, distribution and rural trade are also assisted through animal-powered transport (on-farm, marketing, riding, pack transport). Animals save household (women and children) time and effort by carrying water and fuel wood. Animal power can also be used for water-lifting, milling, logging and land excavation and road construction. Many different types of animal are employed, particularly cattle (oxen, bulls and cows), buffaloes, horses, mules, donkeys and camels.

**Animal power is expanding in Africa. It is widespread and persistent in Asia and Latin America**



***Chisel ploughing in Ethiopia***

In many countries the use of animal power is expanding. In sub-Saharan Africa, in particular, the use of work animals for agriculture and rural transport is increasing every year.



***Single buffalo drawing traditional plough in Thailand***

There are also parts of Asia and Latin America where animal power is expanding and diversifying. In countries that are rapidly urbanising and industrialising (e.g., India, Mexico, Brazil, South Africa) animal power remains important and highly persistent. In these countries, large-scale farms use tractors and long-distance transport depends on engine power. At the same time, the many small-scale farmers and local transports continue to use animal power. This pattern of using tractors on large farms and animal-powered small farms is common worldwide. Even in highly developed regions, such as the European Union, animal power remains important in areas where there are farms of small size (including Spain, Portugal and Greece). Many farms in the United States are run profitably by Amish farmers using only animal power.

### **Animal power has many benefits**

Animal power is a renewable energy source that is particularly suited to family-level farming and to local transport. Animal power is generally affordable and accessible to the

smallholder farmers, who are responsible for much of the world's food production. The availability of animal power allows women and men to increase their efficiency and reduce their drudgery, compared with manual alternatives. The combination of timeliness and timesaving in field operations promotes the achievement of higher and more reliable crop yields. The transport role of animals is important for carrying farm inputs (seeds, fertilisers, and crop protection requisites) and outputs (harvested crops and animal products). The work animals themselves contribute to food production through milk, meat, manure and offspring. Pack animals and carts facilitate the marketing of produce, stimulating local trade and production. Animals can be very important for carrying domestic water and fuel, reducing drudgery (particularly for women) and releasing time that can be used in other productive or socially important tasks. Animal power requires little or no foreign exchange. Money spent on motors and machinery is exported from rural areas. Money invested in animal power circulates within rural areas, helping to revitalise rural economies. While motorised power also brings many benefits, animal power is normally more available and affordable to people in rural areas and fragile environments.

### **Women, men and children all benefit from animal power**

Provided access to animal power is widespread, animal power can benefit all members of society. Access may come from ownership, which provides timeliness. However, most communities have systems for borrowing or hiring animal power, so spreading the costs and benefits. Historically, men have tended to control animal power technologies, including ploughing and transport. In many countries, women are having increased access to work animals. Women, as major carriers of water, fuel wood, food grains and agricultural products can benefit particularly from transport animals.



***Donkey as pack-animal in Cape Verde***

Donkeys as efficient and easily managed transport animals, can be of special benefit to women. In most countries women still have less access to work animals and related support services than men, but women are increasingly involved in controlling animals for agricultural operations, such as ploughing and weeding.

By controlling work animals, children too can contribute to household tasks and family production without excessive physical strain. However, as children attend schools, certain traditional animal-management practices are no longer practicable. Appropriate low-cost alternative management and grazing systems are needed to suit changing family labour profiles. Partial urban migration of male workers also influences labour availability for agricultural operations. Animal power can help to overcome peak labour shortages. It can



also assist in the creation of rural employment opportunities, in the agricultural (large- and small-scale), infrastructure support and transport sectors.

### **Animal power is a forgotten solution**

Despite its many benefits, animal power is old technology. Although its use is actually increasing in many countries, it is seldom included in educational curricula. For the past fifty years, books on farming, whether for school children or agricultural students, have focused on tractor power. The result is that most extension agents, researchers, decision-makers and teachers have never studied animal power topics in detail. With the new generation the vicious circle of neglect increases. This is compounded by international media (television, films, publications) in which animal power is seldom portrayed and perceived by younger generation as old technology. Although food security and self-reliance are important goals, urban-based planners and politicians often ignore the importance of animal power to rural people, as governments tackle the issues of modernisation, industrialisation and urbanisation.

The duality of animal power for transport and fieldwork requires broader responsibility and not confined to agriculture. Transport ministries seldom deal with animal power, even though pack animals or carts are useful in rural transport systems. Similarly, using animals for labour-intensive road construction can be highly cost-effective, but ministry staffs are only trained to plan capital-intensive projects. Animal power can also be efficiently and profitably employed in forestry and for specific operations on estates and large-scale farms.

### **The technology is simple and reliable but needs attention**

Ploughing is often the major farming operation performed by work animals. Animal-drawn seeder and weeder are becoming increasingly important, as these facilitate rapid and timely operations. Work animals can assist with field levelling, crop harvesting and on-farm transport. In some countries, animals are employed for field irrigation and for crop processing.

Although most animal-drawn equipment is quite simple, its design is crucial. The implements and spares must be easily available to farmers. In countries with a long history of animal power, traditional ploughs tend to be very persistent. Not only have the designs been proven over hundreds of years, but local infrastructure exists for their manufacture and maintenance.



*Blacksmiths in Honduras*

Village blacksmiths provide responsive, timely and inexpensive services. If factory-made implements are to be used effectively, comparable rural supply and support services are required. Traditional wooden designs of animal-drawn cart are still produced in some countries. However, there is a worldwide trend towards the use of carts with roller bearings and tyres, using factory-made axles or parts of old vehicles. In the remote rural areas, a shortage of such axles and tyres often constrains the development of cart production and use. Once a critical mass of carts is in place, the technology becomes self-sustaining and animal-based transport systems expand, with major social and economic benefits for the area. For animals to be used humanely and efficiently, good and affordable harnessing systems are required. Village-level production of suitable yokes or harnesses is not usually a problem except when new animal traction operations or species are being adopted.

### **Animal power is sustainable and environmentally friendly**

Animal power is a renewable energy source that can be sustained in rural areas with little external input. The use of animal power in mixed farming systems encourages crop-livestock integration and sustainable farming practices. Not only do work animals produce their own organic manure, they provide transport for manure of other livestock to the fields. This enhances the fertility and structure of the soil. The condition of work animals, and the production of other farm stock, is assisted by transport and storage of crop residues and fodder.



*Terracing work using oxen in Indonesia*

Animal power can be used for a wide range of land management and erosion control systems. Animal-drawn scoops or levellers can assist with water harvesting or the construction of water ponds. In hilly areas, animals can assist with contour ploughing and terracing. Live mulch using multipurpose green plants or leguminous shrubs provides animal feed.

In drought-affected areas, over-grazing may become a problem, particularly around water points. Farmers can make increased use of donkeys, which survive drought better than cattle. Another response is to make greater use of reproductive animals. These strategies allow farmers to obtain essential work from diminishing herds. The emissions of methane by working cattle are negligible in comparison to other sources.

### **Animal-powered transport: profitable, increasing production and stimulating development**



*Rural women in Zimbabwe*

In much of the world, head and shoulder loading women are the main transports of goods in the rural areas. They carry domestic requirements (water and fuel wood), food grains, farm produce, traded items, hand tools and children. With animal transport, their burden is eased and time is saved for other activities with economic and social benefits. As women farmers and traders are freed from the limitations of head loading, more is produced and traded, increasing profits and overall economic activity.

Animal-powered transport can be of particular social and economic benefit. Farmers with animal transport (carts or pack animals) have wider contacts with traders. The resulting enhanced market access allows them to increase their production and also their profit. With animal transport, greater use is made of manure and crop residues, which increases overall farm production. Animal power can provide important local 'feeder' transport between farms and roads, to complement motorised road transport systems. The development of efficient animal-based transport is often constrained by limited supplies of carts and capital or credit for acquisition. However, animal-based transport is usually very profitable. As long as there are sufficient numbers of carts in an area, local artisans ensure the technology is sustainable.



*Oxen-cart transporting harvests to local market in Zimbabwe*

**Well-managed animals are dependable power sources**



Many different animals can be used for work. Suitable animals must be able to thrive under local conditions and be strong enough for the work required. They must be affordable and locally available. In many cases, cattle of the local breed provide the best compromise. Cattle grow during their working life and appreciate in value. As farming systems intensify, farmers often find it more profitable to use cows for intermittent or light operations. Well-fed cows can work as well as producing milk and calves. In many countries, horses, donkeys and mules are employed mainly for rural transport. Donkeys are becoming increasingly important in agricultural production and rural transport systems because of their low cost and longevity.



***Spraying cattle against ticks in Uganda***

Good animal health is a prerequisite for the success of animal traction. Animal sickness and mortality can be particularly serious where animal traction technology, or a new type of animal, is being introduced. Many health problems can be avoided by a combination of indigenous knowledge and modern prevention systems (vaccination/prophylactics).



***Conserving fodder in Albania***

The importance of good animal management (including grooming, feeding, watering and attention to harnessing) is not always appreciated. Animals gain their energy from grazing or supplementary feeding. Seasonal scarcity of feed normally leads to seasonal changes in animal weight. While animals can recover condition, ploughing can be delayed by poor animal condition at the end of a dry season. Purpose-grown fodder species or

supplementary rations may be technically possible, but are often unaffordable. The use of by-products or the preservation of multipurpose fodder (e.g., groundnut hay) may be more appropriate.

### **Animals are complementary to other power sources**

Manual, animal and engine power sources are all important in agricultural development. Animals and engine powered machines help to reduce human drudgery and allow people to achieve more with their time.



*Tractors and draught animals complement farm power needs in Bolivia*

Engine power, where available and affordable, can achieve the highest savings in time and labour. Many smallholder farmers would like to benefit from tractor power, but such aspirations are often unrealistic. Engine power tends to be appropriate for large-scale farming and long-distance transport. Animals are often more affordable and appropriate for small-scale farming and local transport. Individual tractor ownership is seldom possible for farmers with small areas of cultivation, unless they have high-value crops, irrigation and/or multiple cropping (e.g., irrigated rice production). Tractor hire (public or private) is seldom viable to smallholder farmers in rain-fed, food-production systems. Work animals and engine powered (tractors, trucks and pick-ups) can coexist in the same area - even on the same farm. Tractors is better adapted for power-intensive operations (e.g., ploughing) and for large areas of land. Animals may be more appropriate and affordable for control-intensive operations (e.g., weeding) and on small areas of land. Produce may be transported from the fields with animals, and to the towns by trucks. The increased use of tractors and motorised vehicles for transport can even be associated with an increased use of animals, as the overall rural economy grows and diversifies.

### **Animal power issues should be encompassed within development strategies**

Animal power can be an important and viable technology for rural development. It should be one integral component of rural development and mechanisation strategies. In recent years, it has become common to include environmental and gender impact statements in development strategy documents. In a similar way, animal power options in plans relating to food security, rural infrastructure and services and transport should be considered. Whether or not animal power is already widely used the future potential for animal energy to complement other power sources should be assessed, and the practical implications reviewed.



The neglect of animal power technology in recent years may have affected the availability of essential information. In many areas there may be insufficient facts and understanding to allow informed judgements on animal power issues. In such circumstances, participatory appraisal surveys may be required at national or provincial level. Such surveys will establish the present uses of work animals, the existing constraints and the future potential.

Attention should be paid to the infrastructure and services needed to sustain animal power use. The experience of many countries is that animal power can develop and be sustained by small-scale private sector enterprises, provided there is a critical mass of users. It may be important to develop, or to maintain, such a critical mass, to ensure the technology is sustainable. Integrated planning is required since initiatives in one domain (e.g., subsidised tractors, and promotion of new breeds) may affect other areas (e.g., water distribution, rural transport).

### **Animal power can be sustained by the private sector if a favourable policy environment exists**

In most part of the world, animal power is developed and maintained by private farmers and transports, supported by local artisans, traders and informal service providers. Historically, all support services (training, health care, implement supply and repair, credit provision) are available within farming communities. With industrialisation, some input, such as ploughs, started to be manufactured in towns and distributed to rural areas by traders.

Commercialisation and marketing has enabled trading implements from one country to another. Increasingly, formal sector services (e.g., rural banks and credit associations) and publicly funded services and development programmes are operating in rural areas. As animal power support services increasingly come from the formal sector, they are more sensitive to changes in the overall policy environment. Farmers become more vulnerable to decisions made somewhere else. In sub-Saharan Africa, the issue is most critical, since animal traction was often introduced through public sector initiatives. Para-statal agencies are often crucial in providing supporting services (implement supply, credit, health care). Commodity-based (cash crops) industries have often delivered a range of services, including training, credit and equipment supply. They have played a major role in the spread of animal power in Africa, and are still very influential.

The aim of governments and development agencies should be to ensure a suitable policy environment to enable private sector support services to be maintained or to develop. Legislation or development processes should not isolate animal power users or support services, either directly or indirectly. Recent examples of marginalisation include subsidies to alternative power sources (notably tractors and imported equipment), exclusion of animal-powered transport and legislation more favourable to factories than village blacksmiths. The public sector should avoid direct competition with private sector services, for example in the supply of animals, equipment or health products. Though some strategic input may be desirable to promote the formation of a critical mass of users. Credit provision can be particularly important. Rural transport can often be rapidly assisted with a combination of credit and supply of cart axles (preferably supplied through local, private sector workshops). In areas where animal power is new, or an innovative technology (such as animal-powered weeding) is being introduced, participatory training programmes may be justified.

### **Animal power needs a positive image**

Increasingly, the constraints to animal power development are psychological or social rather than technical or economic. Rural and urban based decision-makers and educators do not consider animal power as a modern development option. There is need to

counteract existing negative and outmoded media coverage if people are to continue to consider animal power as a realistic option. Animal traction needs to be portrayed as a renewable technology that is relevant to the modern world. Animal power issues need to be taught in schools and discussed in the national media. Work animals should be seen as ecologically and economically appropriate in rural areas. They should be seen as coexisting effectively with motorised systems, so enhancing the quality of community life. While motorised power is well accepted, animal power can also be portrayed as modern and environmentally acceptable. Positive, realistic and relevant images need to be portrayed through radio, television, films, magazines and books. Most countries would benefit from a broad education programmes on animal power. In-service training will be required in many organisations to overcome past educational neglect and motivate staff. Attractive training systems and materials, such as presentation using multimedia systems and digital information technology is needed.

### **Animal power can be improved through participatory methods**

Animal power needs to develop and evolve. The technology should not remain static, but should respond to innovations and new challenges. Since animal traction has been largely neglected, there may be need for some basic scientific research relating to work animals, harnessing and implements.



*Farmer's group in Laos*

However, the major requirement is for participatory action-research carried out with the end-users in different rural systems. It is generally acknowledged that top-down extension and on-station research trials have little impact in improving animal traction technology. Many changes and improvements have come from the farmers themselves. However, some successes have been achieved by motivated multidisciplinary research-extension teams working closely with farmers (women and men) and rural communities. Progress can be particularly rapid if participatory rural appraisal and constraint analysis is combined with international networking. This ensures that lessons, technologies and experiences can be shared. Relevant areas for adaptive research need to be identified through local participatory appraisal. Topics may include animal feeding strategies, use of cows for work, low-draught systems for use with donkeys and erosion control with animal power.

### **Animal power can be developed through collaboration**

Collaboration at national and international levels is necessary if animal power is to be developed effectively. National and regional animal traction networks are particularly

helpful. Such networks effectively link people who would not otherwise interact and thereby reduce duplication of effort and increase overall progress. National and international networks provide peer support, encouragement, motivation and professional recognition. International networks include ATNESA (Animal Traction Network for Eastern and Southern Africa) and RELATA (Tracción Animal de Latin Americana).

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Several countries have established formal or informal national animal power networks. Many benefits arise from the exchange of experiences, skills and materials through meetings, publications and co-operative programmes. Animal power networks should be multidisciplinary and involve the public, private and informal sectors and users of animal power. They should aim to bring together people concerned with animal power including those involved in research, education, manufacturing (small and large), animal welfare, development activities (public sector and non-governmental), farming and rural transport. Such networks can play crucial roles in identifying key constraints and possible solutions. They help to improve the image of animal power and encourage appropriate support and investment.

### **Animal power as an asset for the future**

Animal traction continues to increase in many parts of the world, particularly those where there are significant numbers of smallholder farmers. Animal power will continue to be important for food security, self-reliance and poverty alleviation. Animal power is renewable natural resource that can assist not only in production, but also in land and water management and conservation. All countries, whatever their degree of industrialisation and urbanisation, can benefit from ecologically sustainable power sources. Domestic animals



can play a valuable role in assisting human endeavours and improving the quality of life of women, men and children. In past years, animal power has been a neglected option, but governments, planners; agencies and the private sector are now taking it more seriously. Animal power should become an integral part of national development strategies, including those relating to food security, resource conservation, rural transport, employment and women in development. With a favourable policy environment and developmental support, the private sector can sustain and develop animal power technologies, benefiting rural communities and economies. Animal power issues need to be adequately covered in education and training programmes and in modern media. Animal power needs to be seen as a valuable and appropriate technology relevant to modern development aspirations.