

# Animal traction in Cuba: an historical perspective

by

Arcadio Ríos and Jesús Cárdenas

*Instituto de Investigaciones de Mecanización Agropecuaria (IIMA), Havana, Cuba*

## Summary

*The paper reviews the development of animal traction in Cuba from its introduction in the 15<sup>th</sup> century to the present day. It highlights the social, economic, political and technical factors that have determined the use of human labour, work animals and mechanical equipment in the periods of colonisation, the republic, the first decades of the revolution and the special period after 1990. There has been resurgence in the use of animal traction in the past decade, due to the changing economic conditions and the scarcity of foreign exchange and fuel. There have also been efforts in the fields of animal traction promotion, implement development and investigation. In the present situation, the scarcity of energy and funds makes alternative, low-cost technologies, such as animal traction, very attractive. In the foreseeable future, the numbers of work animals are likely to remain fairly steady, with the potential for greater efficiency and diversity of uses.*

## Introduction

Animal traction is one of the fundamental energy sources for agriculture. FAO (1987) estimated that, in developing countries, human power contributed 71% of the energy resource, animal power 23% and motorised power, 6%. Table 1 gives a summary of the contribution that the different energy sources made to agricultural production in various regions of the world.

**Table 1. Contribution of the use of human, animal, and motorised power sources to agricultural production.**

<i>Region</i>	<i>Human</i>	<i>Animal</i>	<i>Tractor</i>
North Africa	69	17	14
Sub-Saharan Africa	89	10	1
Asia, excluding China	68	28	4
Latin America	59	19	22
<b>Average</b>	<b>71</b>	<b>23</b>	<b>6</b>

*Source: FAO, 1987*

Although the figures for Cuba are somewhat different, there is similar complementarity of human, animal and tractor power. Much effort has been made to promote the use of animal traction. This is a task that should not be abandoned, even in countries with an advanced or developing agricultural sector. This paper reviews the use of human energy, animals and equipment in different historical periods in Cuba and the determining economic and social factors.

## Geographic, administrative and economic contexts

The Republic of Cuba is an archipelago consisting of the large islands of Cuba and the Isle of Youth (*Juventud*) and more than four thousand small islands and islets, with a total area of some 111 000 km<sup>2</sup>. The island of Cuba is a long strip of land 1250 km in length and with a width of 32 to 210 km located within the tropics between the 20° N and 23° N. The land is generally fertile with predominantly flat or undulating topography. Most (77%) of the land is below 100 m in altitude, with 22% between 100 and 500 m and only 1.3% above 500m. There are three principal mountain ranges located to the west (*Sierra de los Organos*), in the center (*Sierra del Escambray*) and in the east (*Sierra Maestra*). This last range contains the highest point in Cuba, *Turquino* peak at 1974 metres above sea level.

The climate is moderate sub-tropical, with two very different seasons: dry (from November to April); and rainy (from May to October). The mean annual rainfall is 1375 mm and the mean annual temperature is 25°C (Canet, 1949; CEE, 1995).

Cuba is divided administratively into 14 Provinces and one special municipality (the Isle of Youth). The Provinces, from west to east are: Pinar del Río, Havana, Havana City, Matanzas, Cienfuegos, Villa Clara, Sancti-Spíritus, Ciego de Ávila, Camagüey, Las Tunas, Holguín, Granma, Santiago de Cuba and Guantánamo. The Cuban population is 12 million, of which more than 80% is concentrated in urban areas. Two million people live in greater Havana.

The Cuban economy is highly dependent on agriculture that contributes 14% of the Gross National Product and more than 50% of foreign exchange earned. The cultivable area is 7 100 000 ha, or 0.59 ha/inhabitant. The principal products are sugar cane (which occupies about 45% of the agricultural area), citrus (5%), tuber crops (5%), horticultural crops (4%), livestock (35%) and rice (6%). Although only 20% of the population lives in agricultural areas, the sector employs 22% of the national work force.

The agricultural sector now comprises five main types of enterprise.

- Basic Units of Cooperative Production (UBPCs, *Unidades Básicas de Producción Cooperativa*) which derive from the division of the old state farms
- Agricultural Production Cooperatives (CPAs, *Cooperativas de Producción Agropecuaria*)
- Credit and Service Cooperatives (CCSs, *Cooperativas de Créditos y Servicios*)
- State agricultural production farms
- Small individual farms.

The cooperative system is now responsible for most agricultural production. The CPA and CCS cooperatives can be considered as part of the private sector. The UBPCs use state land in usufruct arrangements. All agricultural entities sell part of their production under contract to state distribution enterprises. The remainder they can sell freely on the market at prices governed by supply and demand.

## **Indigenous agricultural systems**

The early inhabitants of Cuba comprised groups, now classified as ranging from hunter-gatherers to farmer-potters. The agricultural tools used were stone axes, clubs (*macanas*), sharpened planting sticks and bows and arrows for hunting and defense. They also used pestles and mortars (made of wood or stone) and scrapers made of shell, stone or wooden. Food was stored in earthenware pots or baskets (called *catauros*) made from palm leaf-bud pods. Agriculture involved clearing and burning areas of forest for the planting of cassava and tobacco. The cassava was used to make a type of tortilla known as *casabe*, which was made by grating and milling the thick fleshy roots and toasting them in the form of a disc over a flat stone. The tobacco was used for smoking, frequently associated with religious rituals. They had no domestic animals, except for a race of dogs, called mute dogs (*perros mudos*) by the Spanish because they did not bark.

The indigenous Cubans did not use work animals, either for transport or for pulling implements. With the arrival of the Spanish from 1492, they were amazed to see white men mounted on horses. It is said that some believed them to be a single animal. Animal traction was not generally used in the Americas prior to the Spanish colonial period. The only exception appears to be the Inca region of South America where llamas were used to carry loads. The Incas had a highly developed agriculture, involving terraces, canals and the use of seabird guano fertiliser. The Incas domesticated both llamas and alpacas.

## **Colonial era**

### **Arrival of work animals in Cuban agriculture**

The first animals that the Spanish colonists introduced were horses, donkeys and mules used for riding and packing for military needs. Soon settlements were established where European style agriculture was started using slave labour. At first, indigenous people were used for labour, but the population of

native Cubans declined rapidly and African slaves were imported. In 1537 there were 5800 inhabitants in Cuba, of which 5000 were indigenous people, 300 were Spanish and 500 were African slaves.

From the first half of the 16<sup>th</sup> Century, the colonialists established farms based on their European experience, to meet the needs of the growing population and the military forces that left for Central and South America on missions of conquest. Oxen and plows were introduced for soil tillage and for transport using wooden carts and sledges. Other imported domesticated animals including goats, sheep and pigs complemented the new work animals (cattle, horses, mules and donkeys).

The first oxen were of European breeds (*Bos taurus*) and were worked in pairs yoked with wooden yokes. The introduction of zebu cattle (*Bos indicus*) only happened in the 19<sup>th</sup> Century and contributed substantially to the creation of the resistant Creole breeds. Horses were generally used for riding and for pulling carriages for transporting people and produce. They were not generally used for agricultural work. Horses were also to carry loads on their back, but the hardier and more robust mules and donkeys were found to be particularly useful for such pack work in the mountains and hills.

### Development of the population and agriculture in the colonial era

Between 1512 and 1774, when the first census was carried out, the Cuban population had increased to 171 600 (Table 2), that is 1.5 inhabitants per square kilometre. Of this total, 25% were African slaves and the remainder of Spanish and Creole origin. The country was sustained through an economy based on cattle raising and a marginal and precarious agriculture based on tobacco and small fruit production. The sugar industry had also started and was producing 10 000 tonnes per year.

**Table 2. Growth of Cuba's population in the colonial period**

	1513	1537	1774	1861	1880
Native Cubans	100 000	5 000	--	--	--
Spanish origin	300	300	45 000	111 700	130 000
African origin	--	500	42 900	642 500	751 000
Creoles	--	--	83 700	642 600	750 000
<b>Total</b>	<b>100 300</b>	<b>5 800</b>	<b>171 600</b>	<b>1 396 500</b>	<b>1 631 000</b>

Source: Núñez Jiménez, 1959

From 1774 the cane fields extended throughout Cuba, and so the slave population grew rapidly. In 300 years the slave ships brought approximately one million Africans to Cuba. The availability of cheap slave labour influenced how animal power was used in this period. For both sugar cane and other crops, ox teams were used for plowing and harrowing. Oxen were only rarely used for subsequent tillage operations, such as weeding, that were done mainly using hoes (*guatacas*). Harvesting was done by machete by African slaves, who then loaded the cane onto ox-drawn carts.

The cultivation of coffee in the mountainous regions was introduced by colonial farmers and by immigrant Haitians after the independence of that country (1804). This brought an increase in the number of mules used for transporting the coffee beans and inputs.

The anti-colonial liberation processes from 1868 to 1898 precipitated the abolition of slavery, which was officially decreed in 1880. Problems caused by the wars of independence, disease and commercial restrictions that Spain placed on its colony constrained the growth of the agricultural sector and the population of the island. In 1899 the population was relatively stable at one and a half million inhabitants.

### Yokes and implements

The traditionally used type of yoke is a head yoke, which rests behind the horns and is fastened by means of ropes that run around forehead pads (*frontiles*). Double yokes are made from a thick length of wood carved to form two curves (*camellas*) that fit the napes of the oxen. The double yoke has a central hole to which the draw-pole is connected. Some single head yokes are used, also with a forehead pad (*frontil*). Withers yokes that are widely used in some other parts of the world are not employed in Cuba.

In the colonial period, the most common plow was a wooden ard, known in Cuba as the Creole plow (*arado criollo*). It derived from the traditional Spanish plow. This is still used today and consists of wooden plow body (*cama*) with a sharpened point (*dental*) to which is attached a steel share. At the other end is the single handle (*esteva* or *mancera*) used for control. A long pole (*timón* or *pértigo*) is inserted into the plow body and is joined to the yoke by means of a rope and wooden or steel peg (*pasador*). A screw (*telera*) between the draw pole and the plow body is used for depth regulation.

From the early years of animal power in Cuba, clod breaking was done with wooden harrows made in the form of a V or Δ, and pulled by a pair of oxen. These harrows generally had metal teeth. In more recent years, harrows made of totally of steel were introduced.

### **Means of transport with animal power**

The simplest form of animal-powered transport introduced during the colonial period was the wooden sledge (*rastra*). Sledges are still used in rural Cuba. They are made from one piece of wood in the form of a V that slides over the ground. Sledges can have a plank platform and vertical wooden posts to contain the load.

Early carts and wagons were generally made almost entirely of wood. The main steel component was the outer rim of the wheels. Some metal bearings may have been used. This means of transport was used for centuries in Cuba to transport all kinds of agricultural products. The most common version was the cane cart, dedicated to the transport of sugar cane to the sugar mill, with a load carrying capacity of 2-4 tonnes and pulled by 2, 3 or more pairs of oxen. Before the appearance of motorised vehicles, public transport depended on horses and mules. Large wagons (*carretones*) were used for hauling freight loads and carriages (*coches*) were for carrying people. Animal power for transport was never completely abandoned in Cuba, and in recent years it has achieved a new popularity owing to the scarcity of fuel and other inputs.

Since the beginning of the colonial period, people have used horses for riding, and pack animals (notably mules) have been used carry produce, especially in mountain areas. Even today, most of the coffee is transported in this way together with other agricultural products harvested in areas where it is neither feasible nor economic to use motorised vehicles. Mule trains (*arrias*) are tied together. Loads are slung over their backs on either side in bags (*zerones*) made of cotton or basketwork.

### **Animal traction and the industrial revolution**

Until the industrial revolution, ox teams were commonly used to turn sugar cane mills (*trapiches*). These machines comprised three wooden cylinders that rotated simultaneously by means of gears as the ox teams walked round and round. The cane was squeezed as it passed between the cylinders so the juice (*guarapo*) was extracted. Evaporating this liquid produced sugar. In the colonial period in Cuba, there were thousands of *trapiches* on the plantations. With the advent of steam engines, large mills (*ingenios*) were constructed that used steam-driven cane-crushing machinery imported from the United States and England. The use of animal-powered *trapiches* declined rapidly.

The introduction of steam locomotives, from 1843, led to a considerable reduction in the need for oxen for sugar cane transport using carts. Before long, the country was criss-crossed by an intricate network of small railways for transporting cane to the mills. These still remain important for cane transport in many parts of the country.

Metal agricultural implements started to be introduced at the end of the nineteenth century. Steel mouldboard plows were commonly known as 'American plows' (*arados americanos*) because of their origin in the United States. Such plows became, and still remain, the main animal-drawn implement used for soil preparation. The common design consists of a metal plow body with two handles and a short frame that is pulled by chain. The shares and other elements are replaceable when damaged or worn. Depth of work is regulated by a land wheel and by the height of the hitch-point of the chain at the extremity of the plow frame. There are lighter and heavier versions, which differ in the width and depth of the work that they perform. The best-known versions are models 1 and 1½ (pulled by a team of two oxen) and models 2 and 2½ (pulled by two pairs of oxen). Another type of plow uses a wooden draw-pole to pull a metal plow body and plowshare, with either a single mouldboard for plowing or

two mouldboards for ridging and cultivating. There are versions with a single handle and with two-handles.

Metal cultivators started to be used in the middle of the nineteenth cen and are still common today. The best known animal traction cultivators (known as *cultivadores araña*) have an adjustable metal V frame, onto which are fixed tines with chisel shares or 3 to 9 duckfoot shares for inter-row weeding. The width of work is regulated by opening or closing the V of the frame.

## **Human power**

Human power has always been important in Cuban agriculture. For centuries, during the colonial period, human labour (slave, semi-slave or free) was vital, even though labourers were considered almost as animals. Slavery started from the outset, with sharing out the indigenous inhabitants between the colonisers. They were made to work in brutal conditions for which they were not physically adapted. This contributed to their rapid decline in numbers in Cuba and other Caribbean islands.

African slaves were imported at the start of the sixteenth century for agricultural work, notably the cane fields. They were considered more robust and resistant than the indigenous inhabitants, especially in the sugar plantations. They were exploited as a low-cost labour pool for all kinds of work for centuries. The Spanish colonialists maintained slaves long after the practice had been outlawed elsewhere in the region, and the abolition of slavery was not implemented in Cuba until 1880. In the mid nineteenth century Chinese labourers started to be introduced, contracted under conditions of semi-slavery for cane cutting and other work.

The hand tools used on farms have included hoes (*azadas* or *guatacas*) for soil cultivation and machetes for cutting cane and for general use. Neither sickles (for cutting the heads of cereal crops) nor scythes (for cutting hay) have been commonly used in Cuba. Post-harvest equipment includes maize shellers, wooden mortars (*pilones*) and pestles to husk coffee and rice, and hand-powered stone mills to grind maize and other grains. For human carrying, there are woven baskets and sacks made of jute or sisal.

## **Animal traction in the time of the Republic**

The success of the independence movement in 1898 led to United States intervention until 1902. However, the independent Republic was strongly influenced by the economic power of the United States. Land ownership was concentrated in the hands of large haciendas and monopolies, and many of the remaining forests were destroyed by private concerns. The sugar industry flourished (apart from the slump of the 1920s). There were also periods of decadence and of misery. The domination of the United States and capitalist interests was felt throughout the economy until the revolution in 1959.

During the time of the Republic (the first half of the twentieth century), the Cuban population grew rapidly. In 1900 there were approximately 1.8 million inhabitants. This rose to six million in 1953 and to twelve million by the end of the century.

Sugar cane was by far the most important source of employment of humans, animals and technology during the time of the Republic. In 1900, the sugar production was 300 000 tonnes. This rose dramatically to five million tonnes in 1925. Although sugar production fell in response to the world economic crisis of the 1920s and 1930s, production picked up again and was at a stable five million tonnes a year in the 1950s. The twentieth century brought imported industrial products, including tractors and trucks. A few combine harvesters were imported for grain harvesting. However, most Cuban agriculture continued to depend largely on plowing with oxen and transport using ox carts. By 1959, there were about 9000 tractors, a small number compared with the seven million hectares of cultivable land.

## The revolutionary process and agriculture

### New land tenure, accelerated mechanisation and the decline of work animals

Following the successful revolution of 1959, there were two agrarian reforms that nationalised the land of large corporations and haciendas. A limit was set of 70 ha per farmer. The large state agricultural enterprises were established and a high level of mechanisation was encouraged. These occupied 70% of the agricultural land, whilst 30% remained in the hands of private farmers and their cooperatives.

Many tractors, combines and other technical equipment were imported, with the aim of improving the efficiency of Cuban agriculture. Tractors were imported at the rate of 5000 per year and the number of tractors increased ten fold, from some 9000 in 1959 to 90 000 in 1990. In addition to the numerical growth, the power of the tractors increased from a mean of 30 kW to 50 kW.

As tractors increased, the use of oxen declined rapidly. The number of oxen fell from about 500 000 in 1960 to 160 000 in 1990 (Table 3). This was not only due to the availability of technology and supporting infrastructure, it was also associated with the mentality of the new generations of farmers and their leaders. The new agricultural workers started to be characterised as a literate people with an average education to sixth grade, whose children left for the cities to become engineers and technicians. The new generation received training from qualified workers, and the ambition of farmers was to drive a tractor. Only infrequently did the young return to work with an ox team as had their fathers. It was mainly the old people who still carried on using oxen. However, animal traction did not disappear. It continued to be important in parts of the country and for some agricultural crops, such as tobacco and some root and horticultural crops.

**Table 3. Numbers of tractors and work animals in Cuba from 1960 to 2000**

<i>Energy source</i>	<i>1960</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>2000</i>
Tractors	7 000	51 600	68 300	70 200	40 000
Oxen	500 000	490 000	338 000	163 000	396 000
Horses	800 000	741 000	811 000	235 000	303 000
Mules	30 000	29 000	25 000	30 000	32 000

*Source:* MINAGRI, 2000

### Centralised planning and distribution in agricultural production systems

Following the revolution, agriculture followed the socialist model of centralised planning, without any real economic controls. The distribution of tractors, implements and inputs was arranged through centralised state plans, by delivery quotas. These were often completely out of tune with the local needs. The supply of equipment, parts, fuel and other inputs was guaranteed by the agreements with the Soviet Union and other countries, at low prices. The real cost of the tractors and their running costs did not have to be met from the local agricultural production. This system did not encourage economical practices or the use of alternative, cheaper technologies, using people and animal traction.

As Cuban agriculture was mechanised, an infrastructure was created for the supply, repair and maintenance of tractors and equipment. A system of training was established for operators, workers, technicians and specialists. A national network was created with local workshops in the agricultural enterprises for daily servicing and technical maintenance and specialised workshops for the repair of engines and specialised parts. Large factories were established for building cane-harvesters, agricultural implements for use with tractors and to a much lesser extent some animal-drawn implements. Development, research and testing of agricultural equipment were initiated to adapt equipment to the conditions in Cuba. Emphasis was on tractor power.

## The new rise to importance of animal traction

### The disappearance of the socialist bloc and the special emergency period

The disintegration of the Soviet Union and the Council for Mutual Economic Assistance (Comecon or CAME) in 1989 deprived Cuba of its secure market for imports and exports. In a matter of months, Cuban agriculture, and the rest of the economy, was faced with an almost complete cut in the supply of fuel, equipment and replacement parts. The majority of tractors had to be used in a restricted way or even stored during the initial years of the crisis. This continued until there was a restoration of supplies under new conditions, with much higher costs reflecting market prices.

Austerity measures were introduced to address the fuel shortage and economic emergency situation, known as the 'special period'. A policy was implemented for the increased use of work animals, particularly oxen. A range of implements suited to animal use had to be made available. In August 1990, it was decided to start a program of selection and training of 200 000 oxen for the state farms and agricultural production cooperatives. This was largely achieved, as can be seen in Table 3. By 2000, Cuba had almost 400 000 oxen in use in agriculture. Horses and mules were also increasingly used for transport.

Another important change that contributed to the use of animal traction was the transformation of many large state farms into cooperatives. Forty-two percent of Cuba's farmland is now allocated to Basic Production Cooperatives (UBPCs) that are entitled to use the land on a usufruct basis (Table 4). For these cooperatives and the small-scale private agricultural sector, the use of oxen and simple implements remains economically attractive.

**Table 4. Changes in land tenancy, 1990-2000 (% of total farm land)**

<i>Sector</i>	<i>1990</i>	<i>2000</i>
State farms	75 %	33 %
Agricultural Production Cooperatives (CPA)	10 %	10 %
Basic Cooperative Production Units (UBPC)	0 %	42 %
Credit and Service Cooperatives (CCS) and private smallholder farms	15 %	15 %
<b>Total</b>	<b>100 %</b>	<b>100 %</b>

*Source:* MINAGRI, 2000

### Research for new implement development

In order to support the more efficient use of animal power, in 1992 the Agricultural Engineering Research Institute, IIMA (*Instituto de Investigaciones de Mecanización Agropecuaria*), was given responsibility for the rapid development of new animal drawn agricultural implements. At this time, the only implements available were the traditional simple plows (*americanos* and *criollos*), tined cultivators and harrows. Implements such as seed drills, sprayers, mowers and multipurpose toolbars were not available.

This research resulted in a new type of multifunction toolbar patented by IIMA under the name of *multiarado*, with versions for tractors and for animal traction. The animal traction *multiarado* comprises a toolbar, onto which can be fitted a plow body, or a range of other attachments. It can be used for plowing, cultivating, ridging, planting and other tasks. IIMA has also tested wheeled toolcarriers, that allow a much wider working width. A seed drill has also been designed that can open a furrow, sow and cover in one pass. This can be coupled to the animal-drawn *multiarado*. Several units can be coupled to a wheeled toolcarrier so that several rows can be sown at once. IIMA developed an animal-powered sprayer, able to apply phyto-sanitary products simultaneously on six furrows with 90 cm spacing. This gives a working width of 5.4 m, allowing a work rated of 1.6 ha/h. There has also been some work on harrows, ox-carts, and an adjustable yoke (allowing different sowing widths).

Small numbers of these implements have been produced by IIMA and local workshops. Large scale production has not started, partly due to the problems of obtaining hard currency to buy the raw materials. Some small production runs have been funded through technical cooperation programmes.

### **Animal traction training and promotion programmes**

Training is fundamental to the use of any technology. Animal traction was an innovative technology for the new generation, and no one was familiar with the new implements developed by IIMA. Therefore an intensive programme of demonstrations and events was developed, at the farm, municipal, provincial and national levels. The aim of these events was to:

- Demonstrate new or little-known implements.
- Help select the most appropriate implements.
- Stimulate interest through competitions and demonstrations by ox-handlers, blacksmiths and manufacturers of yokes and harnesses.
- Exchange animal traction knowledge and experiences.

This programme was most active between 1994 and 1997. In each province, a training school was established for workers and technicians involved in animal traction and implement production and maintenance. In 1995, a total of 40 000 participants and 18 000 ox-handlers participated at small farm and cooperative level (1244 events), state farm level (299 events) and at events held at the level of municipalities (134) and provinces (12). Starting in 1994, national animal traction meetings were held. International congresses on animal traction were hosted in 1995, 1997 and 1999.

### **Programs of international technical cooperation**

Since 1990, several foreign organisations have provided modest assistance to the promotion and development of animal traction in Cuba. These included:

- APS (*Asociación para la Participación en el Desarrollo*), an Italian NGO, financed the manufacture of some animal powered implements and their supply to agricultural cooperatives and schools, as well as related training activities.
- *Socorro Popular Francés*, a French NGO, financed projects to promote the use of equids in hilly areas and to develop appropriate implements and harnesses for these animals.
- *Sociedad de Amistad Italia-Cuba*, an Italian-Cuban Friendship Society has helped to obtain resources for the animal traction projects.
- DFID (the British Department for International Development) has funded this present research programme, as well as training activities organised by Silsoe Research Institute, UK.
- FOMENTA (*Programa Regional de Fomento de la Tracción Animal*) and RELATA (*Red Latinoamericana de Tracción*), animal traction promotional and networking programmes based in Nicaragua, have participated in Cuban international congresses and have sponsored Cuban specialists to attend international workshops on animal traction.

### **Present situation and perspectives**

In 2000, eighty-six percent of the 400 000 work oxen used were in the hands of the non-state sector of UBPCs, cooperatives and small farms (Table 5). Animal power is very important in this sector, which accounts for 67% of the farmland and represents the backbone of agricultural production in Cuba.

**Table 5. Distribution of oxen by sector**

<i>Sector</i>	<i>Number</i>	<i>%</i>
State agricultural production units	40 400	10
Agricultural production cooperatives (CPA)	15 000	4
Basic units of cooperative production (UBPC)	32 500	8
Credit and service cooperatives (CCS) and private small-holders	307 900	78
<b>Total number of oxen</b>	<b>395 800</b>	<b>100</b>

*Source:* CENCOP, 2000

In spite of relatively high numbers of tractors, animal traction remains extremely important technology at the beginning of the twenty-first century. At present, 38% of farm energy comes from oxen (Table 6).

**Table 6. Numbers and capacity of tractors and work animals in 1990 and 2000**

<i>Energy source</i>	<i>Number</i> <i>1990</i>	<i>Number</i> <i>2000</i>	<i>Ratio</i> <i>2000/1990</i>	<i>Draft force potential in 2000</i> <i>(kN)</i>
Tractors	70 200	40 000	0.57	560 000
Oxen	163 000	395 800	2.42	475 000
Work horses	235 000	303 100	1.29	182 000
Mules	30 000	31 800	1.06	19 000
<b>Total potential force</b>	--	--	--	<b>1 236 000</b>
<b>All animals</b>	<b>428 000</b>	<b>730 700</b>	<b>1.71</b>	<b>676 000</b>

*Source:* MINAGRI, 2000

Although animal traction is clearly very important in Cuba, this is not always appreciated, and the topic does not receive all the attention that it deserves. Some high-level leaders consider that oxen, horses and mules are a 'backward' technology, a temporary 'necessary evil'. This is very different from the view held by agricultural leaders at grassroots level (farm units, municipalities or even provinces) who generally consider that animal traction is an indispensable element for achieving production plans.

## Conclusions

Animal traction will continue to be a vitally important economic factor in the agricultural production of Cuba. Significant growth is not foreseen, but neither are substantial reductions. The country is gradually restructuring its economy after the collapse of the European socialist bloc and the availability of hard currency is increasing. However, animal traction, tractor power and manual labour are complementary productive technologies. They are not mutually exclusive. The choice depends on many factors, notably the costs of production. The new methods of economic management, in which the relation between costs and benefits is of greatest importance, will mean that low-cost and fuel-saving technologies should find appropriate niches in the production system. Animal traction will continue to be recognised as an efficient alternative to tractor mechanisation for those times and locations where it is economically justified.

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