Animal traction in the Eastern Provinces of Cuba

by

Daniel Font Rodríguez *

Engineering Faculty, University of Granma, Bayamo, Granma, Cuba

Summary

This study was undertaken by a multidisciplinary group, mainly from the Engineering Faculty of the University of Granma, where there has been a tradition of research into the use of alternative energy sources. The task was to evaluate the use of animal traction in the eastern region of the country (Guantánamo, Santiago de Cuba, Holguín and Granma). A participatory rural appraisal methodology was adopted. Key researchers were assigned to areas in each province considered representative in terms of animal traction use and agricultural diversity. Eight hundred users and owners of work animals were interviewed. The points covered included: animal management practices, tillage systems, transport systems, implements used, crop technology, socio-economic issues and environmental aspects. Oxen are important for soil cultivation and are used with a range of plows, harrows and cultivators. Horses are ridden and used for pulling carts and transport of people and freight in both urban and rural areas. Horse-pulled carriages providing public transport in the city of Bayamo are famous. Mules and donkeys provide vital pack transport in the mountains. The number of implements per pair of oxen is low (2.8) suggesting there is much scope to increase the numbers and diversity of implements in use. However availability of traditional and innovative implements is low due to the limited financial resources of workshops and blacksmiths to obtain materials. Similarly, veterinary services are considered good, but lack medicines and other inputs. Animal traction requires greater attention, and there is need for stronger linkages and cooperation between the various stakeholders, through networks and associations.*

Introduction and methodology

The rapid development of convenient motor-powered agricultural machinery adapted to a wide range of operations brings into question whether non-motorised agricultural tools remain necessary. The use of mechanical power can only be justified where the agricultural systems produce sufficient income to cover the costs of acquisition, operation and maintenance, repair and depreciation of such machinery. Therefore, despite the great advances achieved by motorised energy sources in agriculture, draft animals remain the principal agricultural energy source in many regions where the use of tractors and their associated equipment is not profitable.

Animal traction has become a technology that has gained increasing acceptance as an economically and ecologically appropriate technology for developing countries. In the eastern provinces of Cuba animal energy is abundant, although not all farmers have a thorough understanding of the economic, technical and ecological benefits implied by its use. The economy of eastern Cuba depends principally on the agricultural sector, and there is a need for some policy changes relating to the use of this important source of energy. This provides a challenge for all people of the region who are directly or indirectly linked to animal power use, and this is highlighted by this present study on the use of animal traction in the eastern provinces of Guantánamo, Santiago de Cuba, Holguín and Granma.

Members of the Engineering Faculty of the University of Granma carried out the research between July and September 2000. In the course of the work twelve researchers participated, of which ten were

*** Research team**

The research team, led by Daniel Font Rodríguez, included the following people whose invaluable contribution to the data collection and analysis is fully acknowledged. University of Granma Engineering Faculty Staff: M.Sc. Robell R. Ochoa Casal, Ing. Luis Raúl Parra Serrano, Ing. Luis Zamora González, Ing. Marcos Serrano Varona, Ing. Victor Ferrer Suárez, Ing. Tania Arcia Boza, Ing. Hugo B. Vázquez Milanéz, Ing. Benjamin Gaskin Espinosa, Ing. Luis Mecias López, M.Sc. Romilio Quesada Matos, Ing. Alfonso Ortíz Rodríguez; Engineering Faculty Students: Leunam Labañino Legrá, Yusleydis Cisneros Reyna, Adrián Rosales Sosa, Daniel Pérez Espinosa. Veterinary Faculty Staff: Dr. Armando Cuesta and Ministry of Agriculture Staff: Ing. Esteban Arias Fuentes.

graduates in agricultural mechanisation, two were agronomists, eleven were male and one female. The methodology was based on rapid participatory rural appraisals, as suggested by Starkey (2003).

Context

Holguín Province has an area of 9300 km^2 and its population is 1.03 million giving a population density of 110 inhabitants/km^2, with 41% living in the rural sector (CEPDE, 2000). Its mountain ranges include Sagua, Maniabón, La Sierra de Cristal and the Sierra de Nípe, with the highest point of Pico Cristal at 1300 m. The mean temperature in the Province is about 26ºC, varying with the zone. The city of Holguín is the principal commercial centre. The rich agricultural economy of the province includes coffee, tobacco and beef cattle.

The **Province of Santiago de Cuba** has over one million inhabitants and an area of over 6000 km^2 giving a population density of 167/km^2 (CEPDE, 2000). This is the most urbanised of the four provinces, with 70% of people living in urban areas. Traversed by the Sierra Maestra, it is the most mountainous of all Cuban provinces, with the highest peaks in the country. To the north of the mountains is the main plains region, with the highest human population. The climate is humid tropical, with rainfall over 3000 mm/yr in the peaks and down to 700 mm in the east. The rivers Cauto, Mayarí, Guantánamo and Bacanao rise in the hills in the principal forests of Cuba. The Carlos Manuel de Céspedes dam provides hydroelectricity and agricultural irrigation. The province is the second most important for producing coffee and citrus, and other agricultural activity includes fruits, sugar cane, vegetables and beef cattle. Industrial activity includes sugar refineries, mining, shipbuilding, chemical industry, oil refineries, fishing, fertilisers and textiles.

Guantánamo Province has a population of over half a million inhabitants and an area of more than 6000 km^2, giving a density of 83 people/km^2, with 39% living in rural areas (CEPDE, 2000). The mean annual temperature is 32ºC, and the main crops are sugar cane, coffee, cocoa, coconut and mixed annual crops.

Granma Province, named after the motor launch that brought Fidel Castro from Mexico in 1956, has a population of 830 000 inhabitants, an area of over 8000 km^2 and a population density of 99/km^2 (CEPDE, 2000). This is the least urbanised of the four provinces, with 42% of the population living in rural areas. To the south is the Sierra Maestra, but most of the province comprises plains and the valley of the long river Cauto which supports the farming of rice, sugar cane, tobacco, vegetables and livestock. Its capital, Bayamo, founded 1513, is famous for its use of horse-drawn carriages for urban transport. A popular song says, “I like to go to Bayamo seated in a carriage”. The average temperature in Bayamo is 26ºC, with a maximum of 32ºC in August and a minimum of 19ºC in January. Economic activity centres on agriculture and livestock. Rice production is important in the Cauto marshes and coffee, tobacco, vegetables, citrus, fruits and sugar cane are all significant crops.

Animal traction in the Eastern Provinces

Agricultural systems in the Eastern Provinces depend to a large extent on animal traction. Animals are used for weeding and cultivating, delivering forage to cows, soil preparation, riding, pack transport and for pulling carts, carriages and wagons. In the mountain areas, mules, donkeys and horses are important for transporting coffee and other products.

Animals are particularly effective in wetlands and they are irreplaceable in mountain regions. Increasing animal traction requires the availability of simple, versatile and low-cost equipment, that is easy to repair and maintain, and there are initiatives underway to construct a large number of animal-drawn implements. The most appropriate implements for each task have been identified, and in many instances these are being made by the State farms and by individual farmers. Many independent farmers use very basic implements for clod breaking and levelling, such as pieces of railway line and wood. Due to the scarcity of resources, they do not have access to other options and new technologies such as the ‘6 in 1’ toolbar.

Table 1 shows the numbers of working animals in the State and private sectors in Granma Province.

Table 1. Work animals in State and private sectors in Granma Province

Animals	1999			2000			Difference
	State	Private	**Total**	State	Private	**Total**	
Oxen	5780	24300	30080	5410	25140	30550	470
Horses	8780	25510	34290	8290	22120	30410	-3880
Mules	2120	3190	5310	2260	2990	5250	-60
Donkeys	420	450	870	460	470	930	60
Total	**17100**	**53450**	**70550**	**16420**	**50720**	**67140**	**-3410**

Source. Oficina Territorial de Estadística. Dpto Estadística Económica. Granma, Cuba, 2000.

Although State enterprises use large numbers of animals (over 16,000), most animals (76%) operate within the private sector. Numerically, oxen are the most important work animals. The increase in the number of oxen between 1999 and 2000 was partly due to the animals being transferred from the State herd to the UBPCs. Mules and donkeys maintained their numbers due to the fact that these animals are at present indispensable for transporting produce in isolated mountainous areas.

Institutional framework

The following organisations involved in animal traction are briefly presented in approximate order of their significance in this field.

The Ministry of Agriculture (**MINAGRI**) and the Ministry of Sugar (**MINAZ**) are the two State ministries responsible for several types of farm, both cooperatives and State farms producing sugar cane, crops and livestock.

The **State farms** cover great areas and are large-scale enterprises under the direct responsibility of MINAGRI (for most ranches, plantations, most crops, including large-scale rice production) or MINAZ (sugar cane plantations. On State farms there is much scope for replacing tractors by oxen, horses and mules to save fuel and protect the environment.

Created in 1994 from some State farms, Units of Cooperative Production (**UBPC**) are the basic production units on State land and are independent (although regulated by the responsible ministries). The workers are directly responsible for the agricultural production processes, with usufruct rights. They use animal traction for soil preparation, secondary cultivation and for transport within and outside the cooperative. UBPCs include sugar cane farms (the responsibility of MINAZ) and other farms (the responsibility of MINAGRI).

Agricultural Production Cooperatives (**CPAs)** have characteristics similar to those of the UBPCs, but they own their land and are considered to be in the private sector. Although they are non-State entities, they have an obligation to sell part of their production (crops or livestock) to State wholesalers, according to mutual agreements.

The National Association of Small-holder Producers (**ANAP**) links the independent producers who are owners of their land and their animals. The association agrees with the State on quantities of produce that can to be sold through State marketing, in return for State organisations agreeing to sell the inputs necessary for the production.

Agricultural Training Schools (**ECAs**) are provincial training schools to which cooperatives and farms send their workers to receive courses on (among other topics) the care and management of animals and implements for animal traction. They are important for helping to transmit information and innovations into the various farms.

Agricultural Polytechnic Institutes (**IPAs**) are middle-level schools that produce technicians and qualified workers in the fields of agronomy and mechanisation. Included in this is student training in the management of animals and animal traction implements.

The Cuban Association of Coach Operators (**ACC**) is a transport organisation for owners of animal traction for urban public transport. The organisation regulates and controls the work of this group, and also represents and protects them legally.

Municipal Community Farms (**EMCs**) are the State entities that contract the services of animal-drawn carts and wagons for the urban transport of certain products (eg, water, materials, flowers) and for urban waste removal and town cleansing.

The **carriage factory** in Bayamo is a State entity that manufactures and repairs animal-drawn carriages used for urban transport.

The **State Veterinary Medicine Service** is available to both the State and private organisations to assist with all aspects of animal health (although at times there are difficulties with the supply of certain medicines). There is an **Animal Registry** in each municipality that records and regulates working animals.

Discussion of themes and problems

Transport

Throughout history, animals have been vital for transport, both for the exchange of products between different agro-ecological zones and for the movement of people and social exchanges. During the colonial and republican eras, and up to present times, animal transport has had an important economic function in agriculture and commerce. For example, for many years, sugar cane was transported to the mills by wagons with a capacity of six tonnes, pulled by up to three pairs of oxen. Animal transport has been important for the timely transport of agricultural inputs (seeds, fertilisers and manure) that are indispensable for agricultural production. Animal transport is vital at harvest time to take produce to market and to reduce damage and wastage of the products. With the construction of roads, the organisation of numerous commercial markets and the introduction of motorised transport, animal power is now mainly used for short distance transport.

The use of animals for transporting domestic water and firewood has saved the time of farming families and reduced drudgery, although these uses have been declining with wider availability of piped water and alternative domestic energy sources such as kerosene, gas and electricity.

Equids are widely used for transport. In mountain areas, donkeys and mules are used mainly for the pack transport of produce, while horses are used for riding and carrying light loads. Mules are well adapted to both draft and load carrying, and their strength can be used in numerous agricultural tasks. Donkeys are economical and valuable for many transport chores, including riding, pulling carts and pack transport. They are good navigators and can negotiate steep and difficult paths. Both male and female animals can be employed, and women and children find it easy to work with them.

Horses are occasionally used for tillage and general agricultural work, but their use has been mainly for transporting people and loads, using two-wheel carts and four–wheel wagons and carriages. In Bayamo municipality, Granma Province, there is a long tradition of urban transport using horses. In 1983 there were only 76 horse-drawn vehicles registered for public transport. As a result of the special period, by 2000 there were some 650-750 animal-drawn vehicles offering transport services. Of these 450 were carriages to carry people, 48 were four-wheeled wagons (*cativana*s) and 162 were two-wheeled carts used to transport water and goods such as food and charcoal. It is estimated that each year over 16 million trips are made by passengers in horse-drawn carriages, equivalent to each inhabitant being carried more than 20 times per year. On an average 6-hour day, a carriage does 12 journeys carrying seven passengers. Nearly all the operators of horse-drawn vehicles are men, although in 2000 there was one woman operating a carriage (Cocheros, 2000)

Animal types

Both bovines and equines are used for work, and they vary greatly in size. Most working oxen and bulls are of the Creole type, or are zebu crossbreds, and most are between three and ten years old. Horses are mainly of the Creole type, and tend to be from 2.5 to 12 years. Young animals are broken in and trained for particular tasks.

Table 2 gives information on the fixed buying and selling prices of cattle in 2000, applicable to all sectors (State, cooperative and private). Private sales from one farmer to another pass through official channels, so the State buys from the farmer and then re-sells it to the new owner at the official price. However, in the case of equines, buying and selling is not controlled and the price is arranged by mutual agreement between the owner and purchaser.

Table 2. Prices of bovines according to category and weight

*Animal category **	*Body weight kg*	*Price/kg Cuban peso*
Prime male and female calves of 0-6 months	>120	2.40
Second category male and female calves of 0-6 months	90 to 120	2.05
Prime male and female calves of > 6 a 12 months	>190	3.15
Second category male and female calves of > 6 a 12 months	150 to 190	2.75
Prime yearlings of both sexes	>220	3.60
Second category yearlings of both sexes	190 to 220	3.00
Prime bullocks, bulls and heifers	>420	3.20
Second category bullocks, bulls and heifers	375 to 420	2.45
Prime oxen	>500	2.05
Second category oxen	450 to 500	1.75
Prime cows and un-pregnant heifers	>400	2.30
Second category cows and un-pregnant heifers	370 to 400	2.05

** Prime animals have very good conformation, fat and musculature, while second category animals are a little bonier in appearance. There are also third and forth categories, for animals with poorer conformation and condition.*
Source: Ministerio de Finanzas y Precio, 2001

Animal health and husbandry

Few animals are housed, and some are maintained under sub-optimal conditions, with little protection from the rain, cold or wind. There may be build up of dung, urine and mud in the small corrals, and this may lead to foot problems and increasing parasite loads, which may be exacerbated by excessive work or poor nutrition. Horses are particularly susceptible, but oxen need good management too.

Work animals, particularly oxen, are usually kept under extensive conditions, obtaining their feed through grazing, with supplementation depending on local availability and cost (related to the proximity of sugar cane products or local maize production). For reasons associated with climate and management, pasture quality is often low. The main supplement for oxen is molasses, sometimes prepared in blocks with urea with added minerals. Equids may be fed small quantities of grains, and one of the limiting factors for transport horses may be lack of access time to suitable pasture.

Independent producers in the private sector, breed many work animals using informal methods for control and selection. The eastern zone has an artificial insemination center in Granma Province (Bayamo municipality), which offers the service of inseminators and specialists and the sale of semen to other eastern provinces. This allows the production of a variety of crossbred animals for the dairy

and beef industries, with some of the off take of herds sold for use as work oxen. Available semen includes Zebu, Creole and Holstein breeds.

Veterinary clinics exist in all eastern provinces and many municipalities. In spite of the scarcity of resources, including drugs, vaccines, instruments and animal handling facilities, qualified veterinary staff are available and services are generally available and of acceptable quality. The veterinary clinics also offer on-farm services in the rural areas run by the popular councils.

The principal health problems are: septicemia (high fever); ticks; foot rot (known locally as *mazamorra*), anemia, parasitism, colic and tetanus. Traditionally in the countryside, some diseases have been treated with home cures. This is the case with castration, influenza, back sores, mouth infection (*java*) and foot rot in the case of equines, and horn infections in the case of bovines. However, there is an increasing tendency to use veterinary services and commercial medicines.

It is important that the hooves of equids are in good condition. Shoeing is important in order to protect the hoof. When animals work on hard surfaces and mountain roads, the hooves can quickly wear more rapidly than they can grow. Granma Province in has 190 blacksmiths that make, among other things, horse shoes. Due the lack of metal to make shoes and coal for the forges, the work of blacksmiths is often constrained, and many do not work full time.

Operations

In spite of the development of motorised mechanisation, the use of animal traction will always be appropriate to many tasks and situations where its efficiency has been well proven. These include: mountainous and sloping areas, land with stones and other obstacles, small plots for vegetables and family produce, nurseries and orchards.

In the eastern provinces of Cuba, oxen have traditionally been used for soil preparation and cultivation. Horses, mules and donkeys have been used mainly for transporting people and cargo. However the use of equids in agriculture can increase productivity and profitability, particular for operations requiring little draft force (sowing, weeding, ridging, earthing up).

The use of oxen in agricultural work is highly appropriate for small-scale operations. As a result of the fuel shortage in the 1990s, there is a tendency in the eastern provinces for increasing the use as oxen as an alternative to motorised power for soil preparation (plowing, harrowing and ridging). This applies to State enterprises and the private sector.

Soil preparations implements

Long-beamed ard plow. The wooden plow is also known in the provinces as the small-farmer (*arado sitiero*) plow or the creole (*arado criollo*) plow. It is one of the oldest implement designs in use. This is a symmetrical implement that produces a complex or combined cut, shatters and pulverises the soil without inverting the furrow slice. The principal parts are the wooden plow body, metal plowshare, the metal draw-pole attachment, the wooden draw pole (4 metres) and a wooden handle (400 cm). It has a working width of 20 cm at a depth of 10-25 cm. It is used for plowing, soil pulverisation, seeding, furrowing and making ridges.

Mouldboard plow. The metal mouldboard plow is generally referred to as the American plow (*arado americano*). It inverts the soil, burying weeds and crop residues, which can increase the level of humus in the soil (although over time, mould plowing may reduce the organic matter in the soil). Soil inversion may also expose agricultural pests to solar radiation. Its principal parts are: plow-beam, plow share, mouldboard, frog; landside, handle and depth wheel. It is used for initial plowing; secondary plowing, furrowing, weeding, earthing-up and splitting ridges. There are four common sizes, and some of their characteristics are given in Table 3.

Table 3. Some technical specifications of the mouldboard plow (*arado americano*)

	Plow model				
	Nº ¾	*Nº 1*	*Nº 1½*	*Nº 2*	*Nº 3*
Weight (kg)	30	38	42	45	55
Width (cm)	24	26	27	28	30
Depth of work (cm)	12	13	14	15	16
Depth wheel diameter (cm)	7	7	7	8	10

Source: Sotto, Wong and Armada, 1999

Pole plow (*espolón* or *puyón*). This long-beamed implement has the body of a mouldboard plow (1½ or 2), and for this reason it is also sometime known as an American plow (*arado americano)* in the eastern provinces. The beam length is 4 m, with working width 25-30 cm at a depth of 10-25 cm. It is used in soil preparation, ridging, cultivating and earthing up.

Multipurpose toolbar (Multiarado) "6 in 1". This is an important multi-purpose implement consisting of handles, depth wheel and a straight or curved main beam with a frame and short vertical bar for attaching various implements. The attachments include chisels, sweeps of 200, 300 and 400 mm width, ridgers, mouldboard plow (1½) and root-crop lifters. It is used for plowing, re-plowing, furrowing, weeding, cultivating, earthing up and harvesting root-crops. Its technical characteristics are summarised here in the paper of Sotto, Wong and Armada (2003).

Spike-tooth harrow. This is a traditional implement made from a metallic frame in the form of an equilateral triangle, with a ring for pulling at one of its apexes, soil engaging vertical tines and skids for transport. The circular section steel points are bolted to the frame and may vary in number according to their dimensions, with 15 points at 25 cm spacing being common. The width of work is about 1.7 m, with a working depth of 12 cm. It is used for clod breaking, weeding and clearing crop residues from the field.

Three or five tined cultivator. The cultivator (known locally as *araña* or *grilla*) comprises a steel frame, often adjustable, to which are attached the soil-acting elements. There can be 3 or 5 tines (sweeps or chisels), with a working width of up to one metre and a working depth of 5-10 cm. The implement is used to weed crops such as beans, maize, soya and tobacco, and may also be used to mark and split furrows and ridges.

The costs of implements in one UBPC in Granma Province are provided in Table 4, although these prices should be treated with caution as they do not necessarily imply availability, and prices may vary with distance from the market.

Table 4 Cost of some animal traction implements in Granma in 2000

Implement	*Price (Pesos)*
Traditional pole plow *(sitiero)*	85
Mouldboard plow (*americano*)	213
Toolbar *(multiarado)*	249
Ridger	343
Harrow	295
Cart (large)	312

Source: Font (2000)

Equipment and harness for transport

Many State farms make their own implements according to the availability of resources and materials (although there are also plans for centralised production). This is the case with both small and large

carts which are widely used in agriculture. Carts have a load capacity of about 500 kg. When used with two animals, they have a draw-pole made of wood or galvanised steel tube. When carts are pulled by a single animal they are fitted with two shafts (wood or metal tube). The tyres may be pneumatic or solid rubber, and some carts have leaf or coil springs to absorb the shocks produced by irregular road surfaces.

Carts are widely used by farmers because of the great importance of transporting products and people. Due to the scarcity of materials, many carts are constructed from scrap, which can cause problems in ensuring suitable design with the appropriate location of the center of gravity and line of pull. If these are not correct relative to the animal(s), it can cause problems for the animals and lead to a loss of efficiency.

For equids, the main transport devices are light two-wheeled carts (*quitrines*), light four-wheel carts (*cativanas*) and passenger carriages. Two-wheeled carts (*quitrines)* carry up to four people and may have wooden wheels or metal wheels with pneumatic tyres. Some have shock absorbing leaf-springs. The *cativana,* made of steel and wood, is larger and carries up to seven passengers. It has four rubber-covered steel wheels of the same size. The traditional carriages also have four wheels, but the two front wheels have a smaller diameter than the rear ones, which gives stability and equilibrium to the vehicle. The traditional wheels are made of wood, with solid rubber tyres but metal wheels are also common. In all four-wheel transport devices, the front axle can pivot.

Riding and pack transport are very important for smallholder producers. For riding, saddles are normally used although some people only use a blanket, as saddles are expensive and difficult to acquire. To transport loads on the backs of animals, packsaddles and straps are used. Mule transporters and rural artisans make these, although their manufacture is limited by lack of ropes, cloth and thread for sewing.

Yokes. Oxen are generally harnessed in pairs with a double head-yoke. This is tied securely to the horns using forehead pads (*frontiles*), and this allows the animals to reverse and to brake, as well as pull. Nose rings are use to control animals. The double head yoke simplifies harnessing the animals, but animals cannot move their heads freely. Also the yoke can cause discomfort and stress, and sometimes injury, to the head, neck or horns if an obstacle is encountered. Equids are more delicate around their heads while their chests and shoulders are broad and strong. For this reason, equids should not be yoked, but should be worked with breast bands or collars for transport and agricultural work.

Collar harness. This consists of a hoop of leather and hames of metal or wood, complemented by appropriate padding and adjustable straps. Collars are particularly appropriate for heavy draft with horses and mules. The collar must be perfectly adjusted so as not to rub the animals, as must all other parts of the harness (bridle, clinch, breeching). For lighter draft jobs, a breast-band can be used instead of the collar.

Breast-band. In this type of harness, the traces are attached to a wide band (made of leather or other material) that is wrapped around the chest of the animal. It is cheaper and simpler than the collar and is well adapted to lighter work that does not exert untoward pressure on the animal's chest (CIDA, 1990).

In Table 5, the costs are given for raw materials bought by a UBPC in Granma Province that makes yokes and harnesses.

Table 5. Costs of materials needed to make yokes and harnesses in 2000

Article	*Price (Pesos)*
Yoke 35 cm	38
Yoke 75 cm	44
Lead animal attaching strap (9 m)	1.4
Yoke strap (12 m)	1.8
Yoke ring (1 m)	0.2

Source: Font, 2000

Equipment production

In Granma Province and Holguín there are agricultural workshops part of whose production is devoted to the manufacture of animal traction implements. While the manufacturing capacity and technical services for repairs and maintenance are good, they are severely limited by lack of materials and resources. There is insufficient production of implements and both the private sector and the individual farmers find it almost impossible to acquire new implements and technologies such as the '6 in 1' toolbar.

In 2000, Granma Province had about 22,000 animal traction implements, giving an overall ration of oxen: implements of 1:1.4. This is low, and suggests there is much potential to increase the number of implements in circulation: a very difficult challenge given the scarcity of the required materials and other resources for large scale manufacture of more implements.

Policy issues

According to State and provincial policy, animal traction will continue to be encouraged and oxen will be trained according to needs and production plans. The use of single oxen will be promoted for certain crops and operations. Multipurpose implements will be manufactured and promoted. For transport purposes, wheels will be modified to increase carrying capacity the comfort of operators and passengers. Forehead pads (*frontiles*) for oxen will be lined with leather.

Available tractor power has been declining in recent years, while numbers of oxen have been stable or increasing. Using theoretical calculations, Table 6 shows that in 2000 work oxen represented about 3% of the power available from tractors.

Table 6. Theoretical power potential of oxen and tractors in Granma Province

	1999		*2000*	
Power source	*Number*	*Power (kW)*	*Number*	*Power (kW)*
Tractors	6 078	364 690	5 759	345 540
Oxen	30 089	10 531	30 551	10 693

Note on the calculations
Taking 400 kg as an average mass for a working ox, it can be assumed that the animal can develop a pull force of 40 kg (392 N) during the entire working day. At a forward speed of 0.9 m s^{-1}, the power developed is 0.35 kW. The potential power supply available from the provincial herd of 30 089 oxen in 1999, was 10 531 kW. As equids do not contribute significantly to soil cultivation work (as they do to transport) they have not been included in the comparison.
The potential power available from the most commonly used tractor (Yumz 6) is about 60kW.
Source of data: MINAGRI, 2000; Calculation after Starkey, 1989

Socio-economic issues

Credit in local currency is available to all farming sectors, except to independent farmers who have no formal agreement with the State. A State insurance company provides agricultural credit to cover losses of harvest as a result of drought, pests and the weather, but this does not normally cover losses of working animals.

A training infrastructure has been created to improve the quality and efficiency of farm work. This includes animal traction training as well as training schools and agricultural polytechnics which produce workers and technicians of both sexes. However, much knowledge on animal traction is tradition and passes from generation to generation in farming families and within cooperatives.

During the study, it was observed that some agricultural production cooperatives hire out working animals and implements to individual farmers. Similarly, they may hire private farmers and their animals to perform specific agricultural or transport operations with their animals. This shares the benefits and costs of owning animals, and is mutually beneficial.

Some of the recent changes in agricultural tenure and marketing have stimulated agricultural production and made rural life more attractive. This is likely to stimulate the demand for animal traction in rural areas.

Conclusions

Animal power for agriculture and transport is very important in the eastern provinces. The income of a large part of the families who live in rural areas depends, to a great extent, on animal traction. Although animal traction is a labour-saving technology, its recent increase in the eastern provinces has generated employment. Animal traction is appropriate as it requires relatively little investment in human, material and financial resources compared with other energy sources.

One of the big constraints to animal traction use in the eastern provinces is the shortage of easily available and affordable implements. It is also difficult to obtain components to make carts. This means that many farmers and cooperatives make their own implements, based on old equipment and scrap metal. Small workshops often make equipment without the necessary tools or technical background. The lack of basic resources (such as rope, canvas and thread) needed to make harnesses and pack saddles limits pack transport in the mountain regions. There is much scope for assisting farmers to improve the suitability and performance of their ox-drawn agricultural implements.

Another constraint to animal traction is the availability of feed and supplements. This is especially important for transport animals that work long hours. Despite the existence of good veterinary services, there are shortages of veterinary resources (medicines, vaccines, instruments and animal handling facilities in rural areas). Mules and donkeys are mainly used for pack transport (although mules may be ridden and used to pull carts), but there is no tradition of using them for agriculture. There appears much potential for greater and more diverse use of mules and donkeys, particularly in the mountainous areas.

Animal traction warrants much more attention, with exchanges of information and experiences between those involved (eg, farmers-researchers, research-researchers and farmers-farmers, with transporters and other relevant people also included). Associations or networks should operate at different levels (national, regional, provincial) to assist the development of such links.

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The paper was translated by Brian Sims, Silsoe Research Institute, Wrest Park, Silsoe, Bedford MK45 4HS, UK
It was edited by Paul Starkey, Animal Traction Development, Oxgate, 64 Northcourt Avenue, Reading RG2 7HQ, UK