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The use and role of animal draught power in Cuban Agriculture: a field study in Havana Province.

by

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Abstract

The fall of the socialist bloc in 1989 resulted in a serious economic crisis for the Cuban society and not the least in agriculture, which had been dependent on cheap imported fuel, fertilisers, spare parts and fodder. New agricultural policies and strategies were developed which included a rapid increase in the use of animal traction and its infrastructure, ie ox breeding, management and training of draught-oxen. Additionally, new animal-drawn implements were developed, training of ox-handlers, blacksmiths and artisans, makers of yokes and harnesses. The research questions chosen deals with the importance that animal traction has in Cuban agriculture and the most important factors for further development of animal traction. The methods used were mainly drawn from "Rapid Rural Appraisal" approaches (RRA). Semi-structured interviews were performed with different stakeholders in the animal traction field. The interviews were undertaken in Havana Province and the results therefore cannot be applied to the whole country.

Animal traction and tractors power are both important in all Cuban agricultural organisations (UBPC- and CPA co-operatives, CCS-farms, and state farms) and agricultural systems. Today a mixture of tractor and animal power is used in all agricultural organisations in Cuba. The tradition of using animal traction, the retained knowledge, and the animal traction programme introduced in 1991 have been the most important factors for the greater use of animal traction in both large- and small scale-agriculture in Cuba.

The main problems identified with animal traction today are theft of animals and the non-availability of new implements. Another important factor for the development of animal traction in the future is governmental strategy to change people's perception since some people thinks that the current wide use of draught animals is only temporary during the difficult times of the nineties.

Animal traction has many advantages that cannot be replaced by tractors. The advantages mentioned were the adjustable width of the ox-team that is valuable in different types of cultivation, the possibility to use oxen even in wet soil conditions, and the more favourable economy of animal traction. The adjustable width of the ox-team gives an important flexibility when the cultivations are diversified and the farmer has to weed in, for example, a banana field one day and in sweet potato the next. On the other hand, the more rapid work of a tractor is an important factor, which means better timing when preparing the soil for sowing. In wet conditions the timing of the oxen is better. However, an important drawback for the tractor is its dependency on fuel and spare parts. The complementarity of tractors and oxen in the future in Cuba depends on the development of different niches in the production system.

Keywords:
Animal traction, Cuban agriculture, draught animals, oxen.

Resúmen

La caída del bloque socialista en 1989 resultó en una seria crisis económica para la sociedad cubana la cuál repercutió directamente en la agricultura, la cual dependia de la importación a bajo costo de combustible, fertilizantes, refacciones y forraje. Nuevas políticas agrícolas y estrategias fueron desarrolladas, las cuales incluyeron un rápido incremento en el uso de tracción animal y su infraestructura, por ejemplo el mejoramiento de las razas de bueyes asi como su manejo y entrenamiento. Adicionalmente, nuevos implementos para el uso de animales fueron desarrollados, capacitación de manejadores de bueyes, herreros y artesanos, manufactores de yugos y arneses. Las preguntas de esta investigación tratan sobre la importancia que el animal de tracción tiene en la agricultura cubana y los mas importantes factores para un posterior desarrollo de la tracción animal. Los métodos empleados fueron principalmente de "Rapid Rural Appraisal" (RRA). Entrevistas semiestructuradas fueron realizadas con diferentes tenedores de animales de tracción de campo. Las entrevistas fueron hechas en la provincia de la Habana y los resultados por lo tanto no pueden ser aplicados al pais en su totalidad.

La tracción animal y la fuerza de los tractores son ambos importantes en todas las organizaciones (UBPC- CCS- y CPA cooperativas, granjas privadas y granjas estatales) asi como sistemas agrícolas. Hoy en día una clara mezcla del uso de tractores y animales es empleada en todas las organizaciones agrícolas en Cuba. La tradición, el conocimiento obtenido, y el programa de tracción animal introducido en 1991 han sido los factores más importantes para el uso de esta técnica tanto a gran como pequeña escala en la agricultura de Cuba.

Los principales problemas con la tracción animal son el robo de animales y la carencia de nuevos implementos. Otro factor importante para el desarrollo del animal de tracción en el futuro es la estrategia gobernamental para cambiar la percepción de la gente, dado que algunos de ellos consideran que el amplio uso actual de animales de tiro, es solo temporal dados los difíciles momentos de los noventas.

El animal de tracción tiene muchas ventajas que no pueden ser reemplazadas por el tractor. Las ventajas mencionadas con referencia al uso de bueyes fueron principalmente la de amplitud del equipo, que es muy importante en los diferentes tipos de cultivo, la posibilidad de emplearlos aún en suelos muy humedos, así como el ser menos costoso el usar el animal de tracción que el tractor. La ajustabilidad de amplitud en el arado tirado por bueyes brinda una importante flexibilidad cuando los cultivos son diversos y el granjero debe desherbar en, por ejemplo, un campo de banana un día y en uno de patata al otro. Por otro lado, el trabajo más rápido hecho por un tractor es un factor muy importante, el cuál significa un tiempo mas oportuno para la preparación del suelo para la siembra. En condiciones de alta humedad el uso del buey es mejor. Otra importante desventaja para el tractor es su dependencia de combustible y refacciones. La complementariedad de tractores y bueyes en el futuro de Cuba depende en gran medida, de que las ventajas que presenta el uso de bueyes sean mayores que la eficiencia y rapidez del tractor. Sin embargo, una importante desventaja del tractor es su dependencia de combustible y refacciones. La complementariedad de tractores y bueyes en el futuro de Cuba depende del desarrollo de diferentes nichos en el sistema de producción.

1 Introduction

Draught animals have been used in Cuba for a long time. The development of the sugar industry created great needs for more draught animals. In the years following the revolution in 1959, the number of oxen started to decrease. The government strategy towards a concentrated and highly mechanised agriculture led to a massive introduction of tractors and the establishment of large co-operative and state farms. The former Soviet Union and the rest of the socialist bloc supported Cuba with energy and technology like fuel, tractors and chemical fertilisers, animal feed and foodstuffs. Mechanisation increased, and whereas in 1960 as much as 66.8 percent of the energy need in the Cuban agriculture was constituted mainly by oxen and other draught animals, by 1990 it had dropped to 8.3 percent (Pedro Sotto et al., 1997).

The fall of the socialist bloc in 1989 resulted in a serious economic crisis for the Cuban society and not the least for agriculture, which had been dependent on cheap imported fuel, fertilisers, spare parts and fodder. In Cuba, the period after 1989 is called “the special period in peace time”. The government had to do something to maintain the production of food in levels high enough to feed the people. A new agricultural policy was established which included (Ríos, 1998):

- a drastic reduction in the number of tractors in operation
- a national programme in animal traction development
- a transformation in the forms of land title

The most important measure was the transformation in the forms of land title from 180 agro-industrial complexes cultivating 82 percent of Cuba's arable land into autonomous co-operatives UBPC's (Basic Units of Co-operative Production). State farms today cultivate 33 percent of the agricultural land and are mainly producing export products. Before the crisis the co-operative forms of agriculture (called CPA, Agricultural Production Co-operatives and CCS, Credit and Service Co-operatives) cultivated 10 percent of the agricultural land and, due to the reform, the area cultivated by co-operatives has increased. Additionally, the existing private sector has been encouraged. For these small-scale farmers animal traction is much more attractive than for big state farms (Ríos, 1998).

The animal traction program included ox breeding, management and training of draught-oxen. Additionally new animal-drawn implements were developed, training of ox-handlers, blacksmiths and artisans, makers of yokes and harnesses. Today, Cuba has approximately 385 000 oxen that substitute 40 000 tractors, and animal traction in agriculture is necessary in many organisations. (Ríos, 1998)

In other countries, for example South Africa, Zambia, Zimbabwe and Tanzania, the drudgery in agriculture and the need to produce more food have focused on the importance of draught animals for small scale-farmers, and governments are now working for development of draught animal technology and infrastructure (Paul Starkey, 1996). In Cuba, the situation is different since almost all types of farms, both larger state and co-operative as well as small

private, are using draught animals in some way because of the difficult situation. Research is focused on the future use of both animal- and mechanised power and the mix that might be the most appropriate way for Cuban agriculture. One great advantage with animals, rather than tractors, is that it is a more sound way of managing the red, heavily weathered, nutrient-poor soils. Also the use of implements that do not turn and aerate the soil is supported for the same reason.

The reason for conducting this study is the interesting (although very difficult) situation that Cuba was forced to face (and still is facing) in the first years after the fall of the socialist block. This study deals with a way of solving the energy problem in agriculture. The research questions concern the importance of animal traction in Cuban agriculture, and the most important factors for further development of animal traction. The interviews were undertaken in Havana Province and the results therefore cannot be applied to the whole country.

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2 Research in animal traction, a literature review

2.1 Animal traction in the world

Work animals are being used all over the world to reduce drudgery and to intensify agricultural production. This chapter is an introduction to the use of animal traction in the world, mainly of animal traction used in agriculture. The information source is mainly from Paul Starkey: "A world-wide view of animal traction highlighting some key issues in eastern and southern Africa" (Starkey, 1994).

Small-scale farming is the most important sector of agricultural production in most Sub-Saharan countries and about 80 % use human or animal power in the production of their food and income needs (Gebresenbet et al., 1997). In Asia, draught animals have been used for a very long time, e.g. in Ethiopia where the use of draught animals dates back thousands of years. The most common work animals are cattle and they are generally worked in pairs with withers yokes. The animals are used for tilling and levelling rice swamps and for tilling and harrowing upland soils. Most implements are made in the villages and are mostly long wooden beams with steel shares.

The colonialists introduced animal traction in the Americas. In the tropics, oxen are the main draught animals. They are worked in pairs, using horn/head yokes and it is rare to see more than one person working with the animals. In the north and south Americas, highland and temperate areas, horses, mules and donkeys are preferred to oxen since they walk faster, have greater burst power, and are well suited for transport operations. In North America, oxen were used in the last century but heavy horses and mules steadily replaced oxen as farm equipment diversified and harvesting implements with large power requirements were developed.

In Asia, draught animals are an important power source in agriculture. Buffaloes, oxen and even camels are used. In Southeast Asia draught animals are mainly used in tillage for rice production - ploughing and harrowing paddy fields, transporting and threshing rice. Cattle are mainly found in dryland or upland cultivation and buffaloes in muddy or lowland cultivation. Most animals are traditionally employed in pairs. A big constraint for the further development of animal traction is unstability in governments, there are no clear and effective sets of policies concerning animal traction promotion and development. (Bunyavejchewin et al. see references)

In Europe, oxen were the original work animals, which were superseded by horses in the northern and eastern countries of Europe. Oxen were mainly used in pairs with withers yokes in northern Europe and head/horn yokes in southern and western Europe. Implements used were traditional long-beamed wooden ploughs that were replaced by factory-made, steel implements pulled by traction chains. Today, most of the draught animals, mostly horses, in European agriculture can be found in southern parts and in the eastern parts, where animal power is still an important energy source for small farmers. In the northern parts of Europe, for example in Sweden and the United Kingdom, work horses in forestry are becoming more common. It has been shown that it is economically viable and more environmentally sound to use horses and appropriate equipment rather than the large-scale forestry machines used in forestry in Europe (Benge-Abbott, 1999).

Africa could be divided in four parts, Southern and Eastern Africa, West Africa, Sub-Saharan Africa and finally North Africa and Ethiopia. Ethiopia, where animal power has been used for thousands of years, is unique in Sub-Saharan Africa compared with the rest of Africa where animal traction for cultivation has been introduced within the recent past as one of several technical interventions (Gebresenbet et al., 1997).

In North Africa, animal traction has been used since the time of the Egyptian pharaohs and in Ethiopia draught animals have been part of Ethiopian farming systems for centuries. The Ethiopian wooden ard is the most common implement used for primary and secondary tillage in that country. This plough of wood, except for the share and the ring with the hook made of metal has a very ancient design and has undergone very little modification over the centuries and it did not spread throughout Africa (Gebresenbet et al., 1997). In Sub-Saharan Africa the use of animal traction differs from the rest of the world since their use in crop cultivation has been since the 17th century. Cart transport using draught animals has a longer tradition. Animals used in Africa are cattle, mules, horses, donkeys and camels.

In Western Africa the use is different from country to country depending on the climate, environment and the developing projects undertaken in the areas. Where the draught animal is common, two or three people work pairs of Zebu oxen with withers yokes. The long-beamed, wooden implements seen in other regions of the world are not used in West Africa. Factory-made steel equipment is mainly used, pulled on a traction chain, attached to the yoke. In the semi-humid zone of Western Africa, including the northern parts of Sierra Leone, Côte d'Ivoire, Ghana, Togo and Benin, the tsetse fly that transmits the trypanosomiasis diseases is the main constraint for the adoption of animal traction. In those zones the N'Dameis more suitable, which is a small breed of cattle that can resist moderate challenges of trypanosomiasis.

In southern Africa the use of animal traction is patchy, i.e. in some areas the use is widespread while in others it is non-existing, often in high rainfall zones, tsetse infested areas or arid areas with little crop cultivation. Where animal traction is common, cattle are the main work animals, yoked in pairs using withers yokes. Factory-made mouldboard ploughs are common implements while weeders are quite unusual. However, there are signs that farmers are likely to adopt inter-row weeding soon.

2.2 Key issues concerning animal traction in the world

During this decade, animal traction has been introduced in many countries in Africa. In Mali and other Sahelian countries (Jolly and Gadbois, 1992) and in South Africa (Starkey et al.,1995), policy-makers have stated that animal traction will be the driving force for agricultural development. There are, however, governments that actively discourage animal traction. This has happened in Egypt where the reason was to use forage for dairy-cows instead of using it for feeding draught animals (Starkey, 1990). Although the effects of animal traction on agricultural productivity in many parts of the world have been documented, adoption rates have been disappointing in several West African countries. In this chapter, some draught animal issues will be discussed.

2.2.1 Values of animal traction

In many African countries an increase in food production is essential and the main way to achieve it is to focus attention on technologies that raise productivity of labour. The way of doing this has mainly been by the use of the tractor but for different reasons the results have been disappointing. The high cost of imported machinery, spare parts and the ever-increasing foreign exchange problem have motivated many African countries to actively encourage animal traction (Panin et al., 1994). Different factors important for the profitability of animal traction, i.e. economic factors like the cost of raising animals, work output and efficiency of draught animals are mentioned by Panin et al. (1994) and Starkey (1990). Especially in the early stages of animal traction adoption, the risk is high depending on access to credits or savings. For example, in West Africa cotton companies have encouraged rapid adoption of animal power by providing long-term credit and a market outlet (Starkey, 1990).

Other factors that Panin et al.(1994) and Starkey (1990) mention are technical and institutional factors, equipment availability and repair support services and animal health requirements. Also infrastructure is an important constraint in certain areas, there may be sufficient animals and implements but the lack of infrastructure may cause a distribution problem of draught animals (Starkey, 1990). Research and development, extension and manpower development are also essential. The identification of farmers' constraints, and farmer participation in research and development has to be implemented in the animal traction programmes (Panin et al., 1994). There are examples of novel implements that have been rejected because they were developed by engineers and not by farmers (Panin et al., 1994).

Constraints for the adoption of animal traction to substitute for human labour in Mali found by Jolly and Gadbois (1996) were lack of profitability, high initial investments, short-run cash flow problems, separation of cropping lands and pasture, the lack of suitable pairs of oxen for early training and the existence of tsetse flies (the fly transmits the trypanosomiasis disease in cattle). The potential yield and labour-saving benefits of using animal traction have not been stated under the farmer's conditions, only under experimental conditions. Animal traction helped farmers to increase total surface area cultivated, but not necessarily the area cultivated per active labour unit. The yield per hectare of food crops decreased with the use of animal traction, but that of cash crops increased. Total farm income was higher for all equipped farmers than for non-equipped ones, but income per active labour unit was highest for traditional farmers. The acquisition of animal traction did not ensure food self-sufficiency. Farmers with animal traction attained food self-sufficiency only when animal traction enhanced labour productivity. The yield and labour-saving benefits must be proved to the farmers. (Jolly and Gadbois, 1996)

The use of draught animals is increasing in some countries, for example in Tanzania. It would probably increase faster if farm incomes and crop marketing systems were improved. Animal traction is often complementary to tractor power and seems to be more appropriate for smallholder systems if tractors are not subsidised by the government or by donors. (Starkey et al., 1992)

2.2.2 Animal management

In those places in the world where draught animals are a part of tradition, people are used to keeping, training and managing animals. Implements are available, usually made from local material, and there is a local system of artisans for repairing and replacing them. In many parts of eastern and southern Africa where draught animal technology is a relatively new technology, the infrastructure necessary to train and manage animals or produce and repair appropriate implements are often not well developed (Pearson et al., 1994).

The main issues when managing draught animals are training, feeding and health care. Training will not be treated here since the methods vary widely. Feeding work animals is mainly to provide energy; the requirements for protein, vitamins and minerals other than for maintenance are negligible, unless the animals are growing, are pregnant or lactating (Pearson et al., 1994).

Health of animals is important if the work output is to be maintained. Sub-clinical diseases are more difficult to cope with than the acute diseases, since they may not kill the animal but severely reduce its productivity. In dry areas with rainfed agriculture it can be a big problem with poor condition of draught animals at the end of the dry season caused by a lack of fodder (Starkey, 1990). It may be necessary with supplementary fodder when the animals are needed to be fittest, ie at the beginning of the rains when ploughing is done. In Southeast Asia, parasites that kill the animals are a big problem, both cattle and buffaloes are affected by for example, nematodes, but cattle are less infectious than buffaloes (Bunyavejchewin et al., see references).

2.2.3 Tillage and weeding technology

Tillage is a key element when discussing soil structure of agricultural soils. The mouldboard plough is an implement developed for the European temperate zones, where its damaging impacts are is much less profound than in tropical hot and dry climates, unless irrigation is provided (Stevens, 1994). Reduced tillage, zero tillage, mulch or residue farming and conservation tillage are all different techniques but with the same aim: to minimize soil disturbance and to restore or maintain good soil structure by increasing the organic matter content (Stevens, 1994).

In Ethiopia where the traditional wooden ard with its ancient design is still used, several attempts were made to intensify and diversify animal power by development of implements mainly for primary and secondary tillage operations. Research has been conducted to develop precise and acceptable planters and weeders but with little success. Also a steel mouldboard plough at the smallholder level was introduced but the attempts were unsuccessful because of its weight, and also because it required complicated adjustments and higher power requirements than that of the Ethiopian ard, especially on soils with higher clay contents. It was also too costly to be a success. Gebresenbet et al. (1997) show that innovations in animal traction technology in Ethiopia have been in the hands of a few researchers and farmers who have not understood the context of the problems faced by many small farmers.

Weeding technology is recognised as a serious bottleneck in crop production since in many farming systems the labour available for weeding determines the area that can be harvested. In Africa, animals are rarely used for weeding, even in areas where tilling has been practised for

generations (Stevens, 1994). Additionally, the development of animal traction technology seems to halt after ploughs and carts have been introduced (Stevens, 1994).

Weeding implements for animals in Tanzania are not common. Weeders imported from India have technical problems, and were found to have an inappropriate design. The Mbeya Oxenization Project imported several other types of weeders for evaluation. They also produced a toolbar with weeder and mouldboard plough but it is considered to be difficult to manoeuvre. (Starkey et al., 1992)

2.2.4 Supply and distribution of implements for animal traction

Essential for the development of animal draught technology is the supply of appropriate implements and a supporting infrastructure, including credit provision (Starkey, 1995). Appropriate implements signify a region-specific approach, which takes into account agro-ecological and economic conditions. For successful introduction and use of animal draught power the requirements, among others, are: farmer awareness of existing and/or alternative animal draught power system and adequate communication with the supply side (i.e. effective feedback from the field on farmers' needs and on the acceptability of implements) (Wanders, 1994). In sub-Saharan Africa, centralised systems for the production and distribution of implements have been common, which has tended to inhibit village-level implement production and the development of close farmer-manufacturer relationships (Starkey et al., 1995).

The main implements used in Tanzania are locally manufactured mouldboard ploughs, harrows, planters and ridgers. Weeders are not common due to a lack of suitable designs. In Tanzania, there are both innovative artisan-produced carts and institution-produced inappropriate technology. The Ministry of Agriculture staff in Tanzania maintain that there is an urgent need to address the longstanding shortcomings of animal-drawn implement design, quality and supply in the country. Another implement factory started to manufacture large numbers of ploughs of a prototype design that had never been tested. Many implements that are used are very old (over 30 years) and based on old designs and it is difficult to find spare parts. (Starkey et al 1992)

2.2.5 Women and animal traction

Shifting cultivation based on hoe cultivation which is common in many sub-Saharan African countries has been named "Female farming system" by Boserup (Sylwander, 1994). Women are the main producers of food and men help the women with certain activities like clearing land, building and herding. The colonialists introduced cash crops and a monetary system and with these the colonialists tried to induce the underemployed male villagers to cultivate cash crops (Sylwander, 1994). Due to that, cash crops and mechanised agriculture were from an early stage in the hands of men. In general it seems that when agriculture becomes more mechanised, women continue to perform the simple, labour-demanding, manual tasks while men operate more efficient technology operated by animals or mechanical power. Farming systems using animal draught power for cash crop production have been named " the male farming system" (Sylwander, 1994). Women constitute the main agricultural labour force

(70%) in countries like Kenya, Lesotho and Malawi but men cultivate a larger area and may produce more. Starkey suggests that the improved technology increased production both by direct effects of tillage but also by the improved timeliness of field operations (Sylwander, 1994). Consequently, due to the lack of appropriate technology, women spend more time on agricultural production and produce less.

Women's work in eastern and southern Africa also includes fetching water, collecting firewood and different types of food processing and women have few advanced technical solutions at their disposal (Sylwander, 1994). With the help of animal power most of these tasks could reduce the drudgery for women. Animals are usually only used for purposes and tasks that are identified as male tasks and cattle are, by tradition owned by men, kept by men and handled by men. There has been a development of donkey power in dry areas of the sub-Saharan region (Gibbon, pers. comm., 1999), but there is still an absence of women users of traction in the region, which is a gender issue and has not necessarily to do with women's capacity or capability to handle draught animals as suggested by Sylwander (1994). Consequently, the new animal traction programmes in regions with similar cultures have to include the whole farming family.

In most of Tanzania, men dominate the ownership of cattle and the control of animal traction technology. In most areas, women seldom handle the plough but help to control the oxen. In some districts the situation is the reverse. One of the main benefits for women is using animals for transport of fuel wood, water, harvests and goods for markets, which are usually women tasks (Starkey et al., 1992).

2.2.6 Transfer of technology

Fischer states that transfer of animal traction technology has two main meanings (Fischer, 1994). First, it could refer to the transfer of ideas, techniques or implements from one area to another. For example, transfer from industrialised countries to developing countries, which is important in order to save unnecessary research and development work. Secondly, which is in a narrower sense, transferring or communicating ideas and techniques to the people, i.e. basic extension and training (Fischer, 1994).

Experience from three projects in Zimbabwe, Cameroon and Tanzania suggests the following approach for extension and training: farmers must be interested in what is taught; farmers must be able to use the new technology immediately after training, i.e., they must have their own animals and implements; and training is ideally done with the farmer's own animals and implements and on his own fields (Fischer, 1994).

In Tanzania, work animals have been used on the islands of Zanzibar and Pemba for generations and on the mainland the use of pack donkeys by pastoralists goes back many generations. The colonialists used animal power for transport and later for cultivation. Steel ox ploughs manufactured in Europe were introduced to local farmers in the 1920s and 1930s to encourage the production of cotton. Later, rice production was also encouraged. The 1950s large-scale colonial farmers bought tractors but small-scale farmers continued to use work animals and it spread throughout the country through farmer to farmer contact and private financing. But it has not spread throughout the whole country, therefore when planning for extension in the adoption and development of animal traction it is not appropriate to consider

it a uniform, country-wide extension policy. Areas should be classified and prioritised in terms of their present stage of animal traction use and their potential for change. (Mutagubya et al., 1992)

2.2.7 Conclusion

As mentioned earlier, the mechanisation and tractor hire schemes, subsidised imports and services that were promoted some 30 years ago in many areas in Africa failed to contribute towards the development of sustainable and economically viable farm systems. Many farmers now seem to fall back on more reliable and locally produced power sources like animal traction. It is clear that the use and adoption of animal traction is facing many constraints but the relative simplicity and regenerative character of animal traction technologies, where there is sometimes a strong indigenous character and simple support systems, have resulted in their integration into many African small farm systems (Gebresenbet et al., 1997). But it is also obvious in the literature that animal traction technology in many areas is under-utilised due to (in part) the perception by many decision-makers that the promotion of animal traction represents something that is regarded as backwards and not modern.

The adoption of animal traction could be improved through different kinds of actions to overcome some important constraints:

- access to credit
- general improvements in crop marketing systems, increased producer prices and the development of rural infrastructure
- animal traction should compete on a free-market basis with human power and tractor power
- increasing animal powered transports and interrow weeding may have particular benefits for women
- need for manufacturing of weeders and cultivators

  to overcome design problems, particularly of weeders, an intensive programme of collaborative on-farm testing should be performed, with farmer-oriented and gender-sensitive testing (also a networking methodology should be developed) This should involve the recognition of the role of rural and peri-urban artisans as designers and maintainers of equipment in rural areas.

It is also important to preserve and transmit traditional knowledge on animal traction through improving public awareness. To improve the awareness and change of attitude among young people is one way to ensure that draught animal technologies are covered within agricultural colleges and universities. Changing the attitude of officialdom to animal traction is also important when governments are deciding about subsidies for the agricultural sector. It is especially important that government subsidies are technology neutral in order to promote the most appropriate technology. Research on animal traction should be multidisciplinary, holistic and on-farm.

3 Cuban agriculture, an introduction

Havana Province is known for its poor red soils, although with appropriate agricultural practices, they can be very productive. The Province is therefore dominated by agriculture, especially the low-lying southern plains. The most western province, Pinar del Río, is traditionally the tobacco province. The light and sandy soils are known for being ideal for tobacco. Villa Clara province is located to the east of Matanzas, where in the eastern part of the uplands is dominated by tobacco. Villa Clara is second only to Pinar del Río as a centre of tobacco production. Sugar dominates the northern lowlands. The Sancti Spíritus, Ciego de Ávila, Camagüey, Las Tunas and Holguín Provinces are dominated by cattle production but also sugar cane. The Granma Province in the west is an agricultural province and its economy is almost entirely based on sugar and rice production. The small south-eastern province, Santiago de Cuba, is not widely known for agriculture since most of the province is mountainous with Sierra Maestra in the west and Cordillera de la Gran Piedra in the east.

The main products in Cuban agriculture are sugarcane (15 percent of the agricultural land), tobacco, citrus (5 percent), tubers and roots (5 percent), vegetables (4 percent), and rice (6 percent) while livestock are farmed on 55 percent of the agricultural land (Ríos, undated)

Sugar cane is a perennial grass that has dominated Cuban agriculture since the colonisation up to today. The sugar cane fields are harvested once a year and are ratooning every year. The cane is replanted every fifth to seventh year. The harvest of sugar cane starts in November and lasts until April; because the concentration of sugar in the sugar cane is highest during this dry period (Mojena, pers. comm., 1999).

Tobacco has long been a very important export crop. It is sown in October-November and is harvested after approximately 90 days, in January-February. Much of the tobacco in Cuba is cultivated in the province of Pinar del Río because of the climate and rich reddish-brown sandy loam soils in that region, which are preferable for the cultivation of tobacco. A common crop to follow tobacco in the crop rotation is corn (Mojena, pers. comm., 1999).

Tubers and roots, which always have been an important part of the Cuban diet, are potato, sweet potato, malanga and cassava which are sown in spring when the rains have started. Vegetables, like tomato, onion, garlic, lettuce, peppers etc. are mostly cultivated during the dry period, November to April, with irrigation systems, also in urban areas in so-called “organopónicos” which are intensive systems using irrigation, described later in this chapter. Also pumpkin is an important crop in the Cuban cuisine.

The cereals cultivated in Cuba are rice and corn. Corn is cultivated during the whole year and is often rotated with tobacco, beans, sweet potato, potato, etc. Other types of staple foods in the Cuban diet are rice and beans, especially black beans (Mojena, pers. comm., 1999). Rice is cultivated during the whole year with three harvests a year and beans are sown in late September.

Fruits cultivated are mainly citrus, mangoes, papaya, guyaba, avocado, bananas and plantains.

Coffee is mainly produced in the mountainous areas.

Urban agriculture is a phenomenon that is today important for the sufficient production of vegetables. People in urban areas are entitled to a small plot of land to use for vegetable and fruit production, for their own household or for selling in the market. The “organopónicos”, mentioned earlier are large intensive crop production areas where vegetables are grown in concrete containers and sold just outside in the street. It is a form of co-operative where the land is hired from the state.

A new tendency is to produce for the tourist sector. One of the UBPC that we visited had just started to produce for the tourist sector what they called “not traditionally”, different vegetables for the buffé table and this because it is very profitable.

Livestock- and milk production in Cuba has for several decades been separated from crop production. Pasture species are mainly different kinds of grasses like Guinea grass, and Star grass. Also King grass is used as fodder, it is a tall grass that have to be cut, it is not used as pasture. Research concerning improved fodder crops for animals exists but it still seems to exist mainly on research farms, for example rotating pasture systems with leguminous crops.

4 The Cuban agricultural organisation

4.1 Cuban agricultural systems before the revolution

Before the revolution the agricultural sector was strongly influenced by foreign capital. Foreigners owned about 25 percent of the land and foreign companies; mostly north-Americans. The land distribution was unequal since 8 percent of the landowners owned 70 percent of the agricultural land (Sims, 1993) and the poorest two-thirds possessed only 7 percent of the land. Agriculture was concentrated in sugar production, on around 25 percent of the agricultural land, and mainly for export. There was a low degree of mechanisation and this was overcome by the fact that over 40 percent of the Cuban work force worked in agriculture.

4.2 The land reforms and the development of state farms and co-operatives

Immediately after the revolution, a number of measures were introduced and the three most important for the people were: a land reform that restricted the maximum size of land holdings; rents were cut by 50 percent; the social system was improved.

4.2.1 The first agrarian land reform

The first national agrarian reform began in May 1959 not long after the revolution. The aims were to expropriate the largest farms by putting a 402 ha ceiling on private land ownership (Sims, 1993). Additionally, it gave free title to 100 000 small farm renters and sharecroppers. The result of the reform was that the state controlled approximately 41 percent of the land title and the private sector the rest (Norrlid et al., 1996). The large area expropriated by the state was mainly retained in large farming enterprises (mainly sugar and cattle).

4.2.2 The second agrarian land reform

In October 1963 the second land reform was passed which established a private ownership limit of 67 ha and all farms exceeding this were expropriated by the state. Most of the land expropriated was nationalised, state ownership was raised from 40 percent to 70 percent, although it also gave free title to poor peasant and rural workers to rent or share crop. The number of small property owners tripled to 154 000 in 1963 (Nova Gonzales, 1994). No further land reforms have been passed, but state farms have bought neighbouring private farms and state ownership in 1987 had risen to 81 percent or 8.35 million hectares (PPC, 1988).

4.2.3 Rapid development of mechanisation

The first intention by the government was to break the dominance of sugar production in agriculture, especially after the US embargo. But the fact that the Soviet Union offered to buy Cuban sugar at favourable prices, and since there was an existing infrastructure for sugar, it was decided that the state farms should take advantage of the situation and continue to produce sugar (Nova Gonzales, 1994). The terms of trade offered by the socialist countries opened the possibilities to achieve a more complete and rapid modernisation than most other developing countries. In the 1980s, Cuba ranked number one in the contribution of industry to its economy and it had a more mechanised agricultural sector than any other Latin American country (Rosset, 1997).

4.2.4 New co-operative forms

During the first years of the agrarian reform there were state farms and production co-operatives, with the state as the owner of all means of production, including land. These co-operatives did not perform well and were turned into state farms in 1962 (Norrlid et al., 1996). Individual private farmers were encouraged to organise. In 1962 the ANAP (National Association of Small Producers) was founded. Also simple forms of co-operative formation were encouraged such as Farmers Associations (CA) and Credit and Service Co-operatives (CCS). CAs were production co-operatives, but they did not work well and only a few were active in the end of the 70´s (Norrlid et al., 1996).

4.2.5 CCS, Credit and Service Co-operatives

The CCSs are credit-and service co-operatives, the farmers cultivate their land on an individual basis and the co-operative provides assistance to the farmers. In 1963 there were 587 CCSs and since they have been successful, the number had increased to 2 260 in 1992, organising 115 000 private farmers that owned 78 percent of the land individually farmed in Cuba that year (Nova Gonzáles, 1994). The first congress of the PPC in 1975 pointed out that the integration into state farms was not the only socialist route that small farmers had to follow, the collectivisation in production co-operatives should also be encouraged (Sims, 1993).

4.2.6 CPA, Agricultural Production Co-operatives

The CPAs (Agricultural Production Co-operatives) were introduced at the 5th congress of ANAP (National Association of Private Farmers) in 1977. The CPAs were production co-operatives which were to be formed on a voluntary basis, but the state provided a number of inducements such as improved infrastructure, social services such as schools, health care, housing and pensions, plus access to more land, equipment, technical support and cheaper credits. The co-operative movement grew rapidly and in 1977 there were 137 CPAs with 503 members and in 1986 there was a total of nearly 1 400 with an average size of 740 hectares and 49 members (Sims, 1993). Initially private farmers pooling their individual land formed

the CPAs. Land and means of production were carefully valued and the co-operatives set aside 25-30 percent of their annual net income to compensate members for their contributed assets (Norrlid et al. 1996). The structure of the agricultural sector was that the state farms and about 180 agro-industrial complexes cultivated 82 percent of Cuba's arable land. Co-operatives farmed an additional 10 percent, with the balance farmed by private farmers.

Norrlid et al. (1996) has presented the agricultural structure in Cuba before the special period and the transformation of land title introduced in 1993 (Table 1).

Table 1. Agricultural structure before the special period and the UBPC reform (Norrlid et al., 1996).

	Individual farmers		**Co-operatives**	**State farms**
	Unorganised	**CCS**	**CPA**	
No. of entities	319	2260	1353	385
Percent of agricultural land	3	11	11	74
Members, employees	14 986	114 592	63 838	690 000
Hectare/farm	15	6	569	13 070
Workers/farm	1	1	47	1792

Figure 1. CPA-sign, San Nicolás

4.3 The consequences of the special period

The drastic fall of the socialist countries had disastrous consequences for the Cuban agricultural production, which resulted in shortages of petroleum, animal feed, chemical fertilisers, pesticides and agricultural machinery. The Cubans call this period after 1989 “the special period in peace time”. Without the preferential treatment from USSR/Russia and with a continued American embargo, Cuba had to modify its agricultural policy so as to increase efficiency and decrease dependency on imported foodstuffs.

4.3.1 The formation of UBPC co-operatives

As a consequence, a new structure of the state farms was introduced in 1993. The new law, Resolution 357, authorised the establishment of autonomous co-operatives, UBPC (Basic Units of Co-operative Production), on land given out usufruct “for an indefinite period” by the state (Sims, 1993). These co-operatives own their products, administer their own resources, open their own bank accounts, elect their own managers, develop their own budgets, purchase their own equipment and pay their own taxes (Baker, 1997). They farm government land, but own the crop they harvest (by contrast, traditional co-operatives pool their plots for common land ownership) (Baker, 1997). However, they are still obliged to follow state directives concerning production plans and sell all their products to the state at fixed prices. In 1988 the former state service unit of the farms was available for all the different agricultural units, UBPC, CPA and CCS (Soca, pers. comm., 1999).

The law also authorised the transfer of idle land to private owners. In 1994, 12 000 hectares of tobacco land were turned over to 5 835 families. Families have been granted land in mountainous areas. Private farms currently utilise about 20 percent of Cuba’s cultivable land (they too, are obliged to sell a certain percentage of their produce to the state) (Baker, 1997).

The transformation of agricultural land during the special period has resulted in an increased share of land worked by co-operatives. Table 2 shows the situation in 1994 and since then the UBPCs share has increased. When completed, around 20 percent of agricultural land will remain in the hand of the state farm sector (Norrlid et al., 1996). The average area of a UBPC farm is much smaller than that of a state farm, 1 118 hectares compared with 13 070 hectares in 1989 (Norrlid et al., 1996).

Table 2. Transformation of the farm sector (Norrlid et al., 1996 after Granma, 1995-12-05).

	1992		1994	
	1000-hectares	**percent**	**1000-hectares**	**percent**
Total	6774,9	100,0	6685,8	100,0
State farm	5097,7	75,2	2186,1	32,7
UBPC	-	-	2825,6	42,3
CPA	690,3	10,2	669,0	10,0
CCS	752,7	11,1	772,8	11,6
Private	234,2	3,5	232,3	3,4

4.3.2 The status, labour force and demography in the agricultural sector

Approximately 22.2 percent of the Cuban population are working in the agricultural sector. Agriculture has low status in Cuba and today there is a lack of people working in this sector, in the big co-operatives and on state farms. On the contrary, it did seem like the small farmers were proud of their way of living and were content with their life. They also had the opportunity to gain extra money through selling in the agricultural free market and in the black market (author's observation). Private farmers are not allowed to hire people and to get around that, small farmers hired old people as day-workers and paid in foodstuffs (interviewee's comment).

The demography in the Cuban countryside is concentrated to villages and co-operative villages. The only single houses in the countryside are those of the private farmers and CCS farmers but most of them have moved into villages to have easier access to water and services.

4.3.3 The market system

The free agricultural markets have been open since 1993. They are found in every city and the farmers sell their products there as well as make their purchases. The free market is the way for a farmer to gain extra money, but there is also a black market that is well developed.

The UBPC co-operatives farm state owned lands, but own the harvest; they also own all means of production. The state decides what the UBPC should produce in the form of production plans and the UBPCs are required to sell their production to the state or as decided by the state. They produce their own food requirements and they have the right to sell the surplus in the free market.

Private farmers pooling their individual land formed the CPAs. They are required to sell a fixed percentage to the state. They produce their own food and they have the right to sell the surplus in the free market.

The small CCS farmers own their own land but are obliged to sell some of their production to the state as a tax system. They produce their own food and they have the right to sell the surplus in the free market.

5 Investigation, availability and recent development of animal traction in Cuba

5.1 The recent development of animal traction in Cuba

Agriculture was traditionally based on animal traction, mainly from oxen. Today horses are used for light carting and riding but are not used for tilling (Ríos, 1998). In mountainous areas donkeys are commonly used as pack animals to carry coffee and other farm products (Ríos, 1998).

The number of oxen decreased in the years following the revolution as draught animals were replaced by tractors. Over the three decades from 1960 to 1990 the number of tractors increased ten-fold from 7 000 to 70 000, while the number of oxen decreased from 500 000 to 163 000 in the same period (Ríos, 1998).

In recent years, the situation has changed drastically because of the fall of the socialist states in Europe which has produced a dramatic shortage of fuel, spare parts and hard currency in Cuba. This situation has made the high level of mechanisation in Cuba unsustainable. The new agricultural policies and strategies were developed in the special period and these included (Ríos, 1998):

- a drastic reduction in the number of tractors in operation
- rapid increase in the use of animal traction and its infrastructure
- transformation in the forms of land title from large state farms to smaller units of UBPC-co-operatives.

The animal traction programme included ox breeding, management and training of draught-oxen. Additionally new animal-drawn implements were developed, training of ox-handlers, blacksmiths and artisans, makers of yokes and harnesses. Today, Cuba has approximately 385 000 oxen which have substituted 40 000 tractors (Ríos, 1998)

Table 3. Number of tractors and work animals in Cuba (1960-1995), figures in thousands (from Ríos, 1997, an ATNESA resource book).

	1 960	**1 970**	**1 980**	**1 990**	**1 995**
Tractors	7	52	68	70	40
Oxen	500	490	338	163	376
Horses	800	741	811	235	300
Donkeys	5	4	4	4	4
Mules	30	29	25	30	30

Ríos states that animal traction is a technology suitable for Cuba, especially in the new conditions of an increasing number of small-scale co-operatives and as a means of saving

scarce fuel (1998), although he also mentions some obstacles with the animal traction programme which are of importance (Ríos, 1998):

- farmers, technicians and many officers saw the reintroduction of animal traction as a backward step
- in the beginning there was a shortage of oxen
- problems with training of oxen and ox-handlers
- feeding and healthcare.

The crisis also led to old knowledge becoming valuable, an example in the use of animal traction being that old ox-handlers had to be interviewed and asked for help about the handling and training of oxen. Animal traction was still in use in Cuba before the crisis but not to the current extent.

5.2 Education

The Cuban people are well educated and Cuba has one of Latin America's highest figures of university students and doctors. The Cuban agricultural education at university level is for agronomists, veterinarians and agricultural engineers which all cover five years and give a bachelor's degree. There is a non-university education called "polytechnics" where the students study part time and work in agriculture part time. The education at both university and at lower grades includes courses in animal traction (Pedro Sotto et al., 1997).

There is a change going on and more emphasis is being put on animal traction in study programmes, which includes practical classes in animal traction. Cuba universities also give what are called "diploma courses" where the graduated students go back to university for a limited time period to refresh and collect new knowledge. One Diploma course at the Havana Agricultural University is in animal traction, i.e. handling animals, health and nutrition. The course is for veterinarians, agronomists and agricultural engineers. (Ponce, pers. comm., 1999)

5.3 Availability of oxen and tractors

The state sells oxen, both trained and untrained calves (Zebu or F1[1]), as a consequence of the animal traction programme started in 1991. The price was around 1 500 Cuban pesos (75 $ US) for a pair of oxen. Small farmers also sell animals, often Creole[1,2] that are more expensive than the Zebu and F1 since they are considered to work better. Since 1991 the state has sold about 400 000 oxen although during the most difficult years of the special period many were stolen and consumed (Ponce, pers. comm., 1999). Tractors were also available but

[1] Types of bovines. For more facts see chapter 9.1.1
[2] Creole signifies in this context traditionally Cuban

the price was far too high for even the UBPCs. The tractors we saw were old Soviet and East European tractors where almost every part had been replaced.

5.4 Development of new implements

The most commonly used animal-drawn implements for crop production in Cuba is the mouldboard plough and wooden ards. Harrows, cultivators, wooden sledges and a few basic models of two-wheeled carts were the only others available (Ríos, 1998). There are no animal-drawn planters, fertilisers or wheeled tool-carriers. In 1992 a national programme was started for the development, selection and promotion of new, more suitable implements and the fabrication and supply of traditional and new models (Ríos, 1998). The selected implements were a mouldboard plough, a tine harrow, an ox cart, the multi-cultor and a new model of plough, the multi-plough, "el multiarado 6 en 1". The idea was also to encourage the adaptation of tractor-drawn implements such as sowing machines, fertilisers and sprayers to fit animals (Ríos, 1998).

Additionally, in each of the 15 provinces there is a workshop for the local manufacture of implements. With local manufacturing there is the possibility for the provinces to exploit unused reserves of steel and the ability to adapt the designs to local requirements and preferences (Ríos, 1998).

6 Research questions

How can animal draught technology (ADT) make a significant contribution to the viability of farming systems in Cuba?

Which are the most important factors for further development of animal traction in Cuba within small farm systems?

7 Methodology

The methods used were mainly drawn from “Rapid Rural Appraisal” approaches (RRA). Semi-structured interviews were performed with different stakeholders in the animal traction field. RRA involves methods which are interactive and information is extracted. The semi-structured interviews were performed with a checklist of keyfactors for making sure that nothing was forgotten during the interviews (see Appendix for the used checklist). The methodology also included a review of secondary sources and observations in the field.

7.1 The selection of interviewees

The aim of the interviews was to extract information from a wide range of "representative" farmers and stakeholders in order to get different aspects of animal traction in Cuban agriculture. In the workplan, the following stakeholders were selected:

- three different types of co-operatives and private farms to observe differences between the different forms of farms considering governmental backup and also differences concerning extension
- farming families and members of rural communities (women, men and children, animal power users and non-users)
- local training and research organisations (colleges, universities, research stations etc)
- local government village/co-operative level
- other individuals or organisations that are, or could be, influential concerning animal power.

The intention from the beginning was to try to get in contact with farmers; with minor involvement from the university in order to get a picture of the situation for each farmer. It was not easy to fulfil those intentions. As foreigners it would have been very costly to arrange all transport, and also the university staff would not have offered us any guidance at all if we did not pay for it. However the selection of interviewees turned out well, there is a reasonably wide spectrum of stakeholders and we have not only been taken to the most “prosperous” farms. The interviews were concentrated only in Havana Province and the following programme was followed from the 13th of September to the 30th of October 1999:

The investigation started at the Agricultural University of Havana (UNAH) in San José de las Lajas, Havana province, and the university investigation farm Guayabal.
The interviews performed there were with the following stakeholders:

- three agricultural workers
- two ox-handlers
- one person responsible for pesticide control

- the person responsible for the crop production on the farm
- a professor of mechanisation who is a specialist in animal traction
- a veterinary student

The university farm Guayabal is run by the university and the products, mainly meat and milk, but also vegetables and root crops, produced at the farm are used for supplying food for the university's personnel and students and are also sold to the Cuban state and to the tourist sector.

Three co-operative farms were visited in the same region:

- One farmer responsible for the production in the co-operative
- an ox-handler
- a wife
- a son

A few days were spent in the southern part of Havana county, Melena del Sur. Visits were made to five co-operatives and a factory of harness equipment. A visit was also made to a smaller state farm which produced vegetables for the "minsterio de interior" which is the Cuban police authority. A CPA in San Nicolás was studied and in the end of the period interviews were performed with co-operative farmers in San José de las Lajas.

8 Results

8.1 The current usage of animal power in the Cuban agricultural system

Animal traction was used in all the agricultural organisations that were visited except for one small-scale CCS-farmer. The animals used are mainly oxen but horses are also used, only for transport. The horses that were seen were small and not very well fitted for heavy farm work like ploughing and not as well adapted to the climate as Creole or Zebu oxen. Donkeys and mules are used in the highland for transport of products, but a university professor maintained that they were not common. A combination of tractor and animal traction is practised for soil preparation in all the Cuban agricultural organisations (CCS-, CPA and UBPC co-operatives, state-farms and the university farm). All interviewees preferred tractors when breaking the soil in the first preparation when the soil is compact and very stiff. In the other soil preparations, the choice of draught power (oxen or tractor) depends on many factors and is described in the following chapters. There has been a change in the usage during recent years, mostly because of the economic crisis that Cuba has faced since the fall of the socialist block and, added to that, the US trade embargo. The tractor was the main source of power before 1989 even in the small farms, whereas today the combination of tractor power and animal traction is much more equal in all the different agricultural organisations.

8.1.1 Recent changes

Before 1989, the tractor was used on almost all farms; even most of the smallest farms had a tractor. As one university professor said: “the state almost gave away East European or Soviet tractors before the special period”. The professor also said that before the special period, the farmer could also buy the service for soil preparation from a state farm or he worked at a state farm and could borrow the machines from the farm to work his own fields in his free time. Oxen could be found frequently before the special period in the state farms, the CPAs and the small CCSs farms. Some of the private farmers said that it had been a tradition for many farmers to keep a pair of oxen but also that many farmers only had a tractor. The main use of oxen in all of the agricultural organisations was for transport of products and harvests, furrowing and weeding the soil in the cultivation of tubers, roots and other similar cultivations. The ox-handlers in all the different organisations mentioned the advantage of an ox-team when furrowing and weeding since the width of the ox-team could be adjusted by using different sizes of yokes while the width of tractors implements is more or less set.

It was difficult to find out if the use of oxen in Cuban agriculture had increased since the start of the special period. The UBPC co-operatives had many more oxen than before (for example fourteen compared to four), and they were used mainly for soil preparation purposes and weeding because of the shortage of petroleum. There was no small-scale CCS-farmer that recently had invested in an ox. The soil preparation practises seemed to be a combination of tractor and animal traction and could be found in all the agricultural organisations. Two of the university professors said that the large sugarcane farms, which are highly mechanised, do not use animal traction to the same extent as the more diversified CPA-, UBPC-co-operatives and the private CCS-farms which cultivate vegetables, roots, tubers and fruits. A couple of the

interviewed CCS-farmers only had tractors and borrowed oxen for furrowing and weeding from other CCS-farmers. The reasons for small-scale CCS-farmers not having oxen were mainly the risk of robbery and lack of time. One CCS-farmer, who did not own oxen, said that petroleum for the tractors had been supplied by the state to the CCS-farmers before the special period and still the farmers are offered a small amount but not at all enough. The farmers had a tractor and a diesel-driven irrigation pump, which in dry periods, used up to 20 litres of diesel a day. He seemed to have no problem buying more petroleum in the black market. The state price of petroleum at the time of the fieldwork was one dollar for a litre of diesel.

8.1.2 Implements

The CCS-farmers, CPA- and UBPC co-operatives had two sets of implements, one set for the tractor and one for the oxen. The implements that the private CCS-farmers had were old and the farmers did not think they had a complete set of implements. One small-scale CCS-farmer said that until the 60's it was possible to buy new implements but after that the only option was to repair old ones. Another CCS-farmer said that traditional implements like the wooden ard were manufactured in his village and an ox-handler at a UBPC co-operative said that they repaired and made their own wooden ards. The implements for the oxen were old in the co-operatives also, although in one or two of the visited UBPC and CPA co-operatives new implements were seen but by far the majority of the implements were old.

The options when the implements break are the state repair shop, private repair shops or other farmers. The co-operatives had their own repair shop. One CCS-farmer said that he went to another private farmer or a private repair shop to repair his implements because then he could have it repaired the same day. If he went to the state repair shop with a broken implement it could take up to five days until it was repaired and they seldom had spare parts and he did not have that time although it was cheaper than another farmer or a private shop.

All CCS-farmers that were visited had mouldboard ploughs, a harrow and a cultivator for the oxen. All the ox-handlers thought that certain implements were missing. The private CCS-farmers borrowed or rented from another farmer. The ox-handlers at the state farm did not borrow from other farmers or co-operative because if the borrowed implement broke they had to pay the repair cost.

Implements for oxen observed during the study:

- wooden ard *(arado de palo or arado de madera = arado criollo)*. This implement is usually used to make furrows in cultivation mainly of beans, maize and sweet potatoes (figure 1)

- mouldboard plough *(sp.arado de vertedera)* is used when breaking the soil the first time if the tractor was not used or if a tractor with a disc-plough was used to break the soil, the mouldboard plough was used afterwards to turn the soil if there is a lot of weeds. It is also used for furrowing or earthing up in cultivations of beans, corn, sweet potatoes, etc *(figure 1)*

- cultivator *(sp. surcadora, for the tractor it had two or three units, or aporcadora)*

- "spine harrow" or tiller *(sp. grada de púas or rastrillo)*

- multi-cultivator *(sp. yunticultor)* which is a multipurpose toolcarrier, a metal bar which carries changeable tools like chisel plough, cultivator, harrow, seed drill for grains, fertiliser (Vento, 1999). This implement was only observed at the university farm Guayabal, San José de las Lajas.

- the multi-plough *(sp. multiarado)*, an implement newly developed in Cuba and is similar to the multi-cultivator but the multi-plough is like the name implies - more used as a plough. It was only observed in the state farm of the ministry of the interior and was only used as a mouldboard plough *(figure 2)*

Figure 2 From the left: two mouldboard ploughs and a wooden ard.

Figure 3 The multi-plough

8.1.3 Yokes and harnesses

In Cuba the farmers use mainly working oxen in pairs when preparing the soil. When using oxen as draught power for transport one ox draws the cart. The yokes used are wooden head/horn yokes fastened to the horns of the oxen with a rope (*figure 4 and 5*). There are a lot of different widths of the yokes that are used in different cultivation practises, i.e. weeding or harrowing between the plant rows, tilling etc. The width of the largest yoke was 2 meters between the two oxen and was used when weeding mainly between tomato rows. The one with about 1.3 meters was for harrowing or weeding between rows of sweet potato, maize etc. Each of the oxen was then walking in one path and the implement was in the centre path. The smallest yoke was used (width 30-40 cm between the animals) when using the mouldboard plough to prepare the soil before sowing. The same yoke was used for the wooden ard and when using carts for transport. It seemed that this was the most common yoke that every ox-handler owned. Not all the small CCS-farmers had the wider yokes and therefore they borrowed from other private CCS-farmers. The wood used for the yokes is mainly from the mango- or cedar trees. The private farmers interviewed said that they did not make their own yokes since it is prohibited to cut down trees. It was possible to buy from the state but borrowing from another farmer was more common. One of the UBPCs made their own yokes since they had a carpenter, another one bought them from a factory.

The "frontiles"[3] *(figure 5)*, were of different kinds. At the state farm they made the frontiles of a plastic sack folded together and around that a plastic fabric; more or less the material they had available. In Melena del Sur community there was a factory that made frontiles, very beautiful of cow leather, fabric made of fibres from a succulent plant which is called henequen (a fibre plant very much like sisal) and wood from the Royal palm. The UBPC- and CPA co-operatives and CCSs bought frontiles since they were reasonably cheap. The harnesses were made of ropes of fibres from Henequen.

Figure 4 Yokes with different lengths

Figure 5 The head-yoke and the “frontiles”

[3] Frontiles signify a soft pad placed on the forehead of the oxen and used to fasten the yoke and to protect the forehead

8.1.4 Soil preparation

Interviewees from all the different agricultural organisations (private CCS-farmers, co-operative ox-handlers, university professors etc) preferred the tractor when breaking the soil in the first preparation when the soil is heavy. In other types of soil preparation, the choice of draught power, oxen or tractor, depended on the preference of the user, availability of fuel and weather conditions. The university professors and small-scale farmers thought that if the soil is dry the tractor prepares the soil faster but in wet soils the tractor may not even be possible to use or the risk of compacting the soil is great. The ox was considered by many small-scale farmers, co-operative farmers and university professors to do a better job because it does not compact the soil and the implements do not work the soil as deep as with the tractor implements.

One of the professors at the university said that current soil preparation is much more restricted than earlier. He showed us the schoolbook example of soil preparation that was taught in the schools and universities in the early eighties which included seven to eight preparations with different implements to get an well-aerated soil and get rid of difficult weeds. The result he said was a very low content of organic matter and very sensitive soils for soil erosion, especially in the Havana province with its red, highly weathered and nutrient poor soils. The problems of the special period have also had effect on soil preparation practices both in the fact that there is a lack of fuel but also the realisation of the importance to build up the organic matter content in the soils.

The schoolbook example of soil preparation practice:

1. the mouldboard plough or the disc plough is used to break the soil surface and to aerate the soil. Both of the implements turn the soil surface although the impact from the disc plough is less intensive and therefore recommended. Turning the soil is not actually preferable in tropical conditions because the organic matter content decreases more rapidly.

2. the second operation has the object to segregate the soil and mixing of plant residues is performed with the disc harrow or tiller depending on the amount of weed in the field. The problem with disc implements is that it does not kill vegetatively propagating weeds because they are only cut in smaller parts and are allowed to replicate. To kill such weeds it is necessary with multiple operations or bury them deeply.

3. the last preparation is once again done with the mouldboard plough, discplough or the multiplough and this time the implement is run perpendicular to the first preparation.

4. sowing with either sowing machine or by hand.

8.1.5 Transport

Animal traction is also used as a medium of transport carrying a cart, for example. Oxen have always been used when transporting harvest products or to carry fodder or water. Additionally, a renewed phenomena in recent years is the use of animal traction to transport people, for example "horse-buses"[4] are widely used in smaller cities. The horse is today used more frequently than before also for other types of transports as, for example, goods both in rural and urban areas.

8.1.6. Opinions about animal traction

The majority of the ox-handlers (CCS-farmers, co-operative and state farm ox-handlers) preferred the oxen when having a choice between tractor and oxen because they liked to work with animals. They had in most cases spent their whole life with the animals, learned from their fathers and were now teaching their children. Ox-handlers from the different agricultural organisations and the university professors thought that tractors were more vulnerable since they need fuel, they break down regularly and need spare parts and tyres which are difficult to find today. The oxen work more reliably and the fuel for them is more easily available and much cheaper.

The ones that preferred the tractor (most of the small-scale CCS-farmers and co-operative workers) did so mainly for two reasons; first, it works much faster than oxen, which is an important reason for the small-scale farmer with only the family as work force. Additionally, in the larger UBPCs and state farms there is no time to prepare the soil with oxen although even there it seemed that the oxen played an important role. The second reason is that the work is physically easier with tractor, which an ox-handler at the university farm thought.

The majority of the interviewees (university professors, chiefs of UBPCs, ox-handlers and small-scale farmers) thought that both tractor and animal traction is a necessity in Cuban agriculture because of the different functions of the two energy sources. As mentioned earlier the oxen is considered to prepare the soil better since it does not compact it, which is often the case for heavier tractors and other machines. Additionally ox-handlers and university professors thought that the timing of the oxen is often better today since it is possible to use them in wet soil conditions and most of the time they are healthy while the tractor breaks down regularly and needs spare parts and fuel.

All of the interviewees mentioned the important advantages of the tractor, it does the work faster, and has more power, which they thought made the tractor necessary for Cuban agriculture, especially when preparing larger fields. The better economy of using oxen was also mentioned as an important advantage by many of the small-scale CCS-farmers.

Chiefs of co-operatives and small-scale farmers preferring tractors thought that when and if the situation becomes better the tractor would be used to the same extent as before the special period. A university professor thought that the situation would never become as it was before the fall of the socialist block, with cheap fuel and almost free tractors, and that oxen will play

[4] Horse-bus is a cart with seats drawn by a horse or two in peri-urban areas (not Havana).

an important role even in the future. Most of the small-scale CCS-farmers thought that oxen would always be used in Cuba since it is necessary and a tradition.

8.1.7 Conclusion

The implements for oxen that could be found on all farms were old. The implements for the tractor were newer and that might be because the tractor is a newer power source and the governmental strategy towards a concentrated and highly mechanised agriculture resulted in that the economic resources were spent on tractor power and relevant implements. It seemed to be common to borrow or rent implements among the private CCS-farmers. In the co-operatives they had most of the implements that they needed and it was not common to borrow from other co-operatives or CCS-farmers. That might be because the cost would be very high if the borrowed implement breaks and also almost everything was available but at high prices in the well-developed black market.

There were no new implements available to buy for the CCS-farmers except for the wooden ard. For the co-operatives, new implements for oxen were not bought probably because of the high cost. These factors might indicate a disadvantage for developing animal traction among the small-scale farmers. Here it seems like the policy-makers could do a lot more to facilitate the use of draught animals for all types of farmers, private and co-operatives, together with innovative farmers and artisans, like they have done in the breeding of work oxen.

The black market is important in Cuba today for the farmers to sell their products, to find fuel and other necessary items for the agriculture like fertiliser and spare-parts.

The advantages mentioned of oxen were mainly; the adjustable width of the ox-team that is valuable in different cultivation, the possibility to use the oxen even in wet soil conditions and the more favourable economy of animal traction. The adjustable width of the ox-team gives an important flexibility when the cultivation is diversified and the farmer has to weed in, for example, a banana field one day and in sweet potato the next. The more rapid work of a tractor means better timing when preparing the soil for sowing. On the other hand the timing of the oxen isbetter in wet conditions. Additionally, an important drawback for the tractor is it dependency on fuel and spare parts.

Something that almost all of the interviewees mentioned was the great ecological advantages of the oxen; that the soil does not become compacted as is often the case with the tractor, and the implements do not go as deep as with the tractor because of the lower speed of the oxen. Both these are important ecological and soil conservation factors. The negative effects of compaction most often mentioned are reduced root growth and soil workability. These problems are due to the reduction in pore size and increased mechanical strength of the soil, reduced oxygen transport and the change in hydraulic conductivity due to compaction (Arvidsson, 1997). This knowledge about environmental factors that affect the cultivation is important if animal traction is going to keep its current role in the future and also if the economic situation becomes better in Cuba. The complementarity of tractors and oxen in the future in Cuba depends a great deal on whether the advantages that the oxen have are greater than the efficiency and speed of the tractor.

8.2 Breeds, health and fodder

8.2.1 Breeds

The bovine breeds that were seen in Havana province were the following:

- Zebu *(see front page)*, a breed known for its good resistance to heat, origin from India or Africa, the Cuban state farms imported the breed for meat production
- F1, a mix of Holstein and Zebu that the Cuban state has bred for production of both milk and meat and which has the good milk genes from Holstein and the heat resistance from Zebu
- Creole *(sp. Criollo) (figure 5)*, the traditional breed in Cuba which dates back a long time
- Puerto Rico, it was briefly mentioned by one of the interviewees. It has the same kind of abilities as the Creole, but there are not many left today.

The opinions about which breed are the most effective work animals differed between the farmers. The Creole is preferred by most of the interviewees because it is the easiest to work with, most resistant to heat and sicknesses, although at one of the UBPCs the Zebu was preferred because it is considered to work faster. One CCS farmer thought the Zebu worked well but is more difficult to train and did not like to be handled by different ox-handlers. A university professor said that today most of the Creoles are owned by the CCS farmers since they have kept them by tradition, while state farms and co-operatives have had the opportunity to import Zebu and Holstein. The professor also said that Zebu now could be found in all the agricultural organisations because of the animal traction programme during the special period which resulted in the Cuban state "buying up" approximately 400 000 work oxen.

8.2.2 Animal health

All interviewees (CCS-farmers, co-operative ox-handlers, veterinarians) maintained that the health of the oxen has never been a problem and some of the interviewees compared the health of an ox with cows, which he said had much more problems. The problems that could occur with the oxen were that a horn could break or the oxen become limp. There are veterinary clinics in every village just like there are medical clinics. For farm animals veterinary treatment is very cheap.

8.2.3 Animal feed

The ox-handlers, private CCS-farmers said that pasture was available the whole year, the pasture species were mainly different kinds of grasses like Guinea grass and Star grass. Also King grass was used as fodder, it is a tall grass that has to be cut, and it is not used as pasture. Some farmers also use cassava and sugarcane as feed for the animals. The leaves and pods of Leucaena , a leguminous shrub, are also used as protein-rich fodder. Concentrates for the supply of vitamins, minerals and fat are not given to oxen but to cows, said the university professors. The professors also said that there has been a big scarcity of concentrate fodder during the special period since it was one of the items that Cuba traded with the socialist block before the special period. Two of the university people (a student and a professor) said that they thought that the farmers or ox-handlers did not know the food requirements of hard-working oxen, meaning that they gave the oxen too little calories or too much bulk fodder.

8.2.4 Conclusion

The fodder given to the animals depends on the ox-handler and the possibility at each farm or co-operative. If the oxen only are grazing it is possible that the diet not will be complete in all the minerals. Salt is especially important to provide for livestock (CTA, 1992).

There are no problems of tsetse infestation or other limiting sicknesses, which is a problem in sub-Saharan Africa (Connor, 1994). Currently there is good availability of veterinarians in Cuba and the cost is not a problem for farmers. This is an important factor in animal management and must also be guaranteed in the future in order to sustain the use of oxen for draught power in the agriculture.

The breeds seem to be appropriate, having developed through many years. The breed Creole is the most popular among most of the farmers interviewed because of its favourable characteristics, like heat resistance and good health, although some of the interviewees mentioned that Zebu have some better characteristics. The 400 000 oxen that the Cuban state have raised and sold to co-operatives and private farmers have mostly been Zebu. It is important to guarantee that all the varieties of cattle that are appropriate for the Cuban conditions are kept for the future and not only to concentrate on one or two breeds.

8.3 Social issues

8.3.1 Experience of handling oxen

By far the majority of the ox-handlers that were interviewed had learned to handle oxen when they were young from their fathers or other relatives. One of the ox-handlers we met had learned from the beginning just a few years ago after being a taxi driver for fifteen years. The relation between the ox-handlers and their oxen seemed in most cases very strong and affectionate (author's note).

3.2 Gender issues

In the small farms, gender differences were strict according to the interviewed small-scale farmers and their wives. Men work in the agriculture and the women take care of the household. Women feed the animals but it is not common that they work in the fields, maybe during the busy periods of weeding or harvesting. In the UBPCs there was a male dominance but there were women working in the fields too, although they did not handle the oxen since it was the opinion among men that it was too heavy work for a woman. We spoke to women living in small farms and women working in UBPCs and both thought that it was too heavy work for a woman to handle oxen, although they did not think it was difficult. One woman had a daughter who handled oxen because her husband was sick. People at co-operatives and small-scale farmers confirmed that women handle oxen when transporting goods, for example, during harvest.

8.3.3 Theft

There is a big problem with theft of food products and animals in all the agricultural organisations. From the fields the harvest is stolen and at night animals are stolen from the farmyard. One farmer had lost four horses, others an ox or a cow. A few of the CCS-farmers mentioned this as a reason for not having draught animals. This problem seems more serious now than during the special period, the worst time being the first years of the special period in the beginning of the 90s. Many farms have the animals often locked in with fences close to the house during the night, and some even kept weapons to protect their animals if necessary. The reason to steal is to sell the meat on the black market. The punishment for stealing and killing an ox, cow or horse had been increased recently and, was at the time of the study, was 30 years in jail and the punishment for buying stolen meat was also very strict.

8.3.4 Conclusion

In the tradition of using animal traction the retained knowledge has had an important role in the success of the animal traction programme introduced in 1991. The animal traction programme funded by the Cuban state has been one of the most important factors for the greater use of animal traction in both large- and small-scale agriculture in Cuba.

By tradition the macho culture is strong in Cuba and it has the consequences, among many others, that agricultural work in Cuba is dominated by men and therefore also the use of animal traction. Women take care of the household and help the men in busy periods. The problem in many African countries that women do not use animal traction because of strict gender roles is treated in many papers concerning animal traction (Sylwander, 1994; Marshall & Sizya, 1994). It is difficult to compare the African situation to the Cuban since the circumstances are different. For example, in Cuba the female duties are not limited by time and drudgery as is the case in some countries in eastern and southern Africa (Sylwander, 1994. Lombe et al., 1994). Additionally, in Cuba the cultivation of food for household consumption and cash crop production is not normally separated, which is the situation in

many African countries where the women take care of the household production and the men take care of the cash crop production (Sylwander, 1994). Animal traction in Cuba is a complement to the tractor and not a complement to handcraft like in many farming systems in Africa for small-scale farmers (Lombe et al., 1994).

The problem of theft of animals in Cuba is a major problem and it also influences the use of animal traction. Starkey et al.(1995) report the same problem from South Africa. The Cuban government has responded to the problem by raising the punishment for stealing an animal. Reasons in Cuba for the problem was the high price for meat on the black market. If the availability of food for the people was adequate the problem would probably not exist to such an extent as today.

9 Discussion

One of the research questions stated for this study is "how can animal draught technology make a significant contribution to the viability of farming systems in Cuba?". Animal traction and tractor power are both important in all Cuban agricultural organisations (UBPC- and CPA co-operatives, CCS-farms, and state farms) and agricultural systems. Today, clearly a mixture of tractor and animal power is used in all the agricultural organisations in Cuba and it is not possible to note a difference in use, attitudes or knowledge depending on farm size or type of ownership. Before the "special period" tractors were the main power sources in soil preparation in all the interviewed agricultural organisations and they still are, but animal traction has increasingly become an important complement to the tractor. Animal traction has many advantages that cannot be replaced by tractors. The tradition of using animal traction, the retained knowledge and the animal traction programme introduced in 1991 have been the most important factors for the greater use of animal traction in both large- and small-scale agriculture in Cuba.

Tractors in Cuba are old, most of them more than 20 years, which results in frequent breakdowns and therefore they are a non-reliable power source because of the lack of fuel and spare parts. For draught animals and the corresponding implements there is also a lack of spare parts and new implements, but they are both cheaper and more available than for tractors, food for the animals are more available and more reliable than fuel for machinery. Consequently animal traction has better timeliness in those situations. Additionally, the timeliness for soil preparations is better in wet weather since it leaves the soil in a better condition than does a tractor, and it might not even be possible to use the tractor in a wet field. The timeliness for tractor is better when discussing speed and as long as the tractor works and there are spare parts to buy it will always have the advantage of doing the work faster than oxen because it has more power and it does not need to rest like oxen. The complementarity of tractors and oxen in the future in Cuba depends on whether the advantages that the oxen have are greater than the efficiency and speed of the tractor.

There are farmers who use only oxen on the farm but that is often a matter of farm size, and the number of workers that can be afforded. The use of animal traction, as mentioned earlier, demands more time and labour than use of tractor, and it also depends on the individual opinion of the farmer. Some of the farmers mentioned the better economy in using animals instead of tractors. The findings of the field study indicate that animal traction make a significant contribution to the viability of farming systems in Cuba. When fuel is too expensive on the black market there is nothing that can be done, either you must have draught animals to complement the tractor or it is not possible at all to be a farmer today in Cuba. This is something that differs between farmers that have always used oxen and those who have relied only on tractor power during the last 30 years.

The second research question was "which are the most important factors for further development of animal traction in Cuba within small farm systems". The main problems identified with animal traction today are theft of animals and the non availability of new implements. We heard about newly invented implements like the multi-plough and multi-cultivator but we only found them on a few farms. Additionally, most of the implements seen during the field study were very old and in need of replacement. The theft problem of animals has been a drawback for the animal traction programme and still is a problem, with the result

that farmers does not want to keep animals. This problem is difficult to solve since the reason reflects the economic situation today and the function of the black market in the country. Other important factors for the development of animal traction in the future are governmental strategies, since some people think that the current wide use of draught animals is only temporary during the “special period”.

10 Sources

Literature

Arvidsson, Johan. 1997. *Soil Compaction in Agriculture - from Soil Stress to Plant Stress*. Acta Univesitatis Agriculturae Sueciae. Agraria 41. Swedish University of Agricultural Sciences. Uppsala.

Baker, C.P., 1997. *Cuba Handbook*. Moon Travel Handbooks. First edition. Moon Publications. USA.

Benge-Abbott, Frankie. 1999. *The role of horses in the forests and woodlands of the United Kingdom.* B.Sc. Examination, Wye College, University of London.

Bunyavejchewin, Pakapun, Chantalakhana, Charan. Undated. *Overview of research on draught animals in Southeast Asia*. Research and development centre, Department of Animal Science, Kasetsart University, Bangkhen, Bangkok.

Connor, R J. 1994. *Improving draft animal management with strategic chemoprophylactic control of trypanosomasis.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

CTA. 1992. *Tools for agriculture. A guide to appropriate equipment for smallholder farmers.* Fourth edition. Russell press. Nottingham. UK.

Fischer, René. 1994. *Transfer of animal traction technology: lessons from project experiences in Zimbabwe, Cameroon and Tanzania.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Gebresenbet, Girma, Gibbon, David and Astatke, Abiye. 1997. *DAP - lessons from past research and development activities in Ethiopia and indicators for future needs*. IRDC Currents No 13/14, SLU.

Jolly, Curtis M. and Gadbois, Millie. 1996. *The effect of animal traction on labour productivity and food self sufficiency: The case of Mali.* Agricultural systems. Vol. 51. No. 4.

Lombe, Margaret, Sikanyika, Christine and Tembo, Annie N. 1994. *The importance of women's participation in animal traction in Zambia*. Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Marshall, K & Sizya, M. 1994. *Women and animal traction in Mbeya region of Tanzania: a gender and development approach.* Improving Animal Traction Technology. Proceedings of

the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Norrlid, Anders and Persson, Svante. 1996. *Cuba´s step forward? Cuban Economic Reforms in the Nineties.* Minor Field Study Series. No. 70. Department of Economics at the University of Lund, Sweden.

Nova Gonzáles, Armando. 1994. *Modificación o Transformación Agricola*. (No further information about the source available.) Cuba.

Panin, A and Ellis-Jones, J. 1994. *Increasing the profitability of draft animal power.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Partido Comunista de Cuba (PCC). 1988. *Programa del Partido Comunista de Cuba*. Editora Política. Havana, Cuba.

Pearson, Anne R & Smith, AJ. 1994. *Improving draft animal management.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Ríos, Arcadio. 1998. *Improving animal traction technology in Cuba.* Instituto de Investigación Agropecuaria (IIMA). Havana. Cuba.

Rosset, M Peter. 1997. Cuba: *Ethics, biological control, and crisis*. Agriculture and Human Values 14:291-302.

Sims, G. Brian. *Co-operatives as a Solution to Small Farm Mechanization Problems in Cuba*. Agricultural Mechanization in Asia, Africa, and Lation America. Vol.24 No.4. 1993.

Starkey, Paul. 1990. *Animal tractoin for agricultural development in West Africa: production, impact, profitability and constraints.* Keynote paper for Animal Traction for Agricultural Development, ICTA.

Starkey, Paul and Mutagubya, Wilson. 1992. *Animal traction in Tanzania.* Natural Resource Institute, UK.

Starkey, Paul. 1994. *A world wide review of animal traction highlighting some key issues in eastern and southern Africa.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Starkey, Paul, Jaiyesimi-Njobe, Funiwe and Hanekom, Dick. 1995. *Animal traction in South Africa overview of key issues.* Animal Traction in South Africa: empowering Rural Communities. Ed. Starkey, Paul. South African Network of Animal Traction (SANAT).

Stevens, Piet A. 1994. *Improving animal-powered tillage systems and weeding technology.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Sylwander, Lotta. 1994. *Women and animal traction technology*. Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Vento, Tielves, Raymundo. 1999. *Estudio de los implementos de tracción animal de uso multiple para la preparación de suelos y atenciones culturales al cultivo del tabaco. Resumen.* Tesis para la opción al Grado Científico de doctor en Ciencias Agrícolas. Universidad de Pinar del Río.

Wanders, Aalbert A. 1994. *Supply and distribution of implements for animal traction: an overview with region-specific scenarios.* Improving Animal Traction Technology. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Ed. Starkey, Paul, Mwenya, Emmanuel and Stares, John.

Personal communications:

Gibbon, David. 1999. Professor at the Swedish University of Agricultural Sciences. Uppsala. Sweden.

Ramón Soca, José. 1999. Professor at the Agricultural University of Havana, UNAH. Havana. Cuba.

Mojena Graverán, Modesto. 1999. Doctor in crop production and subdirector of the university farm Guayabal. Agricultural University of Havana, UNAH. Havana. Cuba.

Ponce Ceballos, Felix. 1999. Doctor in agricultural mechanisation and expert in animal traction. The Agricultural University of Havana, UNAH. Havana. Cuba.

11 APPENDIX

The main factors outlined at the start of the study:

The current usage of animal traction in the area?
The change of the use of animal traction over the years?

How the trends will be in the coming years?
Attitudes among different stakeholders - young and old people, social stages, users and non-users.
Curricula of schools

The following themes were discussed in semi structured interviews:

Technology and operational issues
- implements
- yokes and harnesses
- design
- technology availability
- cost
- access
- spare parts
- maintenance and artisan services

Agro-climatic environment
- climate
- crops and cropping system
- animals
- diseases

Socio-economic conditions
- knowledge
- education
- training
- culture
- status
- changes
- gender
- land tenure
- access
- costs
- social/political stability
- security and theft
- services (veterinary, artisans, motors)

Animals
-nutrition (pasture, fodder and water availability)
-health and management
-availability
-species, breeds and sex