La recherche sur les vaches de trait en Afrique: quelques enseignements à tirer

La recherche et la vulgarisation sur la traction animale semble susciter un regain d'intérêt en Afrique après l'échec de nombreux projets de traction mécanique. Dans les pays où la traction animale est déjà bien développée, on a entrepris des recherches sur l'utilisation de vaches afin de pallier la pénurie d'animaux de trait. Le présent article examine de manière critique ces recherches sur les vaches de trait, à la lumière des expériences qui ont été menées dans ce domaine en Asie du Sud-Est. En conclusion, l'auteur déclare que dans les pays où les aliments pour animaux sont rares, il n'est ni possible ni souhaitable de promouvoir l'utilisation de vaches de trait, du fait des conséquences négatives à long terme sur leur fertilité et la production laitière.

Investigación sobre el uso de vacas para la tracción en Africa

Tras el fracaso de numerosos proyectos de mecanización empleando tractores, se ha renovado el interés por la investigación y extensión del uso de la tracción animal en Africa. En las zonas donde ya está bastante adelantada la tracción animal, se han iniciado algunas investigaciones sobre el uso de vacas, a fin de solucionar el problema de la escasez de animales de tiro. En el presente artículo se examinan las investigaciones sobre el uso de vacas para la tracción a la luz de la experiencia adquirida en dicha tecnología en Asia sudoriental. Se llega a la conclusión de que, cuando la alimentación es escasa, no es aconsejable fomentar el uso de vacas para tracción, debido a sus efectos negativos a largo plazo sobre la fecundidad y la producción de leche.

Research on cow traction in Africa: some lessons to be learned

In sub-Saharan Africa, animal traction is well developed in the Ethiopian highlands and common in the highlands of Kenya and Madagascar, but it is absent in other highland areas. The technique is also well developed in areas of the semi-arid tropics and is emerging in some parts of the subhumid zone of West Africa.

It is hoped that with increased population pressure and intensification of farming, particularly in West Africa, the use of traction will also intensify. Indeed, there has been renewed interest in research and in the extension of animal traction after the failure of many tractor mechanization projects on the continent during the 1960s and 1970s. Efforts are now under way to introduce animal traction in new areas and innovations to improve traction use in areas where it is already well developed. Two such innovations are cow traction and the single-ox plough.

Cow traction is commonly used in Southeast Asia but not in Africa, with the exception of Egypt and to some extent the Sudan, where barren cows are used. The International Livestock Centre for Africa (ILCA), Addis Ababa, Nigeria, has started research on cow traction in Ethiopia with the objective of introducing it in areas where animal traction is already well developed. Similar research may be initiated in other areas such as the subhumid zone of West Africa, where animal traction is currently being promoted. The aim of this paper is to review ILCA's research objective and strategy in the light of the experiences of cow traction technology development in Southeast Asia.

ILCA'S RESEARCH EXPERIENCE

In the Ethiopian highlands, ILCA has tried to introduce two innovations: the single-ox plough and cow traction. It has been reported that oxen used singly are able to cultivate approximately 70 percent of the land that paired oxen can normally prepare. The use of single oxen, therefore, may allow poor farmers to improve their crop yield by planting earlier and to economize by keeping or renting fewer oxen (ILCA, 1986). It is further argued that widespread use of the single-ox plough would reduce the number of oxen needed to support food crop production,

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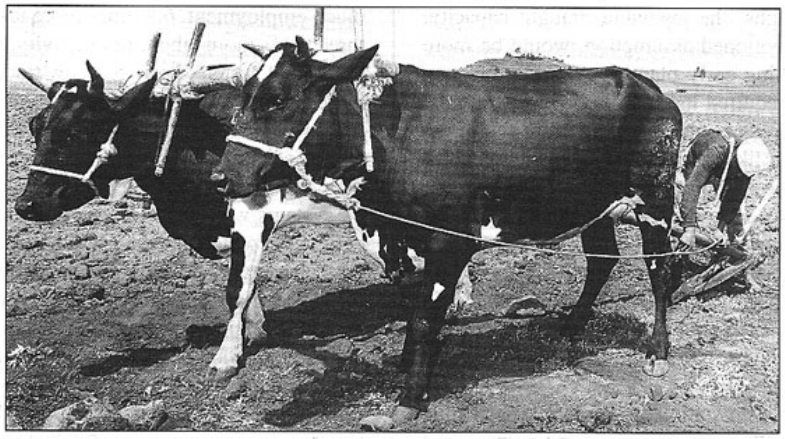
Ploughing with a single animal
Labour avec un seul animal
Arando con un solo animal



A span of Friesian cross-bred cows used for ploughing
Labour avec un couple de vaches croisées Frisonnes
Arando con vacas producto de mestizaje Frisón

Animal traction rental services are available for small farmers
Les petits exploitants peuvent louer des animaux de trait
Servicios de tracción animal arrendados por pequeños campesinos

thereby increasing the feed resources available for each working animal (Gryseels *et al.*, 1984).

Two questions emerge from these assertions. First, although the plough and the harness used for a single ox are lighter than the ones used for a pair, it is difficult to understand how a single ox can achieve 70 percent of the work done by a pair of oxen of the same capacity. Such an improvement in technical efficiency would be considered revolutionary by any standard. Second, an earlier study reported that crop yields were not affected by the level of draught power owned or by the type of plough (single-ox versus paired-ox) used (Gryseels *et al.*, 1984). It is therefore not clear how the use of the single-ox plough may lead to higher yields by planting early. For example, if a farmer who owns a paired-ox plough and has used it to its full capacity chooses instead to use a single-ox plough, the available draught capacity would be 30 percent less than required, so early planting of all of the land would be out of the question. If the paired-ox plough is replaced with two single-ox ploughs, the available draught capacity, under the above-mentioned assumption, would be more than adequate, making early planting possible, but two workers would be required instead of one to operate the ploughs. Unless excess power can be sold in the rental market, this system is likely to be highly uneconomical for this farmer. Thus, the suitability and profitability of using a single-ox plough versus a paired-ox plough depends primarily on the amount of land owned or cultivated. If the land cultivated is less than adequate to use a paired-ox plough to its full capacity, then a single-ox plough would be more profitable; if the land cultivated requires the use of 1.5 paired-ox ploughs, two single-ox ploughs may be more profitable, etc.

In 1983, a 23-week on-station experiment to determine the effect of diet restriction on the work performance and body weight loss of cross-bred and local Zebu oxen used as singles showed that feed restriction resulted in the local oxen losing more weight, but that there was no measurable effect on work performance (Astatke, Reed and Butterworth, 1986). However, farmers who tested single-ox ploughs in 1983 and 1985 reported that the use of oxen as singles was constrained by the shortage of high-quality feed during the dry season, especially for the first cultivation of the season, when the power required to draw the plough was at the maximum limit of the capacity of a single-ox (Gryseels *et al.*, 1984; ILCA, 1986). Feed is likely to be more scarce on smaller farms and so they are unlikely to benefit greatly from using a single-ox plough.

In 1982 and 1983 it was shown that cross-bred dairy cows used for draught could meet the draught requirements of a typical highland farm when adequately fed. It is therefore argued that cows can substitute oxen and, in principle, reduce the aggregate feed demand of livestock enterprises. In 1985, 30 farmers in the Debre Zeit area tested cow traction and concluded that a reliable home-grown source of high-quality feed would be required for the innovation to be effective (ILCA, 1986).

In order to make both single-ox ploughs and cow traction feasible, therefore, feed constraints would have to be overcome. ILCA has already responded in this direction by launching on-station research into forage legumes and legumes sown as relay crops in the regular crop cycle to provide additional feed, but large-scale adoption of such feed production technology is considered unlikely in the next few years (ILCA, 1986).

In the meantime, assessments of the relative economics of different traction systems have continued. Based on a survey carried out in 1985/86 in the Debre Zeit area, the relative economics of teff and wheat production using traditional paired oxen, single oxen and cow traction were compared. It was found that cow traction gave the highest labour productivity for both teff and wheat and the highest land productivity for wheat, but the lowest land productivity for teff.

Using coefficients from the same set of data, a linear programming (LP) exercise also showed that, compared with single-ox ploughing, cow traction gave twice as much employment, 6.8 times more land productivity and three times more labour productivity. Compared with the traditional system, however, cow traction gave 1.7 times more employment, three times more land productivity and twice as much labour productivity.

The conclusion derived from this exercise was that the main constraints on the use of the traditional and single-ox systems were the shortage of animal time during the cultivation period and the amount of arable land available. As the shortage of animal time was most acute in the case of the single-ox technology, this constraint could be avoided by using cows as draught animals. The amount of arable land available set the limit on farm income when using cow traction. These results indicate that, of all the technologies tested, cow traction was the most efficient in terms of resource use and productivity and that further research on cow traction was warranted (ILCA, 1989).

There are a number of pitfalls to avoid in the budgeting and LP exercises, however. An examination of the background data shows that the reported productivity differences had very little, if anything, to do with the traction technology *per se*, because in teff production, for example, twice as much was spent on fertilizing under the traditional and cow traction systems than was spent under the single-ox system. In wheat production no fertilizers were applied under the single-ox system, but 3.4 times more was applied under the cow traction system than under the traditional system (ILCA, 1988). If cows and oxen are considered to be substitutes for one another and are assumed to have similar draught capacities, why should the cow traction option give a different, albeit superior, optimum solution in the LP exercise? Such a solution would be feasible if cows were significantly more powerful than oxen, but in reality the opposite is expected.

The other possibility is to include the value of milk in the cow traction option, but nothing has been said about the methodology for its inclusion within the framework of the crop enterprise budgets. If a single ox is not capable of cultivating a given amount of land (possibly because its

capacity is only 70 percent of that of a pair of oxen), how can cow traction solve the problem, as has been concluded? Perhaps by pairing the ox with a cow (assuming the farmer has one), thereby abandoning the single-ox plough as a solution to the poor man's draught power problem. If this is so, however, what is the price of such a solution in the short and long terms?

Agyemang *et al.* (undated) conducted a study from 1981 to 1983 on the effect of work on the productive and reproductive performance of cross-bred cows over two lactation periods and found no significant differences between draught and non-draught cows. In fact, the draught cows did not carry out enough work to allow any significant effect to occur. This led the authors to conclude that cows could be used for draught for short periods without any adverse effect; however, a period of only two lactations was not sufficient to draw any other conclusions. It may not be easy to determine the minimum amount of work required and to synchronize it with the condition of the animal. For example, the need for draught power may arise at either the early or late stages of pregnancy and even minimum use at these times may lead to abortion or stillbirth.

ILCA's highland programme is currently investigating the effect of draught, including nutritional and environmental stresses, on the physiology of draught oxen and cows. The primary objective of this research is to ensure that feed energy is transformed into work energy as efficiently as possible and to help engineers develop appropriate implement prototypes (ILCA, 1988). A study on the effects of work and husbandry on the fertility and productivity of cross-bred dairy cows was begun in 1991.

The long-term cost benefit of using a cow for draught power will depend more on what happens to the fertility and productivity of the cow and its effective working life than on the efficiency of converting feed energy into work energy. Since cow traction is not common in Ethiopia, it will take many years of on-station observation before the effect of draught on the lifetime performance of a cow can be measured. Evidence available from Asia, however, shows that draught use may seriously affect the fertility and productivity of cows, particularly when food is limited, as is the case in the Ethiopian highlands.

EFFECT OF DRAUGHT ON COWS IN ASIA

In Thailand, De Boer (1972) found that herd productivity was significantly lower in villages where females were used for draught power than in those where draught use did not exist or was less common. Mettrick (1981) found that calving percentages were significantly lower in villages in Bangladesh where cows were used for draught purposes compared with those where they were not. This evidence was used to explain low national herd productivity.

Jabbar and Green (1983) and Jabbar and Ali (1988) have shown, on the basis of detailed farm surveys conducted in Bangladesh, that using heifers for draught power adversely affected their fertility and milk production: draught heifers were older at first calving than non-draught heifers; their calving rate was significantly lower at any age; they produced fewer calves when used for draught before their first pregnancy; they required more services per conception, which increased with older animals and with cows used more intensively for draught; the duration of their lactation period was significantly reduced; and their peak daily milk yield at any given lactation, an indicator of milk yielding potential, was considerably lower than that of non-draught cows.

Jabbar (1989) has shown that the change in the composition of the national herd over a period of time could be the result of more cows being used for draught power, which caused a decrease in fertility.

In Germany during the 1930s and 1940s, cows were used extensively for draught power; however, fertility and milk production were not significantly affected as the cows were given an extra feed ration (K.J. Lampe, personal communication, 1982). J. De Boer (personal communication, 1983) suggested that in Asia feed budget estimates should allow for draught and long-distance walking (if applicable) and that the allowance should be higher for draught cows.

In Bangladesh and other Asian countries the use of cows for draught power has adversely affected their fertility and milk production, primarily because of the poor quality and insufficient amounts of feed, consisting principally of crop residues. Selective feeding is not very common, and milk cows are favoured when it is used. Draught cows are used mostly by poor farmers who face acute feed shortages, so the chances of these cows receiving supplements are remote.

REASONS FOR COW TRACTION DEVELOPMENT

In a recent study of crop-livestock interaction in sub-Saharan Africa, McIntyre, Bourzat and Pingali (1989) concluded that in the densely populated highland zones, where animal traction is well developed, feed competition between dairy and draught animals puts constraints on animal production and, indirectly, on crop production. They reported that milk probably gave the best returns of all animal products, but it was unlikely that its potential level of production would be fully realized without reducing feed competition from draught animals. They recommended that research in the highland zones should concentrate on ways of reducing the feed consumption of draught animals so that crop residues may be released for milk production and soil restitution. Such means could include rental markets, cow traction, reducing the number of oxen in the span, mechanization and new tools. Rental markets are currently the principal means of reducing the feed burden of draught animals. The authors cautioned, however, that these avenues should not be met with too much optimism since, with the exception of mechanization – mainly imported engines – they found that cow traction was the only major change in draught animal management developed indigenously in Africa and in other parts of the developing world.

There are, however, two major flaws in this final

warning. First, in places where there is a long history of animal traction use, whether with cows or not, well-developed rental markets are also found. Rental markets may indirectly reduce the demand for feed, but feed shortage is not the only reason, or even the main one, for the development of such markets. They also develop because of the indivisibility of the animals and the shortage of capital available to smallholders. The number of draught animals kept on a farm must be defined, and it may not coincide with the amount of land owned. For example, of all the farmers who own a pair of oxen, some may have adequate land to make full use of the pair and some may have more land than can be cultivated by the pair, while others may not have enough land to make full use of them. Under such conditions, a rental market develops, as it allows farmers with too few oxen to cultivate all of their land and the surplus owners to earn extra income. Smallholders with inadequate capital to purchase draught animals may rent power from surplus owners. Well-developed rental markets already exist in the Ethiopian highlands and they will continue to play a major role in balancing excess supply and deficit in village communities.

Second, the authors did not explain the circumstances under which cow traction has developed elsewhere and the long-term costs of using cows for draught. Cow traction and single-animal ploughs are widely used in Southeast Asia. No public authority has ever promoted cow traction, however; farmers have been responsible for its development but feed shortage has not been the only or even the main reason for the development of this technology.

Cow traction is used widely in Bangladesh. In Myanmar, Thailand, Indochina, Indonesia and the Philippines, on the other hand, extensive use is made of female buffaloes. Even though animal traction has a very long history in all these countries, cow traction is a comparatively recent phenomenon. A combination of factors, including shortages of oxen, population pressure, the subdivision of holdings and shortage of capital, has contributed to the widespread use of cows for draught. For example, up until 1947, when British India was divided, only barren cows were used for draught by Muslim farmers in Bengal (part of which is now Bangladesh). Hindus did not use them for religious reasons; the cow was given mother status and was exempted from hard work. Today, 50 percent of adult cows are used for draught, constituting about 30 percent of draught animals in Bangladesh (Jabbar 1989). Initially, a growing imbalance between the supply and demand for draught oxen forced Bangladeshi farmers to use cows as an alternative.

A number of other factors continue to support the use of cows for draught (Jabbar, 1980; 1985; Jabbar and Green, 1983). Over the years, mortality caused by disease has remained high because of poor veterinary services and slaughtering has continued to increase with population growth, urbanization and better incomes. Since a significant proportion of cows of reproductive age either die or are slaughtered, the growth rate of the livestock population is contained. Consequently, fewer male draught cattle become available, thus increasing dependence on cows for draught. This has resulted in decreased fertility and, with more cows put to draught use, cattle numbers have declined even further.

Population pressure and the reduction in the size of land holdings have accelerated the process of using cows for draught. Livestock censuses conducted in 1961, 1977 and 1984/85 showed that, in districts with a higher population density and smaller farms, there was a higher proportion of females in the cattle herds and more females were used for draught purposes. This phenomenon can be explained by a number of factors. First, farms, including land, cattle and other assets, are divided among inheritors. As a result of this, a farmer may end up with one ox and one milk cow or just one milk cow. Capital constraints may force this farmer to use the cow for draught, otherwise, crop production, the main priority, may suffer. Second, draught cows are cheaper than oxen, so farms with capital constraints may choose to buy or maintain draught cows rather than oxen. Third, draught cows are considered less powerful than oxen. If the power requirement can be met by cows, the farmer may choose to keep cows rather than invest in oxen. Last, although not for the same reason as the Hindus, Muslims traditionally give low social status to farmers using cows for draught. Large farmers who can afford oxen, therefore, may still resist using cows for draught.

In Bangladesh milk is valued highly, but crop production remains the short-term priority. In Southeast Asia, milk has little value as most of the population is lactose-intolerant (Crotty, 1980); therefore, losses in milk production resulting from draught may not be so important as long as calves receive enough milk to survive.

In Bangladesh and possibly in other Southeast Asian countries, then, the use of cows for draught may have reduced the aggregate demand for animal feeds, which are generally scarce, although overcoming feed scarcity was not the explicit objective of using cows for draught. Experiences suggest, therefore, that cow traction may not be the appropriate option if overcoming feed constraints as well as increasing milk production are the major objectives of developing this technology. Where milk is not valued, the adverse effects on fertility may make the use of cows for draught a costly innovation.

SUMMARY AND CONCLUSION

The International Livestock Centre for Africa has been trying to introduce cow traction in areas where animal traction is already well developed but where feed competition between draught and dairy animals hampers both dairy and crop production. Results of on-farm tests show that using cow traction is more profitable than using the traditional paired-ox plough or the single-ox plough, another of ILCA's innovations. However, upon critical examination of the data, it appears that the claims may not be realistic. Moreover, on-farm tests have also indicated that, rather than solving the feed constraint problem,

successful introduction of cow traction would require an adequate supply of better-quality feeds.

Cow traction is used extensively in Southeast Asia. A review of the diverse circumstances under which cow traction has developed there shows that overcoming feed scarcity was not the explicit objective of using cows for draught. Rather, using cows for draught purposes in a feed-scarce situation resulted in decreases in fertility and milk production in the long term.

The Asian experience suggests that where food is scarce, promoting cow traction may not be feasible, as the Debre Zeit farmers have already indicated. More important, cow traction may not be desirable because of its long-term effects on fertility and milk production. If the feed situation can be improved, the single-ox plough may still be a better and more desirable option to promote than cow traction. If population pressure, capital constraints, division of holdings or any other reasons force farmers to use their cows for draught, steps should be taken to minimize the adverse effects on fertility and milk production. Future research should be directed towards this end. ◆

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