

Animal traction technology in Niger and some implications for Zambia

by

Fred Kruit

Animal Draft Power Research and Development Project, Private Bag 173, Woodlands, Lusaka, Zambia

Abstract

A feasibility study on the use of animal traction in Sahelian (low rainfall) farming systems was undertaken in Niger, West Africa. In one area where animal traction had been used previously, but abandoned, on-farm research was executed and farmers were given training, loans and implements. In another area, where animal traction was still used, village studies were carried out to discover how farmers make animal traction profitable. The results could be of interest and value to the low rainfall areas of eastern and southern Africa.

Introduction

The extent of animal traction use in West Africa seems to be determined by the climate:

- in the Sahelian zone (roughly 200 to 600 mm annual rainfall) there is hardly any use of animal traction because this zone is thought to have low agricultural potential (and hence low or non-existent profitability)
- in the Savanna area (600–1200 mm annual rainfall) use of animal traction is generally widespread
- in the Forest area (more than 1200 mm annual rainfall) there is again hardly any adoption of animal traction, mainly because shifting cultivation systems do not allow its easy introduction, and because disease problems have kept cattle populations low.

A similar relationship between climatic zone and animal traction use is seen in eastern and southern Africa. Therefore, experiences of animal traction use in West Africa could be of interest to eastern and southern Africa.

At the beginning of the 1980s, the Food and Agriculture Organization of the United Nations (FAO) wanted to find out about the possibilities of using animal traction in the Sahelian zone. Niger was chosen as the project country because its agriculture depends on this zone; other "Sahelian" countries concentrate their agricultural activities in the non-Sahelian south. The research was taken over by SNV (a development organisation based in The Netherlands) in 1988, and concluded in 1991.

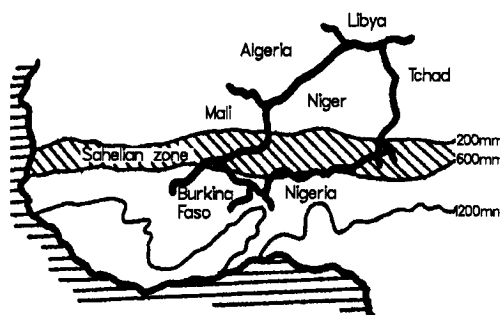


Figure 1: West Africa showing Niger and Sahelian zone

Characteristics of Niger

Climate and population

The southern part of Niger (200 x 1500 km) lies within the Sahelian zone (Figure 1). Annual rainfall is 200–600 mm; the rain falls during a short (three to four month) wet season, but is very irregular and unevenly distributed. This region is home to most of the country's 7.25 million population, 85% of which depend on traditional agriculture for their livelihood. Between this zone and the vast desert in the north is a pastoral transition zone, where nomads roam with their large herds of cattle.

Poverty

Niger is a very poor country. It is land-locked (1000 km from the coast), has a population growth of 3.1%, and has experienced food deficiencies since 1970. Per capita GNP was only US\$ 200 in 1985, even though the local currency (FCFA) is fixed to the French Franc. The national economy depends almost entirely on uranium mining in the north. Export of cattle is important in the south but is generally an unofficial activity.

Topography

The terrain is generally flat, with sandy soils which form crusts after rainfall. Extensive use is made of all possible agricultural land. Almost all of the natural vegetation and rich topsoil have disappeared as a result of high human and cattle population

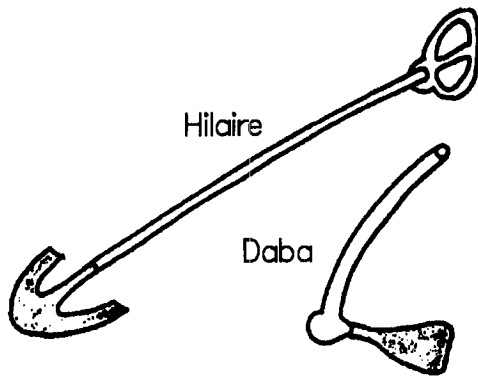


Figure 2: Traditional weeding tools in Niger

densities and of water and wind erosion. Land degradation has become a major problem during the past few decades. Also, the disappearance of vegetation has led to a decline in rainfall over the past 100 years.

Agriculture

An average family consists of six to eight persons with 3–5 ha of land and some animals. The land is farmed extensively, without any inputs, and most farms are barely self-sufficient. Hand tools are used for weeding (Figure 2): the “hilaire” (push hoe) in the pure sandy areas and the “daba” (hoe) in the areas with crusty soils, which are relatively more fertile.

Traditionally, tillage by hand hoe is only undertaken in some small areas with clayey soils, in combination with cash crops.

The main crops are pearl millet (75% of all crops grown; mean yield 300 kg/ha), sorghum and cowpeas (mainly as an intercrop). Yields have declined within the past few years, although total production has increased slightly as agricultural land has been extended. Some income is obtained from the sale of crops and animals, the hire of transport (animal-drawn carts), commercial activities (among the Hausa tribe), seasonal work at the coast and, in some areas, the growing of cash crops.

In the past, nomads grazed their cattle on the stubble fields of farmers after harvest (and so provided manuring) in exchange for millet. Because of the extension of cropped land, fewer grazing areas are now available for the cattle of either the nomads or the villages.

History of animal traction in Niger

For centuries, farmers in the north have had efficient ox or camel operated water-lifting devices above

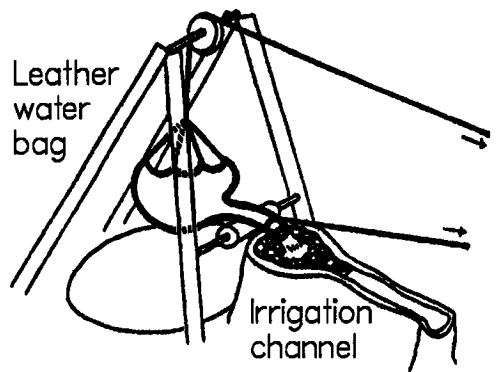


Figure 3: A “delou” in Niger. This is a traditional device that uses animal power to lift water from deep wells

their wells (Figure 3), to irrigate small gardens in the desert oases (de Beus and Kruit, 1989a; 1989b). In the south, animal traction was first introduced in the 1950s to stimulate the production of the cash crops (cotton and groundnuts) in some areas. In the 1970s, after independence, a country-wide loan scheme was established and several regional rural development projects promoted the use of animal traction in some regions by providing training to young farmers. Five local factories were established to meet the future demand for implements and carts, made of steel imported from Europe. Local cooperatives took care of distribution.

However, by the end of the 1980s, animal traction had still not been adopted in most of Niger, for the following reasons:

- the “trickle-down” theory did not work: most of the young “farmers” sent for training were outcasts from the villages and did not have any influence
- farmers could only obtain the whole animal traction package (UCA—unite de culture attelée), which included an *Arara* frame with plow, a cultivator (Figure 4), a ridger, a groundnut lifter, an ox cart and two oxen
- farmers were not trained properly on how to use the different implements, some of which were, in any case, not appropriate for their specific soil types
- spare parts were not available at the local cooperatives and farmers had to buy them from the factories
- insufficient attention was given to the combination of animal traction with organic or chemical fertiliser to improve yields
- donkey traction was not promoted at all, although large numbers of donkeys were already used for transport (carrying loads on

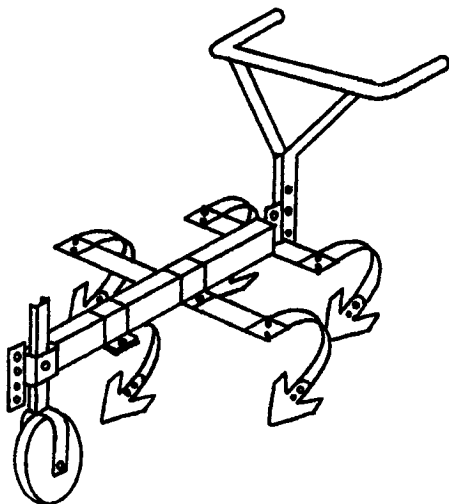


Figure 4: "Canadian" cultivator mounted on Arara frame

- their backs). Farmers believed that only oxen were appropriate for animal traction
- cash cropping (cotton and groundnuts) suffered from the declining rainfall and international market prices. Only in irrigated areas and in some valleys (with heavier soils) can cash crops still be grown and in these areas implements and carts are still used
 - the loan scheme had to be stopped in 1982; repayments were falling seriously behind because of the high costs of the loans and the inefficiency of the scheme
 - during severe drought years (especially 1984) equipment was sold to Nigeria. Without the loan scheme, farmers were not able to repurchase the factory implements.

Around 1990, ox and donkey carts (the "West African type", Figure 5) became very popular, mainly because hiring out transport was a good source of cash income. In some areas farmers had to pay tax when they used carts for commercial purposes other than their own agricultural activities.

Only one local factory (in Tahoua) still produces *Arara* equipment (with steel purchased from Europe with a loan)—mainly plows for the irrigation projects along the Niger river. Farmers use the plow as a ripper: they turn it sideways so that only the point is used to break up the heavy soil. Some cotton fields are ridged. Weeding is mostly done by hand hoe, because the proper use of a cultivator is not well known.

In the rainfed agricultural zone of Niger, animal traction is applied to any great extent in only one area—the Maradi Department. Around 1980,

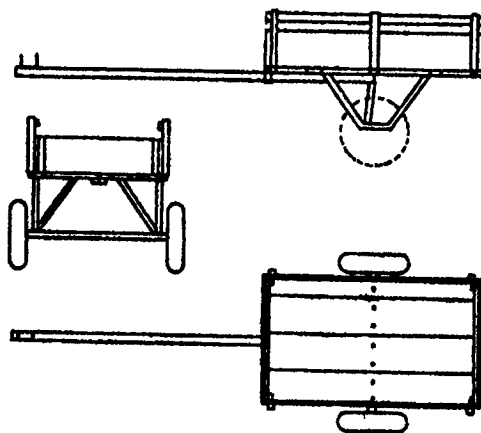


Figure 5: Cart design of the type widely used in West Africa, being based on a fixed solid steel axle, roller bearings and imported wheels and tyres

extension by a regional rural development project had a great impact in this area. Although a lot of equipment was sold to Nigeria during the drought of 1984, local workshops continued to make improved copies of existing implements and carts, using cheap steel purchased in Nigeria.

Feasibility study: animal traction in rainfed agriculture in Niger

In the period 1984–91, research on rainfed agriculture in Niger was carried out by FAO and SNV to see if there was any potential for animal traction within Sahelian farming systems. A feasibility study was carried out in villages of Maradi Department to discover how farmers make animal traction profitable (Löwenberg-de Boer, Abdoulaye and Kruit, 1991). In Tahoua Department, where animal traction equipment was sold after 1984, on-farm research was undertaken and farmers were provided with training, loans and implements (Kruit, 1991).

Tahoua Department

In this area, total production was increased by extending the cropping area. The limit of extension has now been reached and in most areas yields have decreased considerably. Furthermore, much natural vegetation has disappeared as a result of population pressure and overgrazing. Topsoil has been removed by wind and water erosion, leaving bare hard soil, in some places already revealing the rocky layer. Old farmers in Niger still remember the country being covered by medium-sized trees on rich loamy soils. Today, only shrubs and sand or rocks are left, out of

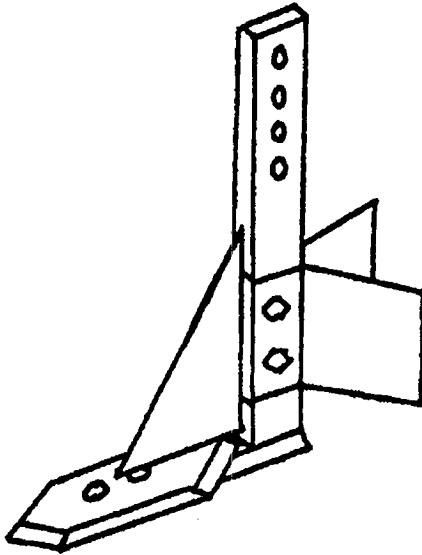


Figure 6: Ripper tine "Konni" to be mounted on an Arara frame

which it will be very difficult to recreate productive agricultural land.

The following advantages of animal traction for crop production were found in the area:

- tillage breaks the crust and causes better rain infiltration and water conservation
- weeding can be done quickly and at the right time. Also the crop can be thinned on time, which influences yields considerably.

These are not spectacular results, but under Sahelian conditions they can be important. Up to now, organic or chemical fertiliser has been applied only in the valleys where water is adequate and cash crops are cultivated—cotton, onions in small gardens and, recently, "doliq", a bean species planted after rains have stopped. In rainfed agriculture the use of fertiliser was too risky: if rainfall is low, the crop will burn, while without fertiliser it will still yield something.

Improved tillage through animal traction makes more rainwater available for the crop and a small application of fertiliser or manure will be possible. In this way cropping systems can be intensified. Although marginal in terms of profitability, this improvement could mean survival to a lot of farmers.

The implement promoted by the project for ox traction was the five-tine spring-cultivator (Arara, Figure 4) available from the Acrema factory nearby. It could be used for cultivating (breaking the crust and working in fertiliser) and weeding. Because crusts are quite heavy and soils are rocky in places,

a solid rigid-tine cultivator would have been better, but this is not available in Niger.

The project also developed a ripper tine (Figure 6) which can be used to make furrows in degraded land. Crops, grasses or trees can then be grown to reform the agricultural land, especially in combination with small contour dikes which capture rainwater running off. Farmers also used the ripper tine to plant crops quickly on crusty soils.

The ridger was not promoted in Sahelian agriculture: timely sowing is important and the risk to farmers of waiting for a second shower is too high. Furthermore, ridging is quite intensive and needs a lot of fertiliser in combination with rain to produce well.

One clear observation was that although ridging promoted a good initial plant stand, yields were poor when no fertiliser was applied. Ripping has the opposite effect: the crop develops slowly, though very uniformly, at first, but at shooting it suddenly develops very quickly, producing large grains, even without fertiliser. An explanation might be that roots catch the descending layer of water and nutrients later in the season.

The project strongly promoted donkey traction, because it is much cheaper than ox traction and affordable by a small farmer. Ox traction, including ox carts, will mainly be used by wealthier farmers to cultivate a large area but this would also speed up land degradation. Furthermore, small farmers who gain cash by weeding for rich farmers will lose this source of income and could even give up farming because of a lack of sufficient suitable land. Also, if a lot of farmers use oxen, not enough fodder will be available in the area.

Five different donkey cultivators were promoted in Niger, but none of them was really appropriate. The project has proposed two new types of donkey cultivator (Figure 7) and a harness design being assessed in Burkina Faso (Figure 8).

Because soils are relatively heavy in the area, good factory-made implements are needed, which are relatively expensive. Farmers in these areas need medium-term loans to be able to buy solid implements. The loans can be paid back slowly through the small income-generating activities mentioned above. However, the combination with a cart will cease to be highly profitable when a lot of farmers start using them, because the opportunities for hiring out carts will then decrease.

Training of animals does not present problems: traditionally farmers have kept oxen and donkeys and trained them for transport purposes.

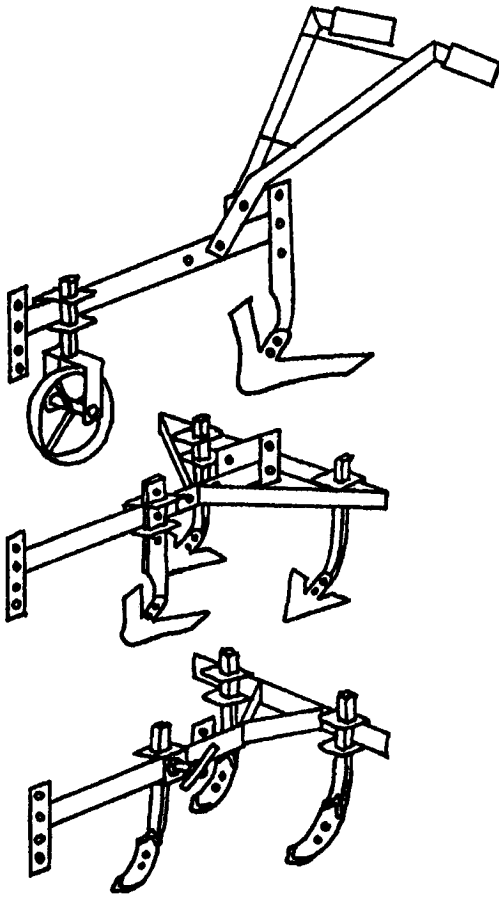


Figure 7: Donkey weeder "Konni".
Basic frame with lifter (top), triangle addition (middle),
"Simone" frame (bottom)

After this animal traction research, a follow-up SNV project—Projet participatif pour le renforcement des institutions villageoises pour le développement de l'agriculture à Tahoua (PRIVAT)—started to intensify agricultural systems in the area by creating village loan institutions to enable male and female farmers to buy inputs themselves (Narua et al, 1990). Another aspect of this new project is extension of research messages.

It was very clear that farmers were not aware of the possibilities of animal traction. After extension and training by the project, some farmers in the research villages started reusing old discarded equipment; others purchased implements with a two-year loan given by the project.

Maradi Department

In Maradi Department the project wanted to find out how farmers make animal traction profitable; this

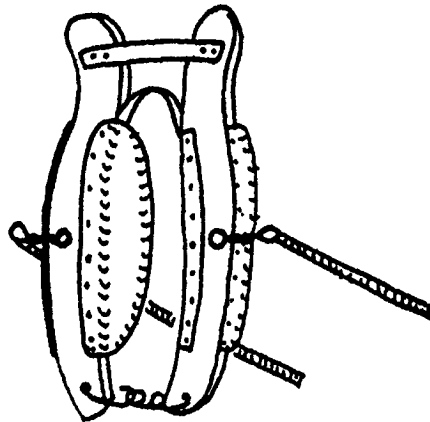


Figure 8: Donkey harness being promoted in Burkina Faso

knowledge would then be applied in other rainfed agricultural areas in Niger.

Initial project assumptions on animal traction use

At the outset it was thought that the profitability of animal traction arose from three main areas: use of animal traction for transport, cattle breeding and cash cropping. However, the project found that these reasons were not as important as expected.

Transport: It had been thought that only the cart was really profitable; that farmers use implements only because the transport animals were available. However, in most villages, the first implements were obtained before the first carts. Although the combination of ox carts with ox-drawn implement was quite common, small farmers mainly used only donkey implements without carts.

Cattle breeding: It had been thought that if farmers bought young oxen, they could sell them within five years at a high profit. However, farmers normally only sell oxen when they have a direct need for cash or if the animals are old, weak or ill. Cattle are seen more as a part of the farm investment which also has running costs (fodder), and will not be as profitable as originally thought.

Cash crops: It had been thought that animal traction depended on the presence of a real cash crop. Certainly, in cash crop areas, up to 100% of the farmers used animal traction, but even in areas with subsistence agriculture, up to 50% of farmers did so.

Farmers' systems of using animal traction

Well-provided extension by a former rural development project made the farmers aware of the possibilities of animal traction.

To raise total crop production, it was still possible in the area to extend agricultural land. The average yield per farm normally remained the same. Enough grazing land was still available for nomads and the village cattle, so fodder costs could be kept low.

The small local workshops reacted to the demand for implements and carts by producing improved copies of existing designs, made from cheap, poor quality steel and scrap purchased in Nigeria. Farmers were able to buy this cheap material without a loan.

The "non-economic" aspect of easing drudgery also proved to be important. Children take care of draft animals after work, but their weeding task is lightened considerably. Since women in most areas do not do weeding, their only benefit from animal traction would be increased food production.

Farmers in this area are beginning to complain that yields are decreasing because extension of cropping land is no longer possible. Their first reaction is to start growing cash crops again, especially *souchet* and pure cowpeas (high yielding variety). The latter need insecticides to produce well, which is difficult to obtain through the cooperatives.

The situation is similar in Tahoua Department: farmers will have to apply organic or chemical fertiliser to stabilise production. It will be interesting to see if the extension of the former project on the use of fertiliser will have its desired effect, such that farmers will "automatically" apply it. The carts will play an important role in transporting cheap chemical fertiliser from Nigeria and manure from villages to the fields.

Figure 9: Donkey weeder widely used in Maradi area. improved from existing models by farmers. Ox weeder is based on Arara groundnut lifter

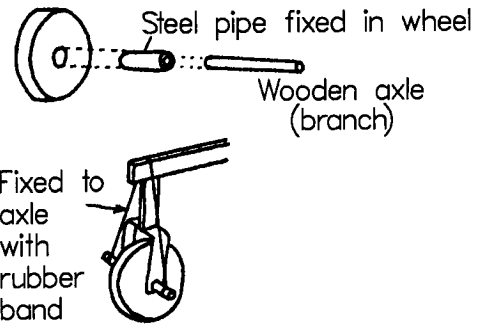
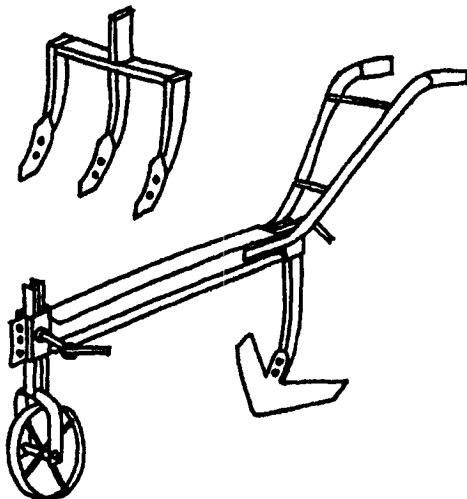


Figure 10: Simple wheel-axle system used in Maradi area

Implement type, manufacture and repair

The most popular implement is the groundnut lifter for oxen, or a small one for donkeys (Figure 9), used for weeding. The blade is set to a steeper angle to act like a ridger. Two passes have to be made between two crop lines (about 1 m apart). Few farmers have a three-tine cultivator to break up the crusty soil. Camels are also employed.

Because steel quality is bad, implements are not very solid and are badly aligned. A lot of cash and time is wasted on repairs, especially of the lifter blade which has to be changed many times each season.

The simple iron wheel is replaced by a wooden one with an axle of steel pipe and a piece of wood (Figure 10), which proves to be very effective.

The Super-Eco seeder, copied and produced by a factory in Niger, is still used to plant cash crops, including groundnuts, cotton, cowpeas (monocrop) and "souchet" (a plant which forms small bulbs).

Repair and some production of implements is carried out by local blacksmiths trained by the former project. Almost all blacksmiths want a generator for welding; at present they have to travel to larger villages to repair and assemble implements, which is expensive in terms of time and money.

Local workshops producing these simple implements could be of use for the sandy areas where simple, cheap tools (groundnut lifter) are sufficient for weeding. For areas with crusty soils, such as Maradi, solid factory implements on loan will be more profitable in the long run.

Some reflections on the different situations in Zambia and Niger

It is difficult to compare the situation in Zambia with that in Niger, for the climatic zone in Zambia (700–1500 mm) starts where it ends in Niger.

The first notable feature is that despite the bad national economic situation in Zambia during recent years, animal traction is still widely used for plowing in the savanna area up to the 1200 mm annual rainfall isohyet. Tillage, which used to be performed manually is essential, but many plows are in poor technical shape.

The agricultural soils need a fair amount of rainfall before tillage is possible and in the meantime weeds grow up strongly. Chemical fertiliser is hard to get (at the right time) and farmers apply animal traction to extend their cropping area to raise farm production. Furthermore, labour is scarce through a high rate of urbanisation, which makes mechanisation inevitable.

One of the main problems seems to be the scarcity of expertise, machines and good raw material to produce proper implements locally. With a better economic situation this could be improved: unlike Niger, good quality steel can be purchased nearby (South Africa).

On the other hand, ox carts are not very widely used, possibly because they are of low economic profitability to farmers. Good designs and spare parts are not available and locally made carts are expensive. Maybe with new government policy they will become profitable, especially for transport of fertiliser and harvest surpluses, and proper designs could be introduced.

In Niger with its dry climate, cattle disease is not a big problem. In Zambia it is a real threat, especially in areas with a high cattle population. This could mean that farmers could be interested in donkey traction, with lower risk.

One concern is careless use of the land, as animal traction is seen as a way of cultivating a greater area. Generally speaking, there is enough space and vegetation available in Zambia, but there are dangers in the high potential agricultural areas, where population density also is high. Here, the use of animal traction to raise total production through extensification (without intensification through fertiliser use) could mean severe land degradation, yield decline and erosion. The environmental effect may be worsened by herds of small ruminants and wood cutting for charcoal for the urban population. This effect can already be observed in certain regions in Zambia, eg, in the Gwembe Valley and Zambezi escarpment.

Only the south valley of Zambia (700 mm rainfall) can be compared with Niger, and care should be

taken to ensure that farmers apply animal traction properly, ie, non-intensive tillage (cultivator or ripper) in combination with small applications of fertiliser. In the north of Zambia (1500 mm rainfall), it will be very difficult to introduce animal traction on a large scale (in many high rainfall areas of Africa animal traction does not exist because of the problems mentioned earlier). Ridging by animal traction could be carried out in areas where ridges are already made traditionally by hand.

More farming systems research should be carried out to find out how animal traction could be more effectively utilised or introduced in Zambia.

Conclusion

Experiences from Niger show that animal traction, especially ox traction, has up to now been used only to extend cropping area to increase total production. The process of land degradation through erosion is speeded up by animal traction, in combination with devegetation by pressures of the human and animal populations.

The only way this process can be stopped is to combine animal traction with organic or chemical fertiliser as a means of intensifying production. Research has shown that animal traction improves water storage in the soil, so low levels of fertiliser can be applied, which previously would have been too risky within Sahelian farming systems. Furthermore, donkey traction for small farmers should be promoted so as not to enlarge the gap between them and wealthier farmers.

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