11. The supply and manufacture of animal traction equipment

11.1 Existing facilities

Many countries in Asia, Latin America and in north and northeast Africa have had a long tradition of animal traction usage. In such countries equipment designs made of locally available materials have been developed over the centuries and equipment has usually been fabricated in villages and small market towns. In recent years some larger urban-based manufacturing enterprises have also been established. As a result, village artisans have often developed new repair and maintenance services for the factory-produced equipment, sometimes in addition to their traditional fabrication work.

In most Sub-Saharan African countries, animal traction has only been introduced this century and has been based largely on factory-produced steel implements. In the colonial era, most animal traction implements were imported from Europe. However a long-term objective of many governments in Sub-Saharan Africa has been the creation of local sources of animal traction equipment and the infrastructure to maintain such equipment at village level. As a result many countries have established workshops to fabricate animal-drawn implements. The addresses of many such workshops in Africa are provided in the Appendix, and further details can be found in the GATE Animal Traction Directory: Africa (Starkey, 1988).

In some cases, including Burkina Faso, Ghana, Guinea, Tanzania and Togo, factories have been established through government development initiatives, backed by external aid donors. In other countries including Kenya, Malawi, Nigeria, Senegal and Zimbabwe the initiatives have been largely those of the private sector. There have also been workshops established with capital derived both from the public sector and the private sector (for example workshops in Mali, Lesotho and Tanzania). Some production has been in large factories (the SISCOMA/SISMAR company in Senegal; the UFI parastatal factory in Tanzania). Some other countries have been able to meet their national demands by small workshops (the government-established UPROMA enterprise in Togo; the private Agrimal workshop in Malawi). In Benin production has been organized through a cooperative (COBEMAG) established with government backing. In this system much of the component manufacture is delegated to village-based members of the cooperative, while final assembly and those operations requiring expensive equipment take place in a central workshop. In Burkina Faso equipment production was arranged through the governmental CNEA, Burkina Faso (Centre Nationale d'Equipement Agricole) network which initially comprised two large and nine small workshops. The large workshops were capable of manufacturing most components including mouldboards and plowshares but only assembled sufficient equipment to meet the requirements of their localities. They supplied basic components to the scattered small workshops that undertook only basic welding, grinding and assembly work. For various organiza-

tional and economic reasons, the network was subsequently reduced in size and scope.

Most animal traction equipment workshops in Africa have **surplus capacity** and most could expand production if market demand increased and if the necessary inputs could be made available. Despite this situation, a high proportion of animal traction equipment being sold to farmers in Africa is either totally or partially manufactured overseas, often in industrialized countries.

There is probably no animal traction equipment factory or workshop in Africa, whether in the public or private sector, that has not faced major problems. These have included problems in the actual manufacturing and selling of suitable animal traction equipment, in establishing a balance between overproduction and underproduction, and ensuring economic independence and long-term viability. It is ironical that while the majority of animal traction equipment workshops in Africa were established with the assistance of one or more aid agency, some of the present problems are also linked to donor assistance.

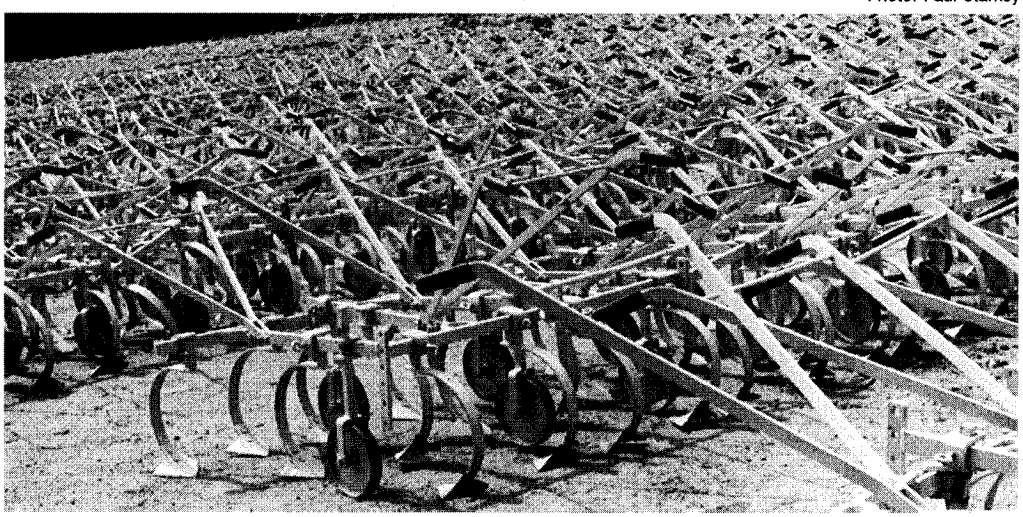
11.2 Donor influences

In most Sub-Saharan African countries the supply of animal traction equipment is strongly influenced by development projects. Due to their abilities to purchase equipment in bulk, transport it to rural centres and provide credit for its purchase, development projects generally dominate the "marketing" end of equipment provision. Donor-assisted projects sometimes control manufacturing facilities and frequently monopolize importations. This inevitably distorts supply and demand patterns, and whether this distortion is beneficial or detrimental depends on local policies. All donor assisted development projects are answerable to the national governments and any decisions relating to the importation of equipment by a project must ultimately be the responsibility of the host government. In practice, governments, donor organizations and development workers know that the influence of bilateral and multilateral aid agencies in determining large and small decisions is very great.

It is well known, for example, that most donor countries state that equipment purchased with

Fig. 11-1: Stockpile of equipment at the SISCOMA factory in Senegal. When the national agricultural credit programme was suspended, sales of animal traction implements plummeted and SISCOMA became insolvent. The factory was acquired by SISMAR, committed to product diversification.

Photo: Paul Starkey



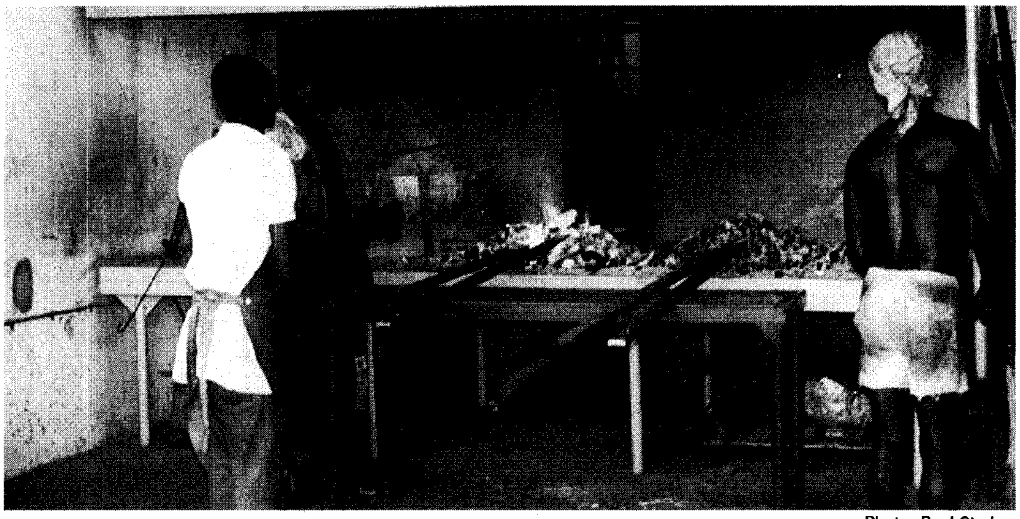


Photo: Paul Starkey

Fig. 11-2: At the UPROMA workshop in Togo, steel bars to make plow beams are heated in charcoal prior to being bent into shape manually.

their financial assistance should come from their own country, unless a waiver is agreed. As a result of such understandings, agricultural development projects supported by The Netherlands have generally ordered Dutch plows or materials, French-supported projects have made use of French designs, British-assisted projects have bought British equipment and when Italian funds have been channelled through a multilateral agency such as FAO, Italian implements have generally been ordered. In several cases bilateral or multilateral projects have imported whole implements, or components that could be made locally, *despite* the existence of local workshops with spare capacity. For example, importations have occurred recently in Burkina Faso, Guinea, Mali, Mozambique, Nigeria, Tanzania and Zambia. Admittedly such importation may have been because the local workshop was suffering from major technical, managerial, financial or supply problems. However in such circumstances projects and their supporting aid agencies have often found it easier, or simply more expedient, to bypass the constraint rather than to confront the root problems.

It must also be recognized that corruption (on several sides) may have sometimes distorted the supply of animal traction equipment, since generous "commissions" may have been available from the manufacturers or suppliers of implements or components.

Since the constraints experienced by workshops in developing countries directly or indirectly affect development projects, field staff and the farmers, some of the problems will be briefly reviewed.

11.3 Problems of local workshops

One basic problem, with which workshops making animal traction equipment have to contend, is the suitability of their implement designs. Few manufacturers can afford their own research and development departments, and where they exist they are naturally staffed by engineers, not agriculturalists. Manufacturers therefore depend largely on three main sources: prototypes or drawings produced by the agricultural engineers of local ministries and universities; the copying of samples from other countries; licensing agreements with foreign manufacturers holding patents on es-

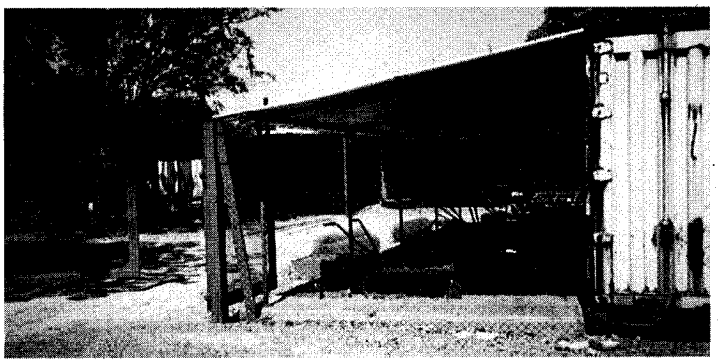


Fig. 11-3: Simple workshop in Burkina Faso made from shipping containers (on right of photo) and roofing material. It was designed to assemble animal traction implements from components made in larger workshops.

Photo: Paul Starkey

tablished designs. The main problem with all three sources is the same: the manufacturer has to go to considerable expense to produce the necessary assembly jigs without being sure that the implement will sell. Seldom can workshop engineers judge the market for such specialized items; they generally rely on the advice of their sources. Many workshops have found out to their cost that their professional advisers were not fully aware of what the farmers wanted or could afford. Some workshops have had to seek second opinions on actual market demand after the management had been embittered by the failure of an expensive production run to sell. Some interesting material is available relating to the difficulties Tanzanian manufacturers and agricultural engineers experienced in identifying suitable designs and on possible national policies to prevent the recurrence of such problems (Kjærby, 1983; ILO, 1987c).

Economic distortions

In several countries, including Angola, Mozambique, Nigeria, Sierra Leone, Tanzania and Zambia, exchange rates fixed below those considered acceptable by the commercial sector have seriously affected the economics of local production. In circumstances where there is a major difference between the official exchange rates and the parallel (black market) exchange rate there can be very severe distortion of local manufacturing costs. Implements purchased and imported at official (low) rates of exchange often appear cheap compared with those manufactured locally. It may even be significantly cheaper (at official rates) to import equipment than to make it locally. This is frequently the case even when primary raw materials such as steel are imported at official exchange rates, for local manufacture inevitably requires some expenditure within the local commercial sector (for example for purchasing welding electrodes, bottled gas, hacksaw blades or even "gratuities" to obtain scarce resources). In countries that have "parallel" rates of exchange, such local purchases will normally involve paying the prevailing commercial prices that have been inflated by black-marketeering. In such circumstances some workshops may opt for keeping production going by buying expensive and possibly illegal goods and services from the commercial sector. Other workshops may insist on obtaining goods and services at lower prices, even if it involves very slow, official channels and even if the resulting delays result in total cessation of production for days, weeks or months. Neither alternative is desirable, and both effectively increase the actual costs of implement production.

In many countries, including Nigeria and Zambia, there have been preferential customs tariffs for complete agricultural implements, while the importation of steel and welding rods for the local manufacture of similar implements was subject to customs duties. In some countries including Senegal, workshops

have had to add Value Added Tax to locally produced implements, whereas imported implements may have been exempt from this tax. Furthermore whatever the local customs tariff structures, most aid donors make it a specific condition of aid agreements that project supplies should be admitted duty-free. This is administratively simple for consignments of ready-manufactured equipment, but it is difficult or impossible to recover duty already paid on materials purchased within the country for the local fabrication of implements. The result is that projects can often make implements available to farmers more cheaply through importation than through local manufacture; low implement prices for farmers may seem an irresistible, short-term argument in favour of importation, even though a broader view might well indicate that an importation policy would be detrimental to the long-term goal of sustainable local production.

Limited capital and associated cash-flow problems can be particularly serious for agricultural manufacturers. Ordering specialized steels in small quantities is disproportionately expensive, while bulk orders require a long commitment of tied capital.

Production runs

For efficient workshop management regular monthly production is desirable, yet animal traction equipment sales are highly seasonal. Poor weather, poor harvests or simply a change in policy of an agricultural credit bank can cause anticipated sales to drop drastically. Few local manufacturers can afford to maintain large stocks of manufactured equipment or raw materials, yet the administrators of development projects expect to be able to order, receive and pay for consignments of equipment in a short space of time. The short contract periods of donor projects tend to favour the foreign manufacturers with more rapid access to raw materials and working capital. The ability of manufacturers in industrialized countries to meet tight production schedules, usually more than compensates for the delays attributable to shipping, and so overseas manufacturers can often meet contract deadlines more rapidly than local manufacturers.

Workshop location

Workshops designed to produce animal traction equipment have often been established in rural areas. This may have eased the cost of distributing the manufactured equipment, but increased the difficulty in obtaining reliable supplies. Many rural workshops in Africa have been severely disrupted by unreliable electricity or fuel supplies. Such problems may be common to many other local industries, but not to foreign manufacturers.

Quality control can be a problem in any workshop, but in developing countries salary structures often accentuate this. The low cost of unskilled and semiskilled labour and the high cost of imported equipment limits the adoption of automated processes that might standardize the cutting, punching, bending and welding of components. The high availability of semiskilled labour tends to restrict the potential salaries of very skilled welders in established workshops, and this leads to a high staff turnover as skilled workers seek more remunerative employment. The cost of management time is high compared with labour (particularly so if expatriates are involved) so that for financial reasons quality control procedures are often neglected. The rural location of many workshops also restricts supervision since management staff often spend time in urban centres arranging supplies or negotiating with government departments. The overall effect can be the fabrication of very variable products; this increases pressures on development projects to import ready-made implements which are generally assumed to be of higher quality. (This assumption that imported implements are automatically of high quality is dangerous, since implements imported from industrialized countries can range from excellent to abysmal).

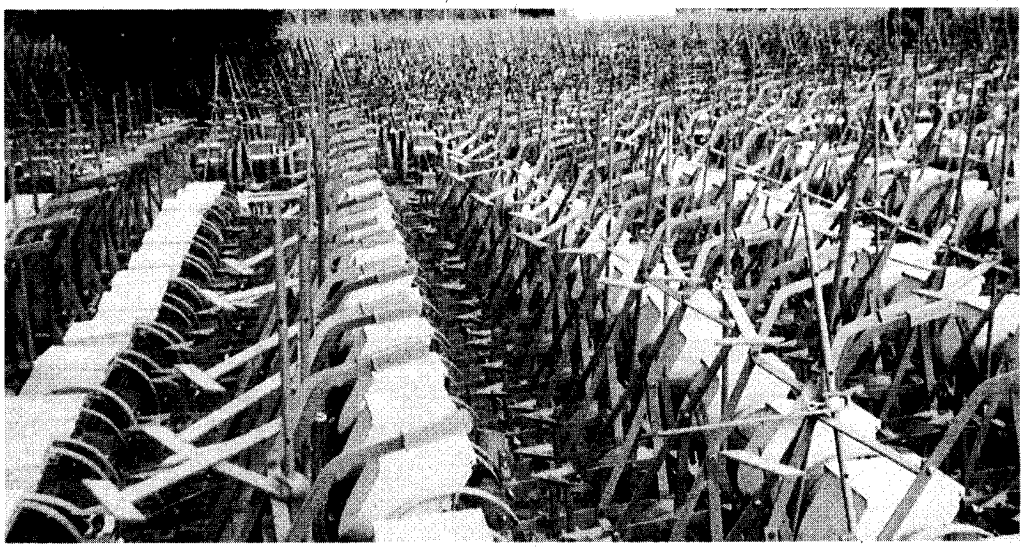


Photo: Paul Starkey

Fig. 11-4: Stockpile of imported seeders in Mali. Since they were supplied by tender, who is now responsible for modifying them to meet the needs of local farmers?

Bureaucracy

Public sector workshops may have particular problems in dealing with, or being part of, government bureaucracy. While small private workshops and traders usually respond quite rapidly to changes in demand, and do not continue to produce equipment that is not selling, government and parastatal workshops often work to targets determined more by their annual budgets than by market forces. There have been many examples of parastatal factories unable to meet genuine market demands for their products simply because their fixed budgets have not been sufficient to meet the requirements for materials. There have also been cases of the overproduction of unwanted equipment for which funds had been budgeted.

Donor-financed imports

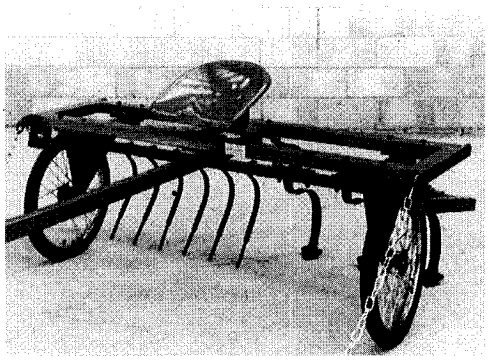
The more a local manufacturer has problems, the more donor-assisted projects will tend to import foreign equipment, so exacerbating the situation. During the early 1980s several West African manufacturers, established with varying degrees of government support, found themselves trapped in the descending spiral of limited capital and low sales as donor-supported projects financed the importations of implements. Private manufacturers and others free to develop their workshops have generally diversified into other manufacturing activities: few independent manufacturers would want to return to the problems of plow production having enjoyed the cash-flow advantages of manufacturing steel windows and burglar bars, items with regular and sustained demand, minimal administrative procedures, private sector funding and low demand for special steels.

With all the problems to contend with, it hardly seems surprising that few local workshops in Africa have managed to produce, on a regular and sustained basis, reasonable quality animal traction equipment at a low price.

11.4 Policy implications

Local manufacture is a universal and natural aspiration of all countries. Nevertheless it is not necessarily cheaper than importation. Since few African countries are likely to have

steel manufacturing facilities in the foreseeable future, implements will continue to have a significant foreign exchange component whether they are imported or locally produced. While local manufacture provides employment, if workshops are underutilized the social and economic benefits of this may be offset by high overhead and recurrent costs. Such costs may be greater than value added to the basic steel by full manufacture overseas. Thus in only a few cases is the main advantage of local production *financial*. Nor can the main advantage be self-sufficiency when local production is highly dependent on imported steel. The most important policy justification for local manufacture should be the potential for *rapid feedback* between the end-users and the manufacturer. As has been noted, this valuable advantage has often been neglected.



Source: Archives of Ministry of Agriculture, Mozambique

Fig. 11-5: Following an international tender, significant numbers of these Lioness wheeled toolcarriers were selected for importation into Mozambique. As may be apparent from this picture, they had not been selected in consultation with the farmers of Mozambique or by those with a detailed knowledge of the local farming systems. Several years later, most had never even been assembled.

Appropriate designs

If public sector organizations (governments and projects) continue to be heavily involved in the supply of equipment to farmers, policy decisions ensuring that the equipment is of *appropriate design* may be more important than those relating to *source of supply*. There have been many recent examples of project administrators ordering (locally and internationally) implements that were very unsuitable. Often it took months or even years for the lessons to be learned, since the lack of uptake was blamed on farmer conservatism and poor extension effort, rather than on inadequate equipment selection.

A few examples will illustrate the problem of projects ordering by tender. For several years in Northern Nigeria, the standard tender documents of a major multilateral agency specified that animal traction equipment packages should include mouldboard plows. To date most of these remain unused, since farmers in the area habitually use ridging plows. In one tender contract in Zambia plow beams were received with small mild steel plates welded on, simply to make the relatively light beams meet the weight specified in the tender documents. In Mozambique several aid agencies financed the importation of wheeled toolcarriers. Although no wheeled toolcarrier design has ever had long-term success at farm-level in Africa (Starkey, 1988), one large and expensive consignment of toolcarriers imported into Mozambique proved to be particularly inappropriate. The implements had bicycle wheels that were weak, narrow and puncture-prone and clearly unsuitable for farmers' fields (Fig 11-5). Their "500 kg cart" was minuscule and off-centre, and to prepare a toolcarrier for weeding required changing at least twelve different nuts and bolts. To anyone aware of field conditions in Mozambique, the implements (that had been designed and manufactured in Europe) were inappropriate. Nevertheless they apparently conformed to the letter of the tender specifications of the international agency that funded the purchase. Most implements from that very expensive importation remain unused. Near them, in Maputo, are stocks of plows imported from Brazil by another aid agency, in an attempt to promote "South-

South" cooperation. These plows have shares and mouldboards of the specified dimensions, but these and the landside are all ***welded*** onto the frog piece. With no provision for ***bolting on*** spare parts, these implements are effectively, one-piece, disposable plows! Many projects and organizations in Africa could cite similar examples of time and money being wasted through tendering procedures that failed to specify what the farmers really needed.

It is therefore very clear that whether policies favour the importation of equipment, the use of large local factories, or the establishment of small rural workshops, procedures should be clearly defined to ensure that those responsible for ordering or manufacturing the implements are reliably informed of farmer needs and farmer reactions.

Standardization

Another major problem with the purchasing of equipment on international tender is that equipment from different suppliers will vary, making the subsequent supply of spare parts difficult. Standardization of designs and components can assist manufacturers, distributers and users. The agricultural engineer Jean Nolle, designer of the *Houe Sine multiculteur* toolbar that has become widely used in West Africa, considered standardization and interchangeability of components between implements to be a major design objective (Nolle, 1986). He developed ranges of equipment with some standard specifications so that clamps or even plow bodies could be used on different implements. Standardization has to be carefully balanced with other design criteria, but in general it is desirable. Standardization can allow manufacturers to stock smaller ranges of steel sections, use fewer jigs and allow suppliers to stock smaller numbers of spare parts. With so many small workshops in Africa, some of which have to import specialized steel sections or even manufactured components, there is much scope for regional cooperation and standardization.

Small workshops

Despite the large over-capacity for plow pro-

Fig. 11-6: Stockpile of plows imported into Mozambique by a donor-assisted project. The plows have numerous technical defects: for example the mouldboards and shares have no bolts but have been welded into place, making replacement in a small village almost impossible.

Photo: Paul Starkey

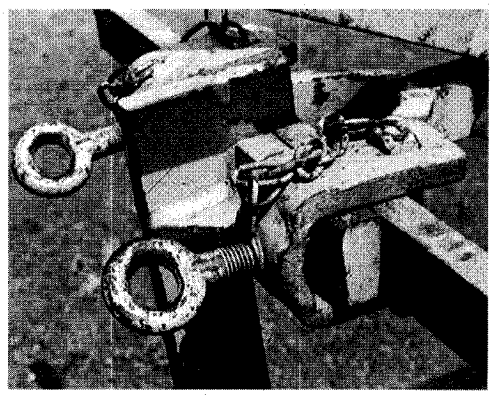


Photo: Paul Starkey

Fig. 11-7: Clamp from Houe Sine toolbar. As part of Jean Nolle's philosophy of standardization a similar clamp is used on several implements. Should the thread strip, it is relatively easy to repair/replace in a remote village.

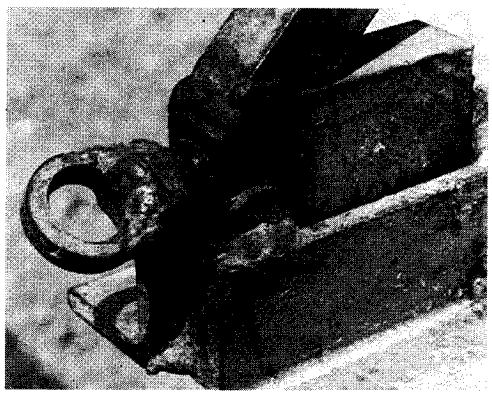


Photo: Paul Starkey

Fig. 11-8: Clamp on an early Anglebar toolbar. When the thread stripped or broke, the whole frame needed to be taken for repair. This problem was identified only when the implement was tested in a remote village without a modern blacksmith.

duction in Africa, new workshops are still being established, generally through aid projects. Increasingly these are small enterprises in rural areas using bought-in (often imported) components. One advantage of such small workshops is that they are generally near the end-users, making it easier for farmer feedback to reach the manufacturers. They should also assist in the provision of spare parts. The main disadvantage is that the small workshops themselves may not be viable (unless they divert their efforts into assured products such as windows and burglar bars!). Moreover while they are in the initial, highly-subsidized, aid-project stage, they may marginalize still further any existing factories or workshops in the country, particularly if these are already in difficulties.

11.5 Project options for the supply and manufacture of equipment

There are few countries in Africa where animal traction equipment is manufactured and distributed on a truly "free-market" basis. Exceptions include Ethiopia, where small-scale artisanal manufacture predominates, and Zimbabwe, a steel-producing country. In the majority of other countries in Africa, the distribution and manufacture of animal traction equipment is heavily dependent on the prevailing policies of governments and assisting aid agencies. The market for animal traction equipment is often precarious, due to the limited purchasing power of small scale farmers and the vagaries of the climate. Perceived short-term shortages of implements have often been "solved" by the importation of large quantities of manufactured equipment, or components for local assembly. Such importations have usually been subsidized and have marginalized still further the local suppliers, who have often turned to ventures that are less prone to risk. The subsequent (often unofficial) diffusion of imported equipment to different areas of the country and even across state boundaries has often distorted market structures well outside the intended target area.

In general, the interests of small-scale farmers would be best served by *assured access* to *well-adapted* equipment that is *modestly* priced. If local manufacturers are to meet this, they require a good understanding of actual farmer needs. They require information exchange systems to ensure that they can receive feedback directly from the end-users. Without the views of farmers, field workers or committed sales agents manufacturers cannot assess the relia-

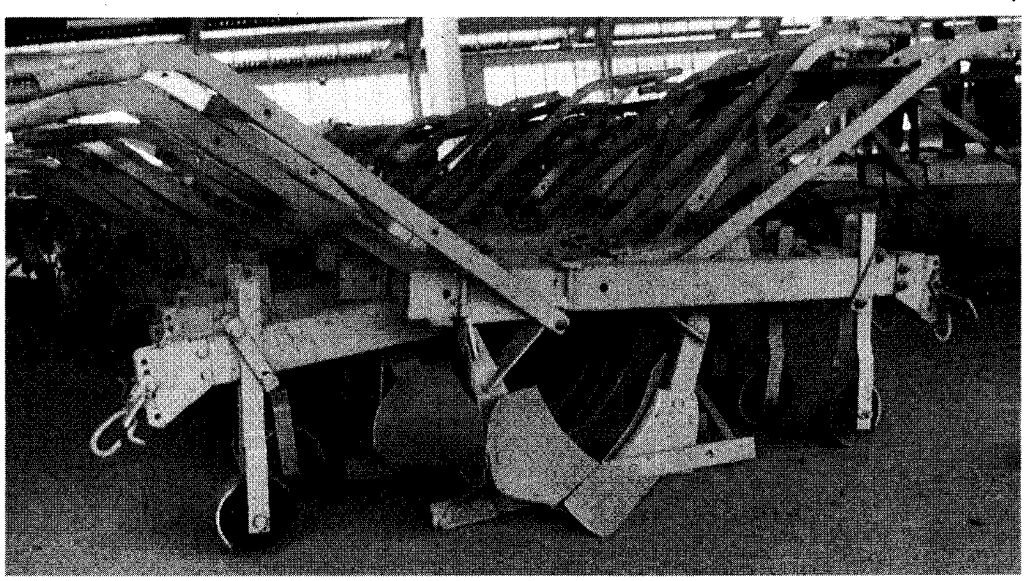
bility of the opinions of the many local or expatriate "experts" willing to offer advice and/or designs. In only a few circumstances is the pattern of animal traction equipment sales in African countries likely to support sustained production or commercially justify the opportunity cost of the manufacturing capability. This implies that public sector funds will be required to support local production, by providing working capital or assured markets.

Existing international tendering systems favour external producers. Newly industrialized "South" countries such as India and Brazil are increasingly capable of undercutting established firms in the "North" on price. It remains a matter of opinion as to whether there are significant quality differences between "North" and "South" manufacturers. However the experience of many African countries illustrates that there is no assurance that equipment ordered by international tender will prove to be of suitable quality or design.

In most countries, the weakest link in the whole equipment manufacture and supply process has been that between the suppliers of equipment (manufacturers or distributing organizations) and the end-users. Liaison at this level is essential in order to ensure that equipment designs are appropriate. Past neglect of such linkages has often resulted in workshops or projects manufacturing or importing unsuitable implements. The proliferation of donor-assisted aid projects in Africa has meant that indigenous and foreign implement manufacturers have learnt the sad truth that for them the actual market for the sale of their production is not the farmer, but the donor-assisted projects. In most cases it has been project staff, not farmers, that have defined specifications and requirements. It has been projects that have been able to order in bulk. It has been projects that have decided whether implement quality has been acceptable and paid the manufacturer. The provision of subsidies and credit combined with a lack of alternative implements (projects often have effective monopolies in equipment sup-

Fig. 11-9: Wooden beam plows stockpiled in Zana Za Kilimo factory, Tanzania. Large-scale production had started before farmer acceptance had been ascertained.

Photo: Paul Starkey



plies) has allowed donor-assisted projects to unload stocks of relatively poor equipment on local farmers. Only when equipment has been exceptionally bad has it remained in project stores. This has meant that neither African nor overseas manufacturers of animal-traction implements have had much financial incentive to ensure their implements have met the needs of local farmers. For the manufacturers, the best short-term strategy has been to sell their production to individual projects. Their best longer-term strategy has simply been to find other donor-assisted projects. There has been almost no incentive to establish communication channels between manufacturers and the ultimate end-users of the equipment. As a result of this sad situation, there are now few places in Africa where feedback from farmers can rapidly affect the specifications of implements available for them to buy.

For the farmers, the ultimate *source* of implement supply is of less importance than its design and quality, assuming spare parts are available locally. In general, farmers have no influence on the source of available implements, this being determined by governments and donor-assisted projects. In the past such decisions have often been taken on the basis of short-term expediency, perhaps in response to a specific offer from an aid-donor or to relieve a temporary national shortage of implements. The lack of long-term planning has sometimes led to initiatives for the supply or manufacture of implements being prejudiced by subsequent national planning decisions. There have even been examples of both private sector manufacturers and government-backed projects being detrimentally affected by parallel initiatives (supported by different donor organizations) that have been attempting to increase equipment supplies in other ways. While the importation of different types of equipment can provide farmers with valuable choice and manufacturers with more competition, it can also wreck the slim prospects of local manufacturers already experiencing difficulties. Unless countries define, and adhere to, clear policies relating to the supply of animal traction equipment, further well-meaning attempts by projects or aid agencies to manufacture or supply implements may well risk being undermined by other, uncoordinated development initiatives.

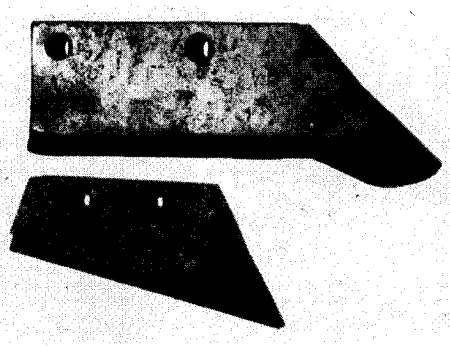
11.6 Spare part provision

One of the most commonly reported constraints to the efficient utilization of animal traction equipment is the lack of spare parts. Difficulty in obtaining spare parts is a major cause of abandoning good implements well before the end of their useful lives. It is also a cited excuse for giving up the use of equipment that was never particularly favoured. Where equipment is really useful, farmers in conjunction with local artisans will go to great lengths to obtain or make spares. To take examples from Sierra Leone: farmers and blacksmiths in some areas kept plows in regular use for over 30 years despite the absence of spare parts; yet in other areas plowing with animals ceased altogether when the plows first needed replacement parts.

The speed at which parts need to be replaced will depend on the conditions of use. Soil type and condition at the time of use together with the quality of the steel will determine how

Fig. 11-10: Plowshares used for just two weeks in abrasive soils, shown resting on top of new shares. In such conditions, farmers may require at least two new shares per season.

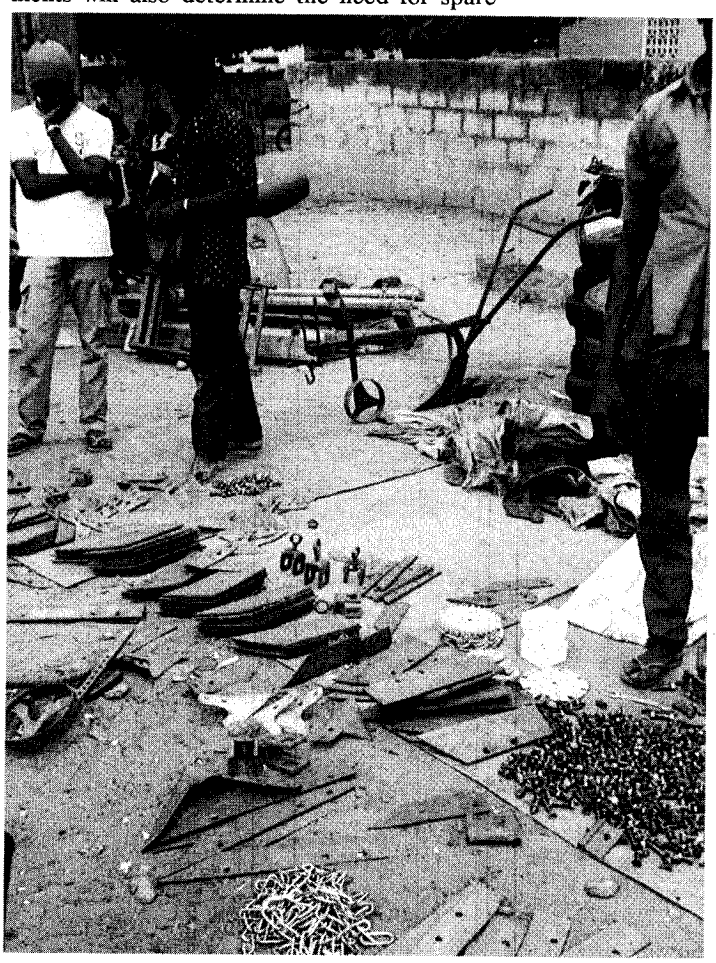
Photo: Paul Starkey



quickly plowshares, landsides and cultivator points will wear. Shares and cultivating points may well require re-working or replacement every season. Wheel bearings wear quickly when abrasive soil enters between the axle and wheel hub; many land wheels presently in use wobble eccentrically or squeak irritatingly, and some have had to be abandoned, so reducing the ease of obtaining good quality cultivation. Traction chains, clamps, mouldboards and countersunk bolts do not need to be replaced frequently, but when they do, they are specialized items that may be difficult to improvise if they are not readily available.

The care that farmers take of their implements will also determine the need for spare parts. The regular oiling and greasing of bolts and moving parts may extend the lives of such parts markedly. Protected storage, combined with cleaning, greasing and oiling, should both facilitate the ease of adjustment and reduce the need for subsequent repairs. Regular replacement or reworking of plowshares will prevent wear to the frog piece and plow body. Restrained application of manual force when tightening ring bolts with a tommy bar will reduce the stripping of threads and the damage to implements. The use of pliers, or spanners, of the wrong size may result in rounded nuts and bolt heads that will then require workshop equipment to remove.

In areas where animal traction is being introduced, farmers may well require specific information relating to the care and maintenance of equipment. Initially farmers are often unaware of the limited strength of steel implements, for example the ease with which a plowbeam can bend if misused as a lever. Even after careful instruction, many people have to learn from bitter experience the delicate balance that exists between a bolt that is too loose and an over-tightened thread that is stripped and needs to be cut off or drilled out.



In general, national systems for the supply and distribution of animal traction

Fig. 11-11: Trader selling spare parts at small market in Mali. Some are imported components, some have been made in a local factory, some have been made by blacksmiths and some are second-hand.

Photo: Paul Starkey

spare parts have proved difficult to maintain. It often seems that only when demand is sufficiently assured for local artisans and small traders to find it profitable to specialize in this area, that problems become reduced. For example in parts of Senegal and Mali the level of animal traction has allowed private traders in the informal sector to specialize in spare parts provision. In these countries, traders are present in all local markets selling a wide range of parts derived from national-level factories, blacksmiths and second-hand equipment.

Photo: Paul Starkey

Fig. 11-12: Cart bodies made by carpenters in small town in Mali.

Perhaps the biggest problems with national systems relate to the maintenance of stocks. Manufacturers, importers, retailers, traders and even projects do not like to have large quantities of capital tied up in stocks of slow-moving spare parts. Demand is highly seasonal and weather dependent, yet decisions on stocks have to be taken long before the actual demand can be assessed. Another problem is knowing the relative needs for spares, particularly on new lines of equipment. In some cases, the equipment may not prove to be useful, and any stocks of spares will be totally wasted. In other cases a national or local requirement pattern will be rapidly established, so that it will be clear that for every 1000 implements in use, there will be an *average* demand for specific quantities of shares, points, frames, bolts, handles etc. However while such a pattern may be statistically valid for a large area, few local depots will experience the ideal "average" demand. In practice local depots have the choice of overstocking to ensure all needs will be met, or accepting lower stocking rates, knowing that some items are likely to sell out and become unavailable. Large numbers of small depots throughout a country will be most efficient in terms of having accessible sources of supply close to farmers. Yet the greater the number of depots, the greater the overall national stock that has to be maintained if each depot is to be able to meet average demand in its own area. In theory the ideal situation would be based on large national or provincial depots, with very efficient systems for rapidly supplying parts to many small outlets. Problems of communications and management make such systems difficult to establish, particularly since such an efficient system is unlikely to be justified on economic grounds.

An example of the decisions that have to be taken when arranging a national system of spare parts may be seen from the experience of Malawi during the period 1974-1984. In this country, the supply of animal traction equipment and spare parts has been largely the responsibility of the private sector or commercially orientated parastatal organizations. National distribution was for several years assured through the network of depots of the national marketing board (ADMARC) which sold equipment nationwide at a fixed price which provided minimal profit. The marketing board was charged with being commercially viable, and it eventually decided it was not cost-effective to maintain this service unless the manufacturer was prepared to sup-

ply the stocks on credit, being paid for only when sold to the farmer. The manufacturer (Agrimal) wanted to benefit from the high level of sales that the comprehensive national distribution system of the marketing board could ensure, but it could not commercially justify so much of its working capital being tied up in slow-moving stocks of spare parts in different parts of the country. Thus the marketing board stopped supplying equipment and spare parts, and private chains of retailing hardware stores undertook the supply. These were also faced with slow-moving items that took up storage space and management time for relatively little annual profit. The retail chains therefore decided to stock only the most needed items, such as plow shares. As a result farmers and extension workers still complained that they could not obtain all the necessary spare parts.

Fig. 11-13: An artisan specializing in making and repairing carts in Egypt. While he increasingly uses wheels obtained from old motor vehicles, he still makes and repairs wooden-spoked wheels and in his hand is a cast iron bearing from a wooden hub.

Photo: Paul Starkey

In some other countries, similar difficulties were experienced at local level, so that externally assisted development projects decided to meet local demand for both equipment and spares themselves. In so doing they bypassed and effectively eliminated commercial attempts to meet the demand, so achieving short-term benefits at the expense of long-term structures.

While the provision of implements such as plows has a certain appeal to aid donors, the supply of spare parts is less attractive, and has often been neglected. Although spare parts require considerable working capital, they are often classified as recurrent items and so are entered in different sections of national and donor budgets. There have been examples of absurd situations in which national governments have found it easier to request completely new implements from aid donors, than to obtain the provision of spare parts.

11.7 Artisanal manufacture, modification and maintenance

A clear distinction can be made between artisanal production and the medium to large workshops referred to earlier in this chapter. While the large workshops are usually orientated towards meeting national or provincial markets, artisanal production is usually aimed at a more local market, perhaps one large village or the area surrounding a small town. Artisans may range from farmers who are also part-time traditional blacksmiths, to small workshops employing several people and some modern equipment. Such artisans generally have low levels of stock and capital equipment, and often operate in the informal sec-

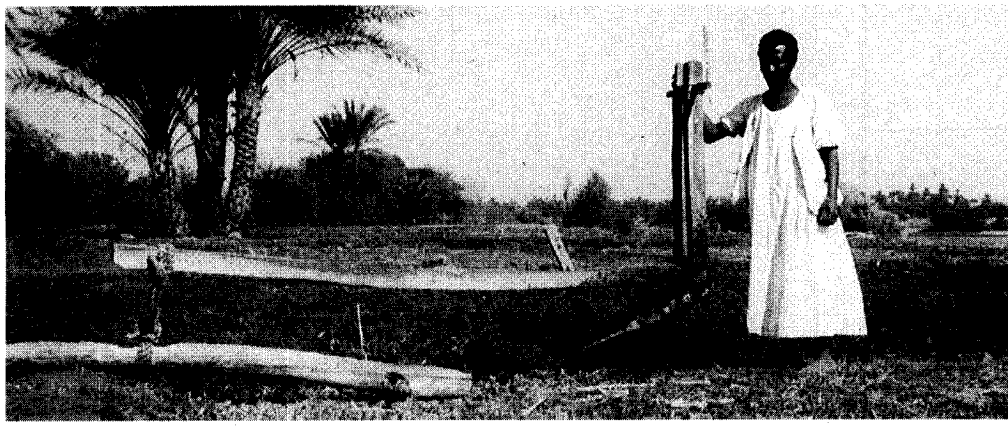


Photo: Paul Starkey

Fig. 11-14: Egyptian farmer with a new ard plow bought in 1988 from the local village artisan for US$25.

tor. UNIDO (1983) defined three categories of such artisans:

- **Traditional blacksmiths** who generally only use traditional tools and a charcoal fire and who usually work at ground level;
- **Modern blacksmiths** who generally operate from a standing position and use some non-traditional equipment such as shears, grinders, vices, steel anvils and gas or arc welding sets;
- **Modern rural mechanics** who specialize in the repair and maintenance of bicycles, motorcycles, pneumatic tyres, or motor vehicles, and perhaps factory-made animal-traction implements.

In Europe, until quite recent times, village blacksmiths, wheelwrights, leather workers and carpenters were extremely important in manufacturing, adapting and developing harnesses and implements for draft animals. It is difficult to see how many rural communities would have survived without the skills and services of a village blacksmith. Many famous large-scale manufacturers of agricultural equipment in Europe and North America today started business as blacksmiths in the nineteenth century. In developing countries where animal traction use has been practised for centuries, the technology is largely sustained by traditional artisans. Some artisans make and repair ards and wooden-wheeled carts using traditional skills and materials. Other artisans, or "rural mechanics", have specialized in providing tyre repair services or in the repair and rehabilitation of factory manufactured implements. People within countries that have a comprehensive infrastructure of artisanal repair services, may find it difficult to understand the very real problems faced by projects in many parts of Africa. Numerous projects have tried to introduce animal traction without the benefit of appropriate artisanal supporting services. Consequently farmers have had severe problems maintaining and repairing implements, obtaining spare parts and keeping carts in working condition. It has not been unusual for valuable equipment to have been abandoned because of minor problems.

It is both convenient and efficient if village blacksmiths, carpenters and rural mechanics provide services for the ***repair and maintenance*** of animal traction equipment. The desirability of village artisans ***manufacturing*** whole implements and modifying existing designs is less accepted by development planners. It is widely felt that village-level fabrication of equipment cannot produce the same standards, quality,

uniformity and consequential operational efficiency that may be obtained from implements made in an urban workshop. Nevertheless village artisans have one critical advantage: they are usually in excellent positions to respond rapidly to feedback from farmers. This may be crucially important for, as has been repeatedly observed, appropriateness of design is generally more important than implement quality (although both are most desirable).

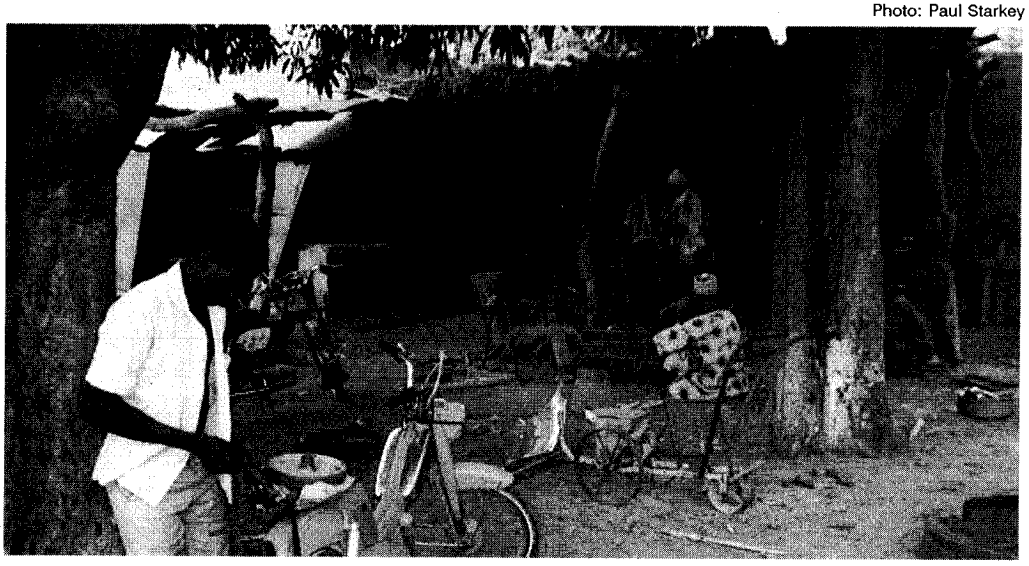
Whether artisans are to be involved in manufacture or simply in repair and maintenance, it would seem evident that schemes to promote the use of animal traction equipment should be very closely linked to the development of artisanal services. Yet in the past this has been neglected, with attention being paid to the construction of large workshops, with associated spare part distribution being arranged through the formal governmental or retail sectors. In more recent years there have been several schemes to facilitate village artisans to manufacture and/or maintain animal-drawn implements.

Coopérative Béninoise de Matériel Agricole

One such scheme was started in Benin. The Coopérative Béninoise de Matériel Agricole (COBEMAG) was established with UNDP support in 1974 and became operational in 1977. Organized as a cooperative of over 100 artisans, it purchases steel centrally and undertakes some cutting and welding at its central workshop. However it delegates much of its practical fabrication work to blacksmiths in different villages, first distributing and then collecting the various components for Arara multipurpose toolbars. Final assembly, quality control and sales have been organized by the central workshop. The biggest problem faced by the COBEMAG cooperative has been lack of capital to maintain stocks of steel and components. The organization of the distribution and collection of components together with the attempts to create a product of uniform quality have almost inevitably imposed a strain on the cooperative management. Since the village blacksmiths make components not complete implements, there has been little scope for creativity, or for blacksmiths to

Fig. 11-15: Workshop of a village blacksmith participating in CMDT-blacksmith scheme. Through the CMDT programme, this blacksmith had received a credit package enabling him to purchase an electricity generator. In 1988, besides providing a local equipment repair service, he fabricated over 200 plows from components imported by CMDT and also experimented with his own implement designs.

Photo: Paul Starkey



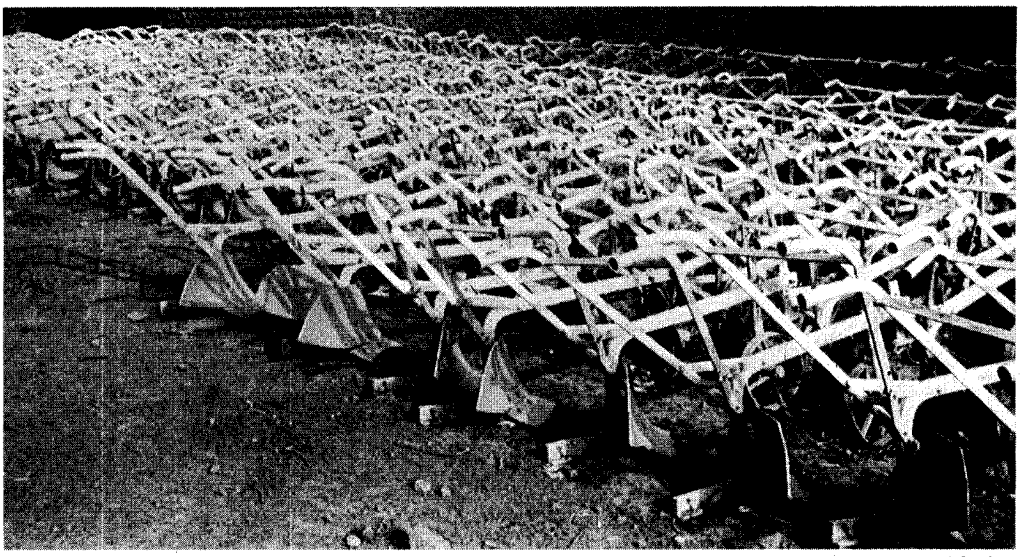


Photo: Paul Starkey

Fig. 11-16: Plows made in workshop of a village blacksmith participating in CMDT-blacksmith scheme.

modify the basic implement design as a result of farmer comments.

CMDT-blacksmith programme

A much bigger scheme has recently been organized and financed in Mali by the parastatal cotton company CMDT (Compagnie Malienne pour le Développement des Textiles), with assistance from several sources including The Netherlands. The aim of the CMDT-blacksmith programme is to ensure that affordable animal-drawn equipment of appropriate design and quality is available throughout southern Mali on a long-term basis. Apparently the financial and organizational problems of the large SMECMA workshop in the capital city had prevented it from meeting the demand for animal-traction equipment in the CMDT zone. CMDT is therefore in the process of providing credit to equip up to 200 village blacksmiths with a range of modern tools. Some blacksmiths are being equipped with simple, hand-operated tools, but other have been supplied with electrical generators allowing the use of drills, grinders and arc welders. Under the present system of blacksmith involvement, CMDT provides the raw materials for 50-200 plows, toolbars or seeders. The blacksmith assembles the implements, and the CMDT collects them for centralized distribution to farmers. In 1988 the CMDT purchased many implements in kit form from The Netherlands, but CMDT plans to establish a central workshop to allow raw steel to be made into components suitable for distributing to blacksmiths.

It is too early to evaluate the long-term effectiveness of the schemes in Mali, since they are still in an early phase with a great deal of external support. One of the biggest dangers of the scheme as presently planned is its centralization. Like the COBEMAG factory in Benin, materials are purchased centrally and equipment fabrication is devolved. It is significant that unlike COBEMAG, in the CMDT scheme blacksmiths assemble complete implements. However following blacksmith fabrication, subsequent distribution and sales are centralized again. This effectively eliminates the possibility of rapid farmer-blacksmith feedback, since farmers do not know which blacksmith actually made the particular implements bought from the central depot. One suggestion has been to encourage each blacksmith to put his name or logo on the equip-

ment he produces (Starkey, 1988). This would allow each blacksmith to develop his own reputation for implement quality and performance. If blacksmiths were to identify their products in this way and if farmers could be allowed to exercise choice, the resulting competition between blacksmiths might be most valuable in stimulating the rapid evolution of the individual blacksmith enterprises and equipment quality and design. As noted in Chapter 6, variation in equipment design combined with farmer selection and rejection, would seem to offer the best prospects for the rapid evolution of harnessing, implements and, eventually, entire farming systems.

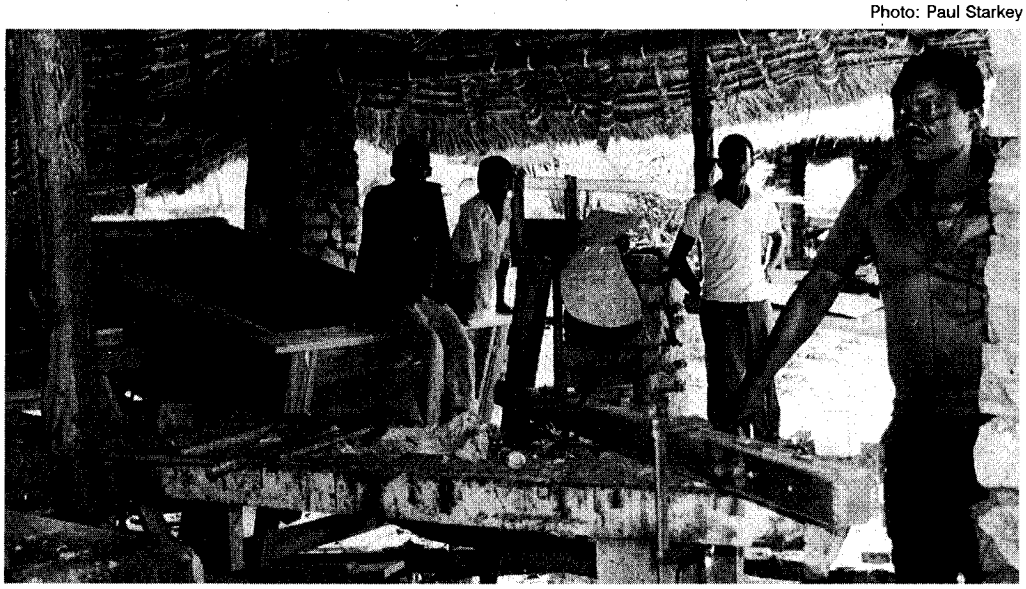
It remains to be seen whether the blacksmith schemes will be allowed to develop with rapid farmer-blacksmith feedback and allow farmers the prospect of implement modifications and design variation not available from centralized workshops. Despite the very imaginative blacksmith-network being developed, innovation and progress could easily be smothered by centralized organization or the imposition of equipment designs selected by central workshop management. However the mere fact that some blacksmiths have been provided with tools and steel may stimulate the development of animal-drawn implements. Some blacksmiths in southern Mali have already shown themselves to be highly innovative: one developed a double-furrow mouldboard plow, while another experimented with a Super-Eco seeder and an old moped/mobylette to obtain a self-propelled seeder. While neither of these innovations succeeded at the first attempt (and may never do so), they represent a most encouraging example of experimentation that could eventually lead to the development of new and improved equipment, designed specifically for local farming systems.

Other artisanal schemes

In another area of Mali, the Opération Haute Vallée (OHV), supported by USAID, has used a different approach to achieve a similar objective to the CMDT-blacksmith programme. OHV has provided credit to allow a small, private, urban-based workshop to manufacture implements from imported kits.

Fig. 11-17: Village carpenters in Zaïre were trained to make carts and wooden-beamed plows as part of a small scheme to introduce animal traction into a new area.

Photo: Paul Starkey



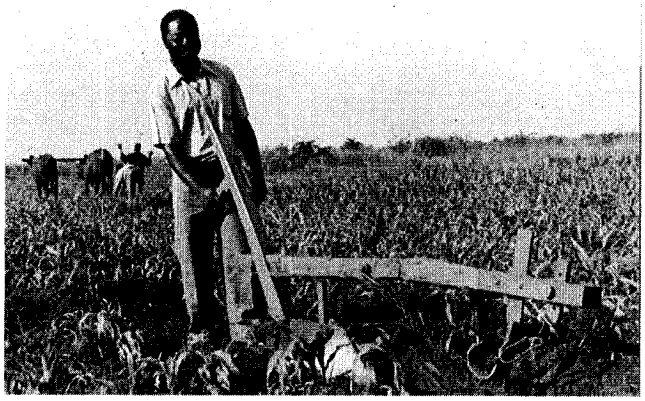


Photo: Paul Starkey

Fig. 11-18: Wooden-beamed plow, fitted with skid, in village in Zaïre. When the plow beam broke, the farmer rapidly made a new one from locally available timber (albeit not straight).

At the same time blacksmiths are being supported to develop repair and maintenance services (Sidibé, 1989).

On a much smaller scale, some non-governmental organizations have tried to combine the introduction of animal traction with village-level implement production. For example one small NGO programme in Zaïre linked the introduction of animal traction with the training of village carpenters and blacksmiths to make and repair plows and carts and other implements (Starkey, 1984; Huybens *et al.*, 1987; Fig. 11-17). The initial results of the project in terms of animal traction adoption and the ability of artisans to make and repair implements seemed most encouraging but the real test of such programmes will be their persistence and growth in the absence of external support.

Blacksmith requirements

Learning to make new implements or spare parts involves considerable investment in time. Village artisans are unlikely to make the necessary efforts to develop new skills and provide efficient maintenance and repair services unless there appears to be a reasonable market for their products. For this reason projects may well find it worthwhile to cluster extension efforts around villages or small towns that have suitable artisans. It may be that in such villages, the use of particular implements or techniques will be able to develop with mutually sustainable artisanal support, and from such established usage, diffuse out more widely. An alternative strategy of spreading extension effort widely in the first instance could fail everywhere through lack of "critical mass" of demand in any one area to warrant special artisanal services.

In several parts of Africa where animal traction has become widespread only in the last thirty years (for example Sine Saloum, Senegal and southern Mali) a critical mass of consumer demand has obviously been reached, local markets are full of spares made by blacksmiths and comprehensive artisanal repair services are readily available. In ideal circumstances, the farmers should be able to afford fair prices for artisanal services that not only cover the costs of raw materials and workmanship, but also allow the artisans to invest in further materials, equipment and designs. Such an equilibrium is naturally dependent on profitable farming systems, and the artisanal sector can be badly affected by poor harvests. It can also be seriously disrupted by cheap "food-aid" products depressing market prices and reducing farm profits. The informal, artisanal sector is particularly vulnerable to well-meaning animal-traction initiatives of "development projects". The release of new, subsidized implements or imported spare parts into a project area can suddenly undermine artisanal services. In contrast, the provision in market towns of stocks of primary steel or suitable scrap, may actually stimulate village artisans, no longer constrained by the time-consuming search for raw materials.

Village blacksmiths are often not only constrained by problems in obtaining raw materials, but also by lack of tools. Some excellent blacksmith training programmes in Botswana, Niger, Senegal and elsewhere have started with the trainees making their own tools from readily available scrap materials. In some areas it may be useful to provide blacksmiths with practical or financial mechanisms, such as access to transport, stock depots or credit, to assist the purchase of both tools and materials. In the long term providing credit to blacksmiths could be at least as important as giving farmers credit for implement purchases. However the same materials and skills required to make animal traction equipment can also be used to make other commodities. It is unreasonable to expect blacksmiths to invest their time and money making plows and plowshares if it is not profitable, or if a significantly greater return to their investment can be achieved my making window grills or repairing "bush taxis".

11.8 Further reading and information sources

Some examples of artisanal programmes from francophone Africa were described by CEEMAT (1971), FAO/CEEMAT (1972) and Le Thiec (1985). An illustrated manual and filmstrip giving information on techniques for repairing animal traction equipment have been produced in Burkina Faso (FAO, 1983). A more comprehensive handbook is being prepared by CEEMAT (1989). Policy issues relating to the supply and manufacture of animal traction equipment have been discussed in general terms by Inns (1980), UNIDO (1983), Uzureau (1984), Imboden (1984), DLG (1987) and Gifford (1988). Case histories discussing the local fabrication options for particular countries or areas have been prepared by ILO (1983 a-g), Muchiri (1983), de Coninck, Duncan and Winter (1984), Silsoe (1986), ILO (1987a-d), Harouna and Imboden (1988), Dibbits and Sindazi (1989), Kanu (1989) and Fall (1989). Further references on the subject are given in CTA-CEEMAT (1989).

A list of some of the workshops manufacturing animal traction implements in Africa is given in the Appendix. Research-development organizations working closely with some of these medium-scale equipment manufacturers include: FMDU, Botswana; Projet-FAO, Niger; Mbeya Oxenization Project, Tanzania; PROPTA, Togo; and Animal Draft Programme, Zambia.

There have been numerous schemes in Africa to develop and complement artisanal services. Several large-scale initiatives to develop blacksmith equipment production have been undertaken in Mali. These have been briefly described by Starkey (1988), Gueguen (1989) and Sidibé (1989). More detailed information can be obtained from organizations in Mali including CMDT, DRSPR, OHV and Projet Arpon. Other organizations in Africa working closely with blacksmiths include: COBEMAG, Benin; RIIC, Botswana; Université Hassan II, Morocco; Projet FAO, Niger; ENDA, Senegal; WSDC/JMRDP/Nuba Mountains, Sudan; Projet Rural, Zaire.

The addresses of the organizations cited in this chapter are provided in an Appendix. Further details about manufacturers of animal traction implements in Africa, as well as programmes involving blacksmith training/support, are provided in the GATE Animal Traction Directory: Africa (Starkey, 1988).

The manufacture of animal traction equipment in workshops is an area of specialist interest of UNIDO, Austria. Blacksmith training and support in relation to animal traction are subjects of significant interest to: CEEMAT, France; the Agricultural Services Division of FAO, Italy; Dutch Technical Cooperation, The Netherlands; the International Labour Organisation (ILO), Switzerland; Swisscontact, Switzerland; and ITDG, UK. The addresses of these organizations are provided in an Appendix.